Wildfire risk reduction in the United States: Leadership staff perceptions of local fire department roles and responsibilities

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ABSTRACT

As wildland fires have had increasing negative impacts on a range of human values, in many parts of the United States (U.S.) and around the world, collaborative risk reduction efforts among agencies, homeowners, and fire departments are needed to improve wildfire safety and mitigate risk. Using interview data from 46 senior officers from local fire departments around the U.S., we examine how leadership staff view their departments' roles and responsibilities in wildfire risk reduction. Overall, our findings indicate that local fire personnel are often performing a variety of mitigation tasks and roles, acting as informants, educators, partners, and planners. The challenges these local departments have experienced also point to how funding, information sharing, and staff buy-in can better facilitate engagement in mitigation work and ultimately help improve community wildfire safety.

1. Introduction

In many places around the world, recent decades have seen growing wildfire impacts on human communities. Due in part to the effects of climate change, in many places it is also a result of increased fuels from decades of suppressing fire's natural ecological role as well as increased human habitation in fire prone areas. Although it is currently recognized that in many ecosystems fire is an important ecological function, in the United States suppression of fires on public lands has been the dominant response to wildland fires for over a hundred years. For much of this period, wildland fires had relatively minimal impact on human settlements, which tended to be in agricultural areas or less intertwined with public lands [18]. As such, in most of the United States the primary wildland firefighting response came from federal land management agencies, such as the Forest Service. However, since World War II, more residential development and human activity in wildland areas have added complexity to the system [1,5]. Along with increased fire ignitions, the mix of ownerships now affected by wildfires requires the active involvement of a greater array of emergency responders, particularly local fire departments, than just federal land management agencies both to respond to a wildfire and to foster mitigation before a fire as the most effective way to improve safety and long-term outcomes. The 2017 fires in Northern California, where wildfires burned through and destroyed whole neighbors in and adjacent to the city of Santa Rosa, highlight the degree to which these issues are beginning to directly impact local structural fire departments.

The greater involvement of local emergency responders in wildland fire, however, has not been a straightforward matter. Historically, local fire departments have focused on structural fire protection while wildfire protection has been the domain of the state and federal government [18]. Each type of protection requires different firefighting techniques and equipment: urban protection is a focused effort to protect structures (requiring heavy duty personal protective equipment, including breathing apparatus, that allows for brief exposure to intense heat that can occur within a building), whereas wildland firefighting emphasizes a more extensive effort to prevent perimeter spread (requiring lighter weight protective equipment that allows for long periods of intense physical work) [17]. As a result, direct involvement in wildfire management, particularly fire mitigation efforts, has not always been seen by local fire departments as in their purview of responsibilities. Given their role as an important local institution and the need for more homeowners to undertake fire mitigation efforts, understanding how fire departments that have been affected by wildfires now perceive their role and the barriers to more proactive involvement is an area that merits more attention.

1.1. Wildland fire suppression and mitigation in U.S. context

In the United States (U.S.) wildland fire response, preparedness, and mitigation activities are addressed by multiple governmental and non-governmental organizations. In terms of response, county, municipal, and volunteer fire departments play an important role in initial response to a wildfire. If the complexity of the wildfire incident increases beyond the capabilities of local resources, the U.S. national incident management system (NIMS) is implemented to coordinate appropriate local, state, and federal response resources based on incident complexity and resource availability. Once non-local resources are called in, local fire department responsibilities tend to focus on structure protection while state and federal resources focus on wildfire management. While some states, such as California, have extensive state level firefighting resources, others states have minimal fire response ability. At the federal level there are five primary land management agencies with firefighting responsibility, with the U.S. Forest Service the organization with the most firefighting resources.

From a wildfire preparedness and mitigation perspective there is no national coordinating group, however, most federal land management agencies provide administrative, research, and outreach services. The main examples of these national efforts include the Firewise USA™, Ready, Set, Go!, and the Fire Adapted Communities Learning Network. In addition, many local and regional community-based organizations have emerged, including firewise homeowner's associations, fire safe councils, and regional coalitions. In addition, public outreach about wildfire risk and mitigation has had a growing role on the agenda of many fire departments whose jurisdictions include the wildland-urban interface (WUI).[1]

The Healthy Forests Restoration Act (HFRA) of 2003 encourages the creation of Community Wildfire Protection Plans (CWPP), which need to be developed collaboratively between local fire departments, local government and area residents. The typical role of local fire professionals in this process is to provide technical insights and tools to the planning process, as well as information about the surrounding area's vegetation and fuels.[2] Participation in CWPP development represents one avenue through which local fire departments act as partners with land management agencies and local residents in community risk reduction efforts.

1.2. Research on wildfire mitigation

A large body of work has developed since 2000 examining various aspects of public[3] response and preparedness in relation to wildfire. Syntheses of this research show that, overall, the public tends to have high acceptance of fuels treatments (such as prescribed burning) on public lands, see it as their responsibility to mitigate fire risk on their property, and that overall wildfire risk mitigation is a shared responsibility [12,20]. Between 2000 and 2008, just 7% of the applicable studies were based outside of the U.S. [13]. However, since 2010, research based outside the U.S. has made up about half the published social science research articles related to wildfire, most coming from Australia. More work has also come from Canada in recent years, as well as from New Zealand and Europe. On the whole, findings from this body of research suggest that there are many similarities across countries in terms of the social dynamics of wildfire management, particularly as related to public trust and people's perceived benefits of

participating in mitigation programs [11].

Specific to homeowners and mitigation, early studies tended to focus on individual property owners and communities in regards to their direct participation in wildfire mitigation actions. In their review of these studies, Toman et al. [20] concluded that homeowners' risk reduction behaviors tend to be influenced most by psychological factors, particularly their perceived effectiveness of the activities and their perceived ability to complete them. Findings regarding the effect of property owners' awareness of fire risk on their mitigation activities have varied. Toman et al. [20] note that some studies found homeowners' awareness of risk to be an important but insufficient factor for adopting risk reduction behaviors. Where risk awareness relates to cooperation with others in mitigation work, Fischer and Charnley [4] found perceived risk to explain private forest owners' cooperation with public agencies, but it did not explain their cooperation with other private landowners.

More recent research has begun to examine the influence of outreach programs on homeowner awareness and preparedness. This work has shown public outreach programs, particularly those that directly connect fire agency personnel with community members, to be key in fostering wildfire preparedness and acceptance of mitigation efforts [11]. Studies have also highlighted how participatory planning processes, such as CWPP development, can provide a platform for interaction, collaboration, and information sharing among property owners, land management agencies, and fire agencies [8,16].

Public outreach, information sharing, and the collaborative process of wildfire protection planning with the community have also been found to help build trust among residents and local fire agencies [16]. In turn, public trust in fire personnel, as well as other local service agencies, has been found to be critical in successfully preparing a CWPP [9]. Evidence from Olsen and Sharp's [15] study of community-agency trust in fire-affected communities in the U.S. and Australia indicates that, in both countries, personnel from local fire agencies tend to engender greater public trust compared to interactions with regional and national actors. Research findings also indicate that local agencies, particularly fire departments, tend to be the public's preferred source of information on fire issues [12]. Given this general status as trustworthy sources, local fire departments have a particularly important role to play in facilitating community risk reduction efforts and engaging local residents.

While important to understand the perspective of individual property owners, it is equally important to understand the perspectives and actions of local fire personnel. Although a less researched area, findings from both Canton-Thompson et al. [2] interviews with Incident Management team members and Shiralipour et al. [19] interviews with local fire department and forestry agency personnel indicate that fire personnel see inter-organizational coordination and information sharing with community members as important in wildfire preparedness. However, the foci, respectively, of these studies relate to the impact on fire suppression costs and the role of neighborhood organizations in wildfire prevention efforts.

As wildfire threat intensifies for many communities located in wildland-urban interface areas across the world, local fire departments' roles in community protection and risk reduction will likely become only more critical in future years. Given this and the limited research specific to local fire professionals' perspectives on their preparedness role, this article aims to address the following questions: How do local fire departments perceive their role in addressing this need? What are the strategies and tactics they use to try to fulfill the role they envision and what are the challenges they face in doing so? Furthermore, we examine how role perceptions and engagement in non-response efforts may differ among departments by regional location, urban or rural community type, and career or volunteer status.

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[1] "Wildland-urban interface" is used in this article to refer to what would be considered *interface*—"where housing is in the vicinity of a large area of dense wildland vegetation"—as well as *intermix* communities, "where housing and wildland vegetation intermingle" ([10]:8).

[2] Any combustible vegetative material that is typically found in wildland, open-spaces or within communities.

[3] Following McCaffrey and Olsen [12], we use the "public" to refer to residents and recreation visitors of a given area.

2. Method

2.1. Background

The purpose of this study was to identify the most important elements in the departments' WUI fire protection program, including both response and community risk reduction. Furthermore, it aimed to describe how fire departments overcome barriers and adapt to risk given the resources available to them.

Findings presented in this article are part of a larger study conducted by the National Fire Protection Association (NFPA) on local fire departments' preparedness and readiness capabilities in the WUI around the United States. Due to the volume of data collected, the larger project was divided into two phases. The Phase One analysis included just the first 25 of the 46 total interviews conducted (see [6], while Phase Two included all 46 (see [7]. Both reports can be accessed on the NFPA website under "News and Research" (see website in reference list).

2.2. Participants

Research participants were Fire Chiefs and senior line officers in 46 local fire departments with an active history of responding and mitigating wildfire in their jurisdictions and that had experienced a major wildfire event within the last five years. Recent wildfire experience was targeted to allow for the ability to examine whether and how local fire departments change and adapt following a major fire event. Participants from departments staffed by all career (typically all paid), all volunteer (unpaid), and a combination of career and volunteer firefighters were included in the sample.

The participants were all experienced firefighters whose senior positions indicated that they would be knowledgeable informants for this study: 34 of the 46 participants were Fire Chiefs; six were either Deputy Chiefs, Division Chiefs, Battalion Chief, or Staff Chiefs; and four were Captains, one of whom also served as his department's Wildfire Mitigation Coordinator. Of the two participants remaining, one was the Wildland Fire Manager and the other the Fire Safety Manager for their respective departments. All interviewees were male and ranged in age from approximately early 40s to late 60s.

Participants worked at departments in all four U.S. Census regions of the country, with most participants coming from the West: 27 informants came from the West, 12 from the South, 4 from the Northeast and 3 from the Midwest. Using the NFPA's [14] rural definition of less than 500 persons per square mile there were 26 rural and 20 urban fire department senior leaders interviewed (Fig. 1).

2.3. Recruitment

Initial recruitment of research participants took place in late March, 2015 at the Wildland-Urban Interface conference sponsored by the International Association of Fire Chiefs (IAFC). Research team members solicited participants through meetings with conference attendees and distribution of brochures describing the research. Seven face-to-face interviews took place during the course of the conference. Conference attendees who were not interviewed on-site but expressed an interest in participating in the research were asked to provide contact information. The remaining interviews, representing the majority (39/46), were conducted over the telephone.

Additional research participants were recruited through a blog post that was disseminated on several NFPA communication networks, and interviewees were asked whether they could recommend others for the study. Through this snowball sampling process additional research participants were recruited until the desired number and geographical distribution of participants was obtained. Due to these sampling methods, the results likely reflect departments that have made some headway in improving their WUI preparedness and readiness

capabilities. As such, it should not be inferred that all local fire departments in fire prone areas are engaging in the activities discussed in our findings.

2.4. Interview guide

The interview guide included 35 closed-ended and open-ended questions, some of which allowed for a series of follow-up questions (see [6], Appendix B: Interview Guide). Sets of interview questions were organized around key topics, including (a) fire department, equipment, and training, (b) recent major wildfire event, (c) responses and resultant changes due to the major wildfire event, (d) community awareness, fire prevention, and risk reduction, and (e) wrap-up and review.

2.5. Procedure

A brief survey, comprised of a set of approximately 20 closed-ended questions, was disseminated to study participants prior to the interview. The data collected in these surveys provided background on departmental structure, training, equipment, funding, and level of participation in community risk reduction activities. Respondent answers were used as a starting point in the semi-structured interviews to which allowed for more context and depth of assessment than allowed by the closed-ended survey responses. The key findings presented in this article are from the qualitative interview data only. Interviews were, on average, approximately one hour long and were audio-recorded and transcribed. To preserve confidentiality, only broad descriptors are used to provide context for narratives and perspectives. Along with job position, staff composition (career, volunteer, or combination), community type, and region, state names are referenced to provide greater specificity and context without revealing the identity of the participant or department.

2.6. Analysis

A modified form of the coding strategy used in the grounded theory approach was used to categorize and analyze the interview data. While interview questions were organized around specific topics, such as fire response, community awareness, fire prevention, and risk reduction, each interview transcript was coded line-by-line to identify relevant data provided by the respondent at any point in the interview. This initial coding process helped identify themes, topics, and actions as they emerged in the data as opposed to applying pre-existing categories to the responses based on the questions that preceded them during the interview. Focused coding was also used to "synthesize, analyze, and conceptualize larger segments of data" ([3]:138). This process revealed themes and patterns among the data initially coded, as well as new categories to examine and reexamine in interviews where they had not been discerned previously. NVIVO v.10 software was used to facilitate the coding process.

The modified grounded theory coding strategy, which advises researchers "to avoid forcing their data into preconceived codes and categories" ([3]:155), proved particularly beneficial in conceptualizing local fire personnel's perspectives on their role in wildfire risk awareness and community risk reduction. Without ever being directly asked about how they view their role in these efforts, the respondents' narratives in response to questions such as "What does your Fire Department do to reduce the risk of a wildfire in the community?" and "What would be the best way to get information about awareness/prevention programs to your communities?" often offered these insights. Emergent themes and patterns in these data then helped to shape our understanding of their perceptions and the construction of roles, as discussed below.
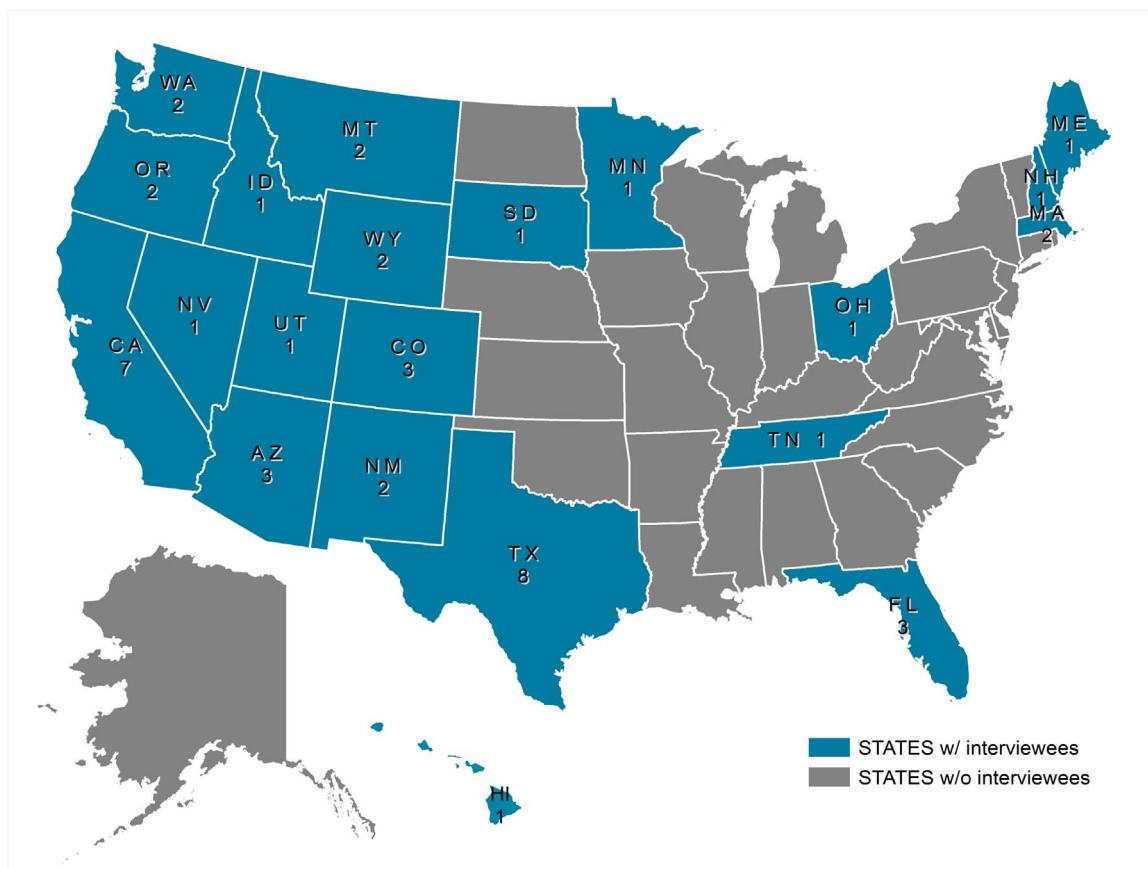
Fig. 1. Map of the United States identifying states where interviewees resided.

3. Results and discussion

Key findings point to participants' perceptions of their fire departments' roles in community risk reduction in terms of communicating with the public and engaging in mitigation activities. Specifically, we discuss the modes and content of their communication with the public, such as through signage, social media, home assessments, property inspections, and formal programs. We also detail various risk reduction activities, such as brush abatement, fuel removals, chipping programs, and strategic mitigation planning. Finally, we highlight the barriers and constraints departments face in carrying out these activities.

3.1. Communication content and modes

"Communication is kind of the linchpin of everything." Rural Massachusetts Chief

Nearly all of the interviewees emphasized the importance of their departments taking an active role in communicating with area residents about wildfire prevention and risk reduction efforts. A large majority of respondents agreed that it is essential for their departments to use multiple modes of communication in order to reach people of various ages, communication preferences, technological savviness, and transient populations: having only one or two modes of communication was felt to result in a lack of community awareness and engagement. Interviewees, particularly in the West where fire danger/risk is especially acute, tended to describe using various means to notify and educate the public not as a courtesy, but as a responsibility of their local fire departments:

"…we've kind of [got] a dual approach. So obviously the latest generation, again I keep harping on social media, but [for] a lot of people it's all about social media and what's on their phone. The older generation's going to be the most traditional—mailed flyers or TV spots or, you know, pamphlet-based information. So I think it's incumbent upon us to make sure we look at who our constituents are and what methodology they use for receiving information so we can tailor our messages in the appropriate way." Urban California Division Chief

Interviewees from across the country often emphasized the importance of their providing timely and accurate information to the public. Specifically, they described efforts to alert area residents and visitors to danger during a major fire incident, on "red flag" warning days when weather conditions are particularly conducive for fire, and when there are fire restrictions/burn bans. Some interviewees felt these notifications served the dual purpose of heightening public awareness of fire hazards so that fires can be prevented while also signaling the need to be prepared to protect themselves should a fire occur.

There was some distinction in the dominant communication modes used by rural versus urban departments. Rural departments tended to report usage of physical boards/signs (e.g. fire danger sign or flying an actual red flag in front of their station, posting fire restrictions at recreational sites) and their department website more than urban departments. While urban departments were more likely to describe robust use of social media, including Facebook®, Twitter®, Instagram®, and Next Door®[4]—some even tracking hits to these sites to assess their impact, to communicate fire danger and prevention information. However, both groups were also clearly moving toward each use:

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[4] Next Door® is a private social networking site for neighborhoods and neighborhood associations. Members within neighborhood groups can message one another and send notifications to their group about happenings in their community. Local agencies, such as fire departments, police departments, and parks departments, can also send notifications to specific neighborhood groups. This site can be particularly useful for targeting specific communities for fire warnings, alerts, and public outreach.

several rural departments noted that they have started to use social media more in recent years and urban departments reported growing use of physical signage. Finally, both rural and urban departments disseminate this information through news media outlets, such as television, radio, websites, and, less commonly, print newspapers.

Even though most departments use a variety of communication methods, the majority of interviewees believed that having face-to-face interactions with community residents is most effective in increasing risk awareness, as well as engaging in risk reduction activities. These interactions might involve conducting wildfire risk assessments, fire personnel going door-to-door to discuss homeowners' fire risk and teach the defensible space concept, or giving presentations at community groups or homeowners' association meetings.

> "I really feel that education is [best when using multiple methods]: if you can read it, you're going to retain 20%. If you can read it and see it, you're going to probably retain 50–60%. But if you can get out there to the private homeowner and they can read it, and they can see it, and you can talk with them, they're going to retain up to 80–90%. And that's what we're trying to do." Rural New Mexico Fire Chief

Just under half of the interviewees (21/46) discussed hazard assessments of individual properties which tended to take two forms: voluntary property assessments and more regulatory-based property inspections. In some cases, property assessments are conducted in response to requests from individual homeowners, on an on-call basis. Homeowners' associations might also field requests from homeowners to have someone from the fire department conduct a wildfire risk assessment on their property. One urban career department in the South works with its local 311 dispatch system to channel wildfire risk assessment requests from both individuals and homeowners' groups. The interviewee from this department finds this system useful in providing a central platform for receiving requests, creating a service request log, and keeping documentation on where assessments have been conducted in their jurisdiction. This department also uses the 311 system to log requests for fire personnel to speak at local group meetings, another common element of departments' community outreach and education.

These assessments are designed to determine the home's vulnerability to wildfire damage and provide recommendations for how to reduce such risk. Typically on these site visits the fire personnel will walk around the property with the owner and discuss actions they could take to mitigate their fire risk. "Pointing out," as a Chief from a midwestern city described, "things like flammable vegetation, their building material, their roofing material, [and] the proximity of vegetation to their home." Some of the other most frequently cited actions discussed with property owners during these assessments were stacking wood away from structures, cleaning gutters, and keeping weeds trimmed and grasses mowed.

A handful of the fire departments, all from western states, also mentioned being involved in property inspection programs. A more regulatory-based approach, these programs differ from requested home assessments in that property owners could be cited for violations of a WUI code found in the inspection. In general, once cited for a violation, if the issue is not corrected within the period of the notice, the fire department will hire contractors to perform the work and bill the property owner. As such, the property owner is not fined per se, but charged for cost recovery. An interviewee recalled how his department would at times incorporate inspections into visits for defensible space assessments and clearance:

> "…And then the other advantage is when our crews are out there we're actually doing an inspection of the house. Even though we're cutting defensible space, [it] gives us an opportunity to give comments and give suggestions to them and, again, if it's a true hazard, then we're actually writing a notice of corrective action and then following up with them." Rural California Chief

Another interviewee from rural California considered his department's "defensible space inspection program" to be its most effective prevention strategy or tactic, as the individualized nature of the inspection allowed it to be an effective means of education and encouraging corrective measures:

> "…Because that [program] is actually having the inspectors go out and leave [violation] notices and information at the homes…on how they can improve around their home and have defensible space." Rural California Battalion Chief

3.2. Facilitating programs and making presentations

The majority of interviewees indicated that their departments played a role in fostering adoption of formal programs like Firewise USA™, Ready, Set, Go!®, Smokey Bear®, the Fire Adapted Communities Learning Network,[5] and One Less Spark - One Less Wildfire®. A few also mentioned Community Emergency Response Teams (CERT) and Stay Alive From Education (SAFE).

Just under three-fourths (33/46) of the interviewees mentioned efforts to reach the community through presenting and/or distributing educational material at local meetings, such as homeowners' associations, neighborhood, volunteer, and church groups, or fire safe councils. Although far less (13/46) discussed their department's involvement in school programs, several interviewees felt school-based campaigns were a crucial tactic in providing information not only in terms of fire prevention and mitigation but how fire can play a beneficial role in our ecological system. Notably, whether or not the local department was involved in administering the U.S. Department of Agriculture Forest Service's Smokey Bear® program, interviewees widely considered the program an effective educational tool and a way to familiarize the public with fire safety early through children in the community.

Many interviewees considered these more community-led programs to be most effective in maintaining long-term community engagement. Interviewees believed that when the community is the driver there is often greater ownership and sustained interest in maintaining fuel reduction and mitigation activities on private lands. Interviewees tended to see their departments as more of an auxiliary resource for the community, making personnel available for providing advice and assistance when needed.

> "…we've got a lot of community members who are gung-ho and who want to be involved in making their communities more fire safe and we as the fire department have to be at the table with them. We can't just say, 'Good luck, folks. Have fun. Let us know if you need anything.' It's not just that easy." Urban California Staff Chief

One benefit of these education/prevention programs and presentations seems to be that they provide a mechanism for direct contact between fire department staff and the public. Fire department staff also described efforts to facilitate networking opportunities between communities through conferences, joint meetings, and alliances.

3.3. Fuel management/risk reduction partners

Along with efforts to encourage homeowner mitigation work, interviewees also described numerous risk reduction activities that fire department personnel perform on private and government-owned lands in collaboration with property owners and municipal, state, tribal, and federal agencies. The most common activities interviewees described were offering brush abatement, fuel (biomass) removals, and chipping programs. Some departments, both with volunteer and career

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[5] Rather than a formal program, the Fire Adapted Communities Learning Network is an information-sharing collaborative with the aim of promoting the idea of coexisting with wildland fire.

firefighters, make their staff and equipment available to homeowners to assist with vegetation management efforts on an on-call basis, while others have specified days or weeks during the year where they go out to the communities. In most cases, the property owners are responsible for piling the removed vegetation and the fire department personnel will then chip it for them. Resultant brush chips may be provided back to the homeowners for mulch or hauled away for disposal or composting.

Chipping programs appear to be less common in urban areas. Only one urban department, located in the West, specifically noted their involvement with chipping and it was in partnership with the State Forest Service. In this case, the State Forest Service owned and operated the chipper; the local fire department removed the brush from the properties and brought it to them. The other urban departments that mentioned chipping did so in the context of how they would invest in these projects if they had the resources. Like the rural departments, they hoped to buy their own chipping equipment and carry out chipping programs for their communities, should they acquire the funding.

"I've seen it used in the [neighboring city] area where there was actually grant money that came in and allowed the fire department to put folks out working on some private lands doing some brush removal, or at least if nothing else to provide free disposal to folks. [You can say to the homeowners], 'If you clear off your lot, clear around your house, get rid of the brush and on whatever day of the month, you put your stuff out in the road and they [fire personnel] [will] come and get it.' Either chip it or haul it off or whatever at no cost to the landowner. And I think that's a big deal because it gets expensive to remove that biomass and if you incentivize it with not having to pay, no cost out of pocket, folks lots of time will invest the labor." Urban Arizona Chief

3.4. Working across landownerships

Besides public outreach, interviewees discussed the need for planning and working across land ownerships.

"That was a big hurdle to recognize that [we needed to be engaged in land management issues] and try to get the point across that, to be successful in a wildfire response, it wasn't just how you responded to the incident, but it was, more importantly, how you prepared and what you did long before the event…And, as we all know, wildfire planning and mitigation borders with land management. And so that [a major fire incident] was the prompt and impetus for us to engage our local land managers and try to work with them and give them the tools and the support that they needed to do the mitigation long before the events, as well as us augmenting that work." Urban Texas Captain

When discussing large-scale mitigation projects, interviewees talked about how the complexities of working across a mix of private and public land ownership highlighted the importance of coordination and good working partnerships among local fire departments, land managers, and the public. Interviewees from departments in the West, in particular, mentioned the departmental resources and local organizational networks that they utilize in developing and implementing strategies, plans, and large-scale mitigation projects.

For example, a department in the rural West works with the BLM and the U.S. Forest Service, and has also worked with the Bureau of Indian Affairs, to create fuel breaks on federal land around sub-divisions. The department has "coordinating group" meetings with the federal agencies a couple times a year to discuss current and future mitigation projects. The department also meets with the agencies separately around a dozen times throughout a year. The department's Chief noted that bringing in the various groups early in the mitigation project planning process was particularly important when working in complex WUI environments, such as where federal land abuts or borders privately-owned structures.

Several departments in the South and West partnered with their respective State Forest Service, municipal governments, and, in some cases, homeowners' associations to develop a mitigation strategy at the county level. Some of the fire departments had been involved with developing a Community Wildfire Protection Plan (CWPP) as part of their wildfire risk reduction (mitigation) program. The CWPPs interviewees described may be targeted for specific communities, as well as developed for county-wide mitigation plans. An interviewee explained how multiple CWPPs can be utilized for developing a plan for the county:

"We've [his fire department] been part of large grants to do county-wide projects. We've taken our CWPPs and actually merged them with all the CWPPs for all the neighboring districts, so that ours actually goes a mile out of our district boundaries using the information gathered from the neighbors." Urban Colorado Chief

The Chief further described how these collective CWPPs are held in a common repository and are available online for incident management teams to use during a fire event. A version of the plan is also available to district residents to see how their houses are graded.

Several interviewees that did not have a CWPP in place commented on how they would like to develop one and hope to do so in the near future. Career, volunteer, and combination departments were all included in this group. A Staff Chief from a department in urban California described the complimentary nature of having both a vegetation management plan and a CWPP. The former, which specifically attends to the types, quantities, and location of vegetation in a given area, provides the tactical means to control and manage vegetation, while the CWPP provides the "framework and the roadmap" for implementing those measures.

3.5. Internal departmental structures

Several fire departments had created separate internal divisions tasked with addressing wildland fire issues. Many of the departments involved in large-scale mitigation projects have dedicated personnel and ample resources to facilitate both planning and carrying out the work. An interviewee described how his career department has worked to create a wildland division since realizing after a major fire incident the need for extensive mitigation work:

"One of the things we're working on is literally creating a wildland division or a wildland program within the city. And we're starting to get there. We've recently purchased some equipment that we use for mitigation efforts. We have recently created a full-time employee position that deals with mitigation efforts. At some point in time, our vision would be that we would have this wildland division and they would do mitigation work in the late fall, winter, and early spring, and then those same employees would switch from mitigation efforts to suppression in the summer." Urban South Dakota Chief

3.6. Constraints/barriers

Interviewees described a number of barriers to their ability to engage in risk reduction activities with their community. These included financial challenges, garnering political support, and fire department culture. The interviewees also pointed out what they thought would be facilitators to being better engaged in these efforts.

3.6.1. Financial constraints

Financial constraints were the most frequently mentioned barrier to carrying out prevention and mitigation activities. For departments facing resource constraints for mitigation work, interviewees could readily pinpoint activities they would pursue should they have the

funds and personnel to do so. Most commonly, additional funds would be used to hire more firefighters who could conduct wildfire risk assessments and participate in fuel reduction on private properties. Some departments also hoped to use additional funding to offer more frequent brush pickup schedules for communities. Others would buy additional equipment for chipping, thinning, and building fuel breaks.

Grant funding was often described as a means of obtaining the necessary resources to engage in community risk reduction projects. Sources of grant funds for local fire departments to conduct mitigation work have primarily been connected with state and federal agencies. Particularly for departments in the rural West that are comprised of mainly volunteer firefighters; state mitigation grants, National Fire Plan funds, and Federal Emergency Management Agency (FEMA) mitigation grants have helped facilitate significant fuel reduction projects and development of CWPPs. However, one interviewee described the challenges of being dependent on such grant dollars:

"Budgetary [issues have been the main barrier]. Which has forced us to apply for more grants. With that said, we're being successful right now in getting grants awarded to us; however, there is always risk of losing those grants. There's always a risk of the federal government cutting back or scaling back on those grant dollars as our national debt increases and those moneys begin to dry up…But so far, knock on wood, we're being successful. Right now we have a pretty good balance of the grant money that's being infused in our community and our ability to implement those dollars in mitigation efforts." Urban South Dakota Chief

3.6.2. Political support

Interviewees from both urban and rural areas noted that a lack of local political support has led some departments to make concerted efforts to educate political leaders about the importance of, and operational details behind, wildfire mitigation projects. For instance, an urban Arizona Chief described how his department has spent time with local elected officials before and after fire events to discuss mitigation work. In this Chief's experience, local political officials have often not been familiar with how mitigation projects can reduce wildfire risk and damages, nor aware of the time, resources, and coordination required for them.

A Chief from an urban department in the West emphasized the need for more support from its local leaders to carry out pre-incident measures (in this case to install cisterns, water-holding receptacles, in their neighboring rural areas). The Chief also noted how such measures can save homeowners money and reduce their risk of losses going forward.

Two career fire departments in the urban West have designated staff members whose responsibilities include working to better educate and communicate with local political officials. Following a major fire event in the early 2000s, an urban California department's Public Information Office has worked to cultivate extensive interpersonal and social media-driven communication networks among the department, elected officials, and community residents, which the representative from the department saw as "a tremendous success story that came out of [the major fire]."

3.6.3. Department culture

Another barrier mentioned by some interviewees was related to the internal structure and culture of their department. Particularly among urban firefighters, wildfire threat and risk reduction efforts may not be considered critically important. Greater attention is often paid toward structural firefighting and suppression tactics, due in part to the lack of threat awareness as well as lack of interest in, and sometimes active resistance to, engaging in wildfire prevention and mitigation activities. Although less than urban departments, rural departments also struggled to get fire personnel to take an active role in wildfire risk reduction because they viewed themselves solely as an emergency response department.

"I don't believe that most paid employees have yet really fully embraced the prevention concept as part of their paradigm. I think if you were to poll them [about their role in prevention], and if they were honest, I think most of them would say, 'Well, you know, that's somebody else's job.'…We've had to give pretty firm direction to the folks in the field that they have to be a part of that [prevention and mitigation activities]. There's some resistance to that of course because that's not the glamorous, fun stuff that they want to do, but it pays off when the events occur. And so from a chief officer's standpoint, it's non-negotiable…" Urban California Staff Chief

As the above quote suggests, disagreement among staff about where responsibility lies for wildfire prevention and risk reduction activities was also seen as a factor. Some interviewees mentioned how staff can be uncertain about whether the primary responsibility for mitigation rests with individual homeowners, with personnel within a specialized wildland division of the department, or with state or federal agencies. An officer from an urban area in the South described the struggles his department has experienced in identifying who "owns wildland fire prevention." While they have a fire prevention division within the department, it has typically been thought of in terms of "structure fire prevention in the traditional sense, independent of wildland fire." The officer described further:

"…one of our internal fire department challenges that you may see elsewhere, is when you do have a wildfire division, is it all things wildfire, or is part of our job to enhance overall wildfire preparedness capacity of the department? And we're trying to find that balance right now."

4. Conclusion

The local fire department personnel in our study clearly believed that they have an important role and responsibility in working to decrease potential fire impacts to their community. Indeed, the data suggest that many fire departments are engaging and working with other agencies and property owners in various capacities in community risk reduction. It should be noted that the sampling procedures and methods used in this study present some limitations to the generalizability of these findings. The sample includes few departments from the Southeast and Midwest, which does not allow for broader generalizations about perspectives in these regions. The departments represented in the study were also all located in fire prone areas and had recently experienced a major wildfire event, which perhaps made them more likely to be engaged in community risk reduction efforts than departments with less perceived threat. Nevertheless, some common characteristics among the departments that have experienced success carrying out mitigation roles may lend insight into ways others can better engage in risk awareness and overcome barriers, particularly financial constraints, to community wildfire risk mitigation.

4.1. Roles of public informants and mitigation partners

There was widespread acceptance of the fire departments' active role in informing the public about daily fire danger and wildfire risk in general. All interviewees placed high value on providing the public with information on fire risk/danger warnings, fire prevention, and mitigation using multiple avenues of communication including social media and department websites. Overall they placed highest value in face-to-face communication, primarily through individual home assessments which were generally voluntary at the request of the property owner but in some cases took the form of regulatory inspections. Interviewees thought both methods were an effective outreach tool for discussing vegetation management and the concept of creating defensible space around people's homes.

Many participants from the departments in this study also placed a

high value on facilitating community involvement and adoption of risk reduction programs. Interviewees spoke about their role as partners to homeowners and land management agencies in fuel management projects on both private and public land. Fire officers representing each type of department—career, volunteer, and combination—discussed their involvement in mitigation activities with their communities, such as brush abatement and fuel removals. A subset of departments (generally urban) had worked to institutionalize their wildland responsibilities internally via setting up a separate fuels management or wildland division. Furthermore, our findings indicate that these fire professionals' perceptions of their departments' role in mitigation planning fall in line with the responsibilities designated to them by the Healthy Forests Restoration Act (HFRA), particularly in terms of collaborative community wildfire protection planning.

4.2. Addressing inadequate funding and buy-in for mitigation work

While some departments have had great success in carrying out mitigation and risk reduction efforts, challenges still remain. Many senior officers expressed a desire for their departments to be more involved in such work, yet funding issues, lack of political support, and department structure and culture presented obstacles. Where funding was a major barrier, departments typically sought state and federal grants for more training and to carry out mitigation work. On the whole, interviewees indicated that it would be a worthwhile endeavor for local departments to pursue funding in order to be able to have dedicated staff as public information officers, wildfire risk assessors, and mitigation crews.

In addition to applying for grants, interviewees suggested that providing elected officials with data on the benefits of pre-fire mitigation could help increase public investment and government support. To aid these efforts, quantifying the impact of brush pickup days, chipping programs, and other mitigation actions were seen as a useful practice. Departments that have limited technical capacity or resources may need information on low-cost methods for collecting data and calculating impact. Further research could examine effective methods for assessing and demonstrating the benefits of mitigation work to different audiences and for local fire departments of various financial means. The ability to convey the importance of pre-fire mitigation work in a clear and compelling manner could help gain municipal support and funding, as well as greater buy-in among fire department staff and homeowners.

4.3. Summary

Overall, the research findings suggest that many fire leadership staff have a keen interest in their local departments playing active outreach and mitigation roles, and are making efforts to overcome barriers to do so. They emphasized the importance of a multi-pronged approach to communicating with the public about how property owners can better protect their homes in the event of a wildland fire in their area. There was also an acknowledgement of the need to better cultivate a department culture that values mitigation work, particularly when the staff is accustomed to structural fire response and has not yet adapted to addressing the dynamic threats of fire in the wildland-urban interface.

Acknowledgments

References

[1] D.E. Calkin, J.D. Cohen, M.A. Finney, M.P. Thompson, How risk management can prevent future wildfire disasters in the wildland-urban interface, Proc. Natl. Acad. Sci. USA 111 (2) (2014) 746–751.

[2] J. Canton-Thompson, B. Thompson, K. Gebert, D. Calkin, G. Donovan, G. Jones, Factors Affecting Fire Suppression Costs as Identified by Incident Management Teams. *Research Note* RMRS-RN-30. Rocky Mountain Research Station: USDA and US Forest Service, 2006.

[3] K. Charmaz, Constructing Grounded Theory, SAGE Publications, London, UK, 2014.

[4] A.P. Fischer, S. Charnley, Risk and cooperation: managing hazardous fuel in mixed ownership landscapes, Environ. Manag. 49 (2012) 1192–1207, http://dx.doi.org/10.1007/s00267-012-9848-z.

[5] R.B. Hammer, S.I. Steward, V.C. Radeloff, Demographic trends, the wildland-urbaninterface, and wildfire management, Soc. Nat. Resour. 22 (2009) 777–782.

[6] H. Haynes, A. Garcia, R. Madsen, Wildland/Urban Interface: fire Department Wildfire Preparedness and Readiness Capabilities, National Fire Protection Association, Quincy, MA, 2015⟨http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/the-fire-service/administration/wildland-urban-interface⟩.

[7] H. Haynes, R.S. Madsen, Wildland-Urban Interface: fire Department Wildfire Preparedness and Readiness Capabilities – Final Report, National Fire Protection Association, Quincy, MA, 2017⟨http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/the-fire-service/administration/wildland-urban-interface⟩.

[8] P.J. Jakes, K.C. Nelson, S.A. Enzler, S. Burns, A.S. Cheng, V. Sturtevant, D.R. Williams, A. Bujak, R.F. Brummel, S. Grayzeck-Souter, E. Staychock, Community wildfire protection planning: is the Healthy Forests Restoration Act's Vagueness genius? Int. J. Wildland Fire 20 (3) (2011) 350–363, http://dx.doi.org/10.1071/WF10038.

[9] P.R. Lachapelle, S.F. McCool, The role of trust in community wildland fire protection planning, Soc. Nat. Resour. 0 (2011) 1–15, http://dx.doi.org/10.1080/08941920.2011.569855.

[10] S. Martinuzzi, S.I. Stewart, D.P. Helmers, M.H. Mockrin, R.B. Hammer, V.C. Radeloff, The 2010 Wildland-Urban Interface of the Coterminous United States, United States Department of Agriculture, Washington, DC, 2015.

[11] Sarah M. McCaffrey, Community wildfire preparedness: a global state-of-the knowledge summary of social science research, Curr. For. Rep. 1 (2) (2015) 81–90, http://dx.doi.org/10.1007/s40725-015-0015-7.

[12] S.M. McCaffrey, C.S. Olsen. "Research Perspectives on the Public and Fire Management: A Synthesis of Current Social Science on Eight Essential Questions." JFSP Synthesis Reports 17. ⟨http://digitalcommons.unl.edu/jfspsynthesis/17⟩.

[13] S. McCaffrey, E. Toman, M. Stidham, B. Shindler, Social science research related to wildfire management: an overview of recent findings and future research needs, Int. J. Wildland Fire 22 (1) (2013) 15–24, http://dx.doi.org/10.1071/WF11115.

[14] National Fire Protection Association (NFPA), NFPA 1142: Standard on Water Supplies for Suburban and Rural Fire Fighting, NFPA, Quincy, MA, 2011.

[15] C.S. Olsen, E.A. Sharp, Building community-agency trust in fire-affected communities in Australia and the United States, Int. J. Wildfire 22 (6) (2013) 822–831, http://dx.doi.org/10.1071/WF12086.

[16] C.S. Olsen, B.A. Shindler, Trust, acceptance, and citizen–agency interactions after large fires: influences on planning processes, Int. J. Wildland Fire 19 (1) (2010) 137–147, http://dx.doi.org/10.1071/WF08168.

[17] U.S. Departments of the Interior and Agriculture (USDI/USDA), Federal Wildland Fire Management: Policy and Program Review: Final Report, USDI/USDA, Washington, DC, 1995.

[18] S.J. Pyne, Fire in America: A Cultural History of Wildland and Rural Fire, University of Washington Press, Seattle, W.A, 1997.

[19] H.J. Shiralipour, M.C. Monroe, K.C. Nelson, M. Payton, Working with Neighborhood Organizations to Promote Wildfire Preparedness, in: Sarah M. McCaffrey's (Ed.), The Public and Wildland Fire Management: Social Science Findings for Managers, USDA, Forest Service, Northern Research Station, Newtown Square, PA, 2006, pp. 151–162.

[20] E. Toman, M. Stidham, S. McCaffrey, B. Shindler, Social Science at the Wildland-Urban Interface: A Compendium of Research Results to Create Fire-Adapted Communities, USDA, Forest Service, Northern Research Station, Newtown Square, PA, 2013 (General Technical Report NRS-111).