Journal of Rural Studies 35 (2014) 59–69

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

Policy tools to encourage community-level defensible space in the United States: A tale of six communities

Melanie Stidham [a,*], Sarah McCaffrey [b], Eric Toman [a], Bruce Shindler [c]

[a] School of Environment and Natural Resources, The Ohio State University, 210 Kottman Hall, 2021 Coffey Road, Columbus, OH 43210, USA
[b] USDA Forest Service, Northern Research Station, 1033 University Place, #360, Evanston, IL 60201, USA
[c] Department of Forest Ecosystems and Society, Oregon State University, 321 Richardson Hall, Corvallis, OR 97239, USA

Keywords:
Wildfire
Community risk
Mitigation
Diffusion of Innovations

A B S T R A C T

Within the wildland–urban interface (WUI), wildfire risk contains both individual and collective components. The likelihood that a particular home will be threatened by wildfire in any given year is low, but at a broader scale the likelihood that a home somewhere in the WUI will be threatened is substantially higher. From a risk mitigation perspective, individuals may take a number of actions to reduce risk exposure, but their risk is lowered even further when neighboring properties also take mitigation measures. Collectively, risk mitigation on individual properties lowers both individual and community-level risk. Multiple factors contribute to whether or not an individual will take action to reduce their risk; when an individual opts to not implement risk mitigation measures that would be beneficial from a community standpoint, community leaders can use a variety of policy tools to encourage the individual to adopt an action or change their behavior. As proposed by Schneider and Ingram in 1990, these include passing rules or regulations, building capacity, providing incentives, and establishing community norms. As part of a larger longitudinal study on WUI communities in the western United States, we reviewed approaches used by six communities in Idaho, Oregon and Utah to mitigate interdependent wildfire risk at two points in time. Each community's approach was different, being well suited to meet the community's specific needs. The most consistent policy tool utilized across communities was capacity-building, primarily through raising awareness of fire hazards and potential mitigation behaviors and leveraging external resources. Another commonality was the involvement of a central group or individual that provided leadership by initiating and championing the mitigation effort and serving as a link to external resources. There are a number of other communities in the WUI that are also at risk for wildfire; these findings can be useful to community members and agency personnel who are seeking to engage residents to reduce individual and collective risk. Within our communities, several different approaches have been effective at encouraging homeowners to adopt and maintain mitigation activities ranging from collective efforts organized locally to others developed externally to provide incentives or potential punishments for not adopting treatments. Understanding the diversity of approaches and activities that have fostered mitigation can help managers identify what will work best for their specific communities.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

As more homes and communities have been impacted by wildfires, increased attention has been paid to pre-fire actions that could be taken to mitigate fire risk, particularly within the wildland–urban interface (WUI). Radeloff et al. (2005) define the WUI as the "area where houses meet or intermingle with undeveloped wildland vegetation" (pg. 799). One of the best ways to prevent house loss is through structural and vegetation measures in the area immediately adjacent to the home (Cohen, 2000). Although this focuses attention at the parcel level, wildfire risk within the WUI consists of both individual and collective components, as a home's risk of ignition can also be influenced by the flammability of nearby structures and vegetation which can carry the fire or act as

* Corresponding author.
E-mail addresses: stidham.39@osu.edu (M. Stidham), smccaffrey@fs.fed.us (S. McCaffrey), toman.10@osu.edu (E. Toman), bruce.shindler@oregonstate.edu (B. Shindler).

http://dx.doi.org/10.1016/j.jrurstud.2014.04.006
0743-0167/© 2014 Elsevier Ltd. All rights reserved.

an ember source (Cohen, 2000; Spyratos et al., 2007). Thus, the risk of property damage can be shared among neighboring properties (including public and private lands). In addition, while the probability is low that an individual property will be threatened by wildfire in a given year (Daniel, 2007), there is a much higher probability that fire will occur somewhere in the WUI, making the collective risk for an area higher than individual risk (Steelman, 2008). From a shared risk perspective, an individual can take actions to reduce their individual wildfire risk, but, particularly for communities with smaller lots, their risk is lowered even further when their neighbors also take action.

In recent years, multiple pre-fire efforts have been undertaken to reduce hazardous fuels and provide assistance to communities to reduce their exposure to wildfire risk (defined as a function of the likelihood of a fire occurring and the severity of consequences if it does occur). To address the interdependent nature of wildfire risk, communities can utilize a number of policy tools to encourage residents to implement mitigation measures on their own properties. These can range from direct approaches that regulate resident behavior to indirect approaches that enhance individual capability to enable residents to take action. Given the diversity of communities within the WUI, such approaches will likely vary depending on local physical characteristics (e.g., location, topography, landscape ownership patterns) and social conditions (e.g., beliefs, attitudes, and norms of local residents; relationships between community members; community resources; governance structures) (Paveglio et al., 2009). However, some factors may prove consistent across locations and provide an important starting point for other communities wishing to reduce their risk. In addition, the value and utility of approaches may change over time, depending on both external (e.g., availability of grant funding) and internal (e.g., stages of mitigation efforts) circumstances. In this paper we explore programs designed to encourage the adoption of risk mitigation efforts in six communities in the western US. The purpose of this study was to identify different approaches communities are taking to mitigate wildfire risk, investigate utilization and effectiveness of policy tools in encouraging certain behaviors, and understand resident perceptions of the approaches used in their community over time.

2. Individual and community risk mitigation

In recent years there has been a shift in disaster management from a response-centered approach to a more comprehensive strategy that emphasizes preparedness and mitigation. The United Nations defines a disaster as: "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources," (United Nations International Strategy for Disaster Reduction, 2009, pg. 9). As this definition indicates, disasters have two components: disruption and response. Communities and individuals are more or less vulnerable to disasters depending on their exposure to the potential hazard and their ability to cope with and recover from the event if it happens (Keim, 2008). An event (e.g., earthquake, hurricane, wildfire) could be a disaster in a community that has done little to reduce its exposure to the hazard and has few resources to respond, whereas the same event could be a relatively minor disruption in a community that reduced its risk exposure and has the ability to effectively respond. Clearly an event that results in a "disaster" is much more costly (both in economic and social terms) than one that constitutes a minor disruption. As such, disaster response agencies, both in the US and internationally, have begun to shift their disaster management strategies from response-only to include preparatory actions that could help to reduce the likelihood that a natural event will become a disaster (Pearce, 2003). Likewise, policies directing wildfire management for US land management agencies have broadened their focus from suppressing fires after they start to also include pre-fire actions that would lessen the exposure of risk for WUI communities (Steelman and Burke, 2007).

Reducing community-level wildfire risk poses an interesting challenge for community leaders and wildfire managers. Many of the necessary mitigation actions need to be undertaken at the individual parcel level by individuals who may or may not choose to implement them on their own (Steelman, 2008). In this context, communities are defined in terms of physical proximity and shared infrastructure rather than broader conceptualizations of community (Hillery, 1955). A number of factors may provide a disincentive for individuals to mitigate their risk: the likelihood of experiencing property damage is fairly low, mitigation actions require resources and may detract from other values owners have for their properties, and risk mitigation does not offer absolute assurance that negative consequences will not occur (Daniel, 2007). Indeed, early research indicated that homeowners were not willing to undertake mitigation actions on their properties (Gardner et al., 1987; Winter and Fried, 2000). However, recent studies show that many communities have begun to take advantage of available assistance to educate residents, facilitate individual mitigation efforts, reduce fuels in common areas, and bolster emergency planning (see e.g., Everett and Fuller, 2011; Jakes and Nelson, 2007; Paveglio et al., 2009; Shiralipour et al., 2006; Steelman, 2008). Moreover, numerous studies have found that a large proportion of study participants in high risk areas have taken action to reduce their risk (see, e.g., Toman et al., 2013).

An individual's willingness to implement fire mitigation activities has been found to be influenced by a number of factors including, but not limited to, awareness of risk, perceived vulnerability to potential negative consequences, trade-offs with other values they hold for the property, knowledge of and ability to implement mitigation actions, and belief that the mitigation actions will be effective (see e.g., Kent et al., 2003; Martin et al., 2009; McCaffrey et al., 2011; Nelson et al., 2005). Of note is that beliefs regarding treatment effectiveness are not always related to actions on an individual parcel alone: residents in two Colorado communities reported misgivings about taking action on their own properties if their neighbors did not also take action (Brenkert-Smith, 2011). These factors play out on a spectrum, potentially leading to substantial differentiation of when people will choose to adopt mitigation behaviors and how much external encouragement is needed.

The theory of Diffusion of Innovations (the process by which a new idea or technology gets established within a population) suggests that certain individuals within a community are more likely to quickly and independently apply a new approach to solve a problem (e.g., creating defensible space to mitigate fire risk) (Rogers, 2003). Termed innovators and early adopters, these individuals have the resources and ability to try new things while there is still much uncertainty as to how beneficial the innovation might actually be. However, these individuals tend to not compose the majority of the population. Other people in the population may need external encouragement in the form of incentives, information, or even rules to adopt the practice, at least while it is still new. Individuals that can provide a link between the general population and experts (termed change agents) have been found to be an important factor in diffusion of an innovation throughout a community. They can introduce the concept and provide information to friends, family, neighbors, and colleagues in a manner that is understandable and relevant, encouraging adoption. As more and more people adopt the innovation it becomes more familiar,

making it more likely that others will also adopt it. Once a critical mass of people has adopted the practice it becomes self-sustaining and less external encouragement is needed for the majority of the population to adopt it (McCaffrey and Kumagai, 2007).

Defensible space falls into the category of preventative innovations, those that are designed to prevent negative consequences from occurring (seat belt use is an analogous example). Preventative actions tend to have a slower rate of widespread adoption, in part because the observable benefits are difficult to see unless a fire actually comes into a community (McCaffrey and Kumagai, 2007). However, wildfire risk presents a sense of urgency in fire-prone communities to speed up the rate of adoption by the majority of property owners.

From a policy standpoint, Schneider and Ingram (1990) propose four broad tools that can be utilized to influence behaviors of citizens that benefit the greater good, but may not otherwise be something the individual would do: build capacity, provide incentives, use persuasion, and use authority. A fifth tool, termed learning, can be used when it is not apparent what policy tool will be effective and decision makers need to learn what will motivate the target population to undertake the desired behavior (Schneider and Ingram, 1990). This tool is not as applicable to the current application as the other four and will not be covered further. *Capacity-building*[1] tools provide information or resources to the target population to help them overcome potential barriers and complete an action. These types of tools assume that the individual would otherwise be motivated to undertake the action, but some kind of barrier (e.g., unaware of mitigation options, lack of ability or resources to complete the work) is in the way and that removal of the barrier will foster action. *Incentives* provide some kind of tangible benefit for completing an action, for instance receiving a tax credit if replacing a cedar shake roof with a fire-resistant roof. Incentive tools assume that the target population is weighing choices, and tries to encourage an action that has higher societal value. *Persuasion* tools try to convince the target population that the desired action is in line with their values or are part of a community-norm. These tools are utilized when an individual already has the capacity to complete an action and is not motivated by incentives; instead attempts are made to instill an intrinsic motivation to implement the desired behavior. *Authority* tools can be used to grant permission to do an action (e.g., allow homeowners to cut trees less than 6″ in diameter at breast height without review by neighborhood groups), prohibit actions (e.g., no cedar shake roofs), or require actions (e.g., all homes must have 100 feet of defensible space).

Using the framework provided by these policy tools, this paper examines the approaches used by six different communities in the western United States to encourage action among their residents to mitigate risk and reduce the likelihood that wildfires will result in catastrophic losses. While most other studies have examined community approaches at a single point in time, this analysis employs a longitudinal research design (Menard, 2002) to examine the outcomes of these programs over time on community members who fall along different points of the spectrum regarding likelihood of adoption. Specific research objectives included: 1) identify different approaches communities are taking to mitigate wildfire risk; 2) investigate utilization and effectiveness of the policy tools described by Schneider and Ingram (1990); and 3) understand resident perceptions of the approaches used in their community.

3. Methods

As part of a larger project (see e.g., McCaffrey et al., 2011; Stidham et al., 2011; Toman et al., 2011), we conducted structured interviews with WUI property owners in six different communities in the western US at two different times, three years apart. The study locations were purposively selected (Babbie, 2001; Rubin and Rubin, 2005) with the help of contacts at government agencies or defensible space programs. We selected communities that represented a range of different vegetation conditions, mitigation programs and engagement activities.

Study sites were located in central Oregon, northern Idaho, and southern Utah (Fig. 1). All were located in the WUI with ill-defined boundaries separating them from surrounding wildlands. All communities except for Idaho shared at least one border with US Forest Service or Bureau of Land Management (BLM) managed lands. Five of the six study locations reflected a distinct community plan with a defined number of properties and similar property sizes (Table 1). However, the community in Idaho consisted of larger and more dispersed parcels, representing a looser affiliation of properties and residences within a general geographic area. Detailed descriptions of the communities can be found in Toman et al. (2011) and McCaffrey et al. (2011).

Individual research participants were selected from lists of residents provided by primary local contacts (employees of government agencies or defensible space programs, or homeowner

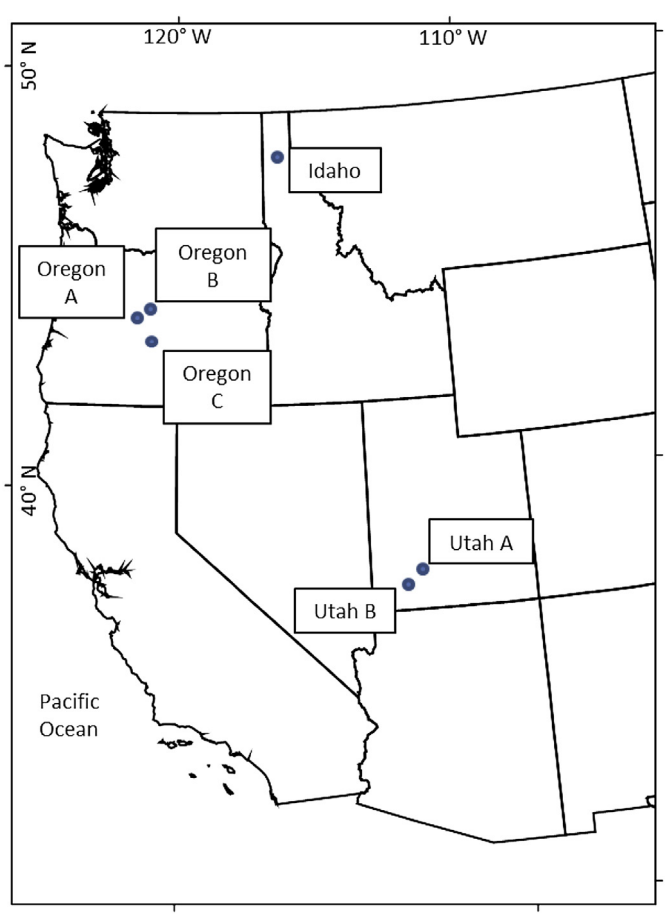

Fig. 1. Study site locations.

[1] There are a number of uses of the term "capacity-building" (see e.g., Potter and Brough, 2004. Systemic capacity building: a hierarchy of needs. Health Policy and Planning **19**, 336–345.); for purposes of this paper we are describing "capacity-building" as a policy tool, as defined by Schneider and Ingram (Schneider and Ingram, 1990. Behavioral assumptions of policy tools. Journal of Politics **52**, 510–529.).

Table 1
Research communities.

Site name	County	Forest type	Parcel size (acres)	Number of homes (% vacant lots)	HOA	# of study participants		% Permanent residents		% Retired		% Respondent gender (PII)	
						P[a] I	P II	P I	P II	PI	PII	Female	Male
Idaho	Kootenai	Northern Rockies dry mixed conifer	1–20	N/A	No	40	26	98	100	30	38	37	63
Oregon A	Deschutes	Ponderosa pine	1	200 (<5%)	Yes	40	28	97	100	55	57	46	54
Oregon B	Deschutes	Ponderosa pine	0.5	440 (<5%)	Yes	46	28	98	100	67	73	53	47
Oregon C	Deschutes	Lodgepole and ponderosa pine	0.5–1	102 (<5%)	Yes	40	24	62	79	56	58	39	61
Utah A	Iron	Pinyon-juniper/ hardwood	1–2	165 (>50%)	Yes	23	14	48	50	35	36	44	56
Utah B	Washington	Pinyon-juniper/ hardwood	2–3	33 (≈50%)	No	9	6	100	83	22	33	50	50

[a] PI = Phase I, PII = Phase II.

association leaders). Data collection in phase I continued in each community beyond data saturation, the point at which we were no longer hearing new information or perspectives (Rubin and Rubin, 2005), to ensure a high enough response rate during phase II for adequate comparisons over time. This type of purposive sampling is not intended to be a representative sample of a broader population, but is instead used to provide a rich understanding from those directly involved with an issue (Babbie, 2001; Rubin and Rubin, 2005).

Interviews followed a structured protocol that included both closed- and open-ended questions examining participant risk perceptions, mitigation measures on participant's property, information sources, community-wide efforts to reduce prepare for wildfire, and perceptions of fuels reduction on public lands. Only questions pertaining to community programs are reported here. Interviews were conducted in pairs of two: one person to ask questions and the other to record responses and take detailed notes on open-ended responses (Kvale, 1996). Interviews were also recorded. Most of the interviews took place in person at the participant's property and lasted an average of 45 min. As we were interested in possible changes over time, data collection took place in two phases: phase I was in 2006–2007 with 198 participants; 126 of these same participants were re-surveyed during phase II in 2009–2010. Where results are compared between phase I and phase II in the section below, only participants that took part in both data collection periods are included.

Participant responses were analyzed using a systematic approach to identify discrete categories of response as well as general themes that emerged from the entirety of each participant's interview (Miles and Huberman, 1994; Rubin and Rubin, 2005). Responses to open-ended questions were coded in Microsoft Word. As an example, responses to the question "what does your neighborhood group do to promote defensible space?" included a number of descriptions of specific activities such as sending a newsletter or inviting fire officials to annual homeowner meetings; all activities mentioned by participants were assigned a code. All codes were entered into a Microsoft Excel database; if someone mentioned a particular code they were assigned a 1 for that response, if they did not they were assigned a 0. Similar codes were later combined for simplicity (e.g., door-to-door visits and personal phone calls were both considered to be direct communication). Calculating the number of participants mentioning a particular code allowed us to compare relative frequencies of responses between and within sites (Miles and Huberman, 1994). In addition, the codes could be analyzed for their alignment with particular types of policy tools (e.g., capacity building, incentives, persuasion, and authority). Questions were open-ended, eliciting responses based on the participants' own experiences. Volunteered responses are thought to be the most salient to participants at the time of the interview, but may not result in an exhaustive list of all activities employed to promote defensible space within a particular neighborhood. This approach enabled examination of the relative salience of different approaches and offered insights into the particular ways that people think about fire and potential mitigation actions both within and between sites.

In the following section, results are presented in two formats: 1) illustrative quotes from research participants to highlight key findings; and 2) tables that show relative frequencies of responses to particular questions. Pseudonyms are used to protect the confidentiality of participants.

4. Results

4.1. Community approaches

In this section, we describe the approaches used by each community to promote defensible space, identify the policy tools utilized by the community, and examine participant perceptions of these approaches including the factors that contributed to program success. The results presented here come from responses to open-ended questions examining community action. Overall, there were several differences in the formality and structure of programs within these communities; however, some common elements also emerged across locations. Table 2 provides an overview of the primary policy tools used in each community and examples of their application.

4.1.1. Idaho

The research area in Northern Idaho was located in Kootenai County, near Athol. Of the six study locations, Idaho had the most formalized program (i.e., an official program with a name, employees, and website) to promote defensible space. FireSmart is administered by the Kootenai County Local Emergency Planning Committee with the cooperation and support of a number of local, state and federal agencies, and the National Fire Plan. The program lists two primary goals: to increase awareness of wildfire risk, and to help WUI property owners to reduce fuels within 100 feet of their homes (FireSmart, 2013).

Study participants described joining the program either by contacting the FireSmart office (after seeing a sign, brochure, or work done on their neighbor's property) or through door-to-door invitations offered by FireSmart contractors. Once they signed up, their property was inspected by FireSmart; properties that needed work had fuel reduction plans developed in consultation with the property owner. Property owners had three options to implement the plan: do the work themselves and get reimbursed for pre-determined costs, hire their own contractor to complete the work and get reimbursed for pre-determined costs, or have a FireSmart

Table 2
Policy tools utilized in community approaches to reducing wildfire risk.

Community	Policy tools			
	Capacity-building	Incentive	Persuasion	Authority
Idaho	FireSmart: risk assessment, fuel reduction	FireSmart[a]: risk assessment, fuel reduction		
Oregon A	Build awareness, involvement with local fire officials, grant acquisitions, evacuation plan, fuels reduction in common areas, debris disposal	One-time financial reimbursement program[a]		CC&R's
Oregon B	Build awareness, evacuation plan, fire hydrants, involvement with local fire officials, SB-360 inspections, grant acquisitions, fuels reduction in common areas, debris disposal			SB-360,[a] CC&R's
Oregon C	Build awareness, grant acquisitions, Firewise Community USA, involvement with local fire officials, work parties, debris disposal		Community-norm[a]	
Utah A	Build awareness, involvement with local fire officials, debris disposal, distribution of fire hoses/sprinklers, community fire plan	Matching hours program[a]	Community-norm	
Utah B	Community work parties,[a] involvement with local fire officials, build awareness, debris disposal			

[a] Represents a cornerstone of the community approach, widely credited by research participants as encouraging property owners to implement defensible space actions. Identified through examination of interviews in each site as a whole; both the number of times they were discussed and the manner in which they were described indicated their influence.

contractor complete the work. As a cost share arrangement, all participating property owners were responsible for disposal of vegetative debris created through these activities and maintaining the resulting defensible space for ten years.

FireSmart's approach utilized both incentive and capacity-building policy tools to encourage community members to create defensible space on their properties (Table 2). The practice of offering both free risk assessments and labor offered strong incentives for residents to take immediate action on their properties. Multiple interviewees said that they knew of the area's wildfire risk and had planned on reducing fuels on their property at some point; FireSmart provided the incentive to actually do it.

> *Having FireSmart come in and do initial work was the single most important thing … FireSmart came in within a couple of months after we moved in; [they] gave us initial training, that was free. It was really nice; we would have done the work anyway, it just would have taken longer.* ~Idaho participant

FireSmart was also a capacity-building program. Some people had not started mitigation actions on their own because they lacked the resources to do so (money, time, expertise, equipment, etc.). In this regard FireSmart built capacity in the community by showing people what needed to be done on their properties, providing resources to get the initial work done, and educating residents on both maintaining work that had been done and additional actions they could take if they wanted to.

4.1.2. Oregon A

Oregon A is located in central Oregon, near the city of Bend. Fire preparedness activities in Oregon A were largely coordinated through a homeowner association (HOA) with a long-standing focus on wildfire preparedness. Over the years the HOA has used a variety of approaches to inform residents of fire risk and to support efforts to mitigate risk throughout the community. In general, these efforts have been led by members of the HOA and have been informed by consultation with forest management agencies (including Oregon Department of Forestry and the US Forest Service). These efforts have evolved over the years as membership on the HOA board has changed and new programs at the state and federal level have become available.

The HOAs approach has utilized a number of capacity-building, incentive, and authority policy tools (Table 2). The most frequently mentioned activities were related to capacity-building, particularly through building awareness. Specific activities included distributing a community newsletter, inviting fire officials to present information at annual homeowners meetings, and providing information packets to new residents. To build capacity and improve response to future events the HOA developed a detailed evacuation plan that included which properties would need advance warning due to disabilities or horses. In addition to the above, the HOA had applied for and received several grants that served a dual purpose of building capacity and providing incentives. Examples include a grant that funded fuels reduction in common areas, which also served the purpose of demonstrating what fuels reduction treatments looked like on the ground. Another grant provided community-wide debris disposal, a much needed service in the community due to annual need to clear pine needles.

As an example of a capacity-building and incentive tool, fire officials were enlisted to walk through the community on an annual basis to identify properties that needed vegetation work to become defensible. Multiple participants said that having a fire official tell them that their property was indefensible, either directly or through a notice left on the door, provided a strong incentive to create defensible space.

A particularly influential aspect of the community's efforts was participation in a one-time grant program that offered a financial incentive (up to $500, depending on the amount of work that needed to be done) for residents to complete work within a relatively short period of time. Many research participants took advantage of this incentive, stating that they had known that the work needed to be done and had planned to do it eventually, but actually completed it because of the grant money.

> *[The HOA] got a grant through the Forest Service, administered by ODF [Oregon Department of Forestry]. ODF had to come out to make sure the property qualified, I qualified for half, then they came out to check. After they checked I got the money. I knew what*

had to be done, knew that overstocked stands are at risk for beetles, which increases fire risk. Then the community group put emphasis on it, which reinforced what I already knew and I got to work. ~Oregon A participant

Authority-based tools had also been utilized when property owners did not otherwise reduce fuels on their properties. The neighborhood's Covenants, Codes, and Restrictions (CC&Rs) were updated to prohibit cedar shake roofs (when the neighborhood was built cedar shakes were required) and provide defensible space guidelines. A couple of people spoke of receiving letters or phone calls requesting they reduce their fuels or face a fine. While it was unclear through the interviews whether the board actually had the authority to levy fines over defensible space (some people said they did, and others said they did not), it was clear that at least some people thought they were going to be fined and did the work because of it.

4.1.3. Oregon B

Oregon B is located in central Oregon, outside of the city of Bend. Oregon B had an active HOA with two paid positions (leadership and maintenance) and a long-standing emphasis on wildfire safety. The HOA leader, Susan, was frequently credited with spearheading the community's multi-faceted fire safety approach through building awareness and taking advantage of Oregon's Senate Bill 360 (SB 360). In 1997 the State of Oregon enacted the Oregon Forestland–Urban Interface Fire Protection Act, commonly referred to as SB 360. Property owners in areas of the WUI identified as having high wildfire risk (designations are made by local county committees, the law currently applies to much of central and southern Oregon) are required to reduce fuels on their property, particularly around structures and along driveways. The program is administered by Oregon Department of Forestry (ODF), which notifies property owners that they are in a designated interface zone and provides information on fuel reduction standards (varies by level of risk). Once the property owner completes the required fuel reduction treatments, they fill out a certification form and send it to ODF. Owners of non-certified properties could potentially be held liable for related fire suppression costs, up to $100,000, if a fire originates on their property. Fire risk maps are updated every five years, at which time properties must be re-certified if changes are made to the forest classification (Oregon Department of Forestry, 2012).

Many residents spoke of Susan as being proactive in keeping on top of mitigating fire risk and taking advantage of opportunities as they came along, such as SB 360 or other grant programs. Other community actions attributed to Susan were placement of fire hydrants throughout the neighborhood (credited with both reducing fire risk and lowering insurance rates), development of an evacuation plan, establishment of additional fire exits, enforcement of rules, and coordinating fuels reduction in common areas.

The HOA and Susan utilized a number of capacity-building tools to encourage residents to implement defensible space actions (Table 2). Raising awareness of risk and actions property owners could take to reduce their exposure were the most frequently mentioned activities undertaken by the HOA to promote community fire safety. Research participants spoke of receiving newsletters with fire-related information and direct communication from Susan through phone, letters or email. Annual homeowner meetings included presentations by local fire officials on fire risk and defensible space. In addition to building awareness, the HOA was engaged in a number of other capacity-building activities including grant acquisition to complete fuels reduction in common areas and occasional debris disposal. Multiple residents spoke of disposing of pine needles as being a significant challenge. One resident said that they take three truckloads of needles to the dump twice a year; others spoke of burning needles, which created its own set of problems.

I would love to be able to get rid of outdoor burns; there needs to be a different way to get rid of needles. Just when it is starting to warm up in spring and you want to have your windows open the whole neighborhood smells like smoke from burning needles so the windows have to be closed. ~Oregon B participant

The emphasis of SB 360 is an example of an authority tool. To encourage compliance of the law, the board covered the costs for several residents to be trained as SB 360 inspectors. Residents could request an inspector to examine their property and show them what actions they could take to improve their fire safety and certify their properties. One indication of the emphasis of SB 360 was the consistency with which residents spoke of it. Even though the law applied equally to all three Oregon research communities, far more participants in Oregon B were aware of the law and had certified their properties than in the other sites, in large part because of the efforts of Susan and the neighborhood's inspectors. Many research participants cited the law and having inspectors show them what needed to be done as primary motivators for completing defensible space actions on their property.

The leadership is tapping into SB 360—they pay for training for 3 people to do SB 360 inspections. The owners will contact Susan and she will contact me to go do the inspection. I try to meet with the owners to talk about what needs to be done. ~Oregon B participant

In addition to SB 360, many residents mentioned the neighborhood's covenants, codes, and regulations (CC&Rs) as influencing community fire safety. Similar to Oregon A, when the neighborhood was established the CC&Rs required roofs to be made of cedar shakes or tiles, but as fire safety became a priority the CC&Rs were updated to prohibit cedar shake roofs.

4.1.4. Oregon C

Oregon C is located outside of the town of La Pine in central Oregon. Although Oregon C had an active HOA, most people in the neighborhood attributed the community's fire prevention efforts to one member of the community, Nancy. Residents reported being inspired by her tireless efforts to educate people, complete projects in common areas and on vacant/seasonally-used lots (with owner's permission), and acquire grant money. Grant money was used to purchase equipment, hire seasonal crews of neighborhood kids, and assist with debris disposal. Research participants reported that through Nancy's persistent efforts almost all lots within the community had improved their fire safety, something they considered to be a great success.

Nancy, commander Nancy. She got neighbors who didn't live here, no one ever sees them, to do work. She became a very positive leader, got people believing it is what we should do, then got grants and paid kids … Still see her out there pulling brush and soon enough you are joining in. ~Oregon C participant

In addition, Nancy and the HOA received permission to extend their efforts onto neighboring Forest Service, Bureau of Land Management, and State of Oregon managed lands to create a buffer zone around the community. Through the community's efforts they have been designated a Firewise Communities/USA community, a

national program that encourage WUI communities to prepare themselves for wildfire.

Efforts by Nancy and the HOA are examples of utilizing persuasion and capacity-building policy tools (Table 2). Many research participants said that seeing Nancy doing so much work on behalf of the community set a community norm that persuaded many to do work on their own properties. Acquisition of grants, debris removal, and permission to complete work on surrounding public lands all removed barriers to completion of mitigation actions, thus are examples of capacity-building activities.

> *We received pamphlets about direction and money available; Nancy went door to door; the HOA purchased chainsaws and weed eaters for those without tools.* ~Oregon C participant

> *We've done a lot of cleanup. Three years ago there was a concerted effort on the part of the HOA to clean up bitterbrush, thin and prune. Nancy got a grant to get kids to clean up this past summer. There was also stimulus money, and they asked for people to pile slash*[2] *and a guy came and picked it up. Lots of people took advantage of that.* ~Oregon C participant

4.1.5. Utah A

Utah A is located in southern Utah near Cedar City. While engaged in a number of risk mitigation efforts, the cornerstone of Utah A's fire safety efforts was participation in a matching hours program with the Utah Division of Forestry, Fire & State Lands. The HOA began participating in the program after someone from the State approached them to discuss the community's fire risk. When property owners completed fuels reduction work on their properties, they were instructed to keep track of the hours they spent and notify the HOA's fire coordinator. The hours were then matched by forestry crews throughout the community, either through debris disposal or by completing fuels reduction work for property owners that signed up for the service. This program was very well regarded in the community and was credited by many as either directly assisting them or providing a strong incentive to create their defensible space. Two aspects of the community made this program particularly helpful; first the majority of homeowners were seasonal residents with limited time to devote to vegetation work. Second, the community was very steep and many owners felt they could not safely complete the work themselves.

This program utilized both capacity-building and incentive-based tools to encourage property owners to create defensible space (Table 2).

> *We started out working with the whole community from the very beginning and worked on our personal property and other peoples' properties to prepare. We helped pass out flyers and videos. The fear was already there, they just needed education; that's what came first, and people got excited about it. It hasn't died down here … it's always on the agenda; it's brought up at every meeting. We do a lot of planning with [fire official]. The hardest thing is filling out the paperwork. We just did a mock fire drill, we wanted to find out where the weaknesses were.* ~Utah A participant

The above quote illustrates that fear of wildfire was in the community, but knowledge on what to do was initially lacking. The HOA worked to enable property owners to complete risk mitigation actions through a range of capacity-building activities. The HOA worked to build awareness through provision of defensible space information on its website and presentations by fire officials at the annual homeowners meetings. Examples of two specific activities include development of a community fire plan that included evacuation instructions, and acquisition and distribution of roof sprinklers and fire hoses to every household. Perhaps what was most striking about these two activities was that multiple people brought them up and consistently explained how they would be notified of an evacuation order, how they would set up the sprinklers and hoses before they left, and then where they were supposed to go when they left their homes. This consistency indicated that fire preparations were widely discussed in the community (even by seasonal owners) and fire safety had become a community norm.

> *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 responsible for their neighbors too.* ~Utah A participant

These ideas illustrate both a descriptive norm (e.g., this is what people do in this community and what is expected of me as a property owner here) and an injunctive norm as the above quote illustrates the possibility of sanctions if the norm were not followed.

4.1.6. Utah B

Utah B is a small neighborhood without a formal HOA, located in southern Utah in Washington County. While neighbors generally kept to themselves, they came together to reduce their collective risk after a fire burned into the community in 2005. Residents widely attributed the community's efforts to one resident, Charlie, who was galvanized into action after his house was damaged in the 2005 fire. He was credited with organizing community-wide work parties to reduce fuels. The group met every weekend for several months to work on individual properties and create access paths through the center of the neighborhood. Residents said that all the homeowners in the neighborhood participated, either by doing physical work or by supplying food, drinks and/or equipment. Meetings with fire officials at the local fire station informed residents on what could be done to improve the community's fire safety, and some people requested walk-throughs on their properties. Residents logged hours they had spent on fuels reduction activities, which were matched by government crews by chipping the debris piles.

> *Right after the fire the neighborhood formed a committee with about 20-25 people going around doing work on different properties. One of the tasks was to build access routes through the neighborhood so that if there was a lightning strike in the middle of the neighborhood again firefighters could have access. Ended up with 30 huge piles of stuff for the Forest Service to chip up.* ~Utah B participant

While Utah B did not have a centralized strategy to address wildfire risk, it did utilize capacity-building tools when needed to address specific problems (Table 2). The fire in 2005 was a vivid event for all of the residents we spoke with and galvanized them into action. While the group was not active at the time of phase II interviews, the informal networks that were created were thought to be a lasting legacy that participants were confident could be called upon as needed in the future.

[2] Slash is defined by the Society of American Foresters as: "the residue, e.g., treetops and branches, left on the ground after logging or accumulating as a result of storm, fire, girdling, or delimbing" (http://dictionaryofforestry.org/dict/term/slash).

Table 3
Perceptions on community efforts to protect itself from wildfire.

Overall rating	ID		OR A		OR B		OR C		UT A		UT B	
	P I	P II	P I	P II	P I	P II	P I	P II	P I	P II	P I	P II
	n[a] = 26	n = 26	n = 28	n = 28	n = 28	n = 28	n = 24	n = 24	n = 14	n = 14	n = 6	n = 6
Excellent	17	4	26	18	46	52	71	50	58	50	50	17
Good	29	31	67	68	39	41	29	46	33	50	50	83
Fair	42	38	7	14	11	7	0	4	8	0	0	0
Poor	8	19	0	0	4	0	0	0	0	0	0	0

Site abbreviations are: ID = Idaho, OR A = Oregon A, OR B = Oregon B, OR C = Oregon C, UT A = Utah A, UT B = Utah B. Ratings were given in response to the question: "Overall, how would rate the actions of your neighborhood to protect your community against wildfire?"
[a] n = number of participants.

4.2. Perceptions of community efforts to address wildfire risk

Given the potential impact that each property owner's actions may have on the wildfire risk exposure for their neighbor, we were also interested in how interviewees viewed the overall actions being taken by the community. One way to measure the success of efforts to mitigate collective risk (short of having an actual wildfire run through the community) is to ask how people perceive their community's efforts. In five of the six communities over 80% of participants thought their community was doing a "good" or "excellent" job in mitigating their fire risk (Table 3), a surprisingly high percentage. This finding suggests that the actions taken by multiple property owners in the community have been successful in reducing perceptions of community risk. These high ratings were consistent over time; while there was a shift from excellent to good between Phase I and Phase II, none of the participant's comments indicated a trend toward more negative perceptions and no one stated that they were purposefully changing their rating.

Idaho was the one community where a large proportion of interviewees provided lower ratings of community efforts (Table 3). This likely reflects the ownership dynamics in the area where lots tended to be larger and privacy was a stronger value than in other sites (McCaffrey et al., 2011). This may have led to less awareness of neighbors' actions, and may also have contributed to a lower sense of interdependent risk by individual property owners.

Participants were then asked why they thought things were going well in their community (or if they gave a poor rating, they were asked if anything was going well). The most common overall response was "cooperative neighbors", in other words, neighbors were doing their part to make the community safer (Table 4). This response was particularly common in Oregon C and Utah B, both communities that had held a number of community-wide work parties to reduce fuels in common areas and on each other's properties.

> *[There is a] sense of community—if everybody else helps and you don't, you feel guilty; we get together as a neighborhood (bring snacks, have potlucks), strong sense of community that pre-existed fuels reduction.* ~Oregon C participant

When reviewing the most common responses by site, characteristics of the community can be seen. Community leadership was suggested by over half of participants in both Oregon B and Oregon C, and by just under half in Utah A—all communities where HOA leaders placed a heavy emphasis on fire safety. The most common reason offered in Idaho and Utah B was "responsible residents" reflecting the more individualistic approaches of those communities. Leadership was mentioned infrequently or not at all in both of these sites, which is not surprising given their lack of an organized community group. About a third of participants in the three communities (Oregon A, Oregon B and Utah B) that had been recently evacuated due to wildfire indicated recent fire activity had galvanized the community into action, but few people in the other sites mentioned this.

> *[We] are aware of fire. Everyone got a real lesson on how quick and close it can come. Made us aware of how we could help ourselves—neighbors help each other.* ~Utah B participant

Although participants identified multiple community-level barriers (Table 5), overall there was little consensus among our participants that any specific barriers were particularly common

Table 4
Reasons community is doing a good job in protecting itself from wildfire (*% mentioning reason*) (*Phase II*).

	ID	OR A	OR B	OR C	UT A	UT B	All
Cooperative neighbors	29	21	38	71	57	67	43
Good leadership/HOA	8	21	58	71	43	0	38
Responsible residents	42	25	31	25	43	67	35
Common sense/awareness of risk	21	36	38	21	57	33	33
People's attitudes	13	25	23	38	43	67	29
Protect investment	21	29	19	25	36	0	24
Recent fire activity	4	32	31	17	7	33	20
Neighbors have pride in their homes	21	25	4	25	0	0	16
Outside program/funding	21	11	19	4	21	0	14
Community members are hard workers	29	4	0	13	14	0	11
Agency support/outreach	8	14	4	8	21	0	10
Regulations/CC&Rs	0	14	23	0	0	0	8

Site abbreviations are: ID = Idaho, OR A = Oregon A, OR B = Oregon B, OR C = Oregon C, UT A = Utah A, UT B = Utah B. Data presented here are from the open-ended question: "Why are things working well here?" Response options were not provided. Data presented are from phase II. Only responses that were mentioned by at least 20% of participants in at least one site are included in this table.

Table 5
Perceptions of community barriers to wildfire protection *(% mentioning perception) (Phase II)*.

Barriers	ID	OR A	OR B	OR C	UT A	UT B	All
Cost	35	26	19	4	15	40	22
Many don't live here full time	8	30	15	39	23	0	22
Lack of motivation	38	22	12	4	0	20	18
Physical limitations	19	19	8	30	8	0	17
Lack of time to do work	23	7	12	9	23	40	15
Neighbors don't have knowledge/resources to do work	27	11	4	22	0	20	14
Lack of community-level cooperation	27	19	0	0	0	20	11
None	0	4	12	13	31	0	9
Distance from fire protection services	0	0	0	0	31	20	4

Site abbreviations are: ID = Idaho, OR A = Oregon A, OR B = Oregon B, OR C = Oregon C, UT A = Utah A, UT B = Utah B, All = All sites combined. Answers provided in response to the open-ended question: "What are the biggest barriers you face as a community in protecting yourselves?" Response options were not provided. Data presented are from Phase II. Only barriers that were mentioned by at least 20% of participants in at least one site are included in this table.

across all of our communities. Along these same lines, no one community had more than 40% of participants reporting a particular barrier, indicating no dominant barriers in any single community. Oregon B and Utah A in particular appear to not have had a particular barrier preventing defensible space actions: in Oregon B none of the barriers were mentioned by any more than 19% of participants, and in Utah A 31% of participants specifically said there were no significant barriers facing the community. This is not to say that there are no barriers to mitigating risk, only that participants in our study did not indicate they or their communities were faced with any substantial barriers. In some regards this is not altogether surprising since each of these communities was engaged in some form of community-wide risk reduction effort.

> *The community has pretty much done what it can.* ~Utah A participant

In sites where over 30% of participants mentioned a specific barrier, the community's fire safety efforts were often targeting that barrier. For instance, in Idaho cost (35%) and neighbor's lack of motivation (38%) were the most frequent responses, and both were addressed by FireSmart (free to participating homeowners, and required no effort to get started). In both Oregon A and Oregon C around a third of participants mentioned that not all residents lived there full-time, posing a barrier to community-level preparation. The HOA in Oregon A and Nancy in Oregon C made concerted efforts to contact seasonal and part-time residents to encourage them to either complete the defensible space work themselves, allow community members to do the work, or to hire someone. The HOA in Oregon A threatened to levy fines if the work was not completed.

> *People who are vacation house owners have others do the work—the association pretty much makes them do it.* ~Oregon A participant

> *Even the vacant lots are clear because of Nancy; without her we wouldn't be a firesafe community.* ~Oregon C participant

The three communities without an HOA-sponsored program that spent considerable effort to support mitigation activities in the community (Idaho, Oregon C, and Utah B), particularly in the form of awareness of risk and mitigation options, had higher perceptions that neighbors lacked information/resources to complete defensible space actions.

5. Discussion

5.1. A variety of policy tools resulting in a variety of successful approaches

Steelman (2008) noted that communities that are especially active in wildfire mitigation will have multiple approaches to reducing risk, and indeed that is what we found as well. The mitigation programs that communities were involved in varied in formality and structure, from a formal external program in Idaho to residents who took on the cause in Oregon C and Utah B. Schneider and Ingram (1990) proposed a set of policy tools that could be utilized to encourage actions or behavior changes. These tools can be of use to communities that are working to reduce collective risk of wildfire through actions on individual parcels of land. Evidence of four of the five policy tools proposed by Schneider and Ingram (1990) were seen in the approaches used within these communities. The three communities where the HOA placed a strong emphasis on wildfire safety had more comprehensive programs and tended to utilize more than one policy tool to encourage action. However, this is not to imply that having an active HOA is a necessary element of addressing community wildfire risk, as evidenced by the success of the programs in the other communities that participated in this study.

The most consistently used policy tool, found in all six sites, was capacity-building, primarily seen in efforts to build awareness (about risk and mitigation options) and leverage external resources (direct assistance, grant funding, and/or guidance from local fire officials). The idea behind these types of tools is that providing information and resources will inspire independent action throughout the community, which in turn reduces collective risk. While knowledge of risk and mitigation options is a necessary precursor to taking action, it does not always automatically translate into action as other factors may influence behaviors (Brenkert-Smith et al., 2006; Collins, 2005; Gordon et al., 2010; Martin et al., 2007; Nelson et al., 2004). In these circumstances additional tools may be necessary to achieve the desired level of adoption and in fact, most of the communities in this study did utilize other tools. Use of incentives was the next most commonly used policy tool, evidenced in Idaho, Oregon A, and Utah A. Incentives included financial assistance to cover some of the cost of fuels reduction activities and direct assistance from contractors or government crews completing work on the participants' property. Authority-based and persuasion tools were each seen in two communities. Oregon A and Oregon B both had rules pertaining to fire safety, and Oregon B placed a heavy emphasis on a state law encouraging defensible space actions. In Oregon C and Utah A community leaders had established fire safety as part of a community-norm.

It is not easy to mitigate wildfire risk, and there are a number of factors that may contribute to an individual choosing not to take action on their properties (Daniel, 2007). While all of the communities in this study took different approaches in addressing their wildfire risk, all were successful in increasing the number of property owners who implemented defensible space actions. That such an array of approaches worked within our research communities is encouraging to other communities and land managers looking to develop programs that match their community's specific needs. Understanding the particular barriers that communities face in addressing their wildfire risk can help in selecting appropriate policy tools and developing programs that will best serve those communities. For instance, in Idaho the primary community-level barriers were cost, lack of motivation, and lack of knowledge or resources. FireSmart was well-suited to meet these needs. In contrast, Utah A's primary barriers were steep terrain and a high percentage of part-time residents, for which their matching hours program was ideally suited. That relatively few participants spoke of barriers currently hindering their ability to implement mitigation actions speaks to the success of the community-tailored programs. Other communities may be able to learn from these successes. For instance, Gordon et al. (2013) found in their research of risk perceptions on the Kenai Peninsula in Alaska that although long-term residents participated in community-wide activities over a four-year period, encouraging new and part-time residents to participate continued to be a challenge.

5.2. Diffusion of Innovations: factors contributing to successful community efforts

Diffusion of Innovations suggests that interpersonal networks, triggering events, and change agents may be particularly useful in eliciting widespread adoption of defensible space in WUI communities (McCaffrey and Kumagai, 2007). We found strong evidence of interpersonal networks playing a role in individual choices to adopt defensible space measures in five of the six communities, although the types of relationships varied. In Utah B the informal

relationships between neighbors allowed them to come together for a relatively short time period to achieve a common goal. In Oregon C and Utah A interpersonal relationships engaged part-time residents in the community's risk reduction efforts, a dynamic also seen by Brenkert-Smith (2010) in six Colorado communities. Interpersonal relationships with outside entities can also be important. In Utah A multiple participants mentioned a particular fire official by name as being influential in helping the neighborhood to reduce their risk, both in information sharing and facilitating the matching hours program. Ongoing relationships between the HOA and fire officials were influential in Oregon A in both pre-fire risk reduction and post-fire recovery. For instance, Stidham et al. (2011) discovered the level of preparations and information sharing during a recent wildfire played a role in less resultant stress and concern over the wildfire as compared to Utah B where these types of relationships with fire officials did not exist. Indeed, in their review of the disaster literature McCaffrey and Kumagai (2007) report that the degree to which the community has established vertical networks, or access to external support and connections with government entities, influences the ability of the community to recover from an incident.

The experience with wildfire in Oregon A, Oregon B, and Utah B served as a triggering agent for defensible space actions, although it appears to have had a greater effect in Utah B than the other communities. In all three communities, having an actual wildfire threaten the community was seen to encourage widespread mitigation measures in the community and was one of the reasons offered for why their communities were doing a good job in protecting themselves from wildfire. In Utah B the fire galvanized Charlie to not only take action on his own property, but also to organize work parties to complete work on properties throughout the community, thus establishing his role as a change agent within his community.

The majority of communities had a central leader, or change agent, that inspired action within the community and served as an important point of contact with external resources (e.g., information, grants, direct assistance). In Oregon A it was the HOA president, in Oregon B it was the HOA manager, Susan, in Oregon C it was Nancy, an inspired resident, in Utah A it was the fire coordinator on the HOA, and in Utah B it was Charlie. Each of these individuals recognized the interdependent risk in their community and served as change agents to bring people together and link the community with external support. In Idaho, the dispersed nature of the housing made it less likely that a single individual could function as change agent and a more structured program was needed to foster change. Through FireSmart Idaho participants also had access to expertise and funding that they would not have otherwise had. In each case, these entities were critically important to their community's success; without them it is uncertain whether individuals within the community would have done as much as they have to reduce their risk.

6. Conclusion

Reducing wildfire risk in the WUI presents interesting challenges. By definition, the WUI is composed of a number of private properties interspersed in natural areas, which in the western US means they are often surrounded by public forests. While there is much that individuals can do to reduce their exposure to wildfire risk, their risk is lowered even further if properties in close proximity also take risk mitigation measures. As more and more individuals undertake risk mitigation measures on their properties, the likelihood that a wildfire will result in a "disaster" is reduced. Communities in this study utilized a number of policy tools, particularly capacity-building and incentives, to encourage residents to take action to reduce both individual and community risk.

In this study we explored six communities addressing wildfire risk preparedness and mitigation and found six different approaches, each suited for the community they served. The majority of participants in five of the six communities thought their communities were doing a "good" or "excellent" job of protecting themselves from wildfire in both phases of this study. Drawing on the theory of Diffusion of Innovations, there were several factors that contributed to their success: interpersonal networks, change agents, and in some cases, experiencing a triggering event. These communities each had established interpersonal networks either within the community and/or to external fire officials that helped them to address their risk. In each of the research communities there was a central leader or group that served as a change agent to initiate mitigation efforts and see them through; this entity also served as an important point of contact for agencies and funding sources, allowing the communities to more effectively leverage external resources. In additional half of the communities had recently experienced a wildfire, which acted as a triggering event to encourage residents to undertake mitigation actions.

Although there are a number of communities that have undertaken risk mitigation efforts, there are others that are still in early stages of addressing wildfire risk. By reviewing successful locations, this paper describes a range of potential approaches that might help agency managers or communities in other locations decide what will work best in their locations depending on the local context. In particular, the recognition that different communities have different needs (sometimes changing over time), can help agency personnel to provide targeted assistance when and where it is most needed.

Acknowledgments

This research was supported by the Joint Fire Science Program (07-1-6-12) and U. S. Department of Agriculture Forest Service, Northern Research Station. We would like to thank all of the research participants and community leaders who made this research possible. We are grateful to James Bennett, Jennifer Sherry, Angela Mallon, Stacey Sargent-Frederick, Patrick Shannon, and Jeff Shindler for their hard work and dedication in data collection and management.

References

Babbie, E.R., 2001. The Practice of Social Research, ninth ed. Wadsworth/Thomson Learning, Inc., Belmont, CA.

Brenkert-Smith, H., 2010. Building bridges to fight fire: the role of informal social interactions in six Colorado wildland–urban interface communities. Int. J. Wildland Fire 19, 689–697.

Brenkert-Smith, H., 2011. Homeowners' perspectives on the parcel approach to wildland fire mitigation: the role of community context in two Colorado communities. J. For. 109, 193–200.

Brenkert-Smith, H., Champ, P.A., Flores, N., 2006. Insights into wildfire mitigation decisions among wildland-urban interface residents. Soc. Nat. Resour. 19, 759–768.

Cohen, J.D., 2000. Preventing disaster: home ignitability in the wildland-urban interface. J. For. 98, 15–21.

Collins, T.W., 2005. Households, forests, and fire hazard vulnerability in the American West: a case study of a California community. Environ. Hazards 6, 23–37.

Daniel, T.C., 2007. Perceptions of wildfire risk. In: Daniel, T.C., Carroll, M.S., Moseley, C., Raish, C. (Eds.), People, Fire, and Forests: a Synthesis of Wildfire Social Science. Oregon State University Press, Corvallis, OR, pp. 55–69.

Everett, Y., Fuller, M., 2011. Fire safe councils in the interface. Soc. Nat. Resour. 24, 319–333.

FireSmart, 2013. FireSmart Kootenai County. Kootenai County Fire Prev. Co-op.. Retrieved: November 27, 2013. http://www.kcgov.us/departments/disaster/firesmart/firesmart.asp

Gardner, P.D., Cortner, H.J., Widaman, K., 1987. The risk perceptions and policy response toward wildland fire hazards by urban home-owners. Landsc. Urban Plan. 14, 163–172.

Gordon, J.S., Gruver, J.B., Flint, C.G., Luloff, A.E., 2013. Perceptions of wildfire and landscape change in the Kenai Peninsula, Alaska. Environ. Manag. 52, 807–820.

Gordon, J.S., Stedman, R.C., Luloff, A.E., 2010. West Virginia wildland fire as latent social discontent. Soc. Nat. Resour. 23, 1230–1243.
Hillery Jr., G.A., 1955. Definitions of community: areas of agreement. Rural Sociol. 20, 111–123.
Jakes, P.J., Nelson, K.C., 2007. Community interactions with large wildfire events: critical initiatives prior to the fire. In: Daniel, T.C., Carroll, M.S., Moseley, C., Raish, C. (Eds.), People, Fire, and Forests: a Synthesis of Wildfire Social Science. Oregon State University Press, Corvallis, OR, pp. 91–103.
Keim, M.E., 2008. Building human resilience: the role of public health preparedness and response as an adaptation to climate change. Am. J. Prev. Med. 35, 508–516.
Kent, B., Gebert, K., McCaffrey, S., Martin, W., Calkin, D., Schuster, E., Martin, I., Bender, H.W., Alward, G., Kumagai, Y., Cohn, P.J., Carroll, M., Williams, D., Ekarius, C., 2003. Social and economic issues of the Hayman fire. In: Graham, R.T. (Ed.), Hayman Fire Case Study, GTR-RMRS-114. USDA Forest Service, Rocky Mountain Research Station, Odgen, UT, pp. 315–395.
Kvale, S., 1996. Interviews: an Introduction to Qualitative Research Interviewing. Sage Publications, Thousand Oaks, CA.
Martin, I.M., Bender, H., Raish, C., 2007. What motivates individuals to protect themselves from risks: the case of wildland fires. Risk Anal. 27, 887–900.
Martin, W.E., Martin, I.M., Kent, B., 2009. The role of risk perceptions in the risk mitigation process: the case of wildfire in high risk communities. J. Environ. Manag. 91, 489–498.
McCaffrey, S., Kumagai, Y., 2007. No need to reinvent the wheel: applying existing social science theories to wildfire. In: Daniel, T.C., Carroll, M.S., Moseley, C., Raish, C. (Eds.), People, Fire, and Forests: a Synthesis of Wildfire Social Science. Oregon State University Press, Corvallis, OR, pp. 12–36.
McCaffrey, S.M., Stidham, M., Toman, E., Shindler, B., 2011. Outreach programs, peer pressure, and common sense: what motivates homeowners to mitigate wildfire risk? Environ. Manag. 48, 475–488.
Menard, S., 2002. Longitudinal Research, second ed. Sage Publications, Thousand Oaks, CA.
Miles, M.B., Huberman, A.M., 1994. An Expanded Sourcebook: Qualitative Data Analysis, second ed. Sage Publications, Thousand Oaks.
Nelson, K.C., Monroe, M.C., Johnson, J.F., 2005. The look of the land: homeowner landscape management and wildfire preparedness in Minnesota and Florida. Soc. Nat. Resour. 18, 321–336.
Nelson, K.C., Monroe, M.C., Johnson, J.F., Bowers, A., 2004. Living with fire: homeowner assessment of landscape values and defensible space in Minnesota and Florida, USA. Int. J. Wildland Fire 13, 413–425.
Oregon Department of Forestry, 2012. Oregon Forestland-Urban Interface Fire Protection Act. Retrieved: May 24, 2012. Oregon.gov. http://www.oregon.gov/ODF/Pages/fire/sb360/sb360.aspx.
Paveglio, T., Jakes, P., Carroll, M., Williams, D., 2009. Understanding social complexity within the wildland–urban interface: a new species of human habitation? Environ. Manag. 43, 1085–1095.
Pearce, L., 2003. Disaster management and community planning, and public participation: how to achieve sustainable hazard mitigation. Nat. Hazards 28, 211–228.
Potter, C., Brough, R., 2004. Systemic capacity building: a hierarchy of needs. Health Policy Plan. 19, 336–345.
Radeloff, V.C., Hammer, R.B., Stewart, S.I., Fried, J.S., Holcomb, S.S., McKeefry, J.F., 2005. The wildland-urban interface in the United States. Ecol. Appl. 15, 799–805.
Rogers, E.M., 2003. Diffusion of Innovations, fifth ed. Free Press, New York, NY.
Rubin, H.J., Rubin, I.S., 2005. Qualitative Interviewing: the Art of Hearing Data, second ed. Sage Publications, Thousand Oaks, CA.
Schneider, A., Ingram, H., 1990. Behavioral assumptions of policy tools. J. Polit. 52, 510–529.
Shiralipour, H.J., Monroe, M.C., Nelson, K.C., Payton, M., 2006. Working with neighborhood organizations to promote wildfire preparedness. In: McCaffrey, S.M. (Ed.), The Public and Wildland Fire Management: Social Science Findings for Managers; GTR-NRS-1. USDA Forest Service, Northern Research Station, Newtown Square, PA, pp. 151–162.
Spyratos, V., Bourgeron, P.S., Ghil, M., 2007. Development at the wildland-urban interface and the mitigation of forest-fire risk. Proc. Natl. Acad. Sci. U. S. A. 104, 14272–14276.
Steelman, T.A., Burke, C.A., 2007. Is wildfire policy in the United States sustainable? J. For. 105, 67–72.
Steelman, T.A., 2008. Addressing the mitigation paradox at the community level. In: Martin, W., Raish, C., Kent, B. (Eds.), Wildfire Risk: Human Perceptions and Management Implications. Resources for the Future, Washington, DC, pp. 64–80.
Stidham, M., Toman, E., McCaffrey, S., Shindler, B., 2011. Improving an inherently stressful situation: the role of communication during wildfire evacuations. In: McCaffrey, S.M., Fisher, C.L. (Eds.), Proceedings of the Second Conference on the Human Dimensions of Wildland Fire. USDA Forest Service, Northern Research Station, Newtown Square, PA, pp. 96–103.
Toman, E., Stidham, M., McCaffrey, S., Shindler, B., 2013. Social Science at the Wildland-urban Interface: a Compendium of Research Results to Create Fire-adapted Communities. GTR-NRS-111. USDA Forest Service, Northern Research Station, Newtown Square, PA.
Toman, E., Stidham, M., Shindler, B., McCaffrey, S., 2011. Reducing fuels in the wildland Urban interface: community perceptions of agency fuels treatments. Int. J. Wildland Fire 20, 340–349.
United Nations International Strategy for Disaster Reduction, 2009. UNISDR Terminology on Disaster Risk Reduction. United Nations, Geneva, Switzerland, p. 35.
Winter, G., Fried, J.S., 2000. Homeowner perspectives on fire hazard, responsibility, and management strategies at the wildland-urban interface. Soc. Nat. Resour. 13, 33–49.