# Outreach Programs, Peer Pressure, and Common Sense: What Motivates Homeowners to Mitigate Wildfire Risk?

Sarah M. McCaffrey · Melanie Stidham ·
Eric Toman · Bruce Shindler

**Abstract** In recent years, altered forest conditions, climate change, and the increasing numbers of homes built in fire prone areas has meant that wildfires are affecting more people. An important part of minimizing the potential negative impacts of wildfire is engaging homeowners in mitigating the fire hazard on their land. It is therefore important to understand what makes homeowners more or less willing to take action. The research presented here comes from a study that interviewed a total of 198 homeowners in six communities in the western United States about the activities they had undertaken to mitigate their fire risk, the factors that contributed to their decisions, and their future intentions. The current paper reports on findings from the first half of the longitudinal study, after 3 years we will return to interview the current homeowner on the same properties to assess maintenance actions and facilitating and limiting factors. Overall we found a body of individuals who understand the fire risk, are taking numerous mitigation actions, and think that these actions have reduced their risk. These homeowners typically did not expect the government to do it for them: they wanted information about what to do and, in some cases, assistance with the work, but saw taking care of their property primarily as their responsibility. Responses also show that key information sources and motivating factors vary by location and that it is not inherently necessary to have relationships between community members to create defensible space.

S. M. McCaffrey (✉)
Northern Research Station, USDA Forest Service,
1033 University Place, Suite 360, Evanston,
IL 60201-3172, USA
e-mail: smccaffrey@fs.fed.us

M. Stidham · B. Shindler
Department of Forest Ecosystems and Society,
Oregon State University, Corvallis, OR, USA

E. Toman
School of Environment and Natural Resources,
The Ohio State University, Columbus, OH, USA

## Introduction

It is an increasingly common story in the media: a large wildfire is burning uncontrollably somewhere in the United States threatening forests, firefighters, and human communities. While fire has always been a part of the landscape, by most accounts they are becoming more common and affecting more people due to altered forest conditions, climate change, and growth in homes built in fire prone areas, also known as the wildland urban interface (WUI) (Noss and others 2006; Pierce and others 2004; Westerling and others 2006). In response, national fire policies (e.g., Healthy Forest Restoration Act 2003, National Fire Plan 2000) have been developed to reduce damage caused by wildfires, with an emphasis on preventative measures. Part of this strategy involves reducing fuel loads on public lands through mechanical thinning, prescribed fire, or both. Another equally important part is engaging private landowners in fire prone areas to take actions to mitigate fire hazard on their land.

Over the last several years, an array of federal, state, and local education and financial assistance programs—many of them through the National Fire Plan—have developed to encourage home mitigation activities. These programs work to engage local citizens and communities in creating defensible space around homes and other structures.

Research has shown that no matter what the condition of forest around them, homes that have defensible space are less vulnerable to combustion through radiant heat or falling embers (Cohen 2000). Actions homeowners can take include reducing flammable vegetation within 30 feet of structures, maintaining a green lawn or rock garden around the house, moving woodpiles and oil tanks away from the home, and building with fire resistant materials (especially the roof).

These efforts have led to growing interest in understanding what makes landowners in the WUI more or less willing to create defensible space on their property. While early studies indicated that some homeowners were reluctant to do anything (Gardner and others 1987; Winter and Fried 2000), more recent studies have found homeowners are taking action to reduce their exposure (Brenkert-Smith and others 2006; Cohn and others 2008; Kent and others 2003; Nelson and others 2004; Shiralipour and others 2006; Steelman 2008). To date, most of these studies have been cross-sectional studies providing a snapshot of ongoing efforts at one point in time. Yet to be successful, defensible space must be a continuous effort as vegetation grows back and thus requires long-term maintenance by the homeowner.

The research presented here comes from a longitudinal study designed to examine homeowner decisions and actions for initial implementation of treatments and their continued maintenance over time. Data come from communities in three states in the western United States with differing ecologies, fire history, vegetation, community organization, and programs to support defensible space practices. In this paper, we report on the first round of data collection to identify the activities undertaken by homeowners to mitigate their fire risk as well as the underlying factors that contribute to their decisions. These data will provide a base line for our follow up work that, taken together, will provide fire managers a more complete picture of those factors that are most influential in engaging community members in defensible space programs over the long-term.

## Literature Review

The decision to mitigate wildfire risk is not a simple one. A number of recent studies have examined various elements that might influence homeowner willingness to create defensible space including perceptions of wildfire risk, amenity values, resource limitations, and the role of community groups.

### Perceptions of Wildfire Risk

Perceived risk is generally defined as the likelihood of an event occurring combined with the potential negative consequences of that event. Extensive research on risk perception has shown that this is a subjective and highly variable calculation as the time frame and spatial scale considered in assessing probability and potential negative consequences will vary for different groups and individuals (McCaffrey 2008). Some may emphasize probability of an event within the next year while others may emphasize a specific consequence—such as a watershed or a house being damaged by a wildfire—leading to very different risk assessments and responses. For instance, given the millions of acres federal land management agencies are responsible for across the country, the likelihood of a large, expensive wildfire in any given fire season is high. So it is no surprise that public land managers see the fire risk as very high and are highly motivated to reduce their exposure through preventative measures, such as fuel treatments in fire-prone forests and public education campaigns. In contrast to the high aggregate risk facing the federal agencies, the probability of a fire actually causing damage to a homeowner's individual parcel of land is quite low (Steelman 2008). Reflecting this spatial dynamic of risk perception, research has shown that homeowners tend to assess the wildfire risk to the general area as higher than the wildfire risk to their individual home (McCaffrey 2008).

It also is generally expected that high risk perception will lead to increased action to reduce exposure. However, numerous studies on fire and other natural hazards have found that the connection is rarely so direct, rather high risk perception is a necessary, but not sufficient, condition that underlies the mitigation decision (McCaffrey 2004). Research has shown that the decision to change behavior is a multi-step process where recognition of the risk is only a first step (Daniel 2008; Martin and others 2008; McCaffrey and Kumagai 2007). Weinstein and Nicolich (1993) have also argued that the poor correlation found between high risk perception and active mitigation may be due to the fact that most studies measure risk perception at one point in time. As a result, the risk perception measured in a study may already have been affected (lowered) by mitigation actions taken, thereby obscuring the possible link between high risk perception and action.

### Willingness to Create Defensible Space

Considering that individual properties are at low risk of experiencing wildfire in any given year, and that creating defensible space requires considerable effort over the course of ownership of a property, one could expect that homeowners in the WUI would not be willing to do it (Daniel 2007; Steelman 2008). However, a growing body of research shows that a large proportion of homeowners do consider themselves to be at high risk from a wildfire and that many are taking action to reduce their risk through

a range of measures including moving woodpiles, clearing vegetation around their homes, and utilizing fire resistant building materials (Brenkert-Smith and others 2006; Cohn and others 2008; Kent and others 2003; Kruger and others 2003; McCaffrey 2008; Monroe and Nelson 2004; Nelson and others 2004; Shiralipour and others 2006; Steelman 2008).

Reasons residents may recognize the risk but choose not to mitigate are generally associated with resource availability and conflicts with other values, such as landscape preferences. Homeowners have reported that removing trees and other vegetation to create defensible space would jeopardize the very reasons they bought the property, such as privacy, naturalness, and wildlife habitat (Brenkert-Smith and others 2006; Nelson and others 2004). In some locations removing trees from near the house directly contradicts messages homeowners receive from their energy companies to maintain these trees for shade, or messages from wildlife organizations to maintain brush piles for habitat (Monroe and others 2003). Additional research has identified that treatment decisions are also influenced by homeowner beliefs about the conditions of nearby landscapes, fire behavior, and effectiveness of defensible space treatments (Brenkert-Smith and others 2006; Bright and Burtz 2006; Daniel 2007; Nelson and others 2004; Winter and Fried 2000). These cases demonstrate that there are many motivations for and against creating defensible space.

Finally, although it is commonly suggested that homeowners do not mitigate because they see protecting their homes as a government responsibility, studies have found that WUI residents report feeling a shared sense of responsibility for risk mitigation with each party being primarily responsible for actions taken on their own land (Winter and others 2009; Brenkert-Smith and others 2006; Cohn and others 2008; Kruger and others 2003; Weisshaupt and others 2007; Winter and Fried 2000).

Role of Social Context

Individual decisions to mitigate fire risk are not taken within a vacuum. Both government and more informal social systems can provide incentives (and disincentives) to create defensible space. Government at the local, state, and federal level can aid individuals through education and site specific guidance, grants to help cover mitigation costs, assistance with disposal of unwanted vegetation, and developing zoning and building codes for fire prevention (Gorte 2006, Jakes and others 2004).

Several studies have demonstrated that social interactions contribute to wildfire protection. A series of case studies of community wildfire preparedness across the United States found that communities with more social networks both within the community and between the community and different levels of government were better able to prepare themselves for wildfire (Jakes and others 2007). These networks are thought to be important in initiation of defensible space efforts through applying for and receiving government grants and assistance and their maintenance over time through the establishment of social norms of fire protection (Jakes and others 2003). Brenkert-Smith and others (2006) found that social interactions were an important component to initiating defensible space but that the interaction did not have to be at the community or even neighborhood level; simple neighbor to neighbor informal interactions were enough. Value orientation also can affect the role of social influences. Bright and Burtz (2006) found that residents who were more individualistic in their value orientation were not influenced by neighbors, community, or expectations of fire protection, but residents with a community-based value orientation were. These studies suggest that while high levels of social interactions can encourage defensible space, communities where there is little social interaction amongst individuals may still successfully adopt behaviors to reduce their risk.

While the literature provides a number of useful insights into what shapes decisions to mitigate, the studies reviewed above were all cross-sectional in nature with data collected at a single point in time. Such studies have limited ability to address a significant question raised within the fire community as to whether homeowners will maintain their property after the initial effort, particularly since in many areas managing one's vegetation is not an insignificant endeavor. Drawing from the health risk literature, Daniel (2008) suggests that although homeowners are making progress in the initiation stage of wildfire risk mitigation, the maintenance stage will be a particular challenge given the high levels of effort required and little positive feedback. We therefore were interested in studying factors that affect homeowner mitigation decision-making over time in order to assess maintenance dynamics. The current paper reports on findings from the first half of a study, identifying activities homeowners are taking to mitigate fire risk, the factors that motivated them to initiate such actions, and their future mitigation plans. After three years we will return to interview the current homeowner on the same properties to assess maintenance actions and facilitating and limiting factors.

Methods

This paper presents findings from 198 interviews with homeowners conducted in 6 WUI communities in the western United States. As a primary focus of this study was on the issue of long-term maintenance of defensible space,

we worked with contacts within state agencies and defensible space programs to purposively select WUI communities where there had been widespread efforts to create defensible space (Babbie 2001; Rubin and Rubin 2005). We chose to engage in structured on-site interviews in order to gain an in-depth understanding of the homeowner decision-making process and the role of local contextual factors, as well as observe and record the actual actions undertaken by homeowners on their properties.

Participants were identified through lists of potential homeowners provided by primary local contacts. In all cases but Idaho this contact was a member of the homeowner association (HOA) or a community leader. Given the project's focus on long-term maintenance of defensible space, we asked that the list provide a range of community members with an emphasis on those who were active in some way in fire mitigation. In Idaho, where there were no distinct neighborhood or community-based efforts to encourage defensible space, the Kootenai County Fire-Smart program manager identified an area in the county where homes were less dispersed and provided a list of homeowners in that area who had participated in their program. Interviews were conducted in each neighborhood until data saturation was reached (Rubin and Rubin 2005); indeed, in each case we sampled well beyond saturation to ensure an adequate sample size would still be available for the second phase of this longitudinal study. This type of purposive sampling is not meant to be representative of a larger population, but rather to provide a rich and deep understanding of the issue at hand by learning from individuals who are intimately involved with the subject of study (Babbie 2001; Rubin and Rubin 2005).

Data were collected using a structured interview format with a mixture of open-ended and closed choice questions, followed by a 2 page survey comprised of mostly closed ended questions. Interviews were conducted in teams of two with one person conducting the interview and the other recording specific answers to questions and taking detailed notes (Kvale 1996). The majority of interviews in Idaho, Oregon B, and Oregon C took place in the summer of 2006;

the remaining interviews were conducted in summer 2007. Most of the interviews took place on the participant's property and lasted for an average of 45 min.

Responses to open-ended questions were individually entered into a Word document and coded based on their content (Miles and Huberman 1994; Rubin and Rubin 2005). For instance, the open-ended question "what have you done on your property to mitigate fire risk" garnered many responses, such as thinned trees, removed brush, added a lawn, etc., which were each assigned a code. In order to assess relative importance of responses within and between sites, data were entered into an Excel database. Participants who mentioned a certain activity in their response were assigned a 1 for that code and a 0 if they did not.

In the sections that follow results for the open-ended questions are presented as relative frequencies and exemplary quotes (Miles and Huberman 1994). Frequencies for responses to open-ended questions represent the percent of respondents that brought up a particular topic without prompting. That 38% of research participants in Oregon A reported personal experience as a source of information does not imply that 62% have no personal experience with fire; rather it was simply not mentioned by those participants during the interview. Assessing how frequently a topic was voluntarily raised provides insights into how people think about different fire topics and the relative salience of responses both within and across sites.

## Site Characteristics

Sample communities were located in northern Idaho, central Oregon, and southwestern Utah (Table 1).

### Central Oregon

Oregon A and Oregon B are communities near Sisters, Oregon. Oregon A has 200 ~1 acre lots and Oregon B has 440 ~0.5 acre lots, the majority of which have homes or other structures on them. Both communities are situated in

**Table 1** Site characteristics and demographics

| Site name | Forest type | Parcel size (acres) | Area recently evacuated due to wildfire | HOA | # of study participants | % permanent residents | % retired |
|-----------|-------------|---------------------|------------------------------------------|-----|-------------------------|------------------------|-----------|
| Oregon A | Ponderosa pine | 1 | Yes | Yes | 40 | 97 | 55 |
| Oregon B | Ponderosa pine | 0.5 | Yes | Yes | 46 | 98 | 67 |
| Oregon C | Lodgepole and ponderosa pine | 0.5–1 | No | Yes | 40 | 62 | 56 |
| Idaho | Northern Rockies dry mixed conifer | 1–20 | No | No | 40 | 98 | 30 |
| Utah A | Pinyon-juniper/hardwood | 1–2 | No | Yes | 23 | 48 | 35 |
| Utah B | Pinyon-juniper/hardwood | 2–3 | Yes | No | 9 | 100 | 22 |

a classic ponderosa pine forest and are surrounded by the USDA Forest Service (FS) Deschutes National Forest. There have been multiple large fires nearby over the last 5 years, and while there has not been any direct damage within the communities from wildfire, one fire did come close enough in 2006 to warrant evacuation.

Oregon C is located outside of La Pine, Oregon and has 102 forested lots, most with homes or other structures on them. The neighborhood is surrounded by a lodgepole and ponderosa pine forest and shares its borders with land managed by three government agencies: the FS Deschutes National Forest, USDI Bureau of Land Management (BLM), and Oregon Department of Fish and Wildlife. There have been several recent forest fires in the vicinity, but none have caused a direct impact.

All three neighborhoods have HOAs, although they vary in their formality. Oregon A's homeowner board is run by elected officers, with at least one officer primarily responsible for fire related activities. In addition to a board, Oregon B has a paid onsite property manager who is very proactive in fire protection. Although Oregon C has a homeowner group, most residents attribute the neighborhood's fire preparedness activities to an individual not associated with the HOA who took on fire risk mitigation as a personal mission. All three communities are covered by the Oregon Forestland-Urban Interface Protection Act (1997) which requires residents in forested communities to mitigate fire risk. Once vegetation has been reduced from around structures, along driveways, and around property lines the property can be certified. Non-certified properties can be held liable for up to $100,000 of fire suppression costs if a fire starts on their land.

### Kootenai County, Idaho

In Idaho, our sample area was around the town of Athol just north of Coeur d'Alene in Kootenai County. Participant lot size ranged from 1 to 20 acres, with an average size of 9 acres. The area is heavily forested with a mixture of public and private ownerships. Forests immediately surrounding the majority of study properties were privately owned and predominately composed of lodgepole pine. No recent wildfires have threatened the area.

Kootenai County has a fire prevention program called FireSmart Kootenai County which uses National Fire Plan dollars to pay local contractors to create defensible space for 100 feet around homes in high fire risk areas. Work was done by the contractors at no expense to homeowners, with homeowners providing a match by being responsible for disposing the vegetation debris produced by the treatments. Homeowners participated in the program by either contacting the FireSmart office to request having the work done or being recruited by the contractors on door-to-door campaigns. Once work was completed, homeowners were supplied with information on maintaining their defensible space and fire safety. None of the properties were part of an organized neighborhood group.

### Cedar City Area, Utah

Utah A and Utah B are located in SW Utah, near Cedar City. The forests within and surrounding the neighborhoods are characterized as pinyon-juniper/hardwood. Public lands near the communities are managed by the FS Dixie National Forest and BLM Cedar City Field Office. Utah A is a steeply sloped community composed of 165 lots of 1 and 2 acres, less than half of which have homes or structures on them. Fire prevention and safety is a key focus of the neighborhood's homeowner's group with one board member's responsibilities almost entirely fire related. The neighborhood participates in a program with Utah Division of Forestry, Fire and State Lands where hours spent by residents on fire mitigation activities are matched with state crew's who assist with vegetation disposal or clearing property. Thus far, the neighborhood has not been evacuated or threatened by fire.

Utah B has 33 forested lots, just over half of which have homes on them. In 2005, the neighborhood was evacuated due to a fast moving wildfire. While no homes were lost, at least one was damaged by radiant heat, several experienced smoke damage, and several vacant lots were burned. The neighborhood does not have a formal homeowner's group, but after the fire neighbors began to work together, galvanized by one individual, to become more fire safe. Utah B has received some state assistance, particularly with chipping of removed material.

## Results

### Demographic Characteristics

The vast majority of participants in all sites, with the exception of Utah A (48%) and Oregon C (62%) were permanent residents (Table 1). Eighty percent of participants had owned their home or property for over 2 years, with 30 percent owning the property for over 10 years. Just over half of the participants in the Oregon sites were retired, compared to roughly a third in the other sites. The mean age of study participants was between 51 and 66 across all sites. The majority of participants in Oregon B, Oregon C, and Utah B held college degrees.

### Landscape Values

When asked what feature they most appreciated about their property and the surrounding area, most participants

brought up natural features such as, trees, scenery, wildlife, recreation opportunities, etc.

> We live in the woods, clean air, sunshine year round; we've been recreating here since 1950, and knew we wanted to retire here. ∼Oregon B Participant

> The vegetation, animals, a place to have horses, not a suburban setting, rural feeling. ∼Utah B Participant

Many participants appreciated their rural setting, particularly the privacy of their property. This was especially important in Idaho with more participants bringing up privacy and rural setting than any other feature and over half stating these characteristics were the most important attribute of their property.

Perceptions of Wildfire Risk

Roughly 80 percent of respondents felt their house was at general risk from fire. The fact that the homes were located in a natural area that was prone to wildfire was the most commonly cited reason for moderate and high risk assessments.

> I don't feel particularly at risk as the fires have always been elsewhere, but if you live close to a forest of course you are at risk. ∼Utah A Participant

However when asked to assess their personal risk on a scale of 1–10 (1–3 calculated as low risk, 4–7 as moderate risk, 8–10 as high risk), few participants thought they were at *high* risk from fire—most participants placed themselves at a moderate or even low risk level. Participant risk assessment appears to be partly a reflection of the mitigation work that had been done. When asked to rate their risk level prior to doing work on their property, roughly 2/3 of research participants reported their risk level was an 8 or above; using the same risk scale only 10 percent assessed their risk as high after the work. The shift was most marked in Idaho and Oregon C where each homeowner's assessed risk dropped by an average of 3.3 points, and least pronounced in Oregon A with a 1.97 point shift on the risk scale. The average shift in risk perception due to mitigation work across all sites was 2.75 points. Around a quarter of respondents explicitly stated that the reason for their lower risk rating was due to actions that had been taken to reduce the risk.

> There is a green belt around the house, the dead debris has been cleared…there are some trees too close to the house, but I have done everything the Forest Service told me to do. So hopefully with the home I built and the landscaping will prevent the home from burning. ∼Oregon B Participant

Participants in the three communities that had direct experience with fire also mentioned the recent fire as contributing to decreased risk by reducing the flammable vegetation on the surrounding landscape.

Fire Risk Information Sources

Participants were asked to identify how they learned about fire risk (Table 2). While citing several sources, personal experience was the most frequently mentioned response across all sites, with just under half (44%) of all participants indicating that it was one way they knew about fire risk. Participants noted such understanding could result from direct experience with a wildfire or from experience gained from employment, fires in other areas, or spending a lot of time in fire prone forests. Common sense was also commonly mentioned response across all sites.

> I knew of the fire danger when I moved in; I've lived in mountains before. ∼Idaho Participant

> In my past career I spent a lot of time east of the Cascades on fires—I started fighting fire when I was 15 years old. ∼Oregon A Participant

> It is common sense—if you can't walk between trees you have a problem. ∼Idaho Participant

In sites with a Homeowners Association (HOA) (see Table 1), the HOA or neighbors were mentioned as an information source by 38–48 percent of participants, while neighbors were named as an information source for only 11% of participants in Utah B where there is no HOA. Agency outreach also was an important information source, particularly in Utah where 52–56% of respondents mentioned it.

> We have a [HOA] board member that is in charge of fire prevention and we got information from him and the fire people that come to the homeowner meetings. ∼Utah A Participant

Decision to Mitigate Risk

Out of 198 research participants, only six had chosen not to take any action to reduce their risk to wildfire. Given the lists used to draw our samples (those participating in defensible space programs) a high percentage is to be expected. Reasons offered for not taking action included work already being completed by the previous owner, lack of knowledge on what to do, part-time residency, lack of time, and low-risk perception.

When participants who had taken action were asked what factors led to their decision to mitigate, awareness of the risk and common sense was brought up by half to over two-thirds of respondents (Table 3).

**Table 2** Information sources for fire risk (% mentioning information source without prompting)

| Information sources | OR A n = 40 | OR B n = 46 | OR C n = 40 | UT A n = 23 | UT B n = 9 | All sites n = 167 |
|---|---|---|---|---|---|---|
| Personal experience | 38 | 57 | 48 | 17 | 33 | 44 |
| Common sense | 40 | 33 | 40 | 44 | 22 | 38 |
| Neighbors/HOA | 45 | 39 | 38 | 48 | 11 | 38 |
| Agency outreach | 38 | 26 | 33 | 52 | 56 | 34 |
| General media sources | 18 | 33 | 15 | 26 | 11 | 23 |
| Family member/friend | 10 | 2 | 3 | 9 | 33 | 7 |
| Local fire activity | 3 | 9 | 5 | 4 | 44 | 7 |

Sources of information are responses to the open-ended question "How did you learn about fire risk?" Sources are only reported in this table if 20% or more respondents in any one site brought them up

There is no data available for Idaho because this question was added to the protocol after data collection was initiated in Idaho when it became clear that this information was not being systematically collected by existing questions

> You have to be prepared—it is common sense. ~Idaho Participant

It didn't take long living here before we realized it was quite flammable. When we had just started building there was work going on [in the neighborhood] and burning; embers got caught in the wind and there were smoke starts all over the yard. Had to run out with shovels and get them all out—it was an eye opener. ~Oregon A Participant

Aesthetics also were important across sites, although less commonly mentioned in Oregon than the other two states.

> It was really overgrown so we started the work for aesthetics, but while doing the work we realized it would be good for fire prevention/protection too and now both are equally important reasons. ~Utah A Participant

A community leader or the HOA was mentioned by 28–47 % of respondents in the four sites with HOA's. In the two non-HOA sites roughly 1/3 of respondents said that some type of peer influence was a reason for mitigating.

> We were forced to by the HOA—we were going to be fined. ~Oregon B Participant

Everyone is very conscious and aware; most people are doing things. Neighbors would get on someone's case if they weren't doing anything. People not only want to protect their own homes, but they also feel responsibility for their neighbors too. ~Utah A Participant

Agency outreach contributed to the mitigation decision for over half of respondents in two sites, Utah B and Oregon A, and was least cited by Idaho respondents (15%). Unsurprisingly, given our sampling process, Idaho respondents made the highest reference to an outside

**Table 3** Participants' motivations for wildfire mitigation action(s) on their property. (% of respondents that brought up a particular motivation without prompting)

| Motivations | OR A n = 40 | OR B n = 46 | OR C n = 40 | ID n = 40 | UT A n = 23 | UT B n = 9 | All sites n = 198 |
|---|---|---|---|---|---|---|---|
| Common sense/risk awareness | 54 | 54 | 58 | 85 | 84 | 78 | 65 |
| Aesthetics | 23 | 37 | 30 | 53 | 47 | 44 | 37 |
| Agency outreach | 56 | 24 | 28 | 15 | 63 | 22 | 33 |
| Community leader/HOA | 41 | 28 | 35 | 0 | 47 | 11 | 28 |
| Non-neighborhood program (i.e., FireSmart, state incentives) | 36 | 0 | 3 | 68 | 32 | 44 | 27 |
| Recent local wildfire | 8 | 37 | 28 | 0 | 0 | 67 | 16 |
| Family member/friend | 3 | 2 | 10 | 30 | 0 | 33 | 11 |
| Regulation / CC and Rs | 13 | 26 | 10 | 0 | 0 | 0 | 11 |
| Clear property for building | 3 | 0 | 5 | 0 | 11 | 33 | 4 |

Motivations are responses to the open-ended question "What led to your decision to do the work?" Motivations are only reported in this table if 20% or more respondents in any site brought them up

program (68%, referring to FireSmart). Incentive programs also were frequently mentioned as a motivator in other sites. Notably, while a little over half of Utah A and Utah B (52 and 56%) residents mentioned agency outreach as a source of information about fire risk, a larger portion in Utah A, which had a matching incentive program, cited agency outreach as a motivation for taking action than in Utah B (63 vs. 22%).

> We got a notice from the forestry department that work needed to be done. We were going to do it anyway, then they offered us money so we did it. The money got us going. ~ Oregon A Participant

> We spent 150 hours this summer clearing around the home to make a fire break. We have a cooperation with the state where we keep track of our hours spent clearing and the state gives us back an equal amount of hours to do chipping and clearing—great program. ~ Utah A Participant

Interestingly, although three sites had been affected by recent fires, fire activity was noted as a strong motivator only in Utah B. In addition, regulation was mentioned only in Oregon where 10–26% of respondents mentioned the local CC and R's and the state liability law as a reason for mitigating.

Respondents were also specifically asked if any particular group or individual helped them decide what to do. Overall around a third of participants indicated that they did not receive help in making their decisions, with almost half of respondents in Idaho and Oregon B indicating that this was the case as compared to around 20 percent of respondents in the remaining communities. For those who indicated another individual or group helped them decide what to do, there was no dominant external influence across communities; instead certain influencing agents appear to be more important in different communities. A forest agency (state or federal) was mentioned by most respondents in Oregon A and Utah A, by slightly less than half of Oregon C and Utah B respondents, and a minority of Oregon B and Idaho respondents (Table 4). The HOA was the most common response in Oregon B, but was also mentioned in the other HOA communities. Even though Oregon C had an HOA, more people mentioned a particular neighbor's action than the property owner group. While FireSmart was the dominant answer in Idaho, a neighbor's influence also was mentioned by 36% of respondents.

> The fire department does promote some [awareness], but not very aggressively; they have information [available] when you get a burn permit and at fairs. A lot of it, FireSmart, is word of mouth, neighbors and signs put out. We knew about FireSmart and didn't use it until they knocked on the door. We would

rather not use government stuff, but if they knock on the door and could do it faster…When people find out it is free a lot use it. ~ Idaho Participant

Although the local fire department was named as an influence in five of the communities, only in Utah B was it named by more than a quarter of respondents.

### Actions Taken

Respondents were then asked what actions they had undertaken to reduce their fire risk. Almost everyone had thinned and pruned trees on their property, and most had removed brush (Table 5). Many participants in the Oregon and Idaho sites talked about adding or maintaining a lawn, often both for aesthetics and fire protection. Lawns were far less common in Utah; in Utah A lawns are prohibited unless there is a spring on the property, and in Utah B few participants chose to maintain a lawn due to water demands. In both Utah sites, rock buffers were maintained for both fire protection and to keep mud out of the home during the winter. In the Oregon sites, located in pine forests, emphasis was placed on disposing of needles each season, particularly in Oregon A. Most respondents who reported using fire resistant materials were referring to roofs, but siding was also frequently mentioned.

> Raking needles is the biggest thing—where needles collect is where embers will collect as they are pushed by the same wind. If you keep up with that it reduces the chances of fire a lot. ~ Oregon B Participant

> [When we bought the home] we re-did the outside with paint instead of stain since that is more fire resistant, and we re-paint it every couple of years. The deck is made of Trex, and that is supposed to be more fire resistant. We have a metal roof. We put gravel all the way around the outside of the home, but at the time that was more to control mud in the winter than for fire, but we maintain it for fire too. ~ Utah A Participant

In addition to being asked during the interview what actions had been taken to lower risk, respondents were asked a similar question in the two-page survey (for more details see Toman and others 2011), but rather than being open-ended, the survey had a list of potential actions. Both methodologies indicate that most respondents are undertaking a number of actions to lessen their risk from wildfire; however, as might be expected, when presented with a list of potential actions, respondents tended to indicate more actions in the survey than their open-ended responses which tended to focus on vegetation management. For instance, few respondents mentioned installing an additional water source during the interview, but a substantial

**Table 4** Individuals or groups that helped participants decide what to do on their property (% of respondents that brought up an individual or group without prompting)

| Individual or group | OR A $n = 32$ | OR B $n = 23$ | OR C $n = 30$ | ID $n = 22$ | UT A $n = 17$ | UT B $n = 7$ | All sites $n = 131$ |
|---|---|---|---|---|---|---|---|
| Forest agency (state or federal) | 81 | 13 | 47 | 5 | 88 | 43 | 47 |
| HOA | 34 | 70 | 17 | 0 | 41 | 0 | 30 |
| Neighbor's action or influence | 16 | 4 | 43 | 36 | 6 | 14 | 22 |
| Local fire department | 6 | 22 | 17 | 9 | 0 | 43 | 13 |
| FireSmart | 0 | 0 | 0 | 64 | 0 | 0 | 11 |

Responses are to the open-ended question "Did any group or individual play a role in helping you decide what to do?" Values are only reported in this table if 20% or more participants in any site brought them up. Frequencies were only calculated for participants that answered yes to this question (roughly 2/3 of participants)

**Table 5** Mitigation actions brought up by respondents during the interview (% of respondents that brought up a particular action without prompting)

| Actions taken | OR A $n = 40$ | OR B $n = 46$ | OR C $n = 40$ | ID $n = 40$ | UT A $n = 23$ | UT B $n = 9$ | All sites $n = 198$ |
|---|---|---|---|---|---|---|---|
| Thinned/pruned trees on property | 100 | 93 | 95 | 100 | 84 | 100 | 96 |
| Brush removal | 77 | 73 | 90 | 85 | 90 | 100 | 83 |
| Create a lawn or rock buffer zone around home | 49 | 38 | 20 | 38 | 79 | 79 | 42 |
| Use of fire resistant materials | 18 | 58 | 25 | 28 | 53 | 79 | 37 |
| Clean up tree debris in yard | 67 | 33 | 30 | 5 | 0 | 0 | 29 |
| Installation of a sprinkler system | 23 | 27 | 8 | 3 | 26 | 33 | 17 |
| Relocate woodpile | 15 | 24 | 13 | 5 | 16 | 22 | 15 |

Actions listed above are responses to the open-ended question "What actions have you taken?" Actions are only reported in this table if 20% or more respondents in any site brought it up

percentage of respondents in most sites indicated they have done so on the survey. Roughly half of respondents in each site reported having improved the visibility of their house numbers on the survey, but only a few brought this up during the interviews. This suggests that certain activities are more prominent in participants' minds as being actions taken specifically for fire mitigation while other actions fire managers promote to mitigate fire risk may be undertaken for reasons other than fire.

Most homeowners did the work themselves (86% overall) with roughly a quarter using private contractors, generally in tandem with their own work. Not surprisingly, given the nature of the FireSmart program, 92% of Idaho participants indicated they had used a private contractor—but clearly they were not dependent on the private contractor for doing all the work as 72% indicated they had also done some of the work themselves. Many of the Idaho participants indicated that they had already planned to undertake the work, but over a period of several years due to time and equipment limitations, and the FireSmart program enabled them to achieve their goal more quickly.

> Having FireSmart come in and do initial work was single most important thing—we burned the piles ourselves. FireSmart came in within a couple months after we moved in—FireSmart gave us initial training, that was free—it was really nice, we would have done work anyway, just would have taken longer. ∼Idaho Participant

Approximately 10 percent of respondents in two communities indicated a neighborhood group had helped with the work, notably one with a HOA (Oregon C) and one without (Utah B). Forty two percent of Utah A residents indicated that a state or federal agency had done the work. As part of its matching incentive program, Utah A can have government hired crews come to the property of qualifying owners to create defensible space. As the community has steep terrain, many respondents indicated that this assistance was crucial in their ability to effectively and safely mitigate hazard on their parcels.

There is good indication that homeowners recognize that vegetation management is not a one-time event. When asked about actions planned for the future 66% indicated that they planned to thin and/or prune more trees and 42% said they would remove more brush (Table 6). Overall, 42% of respondents explicitly stated that they would be maintaining what they had accomplished so far, with much

higher portions of Utah residents (70–89%) mentioning maintenance as a future action.

> [We are] planning on taking an assessment of [our] lot and getting rid of all of the dead stuff. [We] will thin more below the house and will maintain what has already been done. ∼ Utah A Participant

> FireSmart gave us a buffer, but not defensible space—trees are still too close. It is a deterrent, but not a cure. Need to have trees out. Could also use a brush hog. Need to get rid of trees that could come down on the house. ∼ Idaho Participant

Role of Federal/State Agencies

Finally, we asked participants what role local forest agencies should have in relation to creating defensible space on private property. Few participants believed that the agencies had a large responsibility for work on private property. Instead, participants clearly felt that the primary agency role, if any, was to raise awareness of the risk and provide educational materials on what to do (Table 7).

> If you live here you have to be accountable and you are responsible to do as much as you can to protect your home; you assume risk by being here. It is not [the Government's] responsibility to protect private homes. They already do a lot. ∼ Utah B Participant

> Come through and tell each homeowner what they should take out and tell them this is not a one-time deal. ∼ Oregon C Participant

Managing public lands adjacent to the community was another common response, although with variability between locations. For Utah B it was the dominant response instead of agency provision of information while few respondents in Utah A or Idaho raised the idea.

> I don't think the Forest Service has a role – I think it is my problem. At a minimum their job is to protect the perimeters, like they've done, to slow down a fire from reaching my property. It is not the government's role to do work on my property [but] I would like advice. ∼ Utah B Participant

> We are required to have our private property defensible, so the forest boundary should be made protectable as well. ∼ Oregon A Participant

The two Utah communities also placed a strong emphasis on agencies providing direct physical assistance, especially in the form of vegetation disposal. In Idaho the second most common response (18%) after education was that federal agencies had no role. It is notable that, given the nature of the FireSmart program, only 8% of respondents in Idaho named direct assistance as a function, even though many respondents recognized FireSmart as a government sponsored program.

## Discussion

The purpose of this project was to examine the actions taken by homeowners to reduce their vulnerability towards fire, the factors that influence those behaviors, and, eventually, maintenance of mitigation over time. As our sample focused on homeowners who had taken action, inferences from these findings cannot be drawn to the general population. Instead our in-depth interviews provide insights into how homeowners learn and think about wildfire mitigation, the types of actions undertaken, and the factors that shape their decisions to act. As such, these findings provide additional understanding of dynamics cited in the broader literature and within the fire management community as contributors to homeowner wildfire mitigation decisions.

The vast majority of our respondents believed their house was at risk from fire but did not see that risk level as particularly high, which appears due in part to actions they had taken as many explicitly noted their risk had been reduced as a result of their mitigation actions. This supports Weinstein and Nicolich's (1993) suggestion that the failure to find a direct connection between high risk

**Table 6** Mitigation actions planned for the future (% of respondents that brought up a particular action without prompting)

| Planned actions | OR A $n = 32$ | OR B $n = 36$ | OR C $n = 37$ | ID $n = 35$ | UT A $n = 20$ | UT B $n = 9$ | All sites $n = 169$ |
|---|---|---|---|---|---|---|---|
| Thin/prune | 50 | 72 | 67 | 80 | 55 | 67 | 66 |
| Maintain work that has been done | 59 | 25 | 35 | 23 | 70 | 89 | 42 |
| Mow/brush removal | 16 | 39 | 43 | 71 | 50 | 11 | 42 |
| Clean up tree debris in the yard | 22 | 17 | 5 | 0 | 0 | 0 | 9 |
| Install an additional water source | 0 | 0 | 0 | 26 | 0 | 0 | 5 |

Planned actions listed above are responses to the open-ended question "What actions are you planning for the future?" Actions are only reported in this table if 20% or more respondents in any site brought it up. Frequencies were only calculated for participants who indicated they would be taking mitigation actions in the future

**Table 7** Role of local forest agencies in creation of defensible space (% of respondents that brought up a particular action without prompting)

| Role of local forest agencies in creation of defensible space | OR A n = 40 | OR B n = 46 | OR C n = 40 | ID n = 40 | UT A n = 23 | UT B n = 9 | All sites n = 198 |
|---|---|---|---|---|---|---|---|
| Education/awareness | 58 | 78 | 59 | 74 | 65 | 11 | 65 |
| Manage nearby public land for fire safety | 43 | 22 | 23 | 3 | 9 | 56 | 22 |
| One on one advice/information sharing | 18 | 13 | 33 | 15 | 4 | 11 | 17 |
| Direct physical assistance | 10 | 4 | 3 | 8 | 48 | 44 | 13 |
| Leadership/organization | 8 | 30 | 5 | 3 | 4 | 0 | 11 |

Roles listed above are responses to the open-ended question "What role do you think the local forest agencies should have with property owners for creating defensible space around private homes?" Actions are only reported in this table if 20% or more respondents in any site brought it up

perception and action may be because taking action results in lower risk perception. To more clearly make the connection between risk perception and action, risk perception needs to be measured before and after actions are taken, which few studies do.

It is striking that the most common method described for how respondents understood the fire risk was personnel experience and that a substantial number of participants indicated common sense and communication with neighbors (either individuals or through a HOA) were information sources for fire risk. This highlights the social, and often informal, nature of learning among adults. These findings are consistent with research into the manner that adults process new information. Research has shown that adults have a wealth of prior experiences and knowledge and evaluate new information to see how it supports, extends, or conflicts with this prior information (Knowles and others 1998). It is also important to note that despite the frequent mention of personal experience and common sense, not everyone cited them and a majority of participants thought a key role of forest agencies was to provide information about the fire risk, particularly what actions could be taken to mitigate the risk. Ultimately, the variety of sources that people access to understand the wildfire risk and how to decrease their exposure highlights the importance of using multiple forms of communication. Indeed, research suggests agency educational efforts will be most effective when including a range of both content (from general to detail-rich) and multiple methods of communication exchange, including those that draw upon existing channels within the community (Monroe and others 2006; Toman and others 2006).

In terms of factors that motivate mitigation, common sense continued to be frequently mentioned. Aesthetics—which is often thought to be an argument against defensible space—also was raised as a motivating factor by a significant portion (23–53%) of people in each location. Social interactions also play a role for a portion of the population although the type of social influence varies by community. Homeowners associations are important where they exist,

but in communities where no such organization exists peer influence still plays a role and supports the findings of Brenkert-Smith and others (2006) about the importance of informal social interactions. In Idaho, an area where respondents openly acknowledged that there was little desire for any sort of community organization, neighbor's actions and FireSmart—a program designed to work with individual homeowners—were influential in the mitigation decision. It is useful to note that when asked specifically if an outside individual or group helped participants decide what to do 1/3 of respondents said no outside entity had helped. This indicates that there is a substantial portion of the population for whom mitigation is seen as an internal household matter, possibly reflecting the differences in value orientation (individualistic versus community-based) that Bright and Burtz (2006) found shaped defensible space decisions.

Agency outreach was important but varied in influence by location and activity. It was the most commonly cited source of information about fire risk in both Utah sites. However, a much smaller portion of Utah B cited agency outreach as a motivation to act than in Utah A. Agency outreach was the most cited motivator to act in Oregon A, although it was not as dominant a source for information about fire risk. Perhaps most notable is that a forest agency was the most common response across communities in deciding what actions to take. This is reflected by the subsequent finding that most people felt the primary agency role in supporting defensible space was education/awareness building, particularly on what mitigation actions should be taken.

In terms of actual actions taken, vegetation management is clearly the main focus along with maintaining the yard or buffer around the house. The type of actions participants emphasized reflected differences in local ecological conditions such as raking pine needles in ponderosa pine areas and use of rock buffers in the water limited Utah locations. There is also evidence that homeowners recognize that this is not a one-time event with almost 2/3 indicating they planned to do more thinning and pruning and almost half

explicitly stating they planned to maintain what they had done. What is perhaps most striking is the difference between actions brought up in the interview and actions indicated on the survey. The closest points of congruence were the items of vegetation management (e.g., thinning and pruning trees, removing understory vegetation) whereas other type of actions (e.g., moving woodpiles) were less frequently brought up in the interview than they were indicated on the survey. This suggests that most homeowners think of wildfire mitigation primarily in terms of managing vegetation and that many activities fire managers see as being part of fire mitigation may be undertaken by homeowners for reasons other than fire. Thus when asked about what actions they are taking for fire mitigation, homeowners may be underreporting their actions.

Finally, our data do not support two statements routinely heard in the management community: that homeowners think fire mitigation and protection is a government responsibility and that part-time residents are less proactive. When asked about the appropriate role for forest agencies in fostering defensible space, we found little evidence, except in Utah, that homeowners expect direct government assistance: instead the clear answer was education followed by managing public lands for fire safety. In the two communities with the most active government assistance on homeowner property, Utah A and Idaho (where FireSmart, although not necessarily perceived as such, was in essence government funded actions on a homeowner's land), participants indicated that the assistance mostly helped them achieve more quickly, and more safely, actions they had already been planning on undertaking. And in terms of part-time homeowners, despite finding a number of differences between communities we do not see an obvious difference in responses for the communities (Utah A and Oregon C) where a large proportion of homeowners we interviewed were part-time residents.

## Conclusion

Overall our research highlights several key points. First, our interviews found a body of individuals who understand the fire risk, are taking numerous mitigation actions, and think that these actions have effectively reduced their risk. These homeowners typically did not expect the government to do it for them. They wanted information about what to do and, in some cases, assistance with the work, but saw taking care of their property primarily as their responsibility while the government was responsible for taking care of its property. Interestingly, although home protection activities are often thought to conflict with other important values (e.g., aesthetics, privacy, natural setting),

our research suggests that this is not necessarily the case. Many participants indicated that aesthetics was a reason why they took action and individuals who said that a natural setting and privacy were important to them were still actively modifying their vegetation. These findings suggest that home protection activities, including vegetation management, do not inherently conflict with the reasons why people choose to live in more natural areas.

Second, there is no single source of information or motivation for mitigation action. We found a range of information sources and motivators—from the more internal responses of personal experience (which may include interactions with others) and common sense to external social elements such as local peer influence or a government agency. The prominence of common sense is of particular note. Although our study cannot specifically clarify how the common sense developed, its prevalence as a response is likely a reflection of the numerous formal and informal ways in which people may learn about and understand wildfire mitigation and also suggests that fire issues have become a normalized part of the local conversation. Ultimately, the diversity of responses means that in any one location the appropriate balance for key information sources and motivation will depend on local area dynamics and relationships with forest agencies, peers, and local programs. The responses also show that it is not inherently necessary to have formal organization between community members to create defensible space. For some individuals and in some contexts such social networks can be an important element, but not always: even in communities with clear social networks at least one-fifth of respondents said no one helped them decide what to do on their property. These findings highlight the importance of understanding the local community context and what will work in a particular location; the same program may or may not be effective in different communities. The Fire-Smart program appears to be a good example of a program designed to meet the needs of local residents that found success even though most residents were not supportive of peer, much less government, influence on actions on their private property.

Despite the several differences between locations, findings here show homeowners in diverse communities are taking action to reduce their vulnerability to wildland fire. However, the variation among sites indicates key concerns and motivations may differ both within and between locations. As people pay attention to programs that address their concerns (Toman and others 2006), it will therefore be important for managers to understand their specific communities and target local problems and neighborhoods accordingly. The question that still remains is whether these homeowners will continue to maintain their sense of responsibility and action over time. While many indicated

a commitment to maintaining their property, the long-term reduction of fire risk to WUI communities will ultimately depend on whether homeowners can sustain their actions, particularly if much of the supportive infrastructure changes: external funding may end, the community composition can change, and neighborhood organizations may move on to other priorities. We hope in the second half of our study to shed light on the level of maintenance homeowners are undertaking and any shifts in what motivates their actions.

# References

Babbie E (2001) The practice of social research, 9th edn. Wadsworth/Thomson Learning, Inc, Belmont

Brenkert-Smith H, Champ PA, Flores N (2006) Insights into wildfire mitigation decisions among wildland-urban interface residents. Society and Natural Resources 19:759–768

Bright AD, Burtz RT (2006) Creating defensible space in the wildland-urban interface: the influence of values on perceptions and behavior. Environmental Management 37:170–185

Cohen JD (2000) Preventing disaster: home ignitability in the wildland-urban interface. Journal of Forestry 98:15–21

Cohn PJ, Williams DR, Carroll MS (2008) Wildland-urban interface residents' views on risk and attribution. In: Martin WE, Raish C, Kent B (eds) Wildfire risk: human perceptions and management implications. Resources for the Future, Washington, pp 23–43

Daniel TC (2007) Perceptions of wildfire risk. In: Daniel TC, Carroll MS, Moseley C, Raish C (eds) People, fire, and forests: a synthesis of wildfire social science. Oregon State University Press, Corvallis, pp 55–69

Daniel TC (2008) Managing individual responses: Lessons from public health risk behavioral research. In: Martin WE, Raish C, Kent B (eds) Wildfire risk: human perceptions and management implications. Resources for the Future, Washington, pp 103–116

Gardner PD, Cortner HJ, Widaman K (1987) The risk perceptions and policy response toward wildland fire hazards by urban homeowners. Landscape and Urban Planning 14:163–172

Gorte RW (2006) Forest fire/wildfire protection; RL30755. Congressional Research Service, The Library of Congress, Washington

Jakes PJ, Nelson K, Lang E, Monroe M, Agrawal S, Kruger L, Sturtevant V (2003) A model for improving community preparedness for wildfire. In: Jakes, P (ed), Homeowners, communities, and wildfire: science findings from the National Fire Plan. Proceedings of the 9th international symposium on society and resource management, GTR-NC-231, USDA Forest Service, North Central Research Station, St. Paul, Minnesota, pp 4–9

Jakes PJ, Kruger L, Monroe M, Nelson K, Sturtevant V (2004) Partners in wildland fire preparedness: lessons from communities in the U.S. In: 3rd International symposium on human behavior in fire: public fire safety—professionals in partnership. Interscience Communications, London, UK, pp 139–150

Jakes PJ, Kruger L, Monroe M, Nelson K, Sturtevant V (2007) Improving wildfire preparedness: lessons from communities across the U.S. Human Ecology Review 14:188–197

Kent B, Gebert K, McCaffrey S, Martin W, Calkin D, Schuster E, Martin I, Bender HW, Alward G, Kumagai Y, Cohn PJ, Carroll M, Williams D, Ekarius C (2003) Social and economic issues of the Hayman Fire. In: Graham RT (ed) Hayman fire case study, RMRS-GTR-114. USDA Forest Service, Rocky Mountain Research Station, Ogden, pp 315–395

Knowles MS, Holton EF III, Swanson RS (1998) The adult learner, 5th edn. Gulf, Houston

Kruger LE, Agrawal S, Monroe M, Lang E, Nelson K, Jakes P, Sturtevant V, McCaffrey S, Everett Y (2003) Keys to community preparedness for wildfire. In: Jakes P (ed) Homeowners, communities, and wildfire: science findings from the National Fire Plan. Proceedings of the 9th international symposium on society and resource management, GTR-NC-231, USDA Forest Service, North Central Research Station, St. Paul, Minnesota, pp 10–17

Kvale S (1996) Interviews: an introduction to qualitative research interviewing. Sage Publications, Thousand Oaks

Martin IM, Bender HW, Raish C (2008) Making the decision to mitigate risk. In: Martin WE, Raish C, Kent B (eds) Wildfire risk: human perceptions and management implications. Resources for the Future, Washington, pp 117–141

McCaffrey S (2004) Thinking of wildfire as a natural hazard. Society and Natural Resources 17:509–516

McCaffrey S (2008) Understanding public perspectives of wildfire risk. In: Martin WE, Raish C, Kent B (eds) Wildfire Risk: Human Perceptions and Management Implications. Resources for the Future, Washington, pp 11–22

McCaffrey S, Kumagai Y (2007) No need to reinvent the wheel: applying existing social science theories to wildfire. In: Daniel TC, Carroll MS, Moseley C, Raish C (eds) People, fire, and forests: a synthesis of wildfire social science. Oregon State University Press, Corvallis, pp 12–36

Miles MB, Huberman AM (1994) An expanded sourcebook: qualitative data analysis, 2nd edn. Sage Publications, Thousand Oaks

Monroe MC, Nelson KC (2004) The value of assessing public perceptions: wildland fire and defensible space. Applied Environmental Education and Communication 3:109–118

Monroe MC, Long AJ, Marynowski S (2003) Wildland fire in the Southeast: negotiating guidelines for defensible space. Journal of Forestry 101:14–19

Monroe MC, Pennisi L, McCaffrey S, Mileti D (2006) Social science to improve fuels management: a synthesis of research related to communicating with the public on fuels management efforts. GTR NC-267 USDA Forest Service. North Central Research Station, St. Paul

Nelson KC, Monroe MC, Johnson JF, Bowers A (2004) Living with fire: Homeowner assessment of landscape values and defensible space in Minnesota and Florida, USA. International Journal of Wildland Fire 13:413–425

Noss RF, Franklin JF, Baker WL, Schoennagel T, Moyle PB (2006) Managing fire-prone forests in the western United States. Frontiers in Ecology and the Environment 4:481–487

Oregon Forestland-Urban Interface Protection Act (1997) In: OR. REV. STAT., vol 477.015–477.061

Pierce JL, Meyer GA, Jull AJT (2004) Fire-induced erosion and millenial-scale climate change in northern ponderosa pine forests. Nature 432:87–90

Rubin HJ, Rubin IS (2005) Qualitative interviewing: the art of hearing data, 2nd edn. Sage Publications, Thousand Oaks

Shiralipour HJ, Monroe MC, Nelson KC, Payton M (2006) Working with neighborhood organizations to promote wildfire preparedness. In: McCaffrey SM (ed) The Public and Wildland Fire Management: Social Science Findings for Managers; GTR-NRS-1. USDA Forest Service, Northern Research Station, Newtown Square, pp 151–162

Steelman TA (2008) Addressing the mitigation paradox at the community level. In: Martin WE, Raish C, Kent B (eds) Wildfire risk: human perceptions and management implications. Resources for the Future, Washington, pp 64–80

Toman E, Shindler B, Brunson M (2006) Fire and fuel management communication strategies: citizen evaluations of agency outreach programs. Society and Natural Resources 19:321–336

Toman E, Stidham M, Shindler B, McCaffrey S (2011) Reducing fuels in the wildland urban interface: community perceptions of agency fuels treatments. International Journal of Wildland Fire 20:340–349

Weinstein ND, Nicolich M (1993) Correct and incorrect interpretations of correlations between risk perceptions and risk behaviors. Health Psychology 12:235–245

Weisshaupt BR, Jakes PJ, Carroll MS, Blatner KA (2007) Northern inland west land/homeowner perceptions of fire risk and responsibility in the wildland-urban interface. Human Ecology Review 14:177–187

Westerling AL, Hidalgo HG, Cayan DR, Swetnam TW (2006) Warming and earlier spring increase western U.S. forest wildfire activity. Science 313:940–943

Winter G, Fried JS (2000) Homeowner perspectives on fire hazard, responsibility, and management strategies at the wildland-urban interface. Society and Natural Resources 13:33–49

Winter G, McCaffrey SM, Vogt CA (2009) The role of community policies in defensible space compliance. Forest Policy and Economics 11:570–578