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Alternatives to evacuation during wildland fire: Exploring adaptive capacity in one Idaho community

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The use of alternatives to evacuation during wildfire events continues to be an intensely debated strategy in the professional and policy circles of numerous fire-prone countries. The most recent chapter comes in response to the Black Saturday Fires in Australia, which has led to policy changes concerning alternatives to evacuation in both Australia and USA. This study explores the local context that influenced the development of alternatives to evacuation in one Idaho community through in-depth interviews with local residents and officials. It acknowledges alternatives as one 'fire-adaptive behaviour' of the local community, a key characteristic that US fire professionals identify as a means to better manage wildfire. We apply and extend a recently created adaptive capacity framework for wildfire to uncover specific community characteristics that both led to and reinforce the development of alternatives to evacuation that are tailored to the local population. Identification of these characteristics serves as one important step towards better local assessment of adaptive capacity for a broad classification of 'fire-adaptive' behaviours. We conclude that no one combination of local resources can guarantee the development of alternatives to evacuation. Rather, diverse local context will result in different approaches and applicability of the practice.

Keywords: adaptive capacity; alternatives to evacuation; community; wildfire

1. Introduction

There has been much debate in recent years over how to best protect human populations and property at risk from intensifying wildfire events. Historically, US agencies and land management professionals had a relatively simple answer to this question: suppress all fires quickly to keep them from impacting human settlement and evacuate populations when that cannot be accomplished. The latter half of this philosophy clearly reflected and substantiated the preference for evacuation that remains central in the US approach to disasters (Pyne, 2001; Wisner et al., 2004). Yet the law does not require residents to evacuate during *most* hazard events, including wildfire (Wolshon and Marchive, 2007; Mozumder et al., 2008). Thus, private citizens have always faced a personal decision of whether to comply with evacuations or remain to ride out the event. There is a long history of cases during wildfire events where residents have chosen the latter (Cohn et al., 2006; Cova et al., 2009).

More recently, fire professionals and researchers from multiple countries have questioned whether evacuation (or 'relocation', as many now prefer) is always feasible or preferred as a strategy for protecting human life and property during wildfire events. Much of this inquiry has centred on the Wildland–Urban Interface (WUI), where residential structures intermingle with wildland vegetation. Related concepts include the i-Zone, peri-urban landscapes or the rural–urban interface (Cottrell, 2005; USDA and

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USDI, 2009). The outgrowth of this thinking has been the development of various *alternatives to evacuation*. Australian authorities adopted a policy of 'Stay and Defend or Leave Early' (hereafter referred to as 'SDLE') that supported a resident's decision to remain at home during wildfire events, provided that their home was adequately prepared to withstand a wildfire event and that they could actively defend against the fire (Rhodes and Handmer, 2008). Likewise, US authorities have considered a number of formal strategies that would prepare residents to remain at home or in designated shelter areas during certain wildfire scenarios. These include variations on the Australian alternative, more passive options such as shelter-in-place (SIP) in homes or specially designed structures called 'sheltering points' (Paveglio et al., 2008; McCaffrey and Rhodes, 2009).

The biophysical conditions necessary for preparing and implementing alternatives to evacuation during a fire event have been relatively well researched, including appropriate home construction materials and residential vegetation standards (Cohen, 2008; Gill and Stephens, 2009). In this paper, we respond to numerous calls for research on the *social* characteristics necessary to support alternatives to evacuation within any community, thereby advancing the discussion of their importance to fire management (Cova et al., 2009; Stephens et al., 2009). Little empirical research has attempted to uncover the factors that lead to interest in or successful implementation of alternatives to evacuation, including resident responsibility, awareness and preparedness. The few examples that do exist suggest that the social and physical factors supporting alternatives to evacuation differ among communities and need more exploration at the local level. It is at this local level that research on social context, including community capacity, can provide a better picture of what is necessary to advance alternatives to evacuation (Steelman, 2008; Paveglio et al., 2010). The case study of Wilderness Ranch, Idaho, presented here highlights the social elements that are necessary to support alternatives to evacuation as one strategy that can help achieve the US goal of 'fire-adaptive communities' outlined in the *Quadrennial Fire Review* (USDA and USDI, 2009). The elements are organized using a framework of the social factors affecting wildland–urban interface (WUI) community's adaptive capacity (Paveglio et al., 2009).

2. Alternatives to evacuation: an evolving discussion

2.1. Defining alternatives to evacuation

Alternatives to evacuation encompass a broad class of activities that vary in their formality and practice given different local social (local policies, resident awareness or ability to reduce fire risk) and biophysical factors (fuel loadings, aspect and vegetation). A number of specific alternative strategies within this category have been discussed in professional and scholarly literature, including SDLE, SIP in homes and SIP in community sheltering points (Handmer and Tibbits, 2005; Gill and Stephens, 2009).

The primary difference between SDLE and SIP in homes or sheltering points is the level of resident involvement during the hazard event. All require proper vegetation management in the structural-ignition zone and fire-hardened (or 'ignition-resistant') construction, yet SDLE requires that residents combat the fire prior to and following the flame front to ensure human safety and structural protection. SIP is a passive process in which residents take refuge during the entire duration of the fire. For the purposes of this discussion, we will use the terms 'alternatives to evacuation' or 'alternatives' to describe the different practices that allow residents *to choose* to safely remain in the community during a wildfire.

Only a handful of US communities have considered or implemented *site-specific* alternatives as a strategy for dealing with human safety during wildfire. While the alternatives

employed in these communities share common elements, differences exist in the policies and procedures designed to prepare the landscape (buffer zones and vegetation management standards), structures (building codes) and residents (outreach materials, presentations and training) for their implementation (Firewise Communities, 2009; Rancho Santa Fe Fire Protection District, 2009).

2.2. Australian alternatives

Despite long-standing traditions of remaining in homes and other structures during wildfire in portions of Australia, formal consideration of a policy addressing alternatives to evacuation is generally ascribed to the period following the Ash Wednesday Fire of 1983 (Handmer and Tibbits, 2005). Research on the Ash Wednesday Fire and others (Parliament of the Commonwealth of Australia, 2003) eventually led to the development of the SDLE policy, also referred to as the 'stay or go' model in Australia (Rhodes and Handmer, 2008). The SDLE model was adopted by The Australasian Fire Authorities Council and the Bushfire Cooperative Research Centre (Bushfire CRC). Both organizations developed position statements or policy documents in support of SDLE and suggested preparations necessary for resident safety (AFAC, 2005; Bushfire CRC, 2006). Evidence suggests that many Australians in rural areas have followed the practice of protecting both themselves and their property. However, the dynamic nature of wildfire conditions makes standard recommendations by professionals concerning SDLE difficult. Likewise, there is far from a uniform understanding or implementation of the policy by residents (Tibbits and Whittaker, 2007). Others have noted that women and families are more likely to favour evacuation, with able-bodied men the most common family members who might stay to defend property (Proudley, 2008).

The tone of discussions concerning SDLE in Australia changed in the wake of the February 2009 Black Saturday Fires in that country, although support remains for the SDLE policy among fire agencies. Review and revision of the SDLE policy was a major focus of the Royal Commission convened following the widely publicized event. Early conclusions by the commission stated that information central to the SDLE policy was not detailed enough to ensure the safety of residents. They recommended the revision of SDLE outreach materials, a reinforcement that 'the safest option is always to leave early rather than stay and defend', and additional professional authority to advise residents on the 'defendability of their homes' (Teague et al., 2009a).

In the wake of the Black Saturday Fires, homeowners are advised to 'Prepare. Act. Survive', but they retain the option to stay and defend their homes (Harrap, 2010). Meanwhile, research by the Bushfire CRC following the fire event identified many residents who successfully employed SDLE during the event (Victorian Bushfires Research Taskforce, 2009).

Another policy change was the addition of a fire danger rating beyond 'extreme' that reflected the extraordinary weather and fuel conditions that fed the Black Saturday Fires, with residents strongly advised to evacuate on 'catastrophic' days regardless of their plans to stay and defend. The first use of the 'catastrophic' or 'code red' warning occurred in November 2009, although there is some indication that certain residents chose to remain or intend to do so in the future (Strahan Research, 2010).

More recent recommendations by the Royal Commission advocated further research on community refuge areas or private 'fire bunkers' as viable alternatives to evacuation and proposed initiatives to support the construction of such shelters in at-risk communities. These conclusions were a positive note in an otherwise critical discussion of alternatives to evacuation by the commission (Teague et al., 2009a, b).

2.3. US debate over the use of alternatives

The past few years have been marked by increasing consideration and debate over the use of

alternatives to evacuation in the USA (McCaffrey and Rhodes, 2009). Among the significant concerns about adoption of alternatives are social prerequisites (i.e. communal commitment to uniform fuels reduction, standards or policies for building and zoning), psychological preparedness of residents and the need for sustained educational efforts to prepare homeowners (Paveglio et al., 2008; Stephens et al., 2009). Likewise, two significant points of debate among professionals and scholars concern the role of alternatives in a broader strategy for human safety during wildland fire and their applicability to specific at-risk populations (isolated communities, subdivisions, the elderly or the young) (Cova et al., 2009).

McCaffrey and Rhodes (2009) and Paveglio et al. (2008) have both discussed the organizational challenges inherent in changing the evacuation practices of US organizations tasked with wildfire management. More recent work has demonstrated that many professionals are actually supportive of efforts to develop alternatives to evacuation and that those with experience in both wildland and structure fire events see the most utility in the practice (Cova et al., 2009; Paveglio et al., 2010).

Cova et al. (2009) developed decision-action trees for determining the appropriate strategy given wildfire conditions and local contexts (available ingress or egress, proper vegetation management). According to these authors, adoption of alternatives to evacuation is most pressing where infrastructure constraints (poor road conditions, traffic) require an extended period of time to evacuate the local population. Other authors exploring the applicability of alternatives in USA note that improvements in the tools used to predict possible fire impacts or determine the time needed for mass relocations during fire events (i.e. 'trigger points', fire modelling, rate of spread models) could eventually provide professionals and residents with the means to better assess the safest strategy during a given fire situation (Gill and Stephens, 2009; Stephens et al., 2009). However, they caution that such models cannot make absolute predictions of fire severity, nor would they be easily adopted or interpreted by the residents.

Consideration and implementation of alternatives to evacuation appeared to be on the rise in USA preceding the Black Saturday Fires of 2009. However, consideration of alternatives in Southern California was abandoned shortly after the Black Saturday Fires (FIRESCOPE, 2009). Southern California professionals unveiled an alternative policy of 'Ready, Set, Go!' shortly thereafter. 'Ready, Set, Go!' retains a primary focus on ignition-resistant structures and reduction of fuels in the home-ignition zone in an effort to create housing developments that are safe for firefighters and can survive fires without the presence of local residents. In this policy, *early* evacuation is characterized as 'the preferred and safest option for all residents'; sheltering strategies are advised only when residents are trapped by fire (IAFC, 2010). The 'Ready, Set, Go!' policy has received support from the US Western Fire Chiefs Association (Aleshire, 2009) and the International Association of Fire Chiefs, with plans to expand its use across the nation.

2.4. A framework for assessing the ability to develop alternatives to evacuation

Fire policies have generally treated the WUI as a homogeneous collection of people and human systems, with little recognition of the social complexity and variability that affects policy implementation; meanwhile, a growing body of research suggests that some communities have a greater capacity to adapt to environmental disturbance through planning, mitigation actions or recovery initiatives (Norris et al., 2008; Sturtevant and Jakes, 2008). The recent focus on *adaptive capacity* among scholars studying environmental hazards and climate change recognizes the differing ability of communities and the need to better understand local social context in promoting behaviours aimed at reducing risk. Adaptive capacity is the ability or preconditions of a social system that allows it to adjust to environmental changes through the mobilization of resources (Nelson et al., 2007).

A recent study that synthesizes adaptive capacity and social science literature on wildfire management provides a conceptual framework for understanding the social context influencing a community's ability to take civic action to reduce wildfire risk (Paveglio et al., 2009). The authors define the framework using four elements: (1) resident knowledge of the local ecosystem and experience with wildfire (place-based knowledge); (2) access and ability to adapt scientific/technical information to a local context; (3) demographic (i.e. median income, age, ethnicity) or structural (i.e. road infrastructure, building materials, access to resources) characteristics; and (4) interactions and relationships within the community that support collective action.

The argument made by Paveglio et al. (2009) is that the ways in which communities build on and combine these four elements helps explain their different approaches to wildland fire management. Their comparison of two Californian communities' ability to create community wildfire protection plans draws parallels to other fire studies documenting regional and community differences in WUI residents' support of fuels management, implementation of fire protections and willingness to comply with mandatory evacuation (Mozumder et al., 2008; Bowker et al., 2009). Similarly, the emerging research on alternatives to evacuation that we reviewed above indicates that some communities may be more capable of developing or implementing alternatives than others based on both social and physical characteristics (Cova et al., 2009; Paveglio et al., 2010). Our research seeks to expand an understanding of the importance of local context, defined by community adaptive capacity and the conceptual model offered by Paveglio et al. (2009), to the implementation of alternatives to evacuation.

3. Methods

3.1. Site selection and description

Site selection began by contacting national and regional wildfire professionals and web searches to identify any US community considering or implementing alternatives to evacuation. LexisNexis searches for newspaper coverage of the topic also helped identify potential study sites.

For the relatively small list of potential case study communities generated, we contacted local community leaders and fire professionals to determine (1) the community's level of implementation of alternatives to evacuation, (2) the amount of local interest and involvement in the development of alternatives and (3) whether the study area represented a WUI community.

Wilderness Ranch, Idaho, was chosen as the study site because it best met the three criteria described above. With regard to criterion (1), the local fire district had distributed information to residents in support of alternatives to evacuation and was in the process of developing formal recommendations to advance this planning. We discuss the conception of those alternatives in the next section.

Concerning criterion (2), Wilderness Ranch was one of the first communities recognized by the Firewise Communities USA Program. Local volunteers still conduct regular meetings, organize community fuel reduction efforts and assess local conditions as specified by Firewise. Local firefighting capacity in Wilderness Ranch includes the Wilderness Ranch Fire Protection District (WRFPD), which is administered by three elective fire commissioners and supported by local property taxes, and The Wilderness Ranch Fire Fighter's Association, a nonprofit agency staffed by volunteers and funded by annual fundraisers, donations or government grants. The association has a roster of more than 40 volunteer firefighters who regularly train and respond to fire or other emergency events nearby. Development and interest in alternatives to evacuation had occurred locally among these community members involved in organizations such as the WRFPD, members of the Wilderness Ranch Owners Association (WROA) and other residents.

It was also clear during our search that Wilderness Ranch fulfilled the third criterion of a WUI community. Wilderness Ranch is a collection of 270 homes (995 residents) founded more than 20 years ago and scattered along 25 miles of dirt and gravel roads about 24 miles northeast

of Boise, Idaho. Although close to the state capital and major urban centre, Wilderness Ranch does not share the resources and government infrastructure found in Boise. There are only two points of ingress and egress for Wilderness Ranch, and both connect to the two-lane Highway 21, a designated scenic drive and the only major road that links Boise and Idaho City. The local topography is rugged and mountainous, with vegetation on the bordering public land (Idaho Department of Lands (IDL), USDA Forest Service (USFS) and Bureau of Land Management (BLM)) shifting from shrub-steppe and grasslands to thick ponderosa pine and mixed conifer forests as elevation increases.

3.1.1. Alternatives to evacuation in Wilderness Ranch

Although the concept of alternatives to evacuation has been evolving in Wilderness Ranch, one element has remained constant: the decision to evacuate or stay and defend during a wildland fire is made by the local residents – it is their choice. Outreach material provided by the WRFPD and WROA contains elements of the three approaches described earlier, with the terms SDLE and SIP used interchangeably in some material. If residents decide not to evacuate during a wildfire, outreach material emphasizes the possible need to actively suppress spot fires prior to and following the flame front (WRFPD, 2008). While older outreach materials focused on alternatives as a way to ensure both home and personal safety, more recent information has concentrated on life safety:

> Some residents in our communities have the option of remaining in their homes during a fire … The main purpose of stay and defend is to preserve life safety, not to save houses and the possessions they hold… (WRFPD, 2008, p. 1).

The WRFPD and WROA provide 'Stay and Defend', 'Home Defense' and 'Firewise' checklists outlining biophysical characteristics that make a property defensible and actions that residents must take to be safe if they decide not to evacuate. The WRFPD informs residents living in areas where staying in their homes is not advised due to biophysical conditions (i.e. high fuels, increased slope, canyons) or the absence of ignition-resistant construction (i.e. shake roofs, wood siding) that they will soon have another choice: 'refuge houses' or sheltering points. Owners of safe, defensible properties will identify their home as a refuge house and allow other residents to shelter there rather than evacuate during a wildland fire.

3.2. Data collection

Understanding how social elements influence the development of alternatives to evacuation necessitates a qualitative inductive approach. This is because such research is in its exploratory stages: few empirical themes or patterns provide the basis for testable hypotheses (Strauss and Corbin, 1990; Glaser and Strauss, 1999).

A combination of theoretical and representative sampling was used to select study participants. Theoretical sampling is an approach in which subjects are selected not randomly, but rather on the basis of their knowledge or experience in a particular domain (Lindlof and Taylor, 2002). This method was important in our selection of local leaders (i.e. Wilderness Ranch Fire District Chief, local Firewise representatives) and area professionals (i.e. IDL, BLM and USFS fire managers) who might have specialized knowledge about wildfire planning or the applicability of alternatives to evacuation in Wilderness Ranch. Representative sampling was used in the selection of local residents who embodied the range of perspectives surrounding fire protections and alternatives to evacuation. In this case, care was taken to interview residents who live in different geographic locations in the community and representativeness was monitored by recording the location of interviewed residents' homes on a map of the development. Consistent with an inductive approach, data collection in both sampling strategies continued until the authors in consultation with key informants agreed that emergent patterns had stabilized and no novel information would be forthcoming from later observations (Glaser and Strauss, 1999).

During the summer of 2008, the first author conducted 50 semi-structured, face-to-face interviews with individuals who live in Wilderness Ranch, are members of the WRFPD or WROA, or regional agency professionals familiar with protections in the area. Interviews took place in residents' homes, at community gatherings or in professional offices throughout the area. All interviews were recorded and later transcribed.

3.3. Analysis

Data analysis consisted of analytic induction and thematic analysis. Analytic induction is primarily concerned with providing data-driven explanations of phenomena (Silverman, 2001). Patterns identified from initial interview notes are later refined through continual testing against any new observations, a process referred to as 'progressive falsification' (Strauss and Corbin, 1990).

Thematic analysis serves as a complementary coding strategy to analytic induction because it provides a systematic way of supporting or rejecting themes based on their reoccurrence in the data (Boyatzis, 1998; Silverman, 2001). Using the Atlas Ti v. 5 software for qualitative data, the first author (1) coded statements using categories reflective of observed patterns in the data, a process dubbed the 'discovery' stage, (2) identified any observed anomalies or apparent contradictions in these emergent patterns, (3) presented these initial themes and examples to co-authors in order to standardize or reject observations (inter-coder reliability) emerging from the data, and (4) selected the most representative quotations of remaining themes through multiple stages of increasingly restrictive coding.

4. Results

Our results revealed a number of community characteristics that appear to have prompted or supported the development of alternatives to evacuation by local residents and local fire professionals. We have organized the presentation of these various characteristics within the conceptual elements outlined in Paveglio et al.'s (2009) framework of adaptive capacity to wildfire risk in an effort to illustrate how our findings both substantiate and extend their work. While the adaptive capacity framework recognizes that many of these social characteristics interact and could apply to multiple elements, we have made the effort to situate characteristics under the most applicable of their four elements.

4.1. Place-based knowledge/experience

4.1.1. Resident awareness, ability and preparedness

People who were interviewed exhibited a relatively high level of local awareness of wildfire risk. Residents understand that fire is a regular occurrence in their local ecosystem and that they are responsible for reducing wildfire risk. Awareness of wildfire risk and the choice to live a more rural way of life were linked to residents' development of the physical skills necessary to manage their properties, including brush clearing and tree felling. Fuel management in the home-ignition zone was most pronounced among long-term residents of the area and those who had experienced previous wildfires in the area. As one resident said: '…Like hurricanes in Florida, its fires up here, and I try to keep the brush cut back, I've been cutting brush back for 20 years up here…'

The residents we spoke with in Wilderness Ranch were aware of local efforts to promote alternatives to evacuation and had personal plans in place for a fire situation. Residents informed us that they had decided to remain in their houses or their neighbours' homes during a wildfire, and could describe the actions they have taken (i.e. fuel modifications, ignition-resistant construction and experience with fire support) or would take (i.e. putting out spot fires and evacuating to safer homes/areas in the ranch). As one resident said:

> Absolutely, it would be my preference (to stay)…a worst case scenario, about the worst I can think of would be if somehow a limb went

> through the window…I think that's extraordinarily unlikely, I mean this is heavy double-paned or up here triple-paned glass…so my view is we would be perfectly fine anywhere in the house and certainly in that root cellar, you know, where it's 55 degrees and it's surrounded by dirt and then we'd come out and you know, if we needed to fight a little fire, we would.

Other residents were aware of the option to remain, but reported that they would choose to evacuate early if the option was available to them. These potential evacuees reported that local conditions (i.e. vegetation management or shelter location) or personal abilities (i.e. willingness to accept risk or put out fires) were not sufficient to stay.

4.1.2. Local independence and culture

The local culture in the study area is perhaps best characterized as emphasizing 'self-reliance' or 'anti-authoritianism'. This culture promotes the development of solutions residents can carry out and manage themselves. According to one resident who is also a commissioner for the WRFPD: 'Again it's a choice: I'm gonna (i.e. "going to") stay and defend. I don't need the government telling me whether I can or can't do that. And I think we probably see a lot of that, you know, within the area.'

This anti-authority culture meant rejecting predefined approaches to housing development, fire standards and evacuation mandates in other parts of the country. As one resident pointed out:

> If you're from California, you know what it's like living in subdivisions where if a corner of your screen is popped off your window, you're getting fined…..Here, man you know people come here for a reason and leave me the hell alone… if I'm gonna change my roof and there's a new roof that would be less likely to cause a fire to the house if embers fell on it, I'd probably do it, but I'm not gonna put a tile roof on my house just because that's what they've deemed.

4.2. Access to scientific/technical knowledge networks

4.2.1. Firewise Communities USA

The long-time association of Wilderness Ranch with the Firewise Communities USA Program was described by interviewees as a critical contributor to resident ability to reduce wildfire risk, thus laying the groundwork for alternatives to evacuation. As one resident articulated:

> If we can continue to do the Firewise, I think more people will have the confidence to stay…if you are gonna try to hold out, you've got to do the job, you've got to do the Firewise to bring the intensity down.

Key individuals in the community regularly access Firewise information relating to fuel reduction and ignition-resistant construction materials, and use this information to educate their neighbours about reducing wildfire risk. As one resident said: 'We have as much risk as anywhere in the state, it's just, most people here are a lot more aware… (name) does a fantastic job going around and promoting information about being Firewise.'

Members of the community conduct regular Firewise meetings at a communal building in Wilderness Ranch to discuss personal fire protections and plan collective fuel-reduction programmes (see below). Homes that have achieved Firewise standards or with exceptional fire protections are often featured in the *Wilderness Watch*, an online and paper newsletter developed by the residents. Periodic articles in the *Watch* have also focused on the personal choice to employ alternatives and how Firewise preparations can help residents prepare for this possibility.

4.2.2. Professional input on fire protections

Regional fire professionals and emergency managers were uniformly supportive of efforts to develop alternatives to evacuation. As one BLM fire specialist explained: 'There certainly is information out there and if there is a point person (i.e. a leader or organizer) who's willing to take the time to learn about it (alternatives), I think

it is a viable option.' As discussed below, interactions with fire professionals from the USFS, BLM and IDL were often the basis for increased awareness of limited ingress/egress options or the need for additional training for volunteer firefighters.

The professionals we interviewed acknowledged that Wilderness Ranch residents have been proactive in reducing their fire risk and considered many sections of the community 'defendable' enough to allow consideration of alternatives. As USFS fire specialist and incident commander explained:

> Quite a few of those homes are, not in timber, not in dense timber, you know. They got fairly open space, light fuels, roadways, you know, if they've been landscaping their property with you know, at least 30 to 50 feet of green grass all around it and sprinkler systems and whatnot, they could actually stay.

When queried about what is needed to more effectively implement alternatives to evacuation in Wilderness Ranch, state, county and federal emergency managers/fire professionals identified additional information sharing between their agencies and the WRFD and WROA leaders. This included a more accurate count of how many people intended to remain during a fire situation and where they live, a continued focus on fuel reduction and further consultation with wildfire managers or researchers concerning expected fire intensities.

4.3. Demographic and structural factors

4.3.1. Limited evacuation capacity

Local leaders of WRFPD and WROA recognize that the road infrastructure in Wilderness Ranch contributes to the community's wildfire risk and decreases the likelihood that an evacuation could be safe for residents. Residents reported that this view had been supported by a review of wildfire risk by experts (including USFS fuels managers and scientists) and local resident experience. A number of local firefighters and community leaders described the diminished capacity to evacuate as one of the primary reasons for exploring alternatives to evacuation:

> We gotta try to get 270 homeowners out this one road when I'm trying to get engines up to the fire, think about the liability we've got by not having a plan at all and just hoping everybody gets the hell out of here... so we need to look at alternatives and I recognize that there's some risk involved to it, but I just see it as the only solution to our unique problem here at Wilderness Ranch.

Local residents understand this diminished evacuation capacity and they cite it as a primary reason for their interest, consideration or support of local efforts to develop alternatives. Many residents described the dangers they would likely face attempting to evacuate, even early, given the poor road infrastructure and likely traffic on Highway 21:

> I know enough of the people here that I'm not sure if we tried to evacuate we could, the roads are essentially one lane and when people get crazy, I wouldn't want to be fighting the roads. I'd rather take my chances and be here (home).

4.3.2. Identification of sheltering points

Efforts to create sheltering points emerged early in the consideration of alternatives to evacuation at Wilderness Ranch. As a local volunteer firefighter explained:

> There are certain houses that are gonna be much more defendable than others and so yeah, I went through the Ranch and found several that, you know, one in each area that would work (as a sheltering point).

This option became a stronger focus in the community after local leaders and residents studied the variability in vegetation and topography throughout the ranch (grasses and ponderosa pine savannah vs. thick forest, relatively flat terraces vs. scattered canyon areas) and consulted with other fire professionals in the area

(i.e. USFS, IDL, BLM). Residents we interviewed could locate the nearest 'safehouse' and described the understandings between neighbours about collectively using the structure as a shelter during fire events. The WRFD is bringing new attention to 'safehouses' by highlighting the option in recent publications, re-designating 'safehouses' at strategic locations throughout the ranch and planning meetings with groupings of residents that might need the option.

4.3.3. Diverse resident backgrounds

There is a great deal of occupational, economic and social diversity among the residents of Wilderness Ranch. This is primarily because of its proximity to Boise, small towns and large tracts of public lands. Professions range from highly skilled and educated business and government professionals to construction workers and mechanics. A number of retirees moved to the area to be near the mountains while a number of residents work from home or provide services (internet, trash disposal) to residents in surrounding areas. This diversity was a very important factor in the relationships between residents with regard to fire protections.

4.4. Interactions/relationships among residents

4.4.1. Community interaction to address common concerns

The diverse skills and abilities of residents in Wilderness Ranch mean that there are local residents who can fill different roles in the planning and implementation of alternatives to evacuation. As one resident pointed out with regard to the planning or implementation of fire protections: 'I think it's a nice mix up here, you've got people willing to do some hard work and you've got people who are willing to sit down on the computer and we've got enough diversification where there is a lot of talented people.'

The professional skills residents bring to their community support the writing of grants for projects to reduce fire risk and the development of outreach materials to educate their neighbours. Longer-term residents have the experience and ability to carry out fuels reduction on personal or community property – they are knowledgeable about wildfire risk and are comfortable using the tools or operating the machinery necessary to tackle risk-reduction projects. Other residents have ties to law enforcement or fire management, giving them access to networks and other sources of information, 'The guy that lives right over here is a retired sheriff. . .and I talked to him about it and he said you'd be better off to stay in your home rather than try and get down.'

Residents of Wilderness Ranch have learned how to work together to overcome challenges inherent in living in a mountainous area, including isolation as a result of heavy snow or poor road conditions. This ability to work together is also a critical factor in the success of many local organizations, including the WRFPD, the local Firewise group and the WROA. For instance, Wilderness Ranch organizes a yearly cleanup/fuel reduction day each spring, including drop-off zones for vegetation cleared from properties. The community has received grants through state and federal programmes to reduce fuel loadings on private and common property. The WROA also sells fire-retardant gel to residents for added protection during a wildfire.

This ability to work together is often demonstrated by small groups of residents, as the ranch is 'segmented' into smaller 'neighbourhoods' by topography. These smaller 'micro-communities' are useful for organizing the larger community around sheltering points. Likewise, volunteer firefighters within the micro-community serve as a trusted source of information for the neighbourhood. As one resident explained:

> Yes, I know every neighbor here compared to when I lived in the South, or in Simi Valley, I couldn't tell you the person that lived right next to me. . . if anybody gets in trouble or anything like that, it's not like being in the city where you get a 5 minute or less response time, so everybody kind of relies on everybody up here.

We found that the level of involvement by residents across the ranch was not uniform, and

that some members of the community were critical of others' (often newer residents') abilities to deal with wildfire risk. As one resident who has plans to go to a sheltering point during a wildfire articulated:

> This winter was alarming to me on the amount of people, the percentage of people that live up here that cannot take care of themselves so I think it's frightening what you're looking at in terms of a plan or the prospect of people stay(ing).

4.4.2. Local firefighting capacity supported by community volunteerism

Respect for local firefighters and the regular interaction among firefighters and members of the community were significant factors in the dispersal of ideas concerning alternatives to evacuation and resident trust in the opinions of firefighters who supported the concept. As one resident said: 'Just a bunch of guys that were either in their retirement age or good volunteer firemen or whatever, but they got great training...and they come to parties and we talk about the stuff (fire protections).'

Wilderness Ranch has taken a number of steps to improve its firefighting capacity, including expansion of the Wilderness Ranch Firefighters Association, establishment of the WFRD and continual training for volunteer firefighters who live throughout the development. Local leaders also explained that support for this training often came through partnerships with nearby USFS or IDL offices and state or federal grants. But a number of volunteer firefighters and local leaders described how improvements in firefighting capacity have brought a broader realization of the risks the community faces and the limits in firefighter ability to protect property and lives, both of which lead to the consideration of alternatives to evacuation.

4.4.3. Mobilization by 'local champions'

In addition to local volunteer firefighters, a group of highly involved and motivated local leaders emerged to champion the idea of alternatives in Wilderness Ranch. These individuals included an organizer of Firewise programmes and a handyman/community organizer who helped spearhead fuel reduction projects across the community. The respect and influence these individuals had on the community were critical in the promotion and planning for resident use of alternatives. As one of these local champions described: 'As long as we have the "dirty dozen" that will kind of organize and kind of put the word out...probably 5% of the community can get the rest of the community to help out, but it takes that 5% to rally the troops.'

5. Discussion

> 'It's not all about technology...sometimes it's common sense. I'm sure barricade (fire-retardant gel) works real well, but you know what else works well? A 5-gallon bucket of water....'

5.1. Applying the adaptive capacity framework in alternatives to evacuation

Our research on the social characteristics that supported the development of alternatives to evacuation among local residents in Wilderness Ranch, Idaho, is only one case study. However, the in-depth nature of that study helps develop an understanding of the ways in which communities are progressing towards being 'fire adapted' and the identification of locally based community characteristics that make such adaptation possible. We situated our findings within an adaptive capacity framework designed to identify the broad social elements that dictate variable community ability to adapt or act in the face of wildfire risk (Paveglio et al., 2009). We found that the four categories identified in the conceptual framework help highlight some of the elements critical to the promotion of alternatives to evacuation and the development of Wilderness Ranch as a fire-adapted human community (Figure 1). Perhaps more importantly,

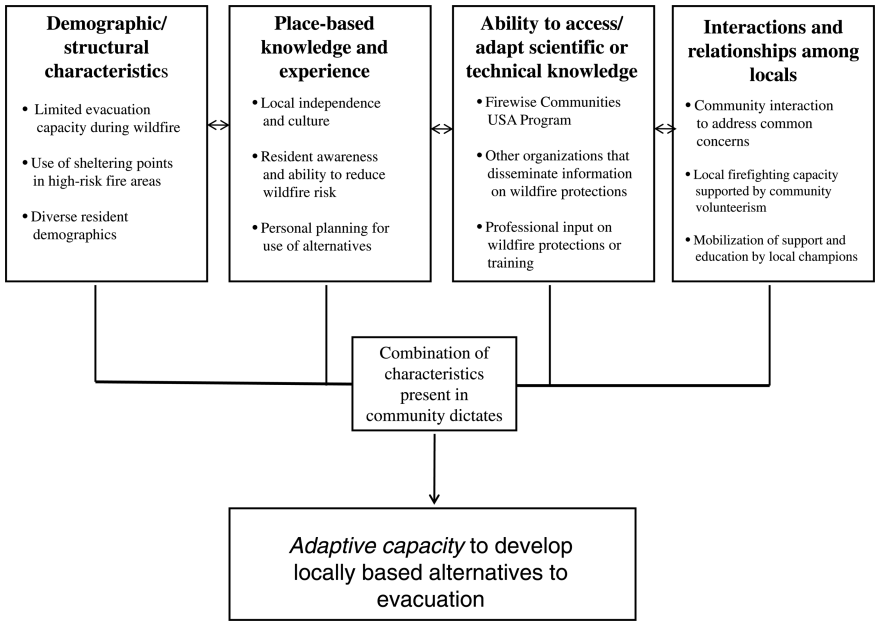

FIGURE 1 Adaptive capacity and community characteristics influencing the development of alternatives to evacuation during wildfire

it can be seen how the factors within each conceptual element interact with others, creating a local context that supports civic action.

Revisiting the four factors of the adaptive capacity framework, we can discuss how the presence of specific community characteristics led to interest and support for alternatives to evacuation among residents in Wilderness Ranch. To begin with, local leaders indicated that the demographic and structural characteristics of Wilderness Ranch that helped create support for alternatives to evacuation included the ranch's limited evacuation capacity and other structural characteristics (fuel loadings, housing construction and location). Other research has highlighted the importance of structural characteristics in wildfire risk (Cova et al., 2009). Our study demonstrates how recognition of these physical factors in Wilderness Ranch spurred the consideration of alternatives to evacuation. Meanwhile, the diverse social, economic and professional backgrounds of residents in Wilderness Ranch meant that within the community there was a wide range of abilities that could be mobilized to reduce fire risk by developing and disseminating outreach materials, securing grants and taking appropriate action. The importance of these characteristics of human capital to reducing fire risk has been observed in other studies (Jakes et al., 2007; Steelman, 2008). However, diversity is not always a plus for collective action, and may make it difficult for residents to frame issues, prioritize projects or generally agree on a course of action.

With regard to place-based knowledge and experience, our results suggest that many residents of Wilderness Ranch choose to live outside an urban setting to be free of regulations and other limits on what they can and cannot do, including the freedom to remain in their homes or nearby shelters during fire events. They take pride in the skills and abilities they have developed that allow them to deal with their own risk. Experience with and knowledge of the role of fire in the local ecosystem and potential fire behaviour are linked to residents' search for information necessary to adapt to local conditions. Behaviours taken in Wilderness Ranch that contributed to a fire-adapted human community include implementing fuels reduction

projects, encouraging ignition-resistant construction, planning for alternatives to evacuation or joining the volunteer firefighting effort. Similar results have been reported by others studying fire preparedness (see McCaffrey (2006) for a summary). All these factors are crucial antecedents in the ability to carry out alternatives to evacuation, should they become necessary.

Local leaders and residents of Wilderness Ranch have sought out and applied relevant scientific or technical knowledge in the pursuit of alternatives to evacuation. The people we interviewed consistently mentioned the importance of expert consultation and professional input. For instance, fire officials from the USFS, IDL and other agencies were instrumental in recognizing the limited evacuation capacity of Wilderness Ranch and providing training to local volunteer firefighters. On the other hand, implementation of alternatives to evacuation may be hindered because community leaders in Wilderness Ranch have yet to collaborate with local fire federal and state fire managers (IDL, USFS, BLM personnel) or provide them with information about the alternatives the community intends to implement (i.e. maps indicating who intends to stay; sheltering points). This collaboration could strengthen planning and implementation of alternatives, thereby reducing risk for residents and firefighters.

A number of residents we interviewed noted how the long-time success of the Firewise Communities USA Program and associated community organized efforts have increased the capability of some residents to implement and maintain vegetation management and structural improvements necessary for alternatives to evacuation. In addition to Firewise, other organizations such as Firesafe Councils, volunteer firefighting organizations and county emergency management initiatives also have information useful for reducing fire risk or links to networks with information resources.

One of the least tangible or measurable characteristics linked to successful community adaptation to wildfire are the interactions and relationships among local residents and institutions or groups within the community. However, the ability of residents to pursue solutions to common problems and help each other deal with risk is a highly influential force grounded in a large body of literature (Jakes et al., 2007; Nelson et al., 2007). In Wilderness Ranch, familiarity with immediate neighbours and regular interactions were borne of shared challenges related to the community's isolation. Many of these interactions are informal, but that makes them no less important in collective preparation. These interactions helped disseminate information on the benefits of sheltering points, in which some residents would use others' homes as refuge during a wildfire situation.

Community organizations such as the WROA, WRFPD, volunteer fire department and Firewise chapter also demonstrate more formal networks that organize individuals to work together, and highlight the importance of community volunteerism. The fact that residents are willing to donate their time, energy and resources to improving local capacities for wildfire preparedness and response demonstrates a commitment to collective action.

Finally, the important role of local champions in establishing local norms, modelling behaviour and educating neighbours about wildland fire management in Wilderness Ranch mirrors other results (Firewise, 2009; Paveglio et al., 2010), indicating that community interest and support of alternatives is often borne first by a select few in a given area. These individuals have helped to overcome the historical conception of evacuation as the safest option during fire by researching and adapting ideas to the local context. Their ability to command local respect and mobilize action has been a factor in the adoption of ideas such as alternatives.

5.1.1. Social diversity and alternatives to evacuation

The characteristics described above will not be present in every WUI community at risk from wildfire, nor will the relative strength of these characteristics be uniform, even in communities

with relatively similar demographic attributes. However, some of the above community characteristics, and others yet to be identified, could eventually serve as indicators for the extent to which communities have become or are capable of being fire adapted. Such advancement would require consideration of how to measure specific characteristics and the type of data local, state or federal agencies could collect to assess the variance of this ability across diverse WUI communities.

The point here is that no one set of local resources is likely to guarantee the development of alternatives to evacuation or other behaviours necessary to fire-adapted human communities, irrespective of whether they are demographic/structural (i.e. ingress/egress, local wealth), place based (i.e. local ecological knowledge, including fire ecology), knowledge based (i.e. local firefighting training, professional consultation) or predicated upon the interactions and relationships within the community (ability to achieve common goals, communal/familial ties) (Figure 1). Rather, different combinations of the above-described elements (and others yet to be defined) in a local context seem highly likely to influence which fire-adaptive behaviour, including alternatives to evacuation, is best suited for the population and social context in which they find themselves. Where a community might lack structural or material resources, they may supplement it with local ability, knowledge and collective planning. This was the case with Wilderness Ranch.

The research presented here suggests that the alternatives to be used in any community may be different from its neighbour depending on social and physical characteristics. To that end, our extension of the adaptive capacity framework developed by Paveglio et al. (2009) is a starting point in the exploration and recognition of the conditions that will drive whether and what type of alternatives are necessary in a given community. Such characteristics are part of a larger understanding that WUI communities are a diverse collection of social, cultural and political entities that vary in their capacity to reduce their wildfire risk and increase their resilience to various disturbances (fire, climate change and drought).

Just as the WUI can no longer be considered one 'type' of community, fire professionals cannot expect that one approach to citizen safety during a wildfire will work in each situation. Rather, through the interaction of residents and emergency managers, communities can determine what their existing ability to deal with fire risk is, how they build capacity, and whether they are best suited to remain or evacuate in various fire situations. This means providing information on the variety of options available to residents, developing tools and training that help them take on this additional responsibility, and (in some ways) stepping back from the role as 'expert' protectors in lieu of a community resource.

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