Summary and Keywords

Throughout the late 19th century and most of the 20th century, risks associated with wildfire were addressed by suppressing fires as quickly as possible. However, by the 1960s, it became clear that fire exclusion policies were having adverse effects on ecological health, as well as contributing to larger and more damaging wildfires over time. Although federal fire policy has changed to allow fire to be used as a management tool on the landscape, this change has been slow to take place, while the number of people living in high-risk wildland-urban interface communities continues to increase. Under a variety of climate scenarios, in particular for states in the western United States, it is expected that the frequency and severity of fires will continue to increase, posing even greater risks to local communities and regional economies.

Resource managers and public safety officials are increasingly aware of the need for strategic communication to both encourage appropriate risk mitigation behavior at the household level, as well as build continued public support for the use of fire as a management tool aimed at reducing future wildfire risk. Household decision making encompasses both proactively engaging in risk mitigation activities on private property, as well as taking appropriate action during a wildfire event to protect personal safety. Very little research has directly explored the connection between climate-related beliefs, wildfire risk perception, and action; however, the limited existing research suggests that climate-related beliefs have little direct effect on wildfire-related action. Instead, action appears to depend on understanding the benefits of different mitigation actions and in engaging the public in interactive, participatory communication programs that build trust between the public and natural resource managers. A relatively new line of research focuses on resource managers as critical decision makers in the risk management process, pointing to the need to thoughtfully engage audiences other than the lay public to improve risk management.
Wildfire Communication and Climate Risk Mitigation

Ultimately, improving the decision making of both the public and managers charged with mitigating the risks associated with wildfire can be achieved by carefully addressing several common themes from the literature. These themes are to (1) promote increased efficacy through interactive learning, (2) build trust and capacity through social interaction, (3) account for behavioral constraints and barriers to action, and (4) facilitate thoughtful consideration of risk-benefit tradeoffs. Careful attention to these challenges will improve the likelihood of successfully managing the increasing risks that wildfire poses to the public and ecosystems alike in a changing climate.

Keywords: wildfire, risk communication, evacuation, management, hazard, decision making, trust, risk perception, efficacy

Introduction

History of Wildfire Management

As European settlement pressed westward in the United States, concern increased about the potential impacts of wildfires on new communities and on valuable natural resources including water quality and timber. Toward the end of the 19th century, these concerns led to the decision to reserve some public lands from private development to ensure conservation of these resources for the future (Lehman, 1995). One of the first government actions in this regard was to reserve large tracts of timber from development and to create what is now the United States Forest Service (USFS). Staffed by professional foresters who developed centralized plans for the nation’s public forests, the USFS embodied the ideals of the Progressive Era, with a focus on using science and technology to improve environmental conditions through expert-driven, government-based interventions (Wellman & Propst, 2004). An integral component of professional forestry in these early years was to suppress fire as a means of conserving future resources. In addition to overseeing timber harvest and sales and addressing disease, the first chief of the Forest Service, Gifford Pinchot, believed that a forester’s job was to control fires (Hays, 1999). Foresters worked to maximize timber production, and in this schema there was no room for fire, as burning timber was a waste of resources. Fires not only needed to be suppressed because they posed a risk to individual private resources, but also because they threatened future resources on largely unsettled lands (Pyne, 1997).

It was not until the 1960s that the policy of fire exclusion began to be questioned, due in large part to the recognition that many of these managed ecosystems evolved with fire and certain species relied on it to thrive (Agee, 1993; Bond, Woodward, & Midgley, 2005). Beyond increasing recognition of the beneficial ecological role of fire, evidence began to emerge that while fire suppression reduced near-term risks associated with wildfires, it could also contribute to larger and more damaging wildfires in the future. This was in...
direct opposition to the goals of earlier foresters focused on conserving forest resources for use by future generations. Specifically, by allowing fuels (i.e., leaves, dead trees, etc.) to build up and modifying vegetative composition from the forest floor to the tree canopy, ecosystems that traditionally experienced low-intensity, ground-based fires were now prone to more intense and destructive canopy fires (Agee, 1997; Dombeck, Williams, & Wood, 2004). This led federal management agencies to explore tactics other than suppression to mitigate growing wildfire risks, such as proactively using fire as a management tool to try to modify future fire behavior.

Prescribed fire, or a fire that is intentionally ignited by managers to achieve previously determined goals, is the most common method employed by managers in this regard. Prescribed fire is typically used as a fuel reduction tool (i.e., clearing vegetation that burns as fuel in the event of a naturally ignited fire), or as a means of managing forest composition to improve wildlife habitat. In addition to prescribed fire, in some cases where conditions are deemed appropriate, naturally ignited fires may be allowed to burn to achieve specific resource objectives. At the federal level, ongoing discussions in recent years have resulted in release of the National Cohesive Wildland Fire Management Strategy with the intention of improving the coordination of wildfire management decisions across stakeholders at the local, state, and federal levels (WFEC, 2014). This strategy recognizes the ecological role of fire and describes the need to consider the tradeoffs posed by suppressing fires on one hand, versus managing fires to provide expected benefits on the other. However, fire suppression remains the primary response to wildfire ignitions. For example, on average from 1999–2008, almost 80,000 wildfires burned annually on almost 7 million acres, while only 354 of those fires covering just over 200,000 acres were managed to provide benefits (National Interagency Fire Center, 2016).

Wildfire, Climate Change, and Increasing Risk

Although current fire policy and management recognizes that wildfires are a natural disturbance in ecosystems across the United States and throughout the world, the growing risks to human values creates difficult tradeoffs between ecological health or resilience in the long term, and the protection of public safety and economic interests in the short term. Specifically, wildfire seasons in the western United States have been lengthening since the mid-1980s, and fire frequency and intensity have increased as well (Westerling, Hidalgo, Cayan, & Swetnam, 2006). As is often the case in complex coupled social and ecological systems, the timescales reflected in human behavior and policy present a mismatch with the timescales over which changes in the natural system occur (Wilson et al., 2015). Specifically, despite the well-intentioned and forward-looking policies of the late 19th and early 20th centuries aimed at protecting future resources, it is now clear that such decisions may have been counterproductive at achieving intended goals. Instead, such policies created systems that often were less resilient to natural disturbances, such as fire. An added complication involves the recent influence of climate change on natural ecosystems. Specifically, numerous models now project that higher
temperatures, earlier spring snowmelts, lower humidity, and increased drought conditions associated with climate change are perhaps underlying the increase in wildfire frequency and intensity, and will continue to exacerbate wildfire risks in the United States (Barbero, Abatzoglou, Larkin, Kolden, & Stocks, 2015; Brown, Hall, & Westerling, 2004; Westerling, Gershunov, Brown, Cayan, & Dettinger, 2003) and in fire-prone regions across the globe (Scholze, Knorr, Arnell, & Prentice, 2006).

In addition to climate change, growth of the wildland–urban interface (WUI), or the area where homes and other structures meet or intermingle with natural vegetation, exacerbates the risks posed by wildfire (Hammer, Stewart, & Radeloff, 2009; Stewart, Radeloff, Hammer, & Hawbaker, 2007). In 2015 alone, wildland fires destroyed approximately 4,600 structures in the United States, 2,600 of which were homes largely located in the WUI (National Interagency Coordination Center, 2015). A recent study documented a 52% increase in WUI area from 1970–2000 and projected an additional growth of 10% by 2030 with growth expected to be particularly high in the intermountain west states (i.e., Arizona, Nevada, Utah, Colorado, and Idaho), an area with substantial fire activity (Theobald & Romme, 2007). Similarly, a recent national review found a 22% increase in WUI housing units from 1990–2000, and projected continued growth as the Baby Boomer generation migrates to high-amenity areas in retirement (Hammer et al., 2009). Although the economic recession and real estate slowdown have likely reduced this growth in recent years, substantial numbers of lives and property remain at risk.

Increased fire frequency and intensity in the expanding WUI context is expected to pose serious economic and health risks. It has already been shown that hospital visits for respiratory distress increase following fire events due to smoke inhalation (Bowman & Johnston, 2005; Schwartz, Slater, Larson, Pierson, & Koenig, 1993). Reduced air quality and visibility due to wildfires is expected to worsen as a result of climate change (Spracklen et al., 2009). Water quality also may be affected by fires via increased turbidity and nitrate levels (e.g., Rhoades, Entwistle, & Butler, 2011). And fire suppression expenditures are already high, often exceeding one billion dollars per year in the United States, with over two billion spent in 2015 (National Interagency Fire Center, 2015). Indirect costs associated with catastrophic fires such as building damage, loss of life, and post-fire flooding can multiply overall economic costs several times beyond suppression costs alone (Lynch, 2004). As it has become clear that attempts to eliminate fire to manage these risks often exacerbates these issues, the challenge today for citizens and resource managers alike is to think about how to manage ecosystems to minimize the negative impacts of wildfire and how to help communities safely coexist with fire-adapted (and often unpredictable) natural systems.

Motivating Action to Reduce Wildfire Risk
Wildfire Communication and Climate Risk Mitigation

Although a rich body of literature exists on fire and forest ecology, and the effectiveness of various management approaches on the landscape, research on the human dimensions of wildfire management only began in earnest in the early 2000s. A primary focus of this research was on public support for fuels management techniques directed at reducing future fire risk and improving ecological health. Successful implementation of these treatments can be influenced by public attitudes toward, and beliefs about, wildfire and the risks and benefits posed by different management techniques. A lack of public support can result in delays, appeals and, in some cases, legal challenges to proposed management plans (Laband, González-Cabán, & Hussain, 2006; Laband, Hussain, & González-Cabán, 2008; Steelman, 2008). As a result, early research focused on identifying socially acceptable management for public lands in general (see review in Shindler, Brunson, & Stankey, 2002) and for fuels management in particular (Toman, Stidham, Shindler, & McCaffrey, 2013).

A second line of research examined what motivates a homeowner in the WUI to prepare his or her own home for potential wildfire events (i.e., household as opposed to forest-level risk mitigation). As windblown embers are the main source of home ignitions during wildfires, there are numerous actions that homeowners can take to limit potential property damage from a wildfire. These include creating a buffer area of reduced fuels in a 100–200 foot radius around their homes by trimming or removing grass, shrubs, and trees (Cohen, 2008; Quarles, Valachovic, Nakamura, Nader, & DeLasaux, 2010); use of heat-resistant building materials; removing plant debris from the lawn and gutters; and covering vents and other openings with fire-resistant screens (Firewise, 2016; Quarles et al., 2010). While some of these are one-time actions, others require sustained maintenance by the homeowner.

In the last several years, research has increasingly focused on during and post-fire (as opposed to pre-fire) decision making. This shift is likely due in part to the increased frequency and severity of catastrophic wildfires, and risk-amplifying events like the Black Saturday fires in Australia in 2009, which claimed the lives of 173 individuals (McCaffrey, 2015). This led to reevaluations in Australia of a long-standing policy that encouraged homeowners to decide for themselves whether they wished to stay and defend their properties or evacuate ahead of a wildfire front. This policy was based on a recognition that in most cases Australian authorities have no right to force owners off their land, that late evacuation is dangerous, and that well-prepared structures can be successfully defended against wildfire, thereby providing a refuge for people and decreasing property loss (Handmer & Tibbits, 2005; Tibbits & Whittaker, 2007). Although, the post Black Saturday reevaluation did not lead to changes to the overall policy, it did result in additional emphasis on communicating the idea that early evacuation is the safest action (Teague, McLeod, & Pascoe, 2010). In contrast, the long-standing official policy in the United States has been to evacuate all communities at risk during a wildfire event (McCaffrey, Rhodes, & Stidham, 2015). The growing body of research on this topic tends to focus on why some individuals choose to evacuate or stay and defend their home while
others prolong making a decision in order to better assess the size of the threat (i.e., a “wait and see” approach) (McLennan, Paton, & Beatson, 2015; McNeill, Dunlop, Skinner, & Morrison, 2015).

In addition to this increased focus on household decision making during and following a wildfire event, there is also interest in targeting resource managers as a critical audience for improved decision making. Managers must be able to quickly and efficiently evaluate the risks and benefits associated with wildfire across temporal and spatial scales in order to make decisions about how to proactively manage natural landscapes as well as how to respond to wildfire events when they occur (Taber, Elenz, & Langowski, 2013). Decisions that require meeting multiple management objectives while balancing short- versus long-term risks across spatial scales involve a high degree of complexity and uncertainty. Despite a recognized need to maintain fire on the landscape, some have argued that managers are reluctant to accept the risks associated with fire (prescribed or wild) and that restrictive policies and a lack of qualified personnel create pressure to suppress fires when they occur (Dellasala, Williams, Williams, & Franklin, 2004; USDA Office of Inspector General Western Region, 2006). These elements increase the likelihood that fire management decisions will be informed by mental shortcuts or experience-based heuristics triggered by the cues that are available at the time of the decision (Tversky & Kahneman, 1974; Slovic, 1995). Recent research is examining the decision making process of managers to better understand simplifying heuristics that may be at play (Wilson, Winter, Maguire, & Ascher, 2011; Wibbenmeyer, Hand, Calkin, Venn, & Thompson, 2013) in order to identify how to best assist managers with the difficult task of managing for multiple objectives and making difficult temporal tradeoffs (Thompson, 2015).

Despite the likelihood that wildfires will be an increasingly common hazard in the future as a result of climate change, few studies have investigated the potential link between beliefs and awareness about climate change and specific actions taken to mitigate risks from wildfire. What research there is suggests that awareness of local climate-related impacts (e.g., drought) does increase perceptions of the risks of, and concern about, wildfire (Schulte & Miller, 2010). However, the determinants of mitigation action in response to wildfire (and other hazards likely to be exacerbated by climate change such as flooding) appear to be more localized and community oriented. Examples include concern about wildfire impacts on amenities (Schulte & Miller, 2010), or general environmental attitudes or values (Brenkert-Smith, Meldrum, & Champ, 2015; Whitmarsh, 2008) rather than beliefs about climate change or the specific risks posed by climate change. An interesting exception in one study was that those who indicated a belief that climate change is a hoax reported engaging in slightly more mitigation actions than those who did not (Brenkert-Smith et al., 2015). While this association is potentially mediated by a factor not accounted for in that particular study, these findings suggest that a belief in climate change is not a prerequisite to the decision to take action to mitigate potential fire risks that may be exacerbated by a changing climate. Taken together these results suggest that broadly framing wildfire risk by focusing on climate change as a primary antecedent may not be the most effective method for encouraging wildfire mitigation. It
Wildfire Communication and Climate Risk Mitigation

may even be counterproductive for some segments of the population. Instead, focusing wildfire communication efforts on the localized increase in the frequency and severity of wildfire and the expected impacts may be a more fruitful tactic (Brenkert-Smith et al., 2015; Schulte & Miller, 2010).

In order to think strategically about how best to engage the public and other key decision makers in appropriate risk management associated with wildfire in a changing climate, it is critical to draw on the wealth of research that does exist. Specifically, what do we already know about building public support for fuels management? What do we know about engaging homeowners in appropriate action before, during, and after a wildfire event? What challenges must be overcome to help resource managers deal with the challenging tradeoffs between short- and long-term risk? In order to answer these questions, the remainder of this chapter will first summarize the literature on public perceptions of wildfire risk, followed by a summary of the determinants of public support for manager use of fire as a management tool, household level preparedness and defensible space, and household evacuation decisions. Finally, we will synthesize the literature on forest and fire manager decision making processes in the context of wildfire risk management. We will conclude the chapter with a discussion of best practice in communication and decision making about wildfire as a hazard drawing from this broad literature, and we will identify lessons that may transfer across the various decisions and audiences.

The Human Dimensions of Wildfire Management

Public Perception of Wildfire Risk and Perceived Control

The vast majority of homeowners in fire-prone locations are aware of their fire risk and have implemented some form of mitigation activity on their property. Two recent summaries of this literature found these results are consistent across a variety of locations in the United States (McCaffrey & Olsen, 2012; Toman et al., 2013). It is perhaps not surprising that awareness and understanding is relatively high as wildfires are a readily visible hazard that is very salient for those living in the WUI (McCaffrey, Stidham, Toman, & Shindler, 2011). Although risk perception is relatively high overall, results show that individuals living in the WUI perceive greater risk for the community at large than for one’s own home (Collins, 2012; McCaffrey et al., 2011). Although it is typically believed that protective action results when an individual perceives the risks associated with a hazard as personal and proximal in space and time (Zwicke & Wilson, 2013), protective action among individual residents in the WUI is quite high despite the fact that concern is
greatest for one’s community versus oneself. This is likely due to the fact that community-level risk is still perceived as relatively personal and concrete relative to risks posed at larger spatial scales (to the nearby forests, to other communities, to other regions, etc.).

In general, residents in the WUI feel they have some control over their risk from wildfire; however, research has found mixed results in homeowner evaluations of the perceived effectiveness of risk reduction activities. In a longitudinal study that assessed implementation and maintenance of defensible space activities over a three-year period, McCaffrey et al. (2011) found that approximately two-thirds of participants felt their risk decreased a moderate amount after implementing risk reduction activities. From a motivational standpoint, this points to the need to increase the sense of efficacy among individuals in the WUI, as they may be concerned and contemplating action but need information about how to take action and the effectiveness of those actions in reducing risk (Floyd, Prentice-Dunn, & Rogers, 2000). Martin, Bender, and Raish (2007) suggest that the information needs of individual residents may vary according to different levels of knowledge, experience, and motivation to act. The authors identify self-efficacy, or confidence in one’s ability to protect him or herself and property from wildfire, as the critical last step taking a homeowner from contemplating a protective behavior to actually taking action.
Public Support for Manager Use of Fire

Findings from a large number of studies indicate that the public has a fairly sophisticated understanding of fire’s ecological role and that acceptance for prescribed fire as a means of reducing fuel loads is quite high and stable over time. Indeed, a recent review of the literature found that more than 80% of respondents across numerous studies expressed conditional or full acceptance for prescribed fire as a tool (Toman et al., 2013). However, less research has examined public acceptance of managing wildfires to achieve resource benefits (as opposed to setting a fire deliberately to burn within a particular prescription). Available findings suggest some support for these practices, particularly in remote locations (Kneeshaw, Vaske, Bright, & Absher, 2004B) or when they are expected to have limited impacts on human communities or natural ecosystems (Kneeshaw, Vaske, Bright, & Absher, 2004A).

While a number of variables have been found to influence acceptance of fire as a management tool, the two most consistently associated with acceptance are familiarity with the practice and trust or confidence in those implementing it (McCaffrey, 2015). Specifically, those with greater familiarity with or understanding of the objectives and rationale behind prescribed fire as a tool are more supportive of its use (Toman et al., 2013). It is likely that familiarity contributes to beliefs about the benefits of the practice, and increases the likelihood of one believing that positive outcomes will result. For example, Ascher, Wilson, and Toman (2013) found that one’s knowledge about a particular practice has a significant indirect effect on support by increasing one’s perceptions of the benefits of the practice. The perceived benefits, in this case, were the images of healthier forests that came to mind when participants in the study were asked to free associate with a particular management strategy. Related, a variety of studies highlight the desire to protect and improve forest health as a critical driver of support for prescribed fire (at least as critical or more so than the desire to reduce future fire risk) (McCaffrey & Olsen, 2012). For example, in one national survey, the greatest concern expressed by respondents was that “fire management programs consider long-term forest health” (Bowker et al., 2008).

Although operationalized in different ways across the literature, citizen trust and confidence in risk managers have consistently been identified as a key influence on support for the use of prescribed fire (e.g., Toman et al., 2014; Vaske, Absher, & Bright, 2007; Winter & Cvetkovich, 2008; Winter, Vogt, & McCaffrey, 2004). Trust is typically conceptualized as a judgment focused on the intentions of the other party, and based on that individual or organization sharing one’s values, goals, and motivations, while confidence tends to be based more on past behavior and one’s belief that the other party can deliver on their good intentions. In fostering public acceptance of fuel treatments, it is likely that increased agency-community interactions and the exchange of information that occurs builds trust and confidence in agency risk managers, which in turn increases support for recommended actions. Trust is less important, however, for understanding
why individuals undertake household level action to reduce fuels on private lands (e.g., defensible space); here we see a belief in one’s own ability to accomplish a practice as more critical (Absher & Vaske, 2011; Siegrist & Cvetkovich, 2000).

Although substantial prior research has found high overall levels of support for prescribed burning, several studies have also identified concerns with manager use of fire. Concerns cited include the potential for a fire to escape outside of the designated burn area and burn out of control, negative air quality impacts from smoke emissions, loss of wildlife habitat, or aesthetic impacts (Blanchard & Ryan, 2007; Jacobson, Monroe, & Marynowski, 2001; McCaffrey, 2006; Shindler & Toman, 2003; Shindler, Toman, & McCaffrey, 2009; Vining & Merrick, 2008). Studies indicate that roughly one-third of households have someone whose health may be adversely effected by smoke, making consideration of potential smoke impacts from prescribed burns and wildfires highly salient for those households (McCaffrey & Olsen, 2012). While these concerns may be problematic, one study assessed support for fire as a tool before and after a prescribed fire “went wrong” and escaped its prescription (Brunson & Evans, 2005). While participants indicated the event negatively influenced their views about the use of fire, their stated acceptance of the use of prescribed fire did not change in the follow-up study. However, participants were less confident in forest managers’ ability to use prescribed fire effectively and expressed more concern about fire use near their home and smoke’s potential impacts on public health.

Despite the (often short-term) risks associated with using fire as a management tool, these risks are not always seen as a reason to avoid the practice. In fact, numerous studies indicate that people often believe that practices like prescribed fire will improve rather than detract from a particular value or objective (e.g., will restore, as opposed to inhibit, wildlife habitat) (McCaffrey & Olsen, 2012). These findings suggest that participants recognize and are likely assessing the tradeoff between the potential benefits of fire in the ecosystem and the perceived risks associated with using fire as a management tool. There is also evidence that individuals are differentially weighting the likely risks and benefits to public safety over time, with some individuals focusing on the short-term risk to safety associated with prescribed burning, while others indicate the exact opposite, focusing on the long-term benefits of improved public safety in a more resilient system (Vining & Merrick, 2008).
Public Support for Risk Mitigation on Private Land

Prior research indicates that the vast majority of residents in fire-prone areas have engaged in mitigation activity on their property, typically modifying the vegetation around their home to decrease wildfire risk (Toman et al., 2013). The research indicates that the responsibility for mitigating wildfire risk is viewed as shared, with land owners responsible for mitigating the risk on his or her own property (including government agencies on public lands). Given the interdependent nature of wildfire risk in the WUI, or the idea that one’s personal risk is dependent on both one’s own actions and those of nearby landowners, there is evidence that concern about actions on adjacent properties influences the decision to engage in risk reduction activities on one’s own property (McCaffrey & Olsen, 2012). For example, one study found that concern about hazardous conditions on nearby public lands was associated both with higher risk perception and with increased cooperation with public land managers to reduce the risk. However, concern about hazardous conditions on nearby private lands was not associated with higher risk perception or cooperation between neighbors in an attempt to minimize collective risk (Fischer & Charnley, 2012). The authors suggested that the lack of association between concern about conditions on nearby private lands and cooperation with other landowners was due to the larger number of barriers preventing cooperation on private lands.

Ultimately, the decision to engage in household-level risk management is perhaps most influenced by factors well known to promote personal protective action in the face of a hazard (Floyd et al., 2000). These factors include the perceived risk associated with the hazard (in particular the perceived severity of the consequences of wildfire—see McNeill, Dunlop, Heath, Skinner, & Morrison, 2013) and the perceived ability to effectively implement actions (i.e., high self-efficacy) and a belief in the likelihood of those actions actually reducing risk (i.e., high response efficacy, or a belief in the benefits of the behavior) (Absher & Vaske, 2006; Brenkert-Smith, 2006; Martin et al., 2007; Martin, Martin, & Kent, 2009). Studies have also shown how the influence of perceived risk is mediated by the costs and benefits of a mitigation activity (Champ, Donovan, & Barth, 2013; McFarlane, McGee, & Faulkner, 2011; Reid & Beilin, 2014) as well as other values that an individual may hold for their property (e.g., promoting privacy, providing wildlife habitat) (Brenkert-Smith, 2006; Collins, 2009; Nelson, Monroe, Johnson, & Bowers, 2004). For example, an individual with high perceived risk toward local wildfire may not take action if they do not believe that the benefits of the mitigation activity will outweigh the costs of taking action.

Finally, there is growing evidence that place attachment is an important dynamic in understanding how individuals respond to wildfire (McCaffrey, 2015). Bihari and Ryan (2012) found that place attachment was positively associated with social capital (e.g., involvement in community actions, extensive social networks) and that those with higher social capital engaged in more mitigation activities. It is likely that place attachment increases the perceived severity of wildfire as a hazard to one’s community, while the
associated high levels of social capital increase one’s sense of collective efficacy to reduce wildfire risk.

Household Evacuation Decisions

As mentioned earlier, research on wildfire evacuation decision making is a relatively new and growing area of the literature. Research indicates that a small minority of individuals in the United States plan to stay and defend their property during a wildfire event, while similar proportions plan to either determine whether and when to leave once they assess the conditions firsthand, or leave early or as soon as officials order an evacuation (McCaffrey & Winter, 2011; Mozumder, Raheem, Talberth, & Berrens, 2008). A similar range of responses has been found in Australian studies, with a relatively larger proportion indicating they plan to stay and defend their home or property (McLennan et al., 2015; Whittaker & Handmer, 2010).

Although a variety of factors influence the evacuation decision, it is often conceptualized as a tradeoff between risks to personal safety and risks to property (Cova, Drews, Siebeneck, & Musters, 2009; McLennan et al., 2015; Teague et al., 2010). The assumption being that many individuals base their decision on the risks they most want to minimize, where individuals who are tolerant of personal safety risk may choose to stay and defend their home, while those tolerant of property risk will evacuate. For individuals who choose to stay and defend their property, there is evidence that they may be motivated by a desire for decision autonomy, concern about limited evacuation routes, a sense of responsibility for protecting one’s property, and concern about evacuating large animals (Cohn, Carroll, & Kumagai, 2006; McCaffrey et al., 2015; McLennan, Cowlishaw, Paton, Beatson, & Elliott, 2014; McLennan, Elliott, Omodei, & Whittaker, 2013; Paveglio, Boyd, & Carroll, 2012). Research in Australia found that those who stay and defend also have a greater sense of efficacy (i.e., a belief in their ability to successfully defend their home without placing their lives in danger), in addition to a strong emotional attachment to their home, and strong sense of community (McLennan et al., 2013). In contrast, individuals who choose to evacuate well ahead of the fire tend to believe that leaving early is the safest option and that the socially appropriate and expected response is to evacuate (McLennan et al., 2014, 2015).

The uncertainty about where a fire is located and how severe the risks might be leads many to take a “wait and see” approach, not evacuating until some external event signals the need for decisive action (McLennan, Elliott, & Omodei, 2012). This is particularly problematic given that historically the majority of people who are killed in wildfires die either from radiant heat exposure, exposure to flames, or in vehicular collisions, often while in the process of evacuating at the last minute (Gledhill, 2003; Haynes, Handmer, McAneney, Tibbits, & Coates, 2010). Although evacuating early is typically the safest option, late evacuations tend to be more dangerous than taking cover in one’s home when it is too late to evacuate safely. While there are many potential decision cues that may
trigger action for this group (e.g., social cues from friends and official cues from public safety officials) (McLennan et al., 2012), one commonly cited cue that motivates (late) evacuation is a physical cue (such as visible flames) (Handmer, O'Neil, & Killalea, 2010; Tibbits & Whittaker, 2007). However, it is often too late to safely evacuate if one is waiting to see the flames before taking action.

Manager Decision Making and Fire Use

As mentioned previously, less than 1% of wildfires that occur annually on approximately seven million acres are managed to provide benefits, while in 2015 alone prescribed fire was used on almost three million acres to achieve similar goals (National Interagency Fire Center, 2016). These statistics demonstrate that prescribed fire is used much more frequently by federal resource managers than use of lightning-caused fires for “managed resource benefits” (Wells, 2009). Research has documented a number of factors that influence resource managers’ decisions to use fire as a management tool ranging from those that are psychological in nature (e.g., risk aversion), to those that are internal to the agency (e.g., fire management policy), to those that are external or structural in nature (e.g., WUI constraints) (Canton-Thompson et al., 2008; Dale, 2006; Doane, O’Laughlin, Morgan, & Miller, 2006; Miller & Landres, 2004). It is often the constraints that are external to the individual that are cited as posing a barrier to the use of fire (e.g., extensive planning requirements, need for specialized personnel, air quality regulations, public pressure, etc.). A recent study found that internal planning documents allowing for the use of alternative tactics were particularly critical to reduced reliance on suppression and willingness to adopt other fire management techniques. Although it is often argued that the public demands suppression, and that this may be driving the preferences of fire personnel as well, the influence of these perceived external pressures was actually more variable than the policies that were internal to the agency (Steelman & McCaffrey, 2011).

Although there has been less focus on psychological factors, the decision to avoid using fire as a tool, even when the fire management plan allows it, may be influenced by personal discomfort with uncertainty and a tendency to err on the side of caution in assessing short-term risk (Doane et al., 2006; Maguire & Albright, 2005). For example, the perceived risk associated with using fire as a management tool may prevent such techniques from being adequately considered during the decision making process compared to other tactics perceived as less risky (e.g., suppression, mechanical means of reducing fuels) (Williamson, 2007). Wilson et al. (2011) identified several common heuristics at play in the decision to suppress a wildfire versus allowing it to burn to achieve resource management objectives. Specifically, they found that USFS manager decisions were subject to how the choice was framed (i.e., choosing the safe option more often when the consequences of the choice (i.e., the homes at risk) were framed as potential gains (e.g., homes saved) versus potential losses (e.g., homes lost). They also found evidence that managers with more experience demonstrated a status quo preference for suppression based on their past decisions. Similarly, Wibbenmeyer et al. (2013) found that
wildfire managers exhibited preferences for wildfire management that were not consistent with a utility-maximizing approach to making decisions under risk, and that this tendency may result in the over allocation of firefighting resources when the relative risk from a particular event is low (i.e., low likelihood, low potential magnitude of the consequences). Further, the authors found that managers exhibited a certainty effect, where they were more sensitive to changes in the probability of negative wildfire outcomes when the probabilities were close to one or zero (as opposed to changes in mid-range probabilities).

**Best Practice in Communication About Wildfire As a Hazard**

Across the literature there are several common themes that emerge in terms of improving communication with at-risk audiences, and ultimately improving the decision making of both the public and managers charged with mitigating the risks associated with wildfire in a changing climate. These common themes are to (1) promote increased efficacy through interactive learning, (2) build trust and capacity through social interaction, (3) account for behavioral constraints and barriers to action, and (4) facilitate thoughtful risk-benefit tradeoffs. This final section will walk through each of these themes, highlighting how they can be employed to improve communication and decision making related to wildfire as a hazard.

**Promote Increased Efficacy Through Interactive Learning**

Interactive learning is both the most preferred and most effective means of providing information to foster preparedness before and response during a fire for communities at risk (Eriksen & Prior, 2011; Toman, Shindler, & Brunson, 2006). Such learning allows individuals to identify what actions might be most appropriate to implement on their own properties, as opposed to basing their decisions on a generic or community-level recommendation (Brenkert-Smith, Champ, & Flores, 2012). Generally speaking, interactive approaches are better aligned with learning theories and allow individuals to ask questions specific to their concerns, integrating the new information within their prior experiences and understanding. Given the importance of efficacy and the need for individuals to understand the benefits of recommended actions, it is likely that this form of communication is most effective at building this sense of efficacy and control (Steelman & McCaffrey, 2012). This consideration of local context through an interactive approach ensures that individuals will see the information as relevant to their situation (Eriksen & Prior, 2011; Steelman & McCaffrey, 2012). In Australia, few people followed the advice of a 2010 extreme fire warning to evacuate because they felt the advice was more applicable to people elsewhere (Reid & Beilin, 2014). The authors suggest that the warning
was too generic to help residents distinguish between the everyday risk of fire and the unique risks posed by the current event in their specific location.

In addition to building capacity within communities, interactive approaches have been rated as more effective at building understanding and acceptance of agency use of prescribed fire and mechanized thinning to reduce fuel loads (McCaffrey, Moghaddas, & Stephens, 2008; Shindler, Gordon, Brunson, & Olsen, 2011; Toman et al., 2006; Toman, Shindler, Absher, & McCaffrey, 2008). There is also evidence that those who evacuate during a wildfire event rely more on interactive information sources, such as public meetings or conversations with fire personnel, than those who do not evacuate as these sources tend to be seen as more useful than unidirectional information sources (McCaffrey, Velez, & Briefel, 2013). Although communication efforts meant to inform decision making often come from an official source (e.g., a public safety official or local wildfire management specialist), informal interactions with neighbors have also been shown to influence both understanding of the potential consequences of a fire and options to mitigate the fire risk (Brenkert-Smith, Dickinson, Champ, & Flores, 2013; Prior & Eriksen, 2013). While interactive communication methods have been shown to be more effective, it is noteworthy that people generally have less experience with these sources as compared to more traditional, unidirectional methods of communication (Toman et al., 2006). A study of five U.S. wildfires found that the most frequently used information sources, such as newspapers and televisions, were generally not rated as the most useful or trustworthy sources (higher rated sources tended to be more interactive such as conversations with the local fire department). Individuals were instead turning to information sources that were familiar as opposed to those that might provide the most useful information (Steelman, McCaffrey, Velez, & Briefel, 2015). This is likely due to the relative difference in availability between these sources and highlight the importance of providing interactive opportunities where feasible.

Build Trust and Capacity Through Social Interaction

While no single outreach approach or policy is likely to be effective in every case, efforts that facilitate development of relationships within communities and with resource managers can contribute to increased preparedness and increased trust in managers (McCaffrey, 2015). Bringing individuals together to learn about local fire issues builds interpersonal relationships and social networks, which in turn foster shared goals and a collective sense of responsibility that can increase motivation to prepare for future fires (Fairbrother et al., 2013). In a study of mitigation action in six U.S. communities, respondents identified the collective actions of their neighbors as one of the primary contributors to their community’s successful wildfire risk mitigation efforts (Stidham, McCaffrey, Toman, & Shindler, 2014). Further, a review of prior research found that opportunities to engage in discussions with resource management personnel, visit demonstration sites, or participate in other interactive exchanges were found to be effective both before and after a fire event (Toman et al., 2013). Prior to an event these
opportunities helped participants learn about and see firsthand examples of actions they could implement on their own properties as well efforts being put into place on public lands. After a fire event, such opportunities allowed participants to gain a better understanding of the outcomes of the fire, learn about recovery options, and share perspectives on the fire with others including management personnel.

Other studies show that these social interactions can also foster trust between the public and local management authorities (Lachapelle & McCool, 2012; Sharp, Thwaites, Curtis, & Millar, 2013). A study in Australia found that engaging the local public in the development of management plans for public lands built trust between the agency and the community (Sharp et al., 2013). A plethora of research identifies the critical need for participatory decision making and the opportunity it provides to identify shared values, goals, and motivations—critical drivers of social trust (see Toman et al., 2014; Vaske et al., 2007; Winter et al., 2004; Winter & Cvetkovich, 2008). Such participatory processes may also increase the likelihood of people turning to the most accurate and official sources of information when considering their options. One study found that information delivered through a range of means from mediated channels (like the radio, television) to interpersonal channels (like neighbors, wildfire specialists) typically increased the perceived probability of a fire occurring. However, only information received from neighbors and friends increased the perceived severity of the likely consequences (Brenkert-Smith et al., 2013), a key factor in deciding to undertake a protective action. It is likely that individuals trust their neighbors and friends more than the other sources of information, and place greater weight on these assessments of the likely consequences (and even benefits of action). One cannot emphasize enough the need for trust between all of the affected parties when managing risks from natural hazards like fire.

Account for Behavioral Constraints and Barriers to Action

Even the most thoughtful and interactive communication effort, which targets the most relevant beliefs and builds trust between the relevant parties, may fail if there are behavioral constraints or barriers preventing an individual from acting on their motivation. The Theory of Planned Behavior (Ajzen, 1991), one of the most well-known theories of human behavior, identifies the critical importance of actual behavioral control in predicting action. Namely, that the likelihood of a particular behavior being adopted increases with positive attitudes toward the behavior, perceived social pressure to adopt the behavior, and perceived behavioral control (i.e., high self- and response efficacy). However, even an individual with very good intentions to act may fail to follow through when their actual behavioral control is low. Financial cost and time are two commonly cited behavioral barriers for household mitigation activities such as creating defensible space (Absher, Vaske, & Shelby, 2009; Collins, 2005; Cvetkovich & Winter, 2008; Daniel, 2008; Kent et al., 2003; Martin et al., 2007). Specifically, that individuals want to put these practices in place, but that they cannot afford them or simply do not have the time to do so. Time is a particularly limiting factor for part-time residents who do not want to spend
their vacation maintaining the property and implementing recommended practices (Brenkert-Smith, 2010; Bright & Burtz, 2006). Other barriers that have been identified include a lack of appropriate equipment or physical ability to carry out the tasks, as well as a lack of understanding about how specifically to implement the recommended actions (creating low self-efficacy) (Toman et al., 2013). Similar to the barrier of time, low self-efficacy is particularly problematic for part-time residents (Bright & Burtz, 2006). Studies have also found that some mitigation actions are incompatible with other values that are relevant to the homeowner (Nelson et al., 2004). For example, removing vegetation as a form of fuels management around the home may conflict with one’s aesthetic desires for the property, or may lead to concerns about other risks such as erosion.

Similarly, one’s intention to evacuate during a wildfire event can be hindered by the same range of constraints—a lack of access to safe evacuation routes, or an inability to evacuate livestock creating a need to stay behind and protect them (McCaffrey et al., 2015). Of course, these external or structural constraints are also relevant to resource managers who may want to use fire more actively as a management tool but find themselves constrained by limited financial resources and restrictive policies, such as air quality standards and the associated public health risk of smoke to local communities. Thinking strategically about how to overcome these barriers will be critical to effective and successful communication. In some cases, these constraints may be quite real (e.g., inability to evacuate livestock), while in other cases they may be perceived (e.g., the time it takes to prepare one’s home), and perhaps could be addressed through more effective communication aimed at changing the perceptions of these barriers.

Facilitate Thoughtful Risk-Benefit Tradeoffs

Ultimately, many of the challenges associated with decision making in this context boil down to the challenging tradeoffs that are inherent when there are competing objectives and risks that may shift over time. Individual homeowners and managers charged with managing wildfire may struggle to make the difficult tradeoffs required between the values or objectives of interest (e.g., public safety versus ecological health, or property protection versus aesthetics), and to assess how to protect these values over time given the inherent risk and uncertainty. There is a clear need to not only communicate the potential risks and benefits of various actions in a more meaningful and concrete way, but also to construct the decision process such that the difficult tradeoffs required do not result in the overuse of common heuristics (e.g., short-term loss aversion). Materials for homeowners can more implicitly highlight the potential tradeoffs that may need to be made (such as accepting some short-term air quality issues from prescribed burning) in order to achieve the multiple benefits associated with long-term fire risk reduction (such as improved habitat for wildlife, more desirable aesthetics, etc.). Information can also be framed to more effectively encourage consideration of risks and benefits over time. Loss framing is a well-known strategy that leverages the fact that individuals are more motivated to avoid future losses than to realize future gains (Tversky & Kahneman, 1991).
A study by Wilson, Ascher, and Toman (2012) indicates that presenting fire as a tool to restore a forest (i.e., recovering a loss) is more acceptable to the public than presenting fire as a means of improving present conditions (i.e., realizing a gain). Similarly, individuals tend to act more consistently with long-term values and goals when primed to focus on the future (Trope & Liberman, 2003). Therefore, if the goal is to encourage WUI residents to take on short-term costs (in terms of time, money) it is best to focus their attention on the state of the local forests or community in 10 years as opposed to the upcoming year. Such a frame should encourage long-term thinking and discourage a focus on short-term, and often more concrete concerns or barriers.

In addition to these simple rules for engaging the public more thoughtfully to overcome an often short-sighted focus on near-term risks, there are decision support tools available to managers to enhance wildland fire decision making including Wildland Fire Situation Analysis (WFSA), and more recently the Wildland Fire Decision Support System (WFDSS). According to McDaniel (2007), the WFDSS incorporates a stratified cost index that identifies local values at risk and the probability of fire spread given current conditions, drawing from local public surveys and records. Although these tools are meant to provide decision makers with the necessary information to make an informed choice, they often do not account for the way that the information will be processed and used in decision making. Specifically, these tools may not take into account the need for information to be presented in a way that balances consideration of potential gains and losses, especially those that vary over time. Thompson (2015) concurs that given the dynamic and complex nature of wildfire management, even well-trained and experienced managers can be susceptible to potential biases in decision making such as temporal discounting and status quo biases. As a result, better quantification of the temporal nature of risks and benefits in decision support systems like WFDSS could assist managers in weighing the benefits of wildfire over time, such as decreasing the severity of future fire, while recognizing that suppression in the near term may transfer (and compound) risks to the future.

Conclusions

The limited research that has looked at interactions between perceptions of climate change and wildfire highlights the idea that while climate change may be increasing risks from natural hazards of many kinds (floods, fires, air pollution etc.), people do not necessarily have to connect the two, or even believe that climate change is happening, to take mitigation actions that combat the immediate risks from these natural hazards. Public support for agency-based risk management and appropriate preparedness and response at the household level is typically high assuming that individuals understand the benefits of the recommended actions, and have the ability to act on their concerns and good intentions. It is also critical that at-risk populations have the opportunity to engage with resource managers and other public officials, as well as build relationships with
other members of their community. These relationships allow diverse individuals to identify shared values and goals, and ultimately build the trust and confidence needed to take action, and to respond positively to community outreach and engagement. Finally, taking action to protect oneself from wildfire risk requires a careful assessment (and understanding) of the risk-benefit tradeoffs. Members of the public and resource managers alike could benefit from a better understanding of the long-term risks and benefits associated with different actions. Building on the breadth and depth of past research on communication and decision making in the context of wildfire, it is possible to minimize the risks that wildfire poses to the public and to the ecosystems in which it occurs.

Suggested Reading

Wildfire and Climate Change


Wildfire and the Human Dimension


Wildfire Communication and Climate Risk Mitigation


Wildfire, the Human Dimension, and Climate Change


References


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


Wildfire Communication and Climate Risk Mitigation


**Robyn S. Wilson**  
The School of Environment and Natural Resources, The Ohio State University

**Sarah M. McCaffrey**  
USDA Forest Service

**Eric Toman**  
The School of Environment and Natural Resources, The Ohio State University