

**Information, Resources, and Management Priorities:
Agency Outreach and Mitigation of Wildfire Risk in the Western United States**

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Abstract

States in the American West are experiencing significant population growth and exurban development, in addition to a longer fire season and a changing climate. These factors contribute to the increasing difficulty of managing wildfire in the Wildland-Urban Interface. Using data collected through a survey of fire professionals, this research investigates the strategies that agencies use to promote wildfire mitigation on private property within the WUI, fire professionals' sense of the effectiveness of those strategies, and support among fire professionals for various regulatory approaches to wildfire mitigation. The findings indicate that fire professionals are keenly aware of the constraints imposed by the political context and acceptability of some tools that they could use to promote more aggressive mitigation on private property. Recommendations based on these findings can help management agencies determine what programmatic wildfire mitigation strategies are most effective at promoting homeowner participation in reducing wildfire risk.

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Introduction

States in the American West are experiencing significant population growth and exurban development in the Wildland-Urban Interface (WUI), defined as the areas “where humans and their development meet or intermix with wildland fuel” (USDOJ & USDA, 2001, pp. 752-753). Due to a century of fire suppression policy, along with increasing drought conditions, the western United States has recently experienced some of the biggest and most severe wildfires in history (National Interagency Fire Center, 2012; Litschert, Brown, & Theobald, 2012). With growth in development expected to continue on fire-prone landscapes (Gude, Rasker, & van den Noort, 2008) as well as the potential for climate change to affect fire severity (Hessl, 2011), it will be increasingly important to mitigate wildfire risk in the WUI. Much of the literature investigating issues related to wildfire risk mitigation on private lands has focused on individual homeowners’ mitigation efforts and their perceptions of risk (e.g., Brenkert-Smith, Champ, & Flores, 2012; McCaffrey, Stidham, Toman, & Shindler, 2011; Syphard, Brennan, & Keeley, 2014). However, the crucial role that fire management agencies and wildfire professionals play in assessing risk and promoting mitigation on private property has garnered less research attention.

Increasing wildfire mitigation on private property in the western United States is a challenge faced by many fire agencies and jurisdictions. While government-mandated regulations related to wildfire risk mitigation, such as building ordinances or development restrictions, are used in many communities across the West to help mitigate wildfire risk, these approaches may not address preexisting built structures or be tolerated in some communities.

Consequently, fire professionals¹ must promote other risk mitigation strategies such as voluntary mitigation efforts and incentive programs. Often faced with limited resources and constrained by the need to divert funds earmarked for mitigation to wildfire response (Paul, 2014), agencies must determine the most effective ways in which they can encourage individual actions that will increase collective wildfire risk reduction through mitigation efforts on private property.

Using data collected through an online survey of fire professionals in the western United States, this research investigates the approaches that fire professionals use to promote wildfire mitigation on private property within the WUI, fire professionals' sense of the effectiveness of those programs, and support among fire professionals for various regulatory approaches to wildfire mitigation. The results of this study indicate varying agency outreach approaches with regard to promoting wildfire mitigation in WUI communities, diversity in the channels used to disseminate that information, and variance in agency priorities with regard to wildfire mitigation on private property. The findings also indicate that fire professionals are keenly aware of the political context and acceptability of certain regulatory approaches to wildfire risk mitigation within communities where their agencies operate. The findings presented here are useful to scholars in understanding management strategies and preferences, but also to fire professionals seeking to target the most effective mitigation outreach approaches for their local communities.

Collective Action and Wildfire Prevention and Response

Collective action scholars grapple with the paradox that, even when groups of people share a common interest in a public good, the collective provision of that public good is likely to

¹ We use the term “wildfire professionals” or “fire professionals” rather than “public lands managers,” “fire managers,” or variants thereof, to capture the multi-jurisdictional nature of wildfire risk communication and mitigation. We define a “wildfire professional” as any public official that works in wildfire risk communication, mitigation, or response, plus any member of a non-governmental organization that focuses primarily on wildfire.

be stymied by individual incentives to “free ride” on the efforts of others (Olson, 1965). A public good is a commodity or service that people cannot reasonably be prevented from using (non-excludable) and that can be consumed by many people at once (non-rivalrous). In situations where individuals might receive the benefit of a public good without bearing the costs, they have an individual incentive to enjoy those benefits without contributing to providing the good. This incentive grows with the size of the group and the scale of the public good. At least since Hardin’s (1982) analysis of the Prisoner’s Dilemma, scholars have investigated the sanctions or incentives required to alter the cost-benefit calculations of groups and their members, enough to encourage cooperation (Taylor, 1987). Studies have found success in collective action under two scenarios: (1) when the benefits of cooperation are high relative to the costs of participation, and (2) when levels of trust between stakeholders are high (Costanza, Low, Ostrom, & Wilson, 2001a, b; Ostrom, 2001; Zellner et al., 2009).

Wildfire risk mitigation and wildfire response can both be considered public goods. When agencies, organizations, or individuals undertake wildfire risk mitigation projects, other nearby residents cannot be excluded from enjoying the associated risk reduction (Stidham, McCaffrey, Toman, & Shindler, 2014). When a wildfire does occur, wildfire response agencies conduct suppression efforts to protect properties without consideration for which properties conducted adequate mitigation (without jeopardizing firefighter safety, which is the foremost goal of fire professionals) (National Wildfire Coordinating Group, 2014). As no one can be easily excluded from enjoying the benefits of wildfire risk mitigation or response, residents may be more likely to free ride on these benefits than to actively contribute to the provision of them, making both wildfire risk mitigation and response collective action problems (Gardner & Cortner, 1988; Winter & Fried, 2000). When government regulations for mitigation are not

present, or are insufficient to promote wildfire mitigation among homeowners, organizations working to promote wildfire risk mitigation on private property in the WUI must consider whether incentives or mandates that levy sanctions² are most appropriate to encourage individuals to participate in mitigation activities on their own property. Such institutional efforts are not fail-proof, however, and are frequently hampered by WUI residents' perceptions that disaster recovery assistance, fire insurance, and firefighting programs are substitutes for on-the-ground hazard mitigation on their properties (McKee, Berrens, Jones, Helton, & Talberth, 2004; Winter & Fried, 2000; Collins, 2005, 2008).

Wildfire professionals face additional barriers to collective action on wildfire risk mitigation efforts beyond classic free-riding behavior. Wildfires do not heed jurisdictional boundaries, making wildfire risk mitigation a multi-jurisdictional problem (Davis, 2001) that encompasses both private lands (including individual lots and privately-held conservation areas) and public lands of all types (city, county, state, and federal). The associated political and jurisdictional fragmentation can pose significant challenges to promoting collective action among disparate and dispersed properties (Zellner et al., 2009).

Federal land management agencies have historically managed wildland fire on public lands. Given increasing population growth in the WUI, however, state and local government agencies and organizations increasingly share the responsibility of fire mitigation with private property owners. Multiple agencies and fire professionals may share the common mission of managing wildland fire, both in terms of mitigation and suppression, but their values, policies, and approaches to achieving their mission may be quite different. Thus, it is challenging to institute a unified plan regarding wildfire risk mitigation in many WUI zones (Reiners, 2011).

² Any organization implementing regulations or requirements can levy sanctions, but the source of power (i.e. the government versus a homeowner's association or an insurance company), as well as the cost to the residents, can vary.

The WUI is also culturally, socially, and politically diverse within single jurisdictions, and even within neighborhoods. The myth of WUI communities as cohesive units of residents who know each other, work together, and share similar attachments to the land has been proven untrue (Cortner, 1991; Lee, 1991). Residents in the WUI have diverse aesthetic and environmental values, think about “living in the woods” in different ways, have varying perceptions of the hazards posed by wildfire, and make different trade-offs between the potentially conflicting values of wanting to live within forested wildlands and the associated risks to life and property inherent in that choice (Daniel, Weidemann, & Hines, 2002). Agencies that promote mitigation of wildfire risk must grapple with these complicating factors as they work to encourage individual mitigation actions among WUI residents.

Engaging Citizens in Wildfire Risk Mitigation

Wildfire mitigation is one area in which management plans and policies must necessarily incorporate the knowledge and preferences of local citizens, particularly in geographic areas where public and private lands intersect. But mitigation also requires highly specialized technical information on fire behavior and management (Anderson, Hodges, & Anderson, 2013). For example, although the National Fire Plan developed in 2000 mandated a more collective approach (i.e., public involvement) to wildfire planning processes, this transition was potentially challenged by “historical institutionalism,” or a reticence/inability of federal agencies to engage with the public (Cheng, Steelman, & Moseley, 2007, p.28). Furthermore, as Reiners (2011) notes, agencies are constrained by other factors: resources, geography, and processes for incorporating stakeholder or citizen input. These limitations challenge the ability of managers to pilot engaging interactions with the public beyond the one-way information stream of a public meeting, for example. A survey of citizen responses to agency efforts to educate and solicit input

on fuels management projects found that public meetings actually rated *last* in terms of effective outreach methods. Local citizens instead preferred interactive formats, such as conversing with an expert or participating in field trips (Toman, Shindler, & Brunson, 2006).

Furthermore, trust is an essential component of the relationship between agencies and local citizens in resource management. Citizens appreciate integrity and sincerity on the part of agency officials, as well as good communication and meaningful engagement in decision-making (Olsen & Sharp, 2013). Given that fire mitigation and fuels management in the WUI are likely to be of significant importance to both land managers and land owners, finding ways to genuinely engage private property owners in the mitigation process, and articulating their stakes in the outcomes (Lachappelle & McCool, 2005), should be a priority for agencies working to reduce fire risk on both public and private lands. Following the 2002 Hayman Fire in Colorado, Kent and Gebert (2003) found that among local residents “there was clear respect for individual Forest Service employees yet often a critical view of the Forest Service as an agency...[as] arrogant, disdainful of local knowledge, obfuscating, and mired in red tape” (p. 371), demonstrating that the individuals who live and work for agencies within a community may have more leverage in building trust and facilitating mitigation work than agency-distributed information.

The importance of trust also extends to community motivation for engaging in fire mitigation, which may be affected by the level of social capital present among community members. In a recent survey, Bihari and Ryan (2012) assessed the mitigation capacity of six communities at risk of wildfire across the United States. Findings indicated that in communities with higher levels of social capital or “community cohesion,” residents were more likely to be active in fire mitigation efforts—both directly through fuels reduction on their own property, and through fuels management projects on neighboring public and private lands (Bihari & Ryan,

2012). Their findings suggest that fire professionals should capitalize on the attachments that local residents have to their particular community in order to accomplish fire mitigation goals at a broader scale than just individual properties.

As Putnam (2000) suggests, the development of social capital extends trust and cohesion between people and groups that may not normally interact. Furthermore, the value of practicing “participatory inquiry as a means of civic discovery” to address complex environmental problems can actually contribute to long-lasting relationships between citizens and experts (Fischer, 2000, p. 240) as well as long-term commitment to managing problems such as wildfire risk. In the case of wildland fire, a local citizenry engaged in productive relationships with fire professionals and experts, either at the individual or community level, can serve as a valuable tool in achieving mitigation goals on public and private lands. However, the various agencies’ role in nurturing this relationship and promoting local engagement bears further exploration.

Clearly, wildfire risk mitigation requires collaboration, cooperation, and trust between fire professionals and homeowners, and between homeowners themselves. However, how best to cultivate this dynamic is not fully known. Traditional regulatory, top-down, and highly technical approaches have been shown to limit the ability to build trust between fire professionals and communities. Therefore, more interactive and informal approaches to wildfire mitigation outreach may yield higher levels of trust and cooperation in the WUI. Understanding fire professionals’ support for and experience with various regulatory or incentive-based approaches to encourage wildfire mitigation may help us understand more about these dynamics.

Agency Outreach and Wildfire Mitigation: Research Questions

There are currently several gaps in the wildfire mitigation literature, including “assessing the role and contributions of local, state, and federal agencies in building and maintaining community capacity” (for wildfire-mitigation activities), and “examining the effect of variations in risk perception (public v. agency and across cultural groups)” (McCaffrey, Stidham, Toman, & Shindler, 2013, p. 20). Attitudes, knowledge, and perceptions of risk by homeowners have been studied (e.g., Brenkert-Smith, 2011; Brenkert-Smith, Champ, & Flores, 2012), but the views of fire professionals on issues of mitigation and outreach, as well as how best to assess risk on private property, have been less thoroughly vetted. In that vein, this research seeks to address the following questions:

RQ1: What approaches are agencies using to promote wildfire mitigation on private property?

RQ1a: What approaches do residents seem to be most receptive to, according to fire professionals?

RQ2: What approaches are agencies using to assess and communicate wildfire risk to property owners and residents?

RQ2a: Are fire professionals' preferred approaches different from what is currently being used in practice?

RQ3: Which fire professionals are most likely to support regulatory approaches to wildfire mitigation and risk assessment?

Research Methods

This study employs a survey of fire professionals from the western United States. Prior to survey administration, comparative case-study research of two Colorado communities affected by recent wildfire events was conducted (Koebele et al., 2014). Researchers conducted in-depth,

semi-structured interviews (Rubin & Rubin, 2012) with key fire professionals (n=8) in each case study community, covering topics such as agency outreach strategies and residents' perceptions of wildfire risk. Subsequently, researchers held focus groups with residents (n=12) of the case study communities to gain insight into individual experiences with mitigation information dissemination, wildfire mitigation practices, and community planning performed by local fire agencies. The qualitative interview data were then used to inform an online survey questionnaire that was disseminated to a broad sample of wildfire professionals in the western United States in order to explore practices and opinions of effectiveness beyond the two case studies, using Dillman's survey protocol (Dillman, Smyth, & Christian, 2014). In addition, researchers consulted with a fire management professional to ensure that questions were phrased in a manner consistent with common language used by fire professionals. These previous case study findings are cited in the context of survey results presented here because in several instances they reinforce the quantitative results of this study.

Because there is no master list of fire professionals in the western United States from which to draw a survey sample, the researchers constructed a sample of wildfire professionals by first compiling a list of significant wildfire events³ beginning in 2012, resulting in 19 fires from eight western states: California, Colorado, Idaho, Montana, New Mexico, Utah, Washington, and Wyoming. Researchers then identified agencies that responded to these events and compiled a contact list of personnel at the agencies who work in fire management (i.e. are not only fire responders). Contact information was obtained from Internet searches, documents, and phone calls made to agencies.

³ A fire was determined to be significant if a Type I or Type II fire incident response team was deployed to the fire response.

The survey was administered online to 499 potential respondents during two two-week survey windows during the summer of 2014. Two email reminders were sent to survey recipients during each survey window in an attempt to obtain a higher response rate, per Dillman's protocol outlined in his Tailored Design Method (2000). One hundred thirty-two surveys were completed, yielding a response rate of 26.5%. The survey instrument consisted of 48 questions grouped in the following categories:

- *Organizational type, function, and mission:* These questions ascertained what type of wildfire work the respondents' agencies engage in, on what types of land such mitigation is conducted, and how central mitigation and prevention is to the agency's mission. In addition, respondents were asked to describe their job responsibilities and how much time they allocate toward wildfire mitigation or mitigation promotion.
- *Strategies employed to promote and inform wildfire mitigation and risk assessment on private property and their perceived effectiveness:* These questions identified various mitigation practices in use, how mitigation is promoted, and what respondents' views are toward their effectiveness in reducing wildfire risk to properties and people.
- *How residents' respond to mitigation promotion and outreach:* While fire professionals may have one view of which strategies are most effective at encouraging wildfire risk mitigation among homeowners, residents' reception of these strategies may determine whether the strategies are actually effective on-the-ground. These questions, thus, investigated fire professionals' opinions about homeowners' receptivity toward various outreach approaches.
- *Values and opinions about who is responsible for wildfire mitigation in the WUI, and the nature of the WUI and fire risk in the area in which respondents work:* Professional

experience influences how effective a fire professional feels a particular strategy is over another. However, professionals' personal values and opinions about broader issues such as the role of both government and the homeowner in wildfire mitigation and prevention and their feelings on wildfire management in general will likely also inform their views. These questions measured respondents' values and opinions on such issues.

- *Basic demographic information:* These questions measured past professional history, age, gender, education, and political affiliation. This information is important in understanding how past experience and demographics might influence respondents' opinions and beliefs. Questions regarding respondents' opinions about the appropriate role of government in regulating individual action, which are likely associated with political affiliation, were also included.

Table 1 provides demographic information on the survey respondents. While there are no reliable statistics on the wildfire profession (as opposed to the municipal firefighting profession, for example, where unions and demographers keep reliable data), the United States Bureau of Labor Statistics (2011) indicates that it is a male-dominated field and is aging. Moreover, especially in the western United States where large tracts of land are managed by federal agencies, federal firefighting presence is significant. The political affiliation of these respondents also reflects the voter registration in several western states⁴ (Colorado Secretary of State, 2014). Overall, the demographics of the survey respondents do not appear to differ from what we would expect for this particular professional population.

INSERT TABLE 1 ABOUT HERE

⁴ For example, in Colorado as of October 2014, 31% of registered active voters were registered as Democrats, while 32% were registered as Republicans.

Findings: Information, Resources, and Management Priorities

The goal of this research was to develop a deeper understanding of the approaches fire professionals use to encourage wildfire risk mitigation on private property, with the understanding that without addressing risk on private property, communities are not adequately reducing risk throughout the Wildland Urban Interface. A majority (73%) of survey respondents indicated that encouraging wildfire mitigation on *private property* is either central to, or somewhat within, their agencies' missions (see Table 2, top section). The types of mitigation approaches promoted by agencies vary, but all of the most common approaches to mitigation (home defense, structural mitigation, fuels reduction, and foci on varying perimeters around structures) were in the portfolio of approaches employed by the survey respondents (see Table 2, bottom section).

INSERT TABLE 2 ABOUT HERE

With the understanding that the majority of survey respondents do focus on wildfire mitigation on private property, the various approaches and effectiveness of the approaches being used to encourage wildfire mitigation were analyzed. Table 3 and Figure 1 illustrate the differences between the approaches used by fire management agencies to promote mitigation and the perceptions among fire professionals of the effectiveness of those approaches.

INSERT TABLE 3 ABOUT HERE

INSERT FIGURE 1 ABOUT HERE

While all outreach approaches are viewed positively by survey respondents, it is clear that agencies see face-to-face strategies, which typically include a fire professional going to a private property owner's home and talking directly with them about how to mitigate on the property, as highly effective. This result supports previous findings about the effectiveness of face-to-face and interactive communication (e.g., McCaffrey, 2004; McCaffrey et al., 2011; McCaffrey & Olsen, 2012; Toman et al., 2006). On the other hand, website information and literature are seen as less effective than other approaches. This is consistent with other research indicating that citizens prefer interactive (rather than "unidirectional") communication methods (Toman et al., 2006). However, fire professionals also rank these more passive methods as some of the most often used approaches to encourage wildfire risk mitigation.

These survey findings also support qualitative evidence gathered from previous case study research in Colorado. For instance, survey respondents ranked meetings and public events as slightly less effective than more direct or interactive approaches such as face-to-face contact or community fire planning. Interview subjects in the case studies indicated that meetings and events were useful for disseminating information, but that residents rarely attended them:

"It's kind of ridiculous how little we get... we talk to other neighborhood champions who say the only contact they have is when they go door-to-door."

"We held this event ...but we had only 100 people out of what—probably 1,000 people or more ... so a lot more of them could've shown up and should've shown up, but they didn't." (Koebele et al., 2014)

Furthermore, according to interview subjects, face-to-face contact or the use of neighbors to inform neighbors (called citizen-to-citizen networks in the survey questionnaire) was a more effective use of limited agency resources than public meetings and events, and was also perceived as being highly effective at encouraging mitigation activity by survey

respondents (despite being used less frequently by survey respondents), which is consistent with other research evaluating fire mitigation outreach efforts (McCaffrey, 2004; Monroe & Nelson, 2010). While this type of network develops organically in many neighborhoods, one agency in a previous case study community (the Colorado Springs Fire Department) has institutionalized a citizen-to-citizen networking process through their “Neighborhood Champions” program, which deputizes motivated citizens to encourage their friends and neighbors to mitigate on their private properties and provides them with financial and technical support for organizing mitigation projects (Koebele et al., 2014).

Survey respondents were also asked to rank their personal preferences regarding various wildfire prevention and mitigation approaches. Options included government-mandated regulations such as ordinances, taxes, or fees, as well as incentive-based options such as education and outreach. Table 4 lists the rankings provided by survey respondents. Using education and outreach methods to promote wildfire risk mitigation was most popular among survey respondents, while more regulatory approaches were ranked as less favorable. Options such as requirements for mitigation enforced by non-governmental entities such as HOAs, and pressure from insurance companies, fell in the middle in terms of support from fire professionals. In the right column, respondents then ranked the education and outreach mechanisms they viewed as most effective.

INSERT TABLE 4 ABOUT HERE

Beyond whether fire professionals view mitigation approaches and outreach strategies positively, understanding whether these professionals experienced positive or negative feedback

from residents when attempting to encourage wildfire mitigation through these approaches is also important to understanding their success. Table 5 and Figure 2 present data on wildfire professionals' perceptions of residents' receptivity toward various outreach approaches. Once again, the regulatory option of ordinances related to mitigation was understood by respondents as negatively received by residents compared with incentives and information-based approaches such as assessing risk on properties, providing information about grant programs to help with mitigation, and presenting information through both passive (literature and websites) and more active (events) means. This supports previous research that found that incentive programs motivated homeowners to mitigate wildfire risk, as did agency outreach that took a "carrot" approach as opposed to a "stick" approach (McCaffrey et al., 2011)

INSERT TABLE 5 ABOUT HERE

INSERT FIGURE 2 ABOUT HERE

Beyond mitigation outreach and strategies, previous studies indicated that risk assessment on private property can be a motivating factor in encouraging residents to mitigate their own properties (e.g., McCaffrey 2004; McCaffrey & Olsen, 2012; Parkinson, Force, & Smith, 2003; Meldrum et al., 2014). The type and extent of risk assessment varied between the two previous cases studied, however (Koebele et al., 2014). Some residents describe being fearful that insurance companies would obtain the risk data and use it to increase insurance premiums. Due to this reported fear, some fire agencies were wary of using their limited resources to focus on risk assessment on private property. In Colorado Springs, Colorado, the fire department uses a simple color-coded risk map of parcel-level data to communicate wildfire risk. Residents

reported that this simple color-coded scheme was highly effective in motivating action by residents. Near Fort Collins, Colorado, residents were much more hesitant to participate in risk assessment and fire professionals had to approach the topic more carefully, using a password-protected system through which risk data were available only to property owners and risk assessment was done only by invitation.

Based on these findings, risk assessment approaches were analyzed in the broader survey sample. When asked, 50% of survey respondents (n=66) indicated that their agency performs wildfire risk assessments on private property. Table 6 uses only this portion of the respondents to further investigate risk assessment methods. A majority of these respondents indicated that they assess property-level risk when asked, but a minority of agencies assesses risk on all properties within their jurisdiction. While this lack of widespread risk assessment likely signals a resource-constraint issue, this finding is noteworthy because face-to-face risk assessment contacts may be a missed opportunity to develop the trust in local government professionals that scholars find is important to encouraging wildfire mitigation (McCaffrey, 2004; Kent & Gebert, 2003). However, it also illustrates the context-sensitivity necessary on the part of fire professionals when designing outreach strategies for the communities in which they work, as some places may be more or less receptive to government involvement in their personal mitigation efforts. While some respondents indicated that they make risk data public, or private through a password system, a majority of respondents did not use either approach. This same pattern is evident in the manner through which risk data are reported: the majority do not report risk data through either a color-coded simple scheme or through statistical data, but use some other means of communicating risk (Table 6).

INSERT TABLE 6 ABOUT HERE

Unlike in the cases studied previously and described above, fire professionals surveyed for this study indicated that individuals are very receptive to risk assessment on their property (38% very receptive, 46% somewhat receptive, and only 6% unreceptive). If residents are perceived as receptive to risk assessment, it may be possible to increase mitigation on private property by informing residents of their wildfire risk through risk assessment approaches. Both fire professionals' preferred risk assessment approaches, assuming an absence of resource constraints, as well as what they use in practice were analyzed to investigate this disconnect. Table 7 shows the rank-order preferences of risk assessment approaches listed by the percentage of survey subjects who ranked the option first. These data include all survey respondents, regardless of whether their agency actually conducts risk assessment. Fire professionals' most preferred approach for risk assessment was to assess all properties and to make the data public, similar to what the Colorado Springs Fire Department does. This is not, however, what most agencies do, as indicated in Table 6, where only 38% of respondents indicated that their agencies assess risk for all properties within the WUI.

INSERT TABLE 7 ABOUT HERE

Why then—if these respondents prefer risk assessment on as many parcels as possible, and they think that the public supports it—are they not doing it? The answer to this question likely lies in the limited resources of fire management agencies.

There is a fairly clear difference in preferred, or perceived support for, wildfire risk reduction strategies, with some professionals (see Tables 4 and 5) stating a greater preference for government regulations over incentives and education. Understanding if there are significant differences between fire professionals who support more regulatory approaches and those who do not may help us understand why certain approaches are favored over others. To analyze this question, an index variable was constructed wherein support for regulatory approaches was determined by higher stated preferences on questions focused on government regulation, taxes, and ordinances as preferred methods of reducing wildfire risk.

In attempting to understand which fire professionals were most likely to support government-mandated regulations as a method of reducing wildfire risk on private property, a linear regression model was constructed to help specify the variables that predict higher levels of support for such regulatory schemes. Table 8 reports the results of this regression. Variables of potential importance based on fire professional demographics may include (1) types of professional experience, including the state where respondents work, (2) number of years worked in a fire-related profession, (3) political affiliation or state political context, (4) the jurisdiction for which an individual works, or (4) the conditions of the WUI near them. Based on the literature above, (5) whether fire professionals have experienced positive public reception of regulations for mitigation may be important to understanding their support for regulations.

Trust between communities and agency personnel is essential to achieving mitigation goals, and “competent” managers earn the respect of their communities (Winter, Vogt, & McCaffrey, 2004). By extension, if fire professionals are cognizant of the beliefs of the community in which they live and work, they may be more likely to support policies that are palatable in that context. (6) Personal beliefs about the role of climate change, (7) appropriate

approaches to risk assessment, and (8) whether WUI risk is increasing locally might influence support of more regulatory risk reduction approaches; other research analyzing what motivates environmental action found “concern” to be an important factor in addressing an environmental risk (Wakefield, Elliott, Eyles, & Cole, 2006). Fire professionals' concern over the possible outcome of a destructive wildfire in their community may contribute to their support of regulatory approaches to mitigation.

INSERT TABLE 8 ABOUT HERE

The results indicate that neither an individual’s political affiliation nor the state political context within which they work/live are significant predictors of support for regulatory approaches to encouraging wildfire mitigation, although state political context is nearly significant in this model. Individuals who perceive fire agencies as being overburdened are no more likely to support regulatory approaches than their peers⁵, which is also true for more experienced fire professionals. The variables that do predict support for government-mandated regulations to promote mitigation are (1) support for more active risk assessment in the WUI and (2) perception of positive responses to regulation among the public. The second finding seems particularly important, as fire professionals seem to strive to work within the constraints of public support, limitations of individual resources, and the realities of fire management agencies. As seen above in preferences of risk assessment strategies (Table 7), fire professionals seem to acknowledge and respect the desires of homeowners when conducting their work. Furthermore, community members also appear to trust local fire agency representatives more so than the

⁵ This finding may be related to lack of variance on this measure since most fire professionals believe that agencies are overburdened.

institution for whom they work (Kent & Gebert, 2003). Building trust by working within publicly-supported approaches to mitigation may be key to eliciting support for fire professionals and reaching out to the public in effective ways. This also explains the near significant result of the state political context variable in the regression model, but the lack of significance of individual political affiliation of our respondents.

Discussion

This study presents findings focused on the approaches that fire professionals who work for fire response and management agencies in the western United States use to encourage residents to mitigate wildfire risk on private property. The analysis presented here indicates that fire professionals use multiple strategies to encourage and inform residents about mitigation, but they prefer face-to-face contact with residents when possible. Despite the perception that face-to-face contact is highly effective in encouraging wildfire risk mitigation, this approach is not one of the most commonly used approaches. This likely has to do with limited agency resources to devote to the relatively time-intensive process of contacting residents individually.

Fire professionals also indicate a lower preference for government-mandated regulatory approaches for mitigation on private property. Those professionals who do prefer these regulatory approaches are those who also support more aggressive and comprehensive risk assessment on private property in the WUI and those who perceive positive response from residents related to regulatory approaches to mitigation. This indicates that fire professionals are aware of, and interested in, the political or social feasibility of the approaches that they use to increase mitigation by residents. This is also supported by the findings presented above related to risk assessment on private property. Survey respondents preferred rating all properties in their

jurisdictions and making the data publicly available, but indicated that when invited to assess risk by a homeowner, these data should be kept private. Fire professionals seem keenly aware of limitations posed by residents' preferences, perceptions, and support for various mitigation and risk assessment approaches.

As such, fire professionals may be well-served to capitalize on approaches that build on the effectiveness of face-to-face contact, but also take into account the limited resources with which agencies must cope, such as the citizen-to-citizen networks used by the Colorado Springs Fire Department (Koebele et al., 2014). For instance, only 38% of fire professionals report using citizen-to-citizen networks often, but citizens report that these are highly effective in encouraging wildfire risk mitigation because they entail aspects of personal contact. Other research has emphasized the importance of establishing and nurturing these networks in different contexts (Fischer, Kline, Ager, Charnley, & Olson, 2014) so it is important to highlight this disparity between agency practice and effectiveness. Additionally, collaborating with NGOs, local governments, and media may be more effective strategies than disseminating passive literature or holding public meetings or community events, which are perceived as less effective and less used by residents.

Conclusion

Understanding the many approaches to promote mitigation on private property and their level of effectiveness is increasingly important as wildfire becomes an ever-more present risk in the growing WUI of the American West. The findings from this study indicate that fire professionals use a suite of methods ranging from passive to active dissemination of information as well as regulatory approaches and incentives for promoting mitigation. The findings also indicate that fire professionals may select mitigation outreach and incentive approaches based, at

least in part, on how well-received they think an approach will be by property owners. Building on the findings presented here, future studies should include larger samples from each western state to enable analysis of state-level preferences and differences in mitigation practices. Additionally, since this study increases general understanding of fire professionals' perceptions of residents' receptivity to mitigation outreach, it would next be useful to study residents' perceptions of those strategies and their use of various mitigation tools and sources of information. An exploration of the economic efficiency of these mitigation outreach approaches would be useful in understanding if, in fact, cheaper but less potentially effective methods of education such as websites and literature are more cost-effective than more resource-intensive approaches such as face-to-face contact.

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Table 1. Descriptive Statistics of Survey Respondents

Variable	Categories of Responses						Total
	Age	26-34 6% (7)	35-54 69% (86)	55-64 24% (30)	65 or Older 1% (1)		
Gender	Male 82% (102)	Female 18% (22)					100% (124)
Education	High School 2% (2)	Some College 12% (14)	College Degree 64% (78)	Graduate School 22% (27)			100% (121)
Years Worked/Fire	0-5 3% (4)	6-10 8% (10)	11-15 16% (19)	16-20 19% (23)	21-25 26% (32)	Over 25 28% (35)	100% (123)
Jurisdiction	Federal 54% (67)	State 24% (29)	County 10% (12)	Local 7% (9)	Tribal/Rural 5% (6)		100% (123)
Political Affil.	Democrat 30% (31)	Republican 26% (27)	Independent 31% (33)	Other 13% (13)			100% (104)

Table 2. Mitigation Roles and Approaches Within Fire Agencies

Importance to Agency Mission		Total		
Mitigation on Private Property	Central to mission	22%		
		(26)		
	Somewhat within mission	51%		
		(61)		
	Not really within mission	18%		
		(22)		
	Outside of our mission	9%		
		(11)		
Total		100%		
		(120)		
		Promote	Do Not Promote	Total
Type of Mitigation (Check all)	Fuels Reduction	62%	38%	100%
		(82)	(50)	(132)
	Home Defense	51.5%	48.5%	100%
		(68)	(64)	(132)
	Structural Mitigation	27%	73%	100%
		(36)	(96)	(132)
	10-30 feet perimeter	48.5%	51.5%	100%
		(64)	(68)	(132)
	>30 feet perimeter	52%	48%	100%
		(69)	(63)	(132)

Table 3. Types and Effectiveness of Mitigation Outreach and Education Approaches

		Often	Sometimes	Rarely	Total
Types of Mitigation Outreach and Education	Public Meetings	36% (34)	48% (45)	16% (15)	100% (94)
	Community events	42% (39)	48% (45)	10% (9)	100% (93)
	Face-to-face individual contact	57% (55)	31% (30)	12% (12)	100% (97)
	Literature or brochures	65% (63)	28% (27)	7% (7)	100% (97)
	Website information	72% (67)	22% (20)	6% (6)	100% (93)
	Citizen to citizen networks	38% (36)	46% (43)	16% (15)	100% (94)
	Community fire planning	69% (66)	26% (25)	5% (5)	100% (96)
			Effective	Neutral	Ineffective
Effectiveness of Mitigation Outreach and Education	Public Meetings	81% (105)	11% (14)	8% (10)	100% (129)
	Community events	84% (109)	11% (14)	5% (6)	100% (129)
	Face-to-face individual contact	98% (129)	1% (1)	1% (1)	100% (131)
	Literature or brochures	76% (99)	16% (21)	8% (10)	100% (130)
	Website information	68% (89)	25% (32)	7% (9)	100% (130)
	Citizen to citizen networks	78% (102)	18% (23)	4% (6)	100% (131)
	Community fire planning	87% (115)	12% (16)	1% (1)	100% (132)

Table 4. Ranking of Approaches to Mitigation and Effectiveness of Outreach

Ranking of Prevention and Mitigation Approaches by Percentage First Rank (n=122)	Ranking of Effectiveness of Outreach Approaches by Percentage First Rank (n=124)
<ul style="list-style-type: none"> 1) Education and outreach to residents in the WUI (42%) 2) Requirements for mitigation in the WUI (23%) 3) Insurance company pressure or non-coverage (14%) 4) Government regulation and ordinances (13%) 5) Taxes or fees to pay for response and mitigation (8%) 	<ul style="list-style-type: none"> 1) Face-to-face contact with individual residents (44%) 2) Residents' personal experiences with wildfire (40%) 3) Literature or brochures on wildfire risk and mitigation (4%) 4) Website content on wildfire risk and mitigation (4%) 5a) Community events to educate about wildfire risk and mitigation (3%) 5b) Peer pressure from neighbors who mitigate on their property (3%) 6) Public meetings (2%)

Table 5. Receptivity of Residents to Various Mitigation Outreach Approaches, Reported by Professionals Working in Wildfire

		Receptive	Neutral	Unreceptive	Total
Receptivity of Residents to Mitigation Outreach Approaches	Risk assessment on property	84% (105)	10% (12)	6% (8)	100% (125)
	Community events	76% (97)	20% (25)	4% (5)	100% (127)
	Literature or brochures	65% (83)	30% (38)	5% (6)	100% (127)
	Website information	65% (82)	30% (38)	5% (7)	100% (127)
	Ordinances for mitigation	47% (60)	15% (19)	38% (48)	100% (127)
	Information about financial assistance for mitigation	80% (100)	18% (22)	2% (3)	100% (125)

Table 6. Approaches to Risk Assessment on Private Property Used by Fire Management Agencies

	Risk Assessment Method	Total
Approach to Risk Assessment ⁶ (Check all) (n=66)	All properties in jurisdiction	38% (25)
	When asked by homeowner	82% (54)
	Publicly available risk data	21% (14)
	Privately available risk data	20% (13)
	Simple color-coded risk scheme	29% (19)
	Numerical or statistical risk data	21% (14)

⁶ Other approaches offered by respondents included direct contact with homeowners to provide informal or formal risks assessments, often using a narrative description of the property's wildfire risk rather than a formal analysis.

Table 7. Ranking of Risk Assessment Strategies

Ranking of Risk Assessment Strategies on Private Property by Percentage

Ranking First

(n=82)

- 1) Assessment of all properties in WUI – publicly available data (67%)
 - 2) Assessment of all properties in WUI – privately available data (20%)
 - 3) Assessment of properties in WUI by invitation – privately available data (10%)
 - 4) Assessment of properties in WUI by invitation – publicly available data (3%)
-

Table 8. Linear regression model for support of government regulation to reduce wildfire risk through mitigation on private property by wildfire professionals in the western U.S.

Variable	Regression Coefficient	SE	β	t	df	P
<i>Wildfire Experience</i>						
Pos. responses to regulations	.915	.423	.268	2.162	4	.035*
Significant growth in nearby WUI	.405	.417	.107	.972	3	.335
<i>Opinions</i>						
Climate change is increasing fire risk	.689	.502	.184	1.375	4	.174
Fire agencies are overburdened	-.158	.653	-.035	-.242	3	.809
Risk assessment of all WUI properties best	1.319	.536	.285	2.463	3	.017*
<i>Demographics</i>						
State Political Score ⁷	.294	.155	.211	1.895	9	.063
Fire agency jurisdiction (fed =1, local =5)	.184	.290	.072	.635	6	.528
Years worked in wildfire	.525	.344	.176	1.528	5	.132
Political affiliation (reference: democrat)	-.139	.247	-.063	-.564	5	.575

R² = .326

Adj. R² = .213

⁷ The State Political Score is a score derived from the party holding the following offices in each state: Governor, State House, State Senate, U.S. Senate (2), % U.S. House of Representatives. Scores range from 0 (Idaho, Utah, Wyoming) to 9 (Oregon). The score is calculated based on whether Democrats hold each office, assuming that Democrats would be positively correlated with higher support for government regulations (dependent variable).

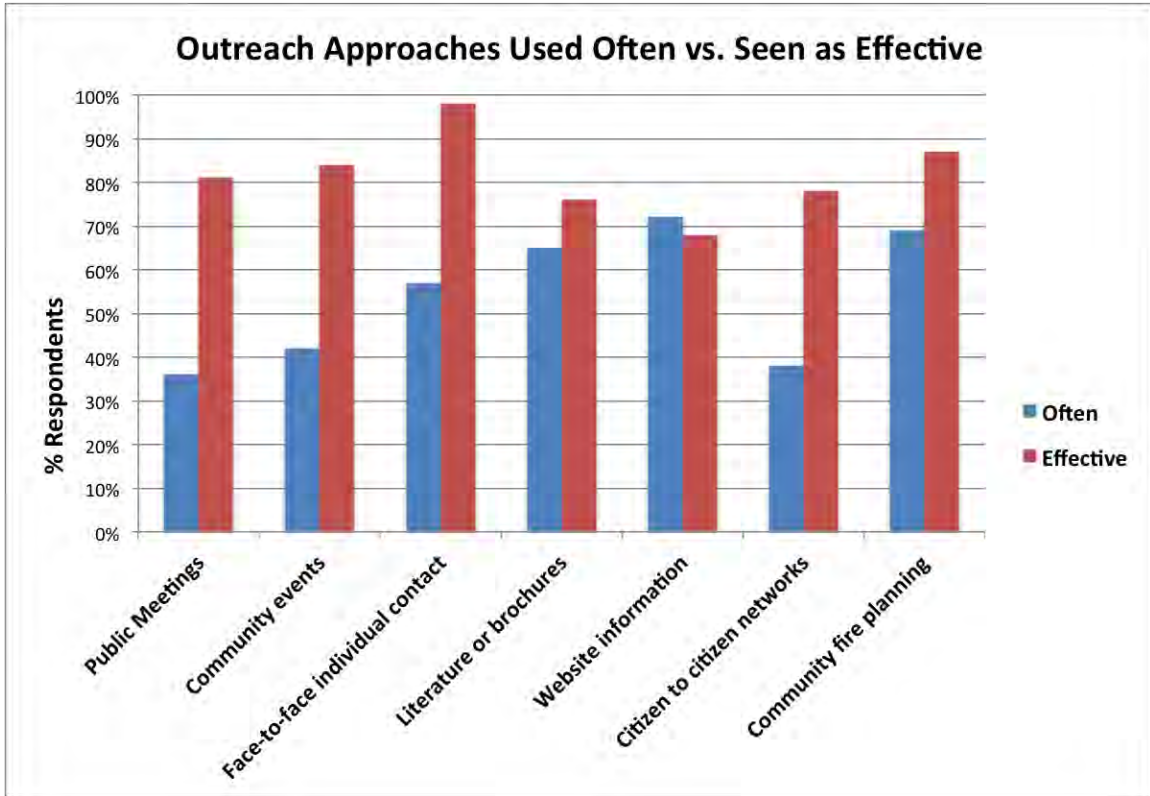


Figure 1. Effectiveness versus frequency of use of mitigation outreach methods

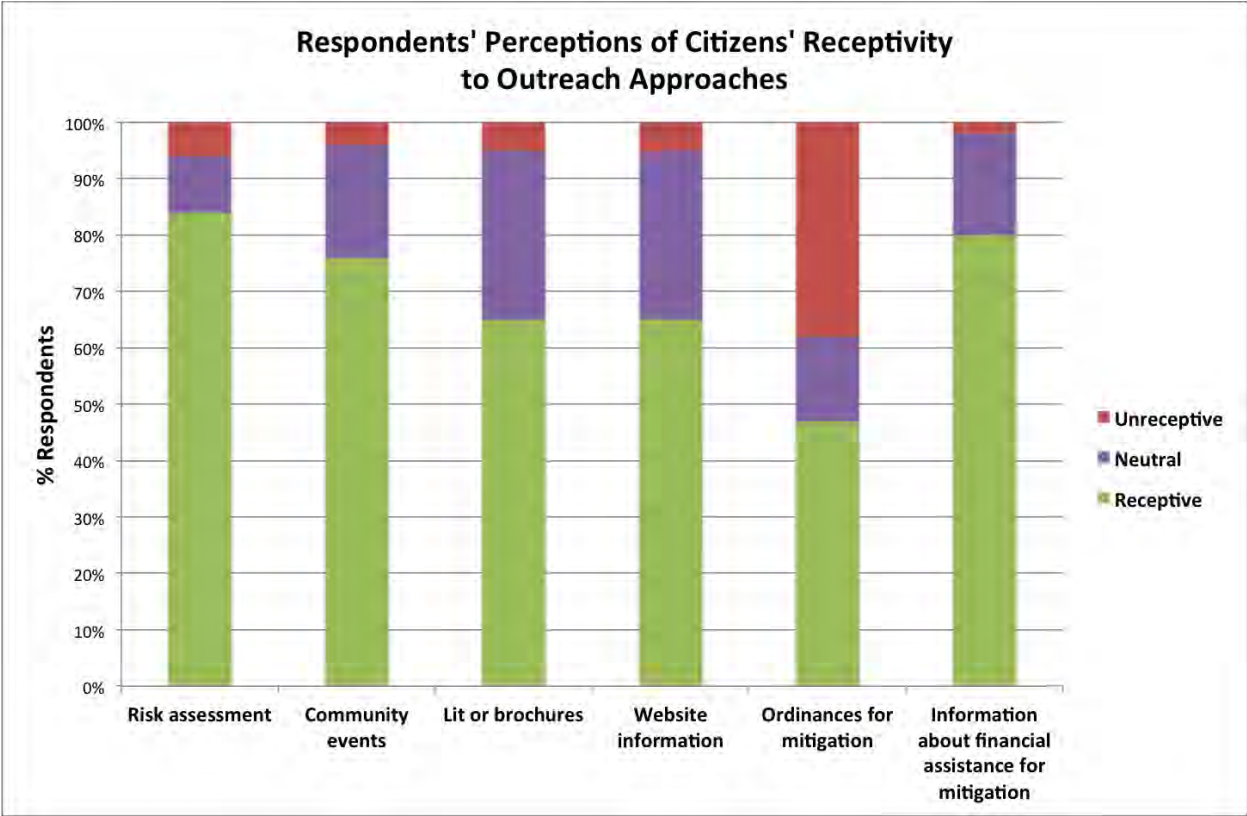


Figure 2: Receptivity of Residents to Outreach Approaches by Fire Professionals