

Adoption and perceptions of shelter-in-place in California's Rancho Santa Fe Fire Protection District

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Abstract. The increasing impact of wildland fire on human settlements in the USA, and a growing recognition that evacuation might not always be the safest option for those in the path of the flames, continue to spur consideration of alternatives to evacuation among the American public and its fire professionals. Alternatives to evacuation typically include the option for residents to remain in fire-hardened structures while the flames pass; however, it appears there is no clear consensus on whether existing Australian alternatives or new variations should be used in American communities, and if any option will reduce risks to residents and firefighters. This study uses structuration theory to analyse adoption of the shelter-in-place policy created by the Rancho Santa Fe Fire Protection District in southern California. We interviewed professionals working in and around the District and the public affected by the policy. Results suggest that professional support and implementation of shelter-in-place are influenced by the breadth of their personal firefighting experience, their agencies' flexibility and constraints on innovation, and perceived potential liability for damage from adoption of alternatives. Resident knowledge and understanding of shelter-in-place are also lacking. We conclude with recommendations for continued development of alternatives to evacuation.

Additional keywords: alternatives to evacuation, community development, public safety, Stay and Defend or Leave early.

'We don't have enough resources to put an engine at every house in harm's way. We figure, if people are going to stay, maybe they can become part of the solution.' – Ventura County, California Fire Chief Bob Roper (Saillant 2009)

'Hearing anyone suggest that homeowners should not get out of harm's way is appalling. Hearing a public safety professional make the suggestion is shameless. Stay-and-defend is clearly a half-baked idea from people who believe that saving money is more important than saving lives.' – Harold Schaitberger, general president of the International Association of Fire Fighters (IAFF) (Schaitberger 2009)

The most fundamental decision any local resident faces in the event of a wildfire threatening his or her neighbourhood is whether to flee (evacuate) or stay and ride out the event. Each choice has its risks and potential benefits. For at least 50 years, the general policy of US civil authorities and public safety officials to evacuate local residents has been based on the presumption that evacuation is the safest choice in any circumstance when a wildfire threatens (Pyne 2001). Recently however, questions have been raised about whether evacuation is always the safest alternative both in terms of protecting human

life and secondarily, protecting property (Firewise Communities Program 2006; IAWF 2007). Evacuation itself can be dangerous, as evidenced by a recent analysis of the 2003 Cedar Fire in southern California, which concluded that almost all 22 civilian deaths occurred *during* evacuation (Mutch 2007).

Protective strategies and fire management tactics in the United States allow for consideration, under some circumstances, of 'alternatives to evacuation' (Paveglio *et al.* 2008; McCaffrey and Rhodes 2009), but as the quotes at the beginning of this article demonstrate, there is little agreement on a universal policy. Alternatives to evacuation generally include an option for remaining in ignition-resistant structures while the flames pass, provided that building construction and vegetation management (natural and ornamental) reduce the likelihood of that structure catching fire (Paveglio *et al.* 2008; Rancho Santa Fe Fire Protection District 2009). Understanding that wildland fire will continue to threaten property and that a growing number of residents will continue to live in the wildland–urban interface (WUI), the area where human settlement is juxtaposed with wildland vegetation, many fire professionals and residents are beginning to consider alternatives to evacuation during fire events. Yet there is clearly resistance to implementation of these new ideas in the professional and public spheres. Our goal in

this paper is to present the first empirical, case study-based research in the USA focussed specifically on the debate over the use of alternatives to evacuation. In this context, we will explore factors influencing professionals' and citizens' support for the development and implementation of these strategies. We will also investigate the role for alternatives to evacuation in protecting the public during wildfire.

Although wildfire events are growing in relative magnitude across areas of the USA, they are not a particularly new threat. What has and will continue to change, however, are the ways Americans deal with wildfire threats in an age when fire is recognised as an important and natural part of many wildland ecosystems. US policy has historically mandated the exclusion of fire at all costs to protect American safety and property, along the way creating the largest firefighting system in the world (Pyne 2001). It is now generally accepted that the exclusion of fire from US wildlands, particularly in the dry-land ecological types that encompass much of the Inland West, has resulted in fuel build-up and much more severe and destructive fire events (USDA and USDI 2009). This exclusion, coupled with the potential impacts of global climate change, has led people in many localities to conclude that land management needs to consider fire as a stochastically predictable cyclical occurrence rather than a rare event (Arno and Allison-Bunnell 2002). Likewise, there is increased recognition of the responsibility of WUI residents to learn to live with fire. This means that they, along with fire and land managers, must assume responsibility facilitating fire management in and around residential areas rather than assuming it can always be prevented (Jakes *et al.* 2007a, 2007b).

These realisations are positive steps, yet they alone cannot reduce the risk posed by destructive WUI fires that show no sign of abating. More than 85 820 fires burned nearly 9.3 million acres (3.76 million ha) and destroyed 5326 structures in 2007, part of an upward trend since 2000 in damage caused by wildfire events (National Interagency Fire Center 2009). Paired with this is the growing evidence that many Americans, especially the growing population living in or moving into the WUI, might not be able to evacuate from fire in time to avoid harm, potentially exposing them to more extreme risk as they flee the flame front (Cova 2005). Evacuations also can be extremely disruptive socially, often creating considerable uncertainty among residents who are forced to evacuate quickly and remain at shelters or with family for undetermined amounts of time (Carroll *et al.* 2006; Cohn *et al.* 2006).

Experience and research in Australia and the USA has demonstrated that home ignition often occurs as a result of falling embers preceding or following the main flame front (Cohen 2000). Such embers can be dealt with well before structural ignition if someone is present to take action and when the structure is prepared to withstand this type of ignition. The Firewise Communities Initiative and National Wildfire Coordinating Group now refer to 'reducing wildfire hazards in the home ignition zone' rather than creating 'defensible space', an evolution in thinking about why residents need to take responsibility for reducing risk on their properties. The development of alternatives to evacuation is one element in responding to the above understandings. Alternatives to evacuation make up a broad category of current and potential practices that have yet to

be standardised in the USA (Paveglio *et al.* 2008; McCaffrey and Rhodes 2009). Two alternatives that have received perhaps the most attention among wildfire and public safety professionals are the 'Stay and Defend or Leave early' (SDLE) approach and 'Shelter-in-Place' (SIP) (both defined below). Both strategies attempt to improve the safety and well being of residents during a fire by allowing them to remain in their homes or protect their belongings.

The case study reported here is based on the analysis of nearly 80 interviews with a variety of fire professionals and managers in the San Diego area and residents of five communities in the nearby Rancho Santa Fe Fire Protection District (RSF District). The goal was to gauge their understandings and perceptions of alternatives to evacuation. The RSF District's educational material and reports in local media represent these communities as some of the first and most advanced US efforts to develop alternatives to evacuation for resident safety and to further reduce devastating property damages. Current conditions in the five housing developments designated SIP by the RSF District represent years of work by area professionals to develop strict building, zoning and vegetation management standards surpassing even the advanced safety codes now mandated throughout the fire-prone San Diego area. Planning for these communities includes the option to shelter-in-place, a somewhat passive alternative in which residents could remain in their ignition-resistant homes and developments while the fire passes.

Literature

Alternatives to evacuation

Alternatives to evacuation during wildland fire take different forms depending on the local context, and in particular, the policies and perceptions of managers in that location. American notions of alternatives, though in their formative stages, retain influences from sheltering procedures during other short-term disasters such as tornadoes and chemical spills (Mannan and Kilpatrick 2000; National Institute for Chemical Studies 2009) while borrowing heavily from the much more well-developed Australian SDLE model. The latter version evolved specifically in response to Australian bushfire situations (Handmer and Tibbits 2005; Tasmania Fire Service 2009).

As evidenced by the relative paucity of US communities with policies that include alternatives to evacuation, it appears that it is still considered 'fringe thinking' by the majority of residents and managers in this country (Paveglio *et al.* 2008; McCaffrey and Rhodes 2009). Yet certain communities in the fire-prone American West in particular have begun to consider and implement their own versions of alternatives. Some, like the Painted Rocks Fire Department in Montana are attempting to adopt the Australian SDLE approach (McCaffrey and Rhodes 2009). Other fire districts such as Rancho Santa Fe, California (Rancho Santa Fe Fire Protection District 2009), are at various stages of considering or implementing an SIP approach by mandating ignition-resistant building materials, creating buffer zones around communities with little to no fuels and regulating what residents plant near their homes to reduce the probability of structural ignition. In other communities, such as Bend, Oregon, attempts to introduce alternatives have resulted in retention of

evacuation as a primary option and recognition of SIP a last resort if residents are trapped in their homes (Project Wildfire 2009).

The primary difference between the SIP and SDLE approaches is the level of resident involvement before and during the hazard event: the former is a passive process during which residents take refuge in homes during the entire duration of the fire, whereas the latter is a multistage process in which neighbourhood standards of the SIP process *and* resident efforts to combat fire are both needed to ensure human safety and structural protection (Paveglio *et al.* 2008).

There is a robust literature documenting the progression of Australian thinking regarding residents' roles during a bushfire (Handmer and Tibbits 2005; Tasmania Fire Service 2009). For instance, mention of situations where staying in homes while a fire passes could have saved lives appears in literature as early as 1939. The concept gained serious consideration following the deaths of 83 people in the 1983 Ash Wednesday Fire. Research on this bushfire (Wilson and Ferguson 1984) and further inquiries following other significant fire situations (Parliament of the Commonwealth of Australia 2003) codified what is now the SDLE policy, also referred to as the 'Stay or Go' model in Australia (Rhodes and Handmer 2008). The Australian model strongly encourages residents to be prepared for the fire and *actively* defend their property, a practice exemplified by the adage 'houses protect people and people protect houses' (Bushfire CRC 2006). The Australasian Fire Authorities Council accepted the SDLE model and released materials on the preparations necessary for resident safety (AFAC 2005; Bushfire CRC 2006). However, the concept was not met with universal acceptance, success or understanding (Tibbits and Whittaker 2007). For instance, researchers have identified a gender divide in acceptance of the practice and different conceptions among those with families. Women and families are more likely to favour evacuation, with able-bodied men the most common family members that might stay to defend property (Proudley 2008).

Revision of the SDLE policy is occurring in the wake of the February 2009 Black Saturday fires in Australia. The Royal Commission convened to review conditions surrounding the fires concluded that 173 people died, with 113 of these found inside their homes. However, evidence about the actions and intentions of those who died is still preliminary (i.e. whether they had made the choice to stay and defend or were trapped by the fire). The Commission's review of 'Stay or Go' concluded that information central to the policy (i.e. when to evacuate, adequate protections) was not detailed enough to ensure the safety of residents (Teague *et al.* 2009a). Recommendations from the Commission include revision of the above 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'. The creation of an additional fire danger rating beyond 'extreme' was recommended to reflect the extraordinary conditions (i.e. weather and dry fuels) 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 (BBC 2009). The Royal Commission also recommended

that incident commanders be granted additional responsibility to order evacuations when they feel conditions are too dangerous for residents. Recommendations concerning community refuge areas or private 'fire bunkers' emerged as one of the few conclusions that may advance discussion of alternatives to evacuation (Teague *et al.* 2009a, 2009b).

Increased interest in alternatives to evacuation in the USA

In recent years, several US symposia and conferences have featured discussions of what role alternatives to evacuation might play in WUI fire management (Firewise Communities Program 2006; ISSRM 2006; IAWF 2007). The overall tenor of these discussions has been the same: there is significant evidence that alternatives to evacuation need to be considered given (1) advances in fire-resistant materials and understanding of home ignitability (Cohen 2000), and (2) the poor evacuation capacity in the WUI (Cova 2005; Wolshon and Marchive 2007). Research has helped reduce the risk to WUI populations by supporting the development of fire-safe standards for vegetation management around homes, increased ingress and egress from communities at risk for fire, and improved building construction (i.e. fire-resistant roofing materials and proper venting, stucco or concrete sided walls, boxed eaves) to prevent structural ignition by embers or radiant heat. Increased predictive capacity and planning tools (i.e. 'trigger points') for understanding fire risk (Cova *et al.* 2005) are another important aspect in mobilising WUI populations at risk, as is the desire of residents to remain given negative evacuation experiences (Graham 2003).

However, managers participating in the above discussions also agree that significant issues need to be addressed before implementation of these plans, and often call for a standardisation of what role alternatives to evacuation will actually play in a fire event (National Fire Protection Association 2005). This includes homeowner responsibility during a wildfire, the development of agency plans, training manuals, or best practices documents and other tools, and the ability of homeowners to understand or adapt in dynamic fire situations (Paveglio *et al.* 2008; McCaffrey and Rhodes 2009). Recently, fire chiefs in Southern California considered adopting some version of the SDLE policy (Saillant 2009), but ultimately decided to retain focus on evacuation as the best option for public safety (FIRESCOPE 2009). It appears that this decision was at least influenced by the 2009 Black Saturday Fires. Development and presentation of a new policy, 'Ready, Set, Go!' was unveiled by fire professionals in Southern California not long after the Black Saturday Fires (Hernandez 2009). 'Ready, Set, Go!' continues to focus on ignition-resistant structures and reduction of fuels in the home ignition zone. The intent is to create housing developments that can survive fires without local residents present. The policy favours early evacuation above all options and recommends shelter only when residents are trapped by fire (Ventura County Fire Department 2009; IAFC 2010). It is supported in the USA by the Western Fire Chiefs Association (Aleshire 2009) and the IAFC (2009).

US research on the applicability of alternatives to evacuation is in a relatively early stage. Paveglio *et al.* (2008) laid out several recommendations to rectify the apparent dearth of social science knowledge on issues surrounding alternatives, including

how organisational structure and culture influence their adoption or use, and the role of education and collaboration in facilitating large-scale implementation that will better protect homeowners. McCaffrey and Rhodes (2009) and Stephens *et al.* (2009) have explored the applicability of Australian alternatives to evacuation in the USA. All seem to agree that alternatives to evacuation practiced in other countries cannot be imported in their entirety and that significant work remains to be done in adapting alternatives as protective measures for US populations.

Structuration theory

It is clear from the above discussion that alternatives to evacuation can be considered an innovation that different institutions, organisations and governments are considering adopting. As such, classic diffusion of innovation theory and its focus on the outcomes of new advances (Rogers 1962) could offer some insight as to why alternatives to evacuation face challenges in wide-spread adoption. However, the theory of innovations cannot describe all the interacting structural factors that determine when and why some groups or individuals adopt new strategies. Because wildfire management involves a variety of organisations with different rules and resources for action, a study concerning the adoption of an innovation, such as alternatives to evacuation, would need to account for these differences.

Giddens' (1984) structuration theory attempts to span the apparent gulf between organisational structure and action (agency), by postulating that rules and resources (structure) both enable and constrain the actions (agency) of social actors and organisations. Action is facilitated or limited when organisations and their members replicate an established structure across time and space or alter those structures through practice. Giddens defines rules as the 'techniques or generalisable procedures applied in the enactment/reproduction of social practices' (Giddens 1984, p. 21) and divides resources in two categories: (1) allocative (control of material resources); and (2) authoritative (control over persons, including power dynamics). In the case of wildfire and firefighting organisations, examples of rules include the standardised tactics employed to suppress fires, memorandums of understanding among firefighting agencies and the chain of command during large events (i.e. Incident Command System). Likewise, each of these agencies employs a variety of allocative resources (i.e. engines, hoses, personnel) and authoritative resources (i.e. control over residents under their protection, including recommending mandatory evacuations and enforcing fire codes).

Giddens (1984, 1991) recognises that actors and organisations are knowledgeable of the social conventions, roles and relations necessary for achieving goals and objectives, whether consciously through experience or subconsciously through daily routine. Much of this learning stems from the ability of human beings and their institutions to reflect on their actions, the consequences (intended or otherwise) of those actions, and the structures inherent in societal functioning. In wildfire management, learning is perhaps most visible during post-incident reviews. Giddens' 'institutional reflexivity' refers to the constant filtering back of expert theories, findings and concepts to the greater public (Giddens 1991). Firewise, the International

Association of Fire Chiefs and the Joint Fire Science Program are examples of institutions that attempt to facilitate the exchange of wildfire management information among experts, government and the public.

Structuration theory continues to gain attention as an approach for understanding and interpreting innovation in organisational and institutional contexts (Edwards 2000; Dougherty 2008). The theory can be valuable for understanding the adoption or non-adoption of alternatives to evacuation, as adoption is the result of individuals and organisations modifying established practices, rules or understandings through interaction in a social network that encompasses their environment, history, cultural systems and broader political context (Carroll *et al.* 2006). We contend that the use of structuration theory to explain the adoption of new protective strategies can facilitate hazard management by providing a more detailed identification and interpretation of the way social processes support or detract from the implementation of some practices over others. Thus, using the principles of structuration theory, the present study investigated how the emergence and acceptance of alternatives to evacuation are constrained and enabled by existing structural factors (including prevailing opinions and institutionalised practices among public safety officials) and the affected public.

Methods

Site selection

Selection of a research site for the investigation of alternatives to evacuation meant first attempting to identify all US communities considering or implementing such practices. We did this by contacting national and regional professionals who are aware of such communities and searching the Web for outreach materials or news stories indicating the consideration of alternatives to evacuation. These searches resulted in a fairly short list of communities. The communities on this list were further evaluated by the authors using several factors, including: (1) how far along the community was in actually implementing the alternatives (rather than just expressing interest); (2) the level of professional and resident involvement in the project; and (3) whether the study site represented a WUI community. The first of these considerations was the most important, as we needed a community that was far enough along in implementing alternatives to evaluate whether the alternative could be used effectively, what barriers (if any) were impeding progress and what could be improved on.

We made contact with representatives from five communities that satisfied the above criteria. It is important to note that in almost all of these cases, only specific housing developments within the larger community were investigating or implementing alternatives. The five RSF District communities designated SIP emerged as the best choice for study because they appeared to have implemented their alternative to evacuation – shelter-in-place. Evidence supporting this perception included code and building standards satisfying the physical components of SIP, a policy directive outlining the purpose of SIP for homeowners, education and outreach efforts meant to inform homeowners as to their role in SIP, and discussion in the media about the SIP designation. The RSF District appeared to be far enough along in the process of implementing an alternative that we could

examine the process and draw lessons for other communities considering implementation of alternatives to evacuation.

The RSF District lies ~30 miles (48.28 km) north-east of San Diego and covers ~42 square miles (108.78 km²) (Rancho Santa Fe Fire Protection District home page, see www.rsf-fire.org/index.asp, accessed 30 December 2009). It contains a variety of older and newer housing developments, with the five newest – The Bridges, Cielo, The Crosby, 4S Ranch and Santa Fe Valley – designated as SIP owing to developer and resident implementation of measures that go beyond the International WUI, California and County of San Diego fire codes. Included in the RSF District codes are the requirement for residential fire sprinklers in every home, yearly inspections of properties to ensure that vegetation management is maintained, and homes constructed with the most ignition-resistant construction features (i.e. roofing and wall materials) (see www.rsf-fire.org/index.asp). Satisfaction of these stricter RSF District codes is required to build or develop in the District boundaries.

The families in the RSF District are much more affluent than the average WUI family in the USA. According to US census figures released in 2003, Rancho Santa Fe was the wealthiest town in America with more than 1000 households (US Census Bureau 2003). At the time of this study, it was common for housing prices in the RSF District to top US\$1 million. In addition, four of the communities in the RSF District (The Bridges, Cielo, The Crosby and Santa Fe Valley) are gated developments with restricted public access.

Data collection

Data were gathered using semi-structured, face-to-face interviews following an analytic induction approach (Glaser and Strauss 1999). Analytic induction is ideally suited to studying the development of social phenomena such as SIP or other alternatives to evacuation because it allows for the identification of patterns and themes surrounding concepts that have received little empirical attention. Data were collected until observed patterns stabilised and no novel information was forthcoming from additional observations (Glaser and Strauss 1999).

A combination of purposive and snowball sampling was used to select research participants for this study (Lindlof and Taylor 2002). Both methods were necessary as we wished to interview (1) a broad cross-section of people who represent the variety of local stakeholders affected by shelter-in-place policies; and (2) key informants and professionals with specialised knowledge concerning the development and implementation of alternatives. Special care was taken to select professionals involved in all aspects of the planning, regulation and implementation of SIP across multiple levels of governance, even those without direct impact on RSF District policy. This allowed us to investigate not only the development and implementation of SIP in the communities selected here, but its expansion to other residential areas. Key informant residents (i.e. homeowner's association presidents or committee members) suggested additional contacts among residents with different opinions on SIP and levels of participation in the community.

The senior author conducted a total of 77 semi-structured, face-to-face key-informant interviews in the study area during July and August of 2007. Twenty-nine of these interviews were

with local and regional professionals involved with fire management and 48 were with residents in four of the five communities designated SIP (Cielo, The Crosby, 4S Ranch and Santa Fe Valley). Interviews generally lasted from 20 to 60 min and were conducted in professionals' offices, at community meetings or in informants' homes. All interviews were digitally recorded and later transcribed.

Data analysis

The interviews resulted in a large dataset, so the senior author conducted a thematic analysis of the data using the *Atlas-ti* program for qualitative data (Atlas.ti Scientific Software Development GmbH, Berlin, Germany). The program allowed us to organise and develop codes in order to identify relevant themes that emerged from the interview data (Silverman 2001). In line with the logic of analytic induction, thematic analysis is a means for identifying and expressing patterns in qualitative data; the researcher codes statements into categories reflective of observed patterns in the data. These are then situated into larger themes and illustrated by representative quotations through multiple stages of increasingly restrictive coding (Aronson 1994; Boyatzis 1998).

Results

Nearly all the participants interviewed saw development of alternatives to evacuation such as SIP as a positive endeavour, and believed that one day alternatives would become viable, with risks and benefits at least comparable with evacuation. However, both professionals and residents indicated that further testing and evaluation of alternatives were necessary to convince them that residents would be better off staying in their homes rather than evacuating. As one San Diego county fire professional said:

I mean, Rancho Santa Fe has these shelter-in-place communities but there has not been one fire that has come through to demonstrate that these are effective. But if there were one, you know, that ended up having a holding point or that there was a particular group of homeowners that were prepared to shelter-in-place and they did ... and that they demonstrated that their homes are still there ... Then I think it could potentially begin to shift that paradigm.

Fire professionals

The RSF District staff feels that their SIP policy is a 'moderate approach' to the question of alternatives to evacuation. Most district officials stated that they did not encourage residents to shelter as a primary strategy, but described SIP as 'another tool in the toolbox for firefighters' that could be employed in certain situations. Fire professionals in the RSF District held a variety of opinions on what the concept of SIP means. On one hand, the RSF District literature disseminated to residents is very clear about what their SIP policy means:

By residing in one of the five communities listed below, your home is considered shelter-in-place. **This means that you will not evacuate during a wildfire.** Homes in these master-planned communities are designed and constructed to

withstand wildfire, so residents are safe to shelter inside. [Bold and italics included in the District literature] (Rancho Santa Fe Fire Protection District 2004)^A

Despite this statement, the majority of RSF District officials we talked to acknowledged that they consider evacuation the safest alternative. As one District fire official said:

Well, let's do shelter-in-place. And everybody has a different concept ... I don't recommend that [residents] stay like they do in Australia and fight the fire ... I fall on get out early, because most people don't know what to expect in wildland fire.

It also became clear during our interviews and review of the RSF Districts codes that some fire professionals believe that SIP policy is about home construction and actions to increase preparedness – actions taken *before* the fire event:

... [other officials and residents] think [the policy is] stay and defend. They are really stuck on that. We are saying no, it's not, its dealing with proper building construction and other issues.

The above RSF District official has interpreted the policy as an effort to reduce wildfire hazards in and around homes (what Cohen 2000 calls the 'home-ignition zone') and not necessarily an approach that would allow residents to remain in their homes during fires.

San Diego fire professionals outside the RSF District are no closer to consensus on what it means to have an SIP policy or to be an SIP community. As one CAL FIRE representative said:

I am not sure there is a consensus [on the use of SIP] ... I think any consensus would be just heavily biased on who was doing the talking to who and which fine point, which subtle node of complexity you were dealing with ... it's not necessarily a new idea but it's a new, it's relatively new here ... so there hasn't been a lot of discussion and all about it.

Evacuation (or relocation, as some preferred) remained the primary protective strategy during fire among managers and professionals in the San Diego area as it did for RSF District professionals:

You know evacuation is always really like what is first encouraged, regardless of if it's a fire-safe community or shelter-in-place community.

However, professionals in both the RSF District and outside of it recognised that there are instances where evacuation is not practical or safe. As one fire protection consultant and former Incident Commander for the USDA Forest Service summarised:

At some point in a timeline, it's more dangerous to leave than it is to stay ... Up until [a certain time] before, fine, leave. Take your sick grandmother, load your pets and your cats and your dogs and your horses and stuff. Go ahead and leave, I

think it's great ... but at some point that timeline closes... the evacuation needs to be cut off ... So when is that? Well, you gotta have a lot of information, but I think it's better than letting it go till a certain point and then tell them to evacuate. Because then... the die is cast. These people are just going to be victims of their circumstances.

This quote suggests the need to develop principles around alternatives to evacuation, so that when appropriate or necessary, an alternative such as SIP could be used as a primary strategy.

Despite the confusion and lack of consensus, few of the professionals were inflexible on the subject of alternatives to evacuation, and many indicated that new ideas were beginning to be considered. As one former fire marshal said, 'Now [many professionals] are stepping back and they are willing to take a look at [SIP]. Before they were just adamantly opposed to it.' What was clear from the interviews was the need for additional discussion of where SIP and other alternatives fit in the established structures and procedures of local firefighting agencies. As one fire professional with experience in San Diego and state-level fire policy explained:

Well, you can't just make the statement 'I will shelter in place' without a properly designed community ... the term has been misused ... it needs to be defined. And probably at some point defined in the code, fire code.

In general, perceptions of SIP as an alternative to evacuation by fire professionals in the RSF area (including within organisations) ran along a continuum from perceived low utility and applicability to perceived high utility and applicability (Fig. 1). These differences in the perceived usefulness of alternatives among professionals no doubt dictate the development and understanding of any policy regarding alternatives, including within the RSF District. Our data indicate that an individual's firefighting experience affects where they fall on this continuum. People with *both* wildland firefighting experience and structural fire protection experience were more likely to support alternatives to evacuation than people with only one kind of experience. In addition, those who indicated that they had the freedom to innovate with their organisations were more supportive of alternatives. Of the people we interviewed, consultants in subdivision fire protection planning and development were most likely to perceive SIP as having high utility or applicability. They are the people most likely to have diverse firefighting experience (due to previous career involvements) and to be independent of highly organised firefighting organisations.

Firefighters who expressed concern that their organisations could be held liable if residents or their property were impacted owing to new protective measures tended to be less supportive of alternatives. One fire professional summed up this sentiment: 'The fire services, because of political and liability issues, they will never say shelter-in-place is first priority.'

In summary, professionals were less likely to see alternatives to evacuation as having high applicability or utility if: (1) their

^AVersions of the RSF District literature produced after this study clarify the incongruence in this message. The title of the most recent outreach material states: 'Shelter-in-place ... if you can't evacuate'. The publication identifies early evacuation as the best option, describes SIP as a choice and advocates SIP when residents are trapped by fire (Rancho Santa Fe Fire Protection District 2009).

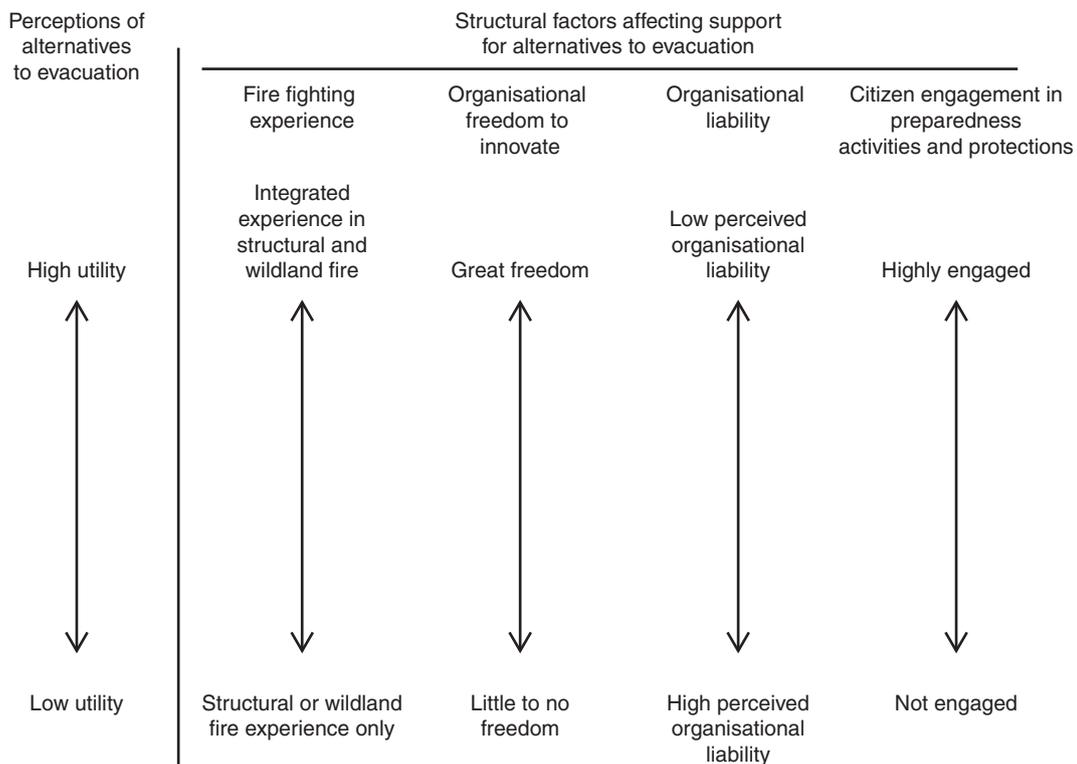


Fig. 1. Linking perceptions of alternatives to evacuation with structural factors affecting support for alternatives.

firefighting experiences are primarily in one area (structural or wildland); (2) they work for organisations with strict practices, procedures and firefighting protocols; or (3) their agency would likely be blamed for any damage or casualty resulting from implementation of the alternative.

Local residents

Resident awareness and perception of SIP

Interview results indicate that resident awareness and understanding of SIP implemented in the RSF District communities were undeveloped. Only some of the residents interviewed were aware of the SIP policy or the planning that had occurred in their respective communities.

More residents were aware of the SIP option in the relatively homogeneous gated communities studied than 4S Ranch, a much larger, open community that resembles a more traditional neighbourhood. Residents in the gated communities of The Crosby and Cielo were most aware of the SIP policy. This increased awareness could be explained in The Crosby by newly placed signs advertising 'shelter-in-place' and a recent educational presentation by the RSF District. However, many of these residents also became aware of the SIP prescriptions when building or remodelling a home. As one Cielo resident explained:

I think we learned [about SIP] because, when we were going through our plans for our house, you know, they are pretty strict on what can be built, what can be planted on your slopes ... and they said that is because this is a non-evacuation area.

Such involvement in the building process is less common in 4S Ranch, where more designs are preplanned. Residents in Santa Fe Valley, which is older than the other gated communities mentioned, displayed only slightly more awareness of alternatives than those in 4S Ranch.

Among those residents who were actually aware of the concept of SIP, a majority reported that they did not know what they were actually supposed to do during a fire event. Although they knew that they were supposed to remain in their homes, they did not know what to do beyond this. As one Cielo resident articulated:

What we would all like to know, is um, what is the safest thing to do in case there is a fire. And somebody saying, well, this is shelter-in-place, that doesn't answer the question ... I don't know the conditions under which they expect it to take place...

A lack of understanding about SIP coincided with some residents' plans to remain at home and only evacuate when a wildfire got close, putting them in perhaps the most dangerous situation possible. As one resident from 4S Ranch reasoned:

I'd stay, I'd stick around. When it started hitting these houses over here, that's when I might be a little worried, that might be like, all right, it's time to probably leave.

At least some of the confusion and lack of understanding about alternatives to evacuation stems from resident willingness to 'depend on the fact that we got professionals designing this'. Residents expressed little interest in playing any role in the

planning and implementation of alternatives because they thought the decisions should be left to the professionals. According to the interviewees, this trust in professionals was due to the proximity of fire stations to the SIP communities, the visibility of firefighters in the community and resident confidence in fire officials' abilities. As one resident in The Crosby said:

Sometimes if you go to these [homeowner association] meetings and people start having these opinions and you're like, are you kidding me? I think it's better just to leave it to the experts to figure out what we should be doing ... sometimes, you know, I think that would be way too many chefs in the kitchen.

Residents' perceived support of SIP

Fewer than half of the residents interviewed indicated they would actually stay in their homes during a fire event. The choice to implement alternatives was linked to residents' knowledge of the protections in place (i.e. home construction and vegetation management), with residents who understood the additional codes and standards much more likely to support SIP. As previously mentioned, support for fire district personnel also played a role. As one Cielo resident explained:

I guess at the end of the day, it makes sense. If your house is safer than driving out there, you know, getting caught in the road ... you can't see and the fire comes in, it makes a lot of sense. We have sprinkler systems in place ... and the house is made out of stucco and brick and tile, so it would be difficult to burn down.

However, many residents explained that they would decide whether to stay or leave based on the circumstances of the fire and how long they had to evacuate:

I mean [I would make my decision to stay or go] according to the odds of whether I would be in trouble or not, I wouldn't want to stay in my house if fire was surrounding it and it was up to me to fight it.

Residents who indicated that they would not SIP during a fire often reacted to alternatives by assuming that they were aimed towards reducing damage *to structures* and that the practice carried with it more *personal* risk than evacuation, an option they viewed as safer. What often followed was something we have dubbed the 'insurance motivation', best articulated by this response from a homeowner in 4S Ranch:

As far as I'm concerned, you can burn a place to the ground and I got insurance. As long as I get my hound out of here and my family, everything will be cool.

Residents' perceptions of role of firefighting organisations

Firefighting professionals and agencies were perceived by the residents we interviewed as most liable for the safety of residents given a SIP recommendation. As one resident said:

Well, I think for the fire department to say stay in your house, they're liable just by making that statement because they are an authority figure ... they're supposed to know more than

you are, so if you stay in your house ... and you die, they should have some liability to that.

The residents in these Rancho Santa Fe communities see themselves as (high-end) suburbanites living adjacent to a metropolitan area rather than as WUI residents living near wildlands. As such, they expect the protections inherent in municipal areas characterised by structural firefighting practices. As one resident of The Crosby said:

You would expect when you're in a high-end community, that there'd be rules about the structure of your home as well as compliant things that are expected and so forth, and by and large, I mean if there's been any complaint about any things, it's just the fact that people would like to live with no rules in life.

Discussion

Despite literature and media coverage that have clearly identified housing developments within the RSF Fire Protection District as SIP communities, there is little consensus on the part of fire professionals or residents on what it means to be a SIP community, or broad-based support for working to achieve that consensus. We would maintain that in fact, the RSF District has really *not* implemented an SIP policy that encourages residents to stay during a wildland fire. Rather, the RSF District has clear and consistent guidelines for building and landscaping that are strictly enforced to minimise damage during wildland fire. In fact, some of the residents and fire managers we interviewed defined SIP as a protective strategy for structures and property. Although the structural and landscaping elements of SIP are in place in our case-study communities, the social elements of SIP, including preparing residents for the psychological impacts of such a policy, are missing. Evidence of the effectiveness of the structural and landscaping guidelines was provided by the 197 900-acre (80 087.29 ha) Witch Fire that passed directly through the RSF District SIP communities in 2007. Although the fire destroyed more than 2220 homes, no homes were damaged or destroyed in the RSF District SIP communities. However, the five RSF District SIP communities were included in the evacuation order resulting from the fire, and residents left their homes (Ekard *et al.* 2007).

Firefighting organisations and the adoption of alternatives to evacuation

Structuration theory helps us understand the factors that facilitated or constrained the adoption of SIP in the RSF District and affect the adoption of alternatives to evacuation elsewhere. Regardless of the RSF District's relative independence, there is a hierarchy of organisations in San Diego County that promote wildland fire preparedness, response and recovery. These include federal, state and local agencies or governments, not to mention other local entities (for example, Fire Safe Councils). Each organisation operates under different rules, plays different roles and deploys a variety of resources in the management of wildfire. These characteristics, which clearly fall under Giddens' (1984) notion of 'structure', fall along a continuum that reflects the organisation's ability and flexibility to

implement innovations such as alternatives to evacuation (Fig. 1).

Of the San Diego area fire organisations included in this study, the locally based RSF District was most flexible. Because the RSF District focusses on a limited geographic area with fairly homogeneous ecological and social contexts, it can tailor programs aimed at reducing fire risk, including alternatives to evacuation, to the needs of the community, and can work with community residents to help them understand the implications of any initiative. In addition, if implementation of an alternative to evacuation involved reorganising the RSF District or writing new guidelines and procedures, these steps would be easier to take in an organisation the size of the District rather than in a larger and more diverse organisation. The RSF District was able to adopt *its version* of SIP with the support and guidance of a few local champions who had the trust of local residents. This support and that of professionals in the RSF District allowed them to adopt stricter codes and practices than the surrounding areas.

Larger and perhaps less flexible organisations like CAL FIRE and the San Diego County government develop initiatives for a diverse set of communities and landscapes, and therefore cannot address many of the specific local concerns of any one community. Furthermore, new or revised codes and standards may need to go through a much longer process of adoption involving other departments or agencies at higher and lower scales. In short, the rigidity of their current practices and codes are much more difficult to change. Given the aforementioned issues, the size of these agencies and their diverse structures, it is understandable that adoption of alternatives to evacuation would be slower and more problematic. These results support discussions of structural constraints by Paveglio *et al.* (2008) and McCaffrey and Rhodes (2009).

One advantage a broad-scale organisation such as CAL FIRE or a San Diego County department has over a local fire protection district is that once a decision is made, it is possible to work across jurisdictions to achieve multiorganisation collaboration on the new initiative. Working across jurisdictions is much more difficult for a local entity like the RSF District. Thus, whereas CAL FIRE or San Diego County may have more capacity and resources to put new initiatives into action, implementation of alternatives at a local scale can be constrained because of the variation in capacity (including social norms and values) across their jurisdictions.

Residents and fire professionals in the RSF District identified another factor in the adoption of alternatives to evacuation – liability. As evidenced in our results, traditional firefighting professionals and organisations are perceived as having higher levels of liability than others involved in fire management (consultants, outreach specialists, non-governmental organisations) should application of currently non-standard procedures such as alternatives to evacuation result in damage to or loss of property and life. Overcoming this challenge will not be an easy task given the litigious culture of America and many residents' expectations regarding the services that should be provided by local or county governments (Daniel 2007).

Professional support for alternatives to evacuation reflects differences in firefighting training and experience. Given the enduring nature of these experiences and the tradition of fire

organisations (Pyne 2001), expecting every professional to approach the topic of alternatives to evacuation uniformly is naïve at best. However, we observed that an ability to integrate wildland and structural firefighting experience enables professionals to support and begin to implement alternatives to evacuation, whereas having experience in only one setting (structural or wildland firefighting experience but not both) constrains wildfire managers in adoption of alternatives.

Finally, the structures of fire management organisations place central focus on the safety of both professionals and local residents, and the consideration of alternatives to evacuation is an attempt to increase their safety. However, fire management is also about understanding the role of fire in the natural landscape. A move to reintroduce fire in and around expanding WUI communities blurs the lines between suppression and management (Steelman and Burke 2007) and challenges the old notions and boundaries that are the foundation of US fire organisations and the standards of safety the public has come to expect. This means that managers considering alternatives to evacuation cannot simply approach the problem from a firefighting perspective. Rather, alternatives to evacuation make fire managers and local residents partners in fire preparedness, suppression and recovery, and in finding ways to live with fire as an inevitable part of the landscape (Jakes *et al.* 2007a, 2007b). This will require a larger, community-wide interplay between fire professionals and local residents as they work to find solutions that all can live with and implement effectively.

Using structuration theory, the result of these differences in organisational structure, professional socialisation and firefighting experience can help explain the variance in professional conception and perceived utility for alternatives to evacuation (even within organisations). According to Giddens (1984), individual actors use their personal experience to reflexively monitor communication about a particular issue and decide on its meaning. Practice becomes structure when the meaning for an object (in this case SIP) is agreed on among actors. This shared meaning becomes the basis for action. Given the different experiences, training and organisational structure that define professionals' experience and communication with others, it is of little surprise that they often conceive of SIP or related concepts differently.

Local residents and the adoption of alternatives to evacuation

Regarding local residents and the adoption of alternatives to evacuation (in this case SIP), Giddens (1984, 1991) and Edwards (2000) have pointed out that enabling populations to adopt innovations means sufficiently modifying or overcoming the structural constraints limiting their ability to do so. This may be especially challenging for alternatives to evacuation given our longstanding conceptions of fire as a destructive, alien event that humans need to suppress and flee from (Pyne 2001). Adoption of alternatives to evacuation is also constrained because residents do not perceive the alternatives as legitimate and viable protective measures for themselves and their property. In our research, residents and some managers expressed a desire for additional evidence (structure) and assurance that staying in properly designed homes or neighbourhoods is indeed

safer than evacuation. Although we identified some of the most notable physical fire research related to evacuation (Cova 2005), building materials and the ignitability of structures (Cohen 2000), none of this research deals explicitly with the prospect of residents remaining in structures during the fire. Faced with inconsistent structure, residents and managers will generally not adopt a new initiative such as alternatives to evacuation. This is due to a lack of assurance that their choice will result in additional protection or avoid harm. Giddens (1984) called this 'ontological security', a crucial component in societal participation.

From a practical perspective, our research indicates that the most significant and currently unaddressed factor constraining the development, modification or enactment of alternatives to evacuation by local residents and property owners is an understanding of what alternatives like SIP mean for residents during a fire. In addition, the lack of standardisation and the conflicting views of fire professionals in the San Diego area about alternatives contribute to confusion among local residents about SIP. This finding reflects similar results in an Australian study of SDLE by Tibbits and Whittaker (2007). In the RSF District, we saw that those residents who were most informed and involved in the preparedness process were most supportive of alternatives to evacuation (Fig. 1). This engagement often occurs when building guidelines are enforced and people seek explanation as to why they are being required to take certain steps. But local residents have received no training as to what to do when a fire approaches. In addition to knowing what action to take in defending a home during a wildfire, there needs to be dialogue around associated psychological impacts of staying.

In the terminology of structuration theory, there has been little to no structure developed within organisations or within the community around alternatives to evacuation – no codified sense of what it means, no enabling of local actors to adopt and replicate the new ideas surrounding alternatives. Thus, key actors revert to replicating the established structure surrounding traditional wildland fire responses (i.e. evacuation) because firefighters and residents are familiar with this response and understand why that action is taken.

Conclusions

Consideration and implementation of alternatives to evacuation will continue to grow in the USA as residents, fire managers and local government representatives seek ways to better protect WUI communities. Places like the RSF Fire District have earned a great deal of respect for the advances they have made concerning the physical standards necessary to advance these protections. However, the diverse social and ecological contexts found in WUI communities will require different approaches to developing and implementing alternatives to evacuation (Paveglio *et al.* 2008, 2009). For example, the physical standards (primarily building codes and landscaping requirements) in place at RSF could be more difficult to implement and enforce in less affluent communities. Yet financial capacity need not be a barrier to implementation when elements of community capacity such as social norms and reciprocity support a community's adoption of alternatives (Jakes *et al.* 2007b). Conversely, these elements may discourage a community from adopting

alternatives despite adequate financial capacity; for example, local residents may not support regulations affecting private property development necessary to ensure the reduction of hazards in the home ignition zone. More rural but less affluent residents may be more engaged in the planning necessary to implement alternatives to evacuation owing stronger local ties and experiences with other collaborative projects that facilitate collective solutions. Local culture and experiences gained from living in fire-adapted ecological systems have also resulted in rural residents having greater understanding and increased ability to reduce some aspects of risk (i.e. personal vegetation management, previous fire experience) (Paveglio *et al.* 2009). Planning that originates with residents or includes them as major participants may well be most effective in developing alternatives for protecting local populations (Jakes *et al.* 2007b). Finally, the biophysical conditions of local ecosystems (i.e. fuel types and loadings, aspect, exposure) will dictate whether and what type of alternatives may be possible across a landscape. Our research suggests that a unifying definition or standardisation of alternatives across a broad political landscape may be sought by some professionals, but will not guarantee success. Rather, these are fundamentally local decisions and it is at the local level (a neighbourhood, community, or county) that agreement will be most critical (Carroll *et al.* 2006).

Overcoming a reflexive response to evacuate in response to every major WUI fire means recognising the importance of increased understanding for alternatives to evacuation among the *local* organisations disseminating information or enforcing codes *and* among residents expected to play a role. The development of definitions and guiding principles for alternatives to evacuation at the national level by leading professionals and political leaders may be important to some, yet ultimately each locality will need to interpret alternatives to evacuation within the local context. This is clearly the case with the RSF Fire District, which has advanced its version of alternatives beyond that of surrounding areas and overlapping organisations' jurisdictions. Where the RSF District plan needs further development is first in building uniform understanding of their alternatives among local organisations and individuals within the community, and then across the broader social landscape.

It is not necessary that everyone agree on a checklist for employing alternatives; rather, the stakeholders involved should agree on their *viability in dynamic situations*. For example, is the alternative a primary response, a secondary consideration, or a last-ditch effort when evacuation is not possible? How does implementation of alternatives change given a variety of fire environments during the event, the estimated time for evacuation of affected publics, or the percentage of people indicating they would remain at home in a fire event? Such adaptive mechanisms create the structure needed for professionals and residents to implement the alternatives but do not overtly constrain action to the point where professionals are not allowed to make on-the-ground or site-specific decisions should conditions change.

Such measures can also help overcome issues of liability by explicitly setting forth policies and procedures implicating alternatives as a *choice* that do not guarantee either life safety or reduced property damage. These efforts can begin to provide a paper trail and legal precedent that could start to alleviate

resident conception that fire authorities should always bear legal liability, especially in providing information about a personal decision like the implementation of alternatives to evacuation. It is unlikely that such strategies will immediately change the legal landscape of fire protections. However, it provides some initial progress concerning an issue that is central to future fire protections and will undoubtedly need further discussion.

This case study identifies some preliminary social factors for fire professionals and other managers to consider in the development of alternatives to evacuation. These considerations are crucial steps that complement the development of physical standards for protection. This research broadly addresses some of the many complex and detailed issues that still need to be explored surrounding the applicability of alternatives to evacuation during fire. For instance, social issues including communication and outreach need to be more thoroughly addressed, as do the impacts of different community cultures and local knowledge. Other issues we were not able to address but nonetheless are crucial research include the roles of other stakeholder groups such as homeowners associations, Fire Safe Councils, outreach organisations (e.g. Firewise), developers and insurance companies. Additional work on all these subjects will give us a better picture of what role alternatives will continue to play in the protection of a resident population at risk in an age of fire inclusion and increased risk.

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