Community safety during the 2009 Australian 'Black Saturday' bushfires: an analysis of household preparedness and response

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Keywords
preparedness, household, analysis, bushfires; response, saturday', community, 'black, australian, 2009, during, safety

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On Saturday February 7, 2009, 173 people lost their lives and more than 2000 houses were destroyed in bushfires (wildfires) in the Australian state of Victoria. The scale of life and property loss raised fundamental questions about community bushfire safety in Australia, in particular the appropriateness of the ‘Prepare, stay and defend or leave early’ policy. This paper presents findings from research undertaken as part of the Australian Bushfire Cooperative Research Centre’s (CRC) ‘2009 Victorian Bushfires Research Taskforce’. The research examined factors influencing patterns of life and property loss/survival across the fires through mail surveys (n=1314) of fire affected households. Just over half of the respondents (53%) stayed to defend their homes and properties, while the remainder left before or when the fires arrived (43%) or sheltered in a house, structure, vehicle, or outside (4%). Results reveal a survival rate of 77% for houses that were defended by one or more household members, compared to 44% for unattended houses. The paper identifies inadequate planning and preparedness and the tendency for people to wait until they are directly threatened before taking action as major factors leading to late evacuation, failed defence, and passive shelter.

Brief summary:

This paper examines household preparedness and responses to the 2009 ‘Black Saturday’ bushfires in Victoria, Australia. Results from a mail survey indicate that while leaving early is the safest response to bushfires, staying to defend can be a viable alternative to evacuation for some people.

Keywords: bushfire; wildfire; evacuation; emergency response; community safety.
1. **Introduction**

On Saturday February 7 2009, 173 people lost their lives and more than 2000 homes were destroyed in bushfires in the Australian state of Victoria. Fires burned under the most severe fire weather conditions on record in Victoria, with a record high maximum temperature of 46.4°C (115.5°F) in Melbourne, record low relative humidity, and strong winds throughout the state (Karoly 2009). These conditions were accurately forecast, and Victorians had been warned to prepare for ‘the worst [fire danger] day in the history of the state’ (Premier of Victoria, John Brumby, cited in Moncrief, 2009). The day saw more than 400 fires across Victoria, with most of the major fires started by fallen powerlines or arson (Teague et al., 2010). Fires quickly burned out of control as communities came under threat with little or no official warning. The speed, intensity and extent of the fires meant that firefighting capacities were stretched and, in line with official advice for all bushfires, most residents responded without direct assistance from fire services.
Under the ‘Prepare, stay and defend or leave early’ (PSDLE) policy, Australian fire services had advised residents to prepare to stay and defend their homes and properties against bushfire, or to prepare and leave well before a fire arrived in their area (AFAC, 2005a). This advice was based on evidence that residents can protect houses from bushfires, provided they are prepared to do so, and that a large number of deaths have occurred during late...
evacuations.¹ However, with police reports that 113 people had died inside their homes in the February 7 fires (AAP, 2009a) the colloquially termed ‘Stay or go’ policy came under scrutiny (AAP, 2009b). Questions were raised about the adequacy of warning systems; the preparedness and responses of residents and of fire and emergency services; and the effectiveness of the land use planning system that controls development in high-fire risk areas. These and other issues were investigated by the 2009 Victorian Bushfires Royal Commission, which handed down 67 recommendations in its final report to the Victorian Government in July 2010 (Teague et al., 2010).

This paper presents findings from research undertaken as part of the Bushfire Cooperative Research Centre’s (CRC) ‘2009 Victorian Bushfires Research Taskforce’. The Taskforce was established to provide the Royal Commission and Australian fire and emergency services with an independent analysis of the factors that contributed to the fires’ severity and impacts. Research covered three broad areas: fire behaviour; human behaviour and community safety; and building and planning issues. This paper presents findings from the human behaviour and community safety research, which investigated factors that influenced patterns of life and property loss/survival across the fire affected areas. The paper begins with an overview of the Australian approach to community bushfire safety, before discussing the research questions and methods that were used to conduct the research. Key findings are then presented and discussed. The paper concludes by considering the implications of the research for community bushfire safety – in particular, the applicability of the PSDLE approach.

2. Community bushfire safety in Australia

¹ We use the term ‘evacuation’ to refer to the act of leaving when bushfires threaten. In Victoria, authorities may advise residents to evacuate; however, responsibility for the decision and act of leaving lies with the resident.
In 2009, the Australian approach to community bushfire safety centred on the PSDLE policy. Under the policy, adopted by all Australian fire services, residents were advised to prepare to stay and defend their homes and properties from bushfires, or to prepare and leave well before a fire arrived in their area (AFAC, 2005a). The policy was underpinned by evidence, discussed below, that: (i) well-prepared houses can be successfully defended against bushfires and provide safe refuge during the main passage of the fire front; and (ii) that late evacuation is an inherently dangerous response to bushfires. Importantly, the policy recognised that fire and emergency services are unable to help everyone during a fire, whether through firefighting or assisted evacuation, and that residents must be prepared to respond without assistance. It also recognised that there are people who will want to stay with their homes and others who will want to leave. In effect, the policy simply formalised an approach to bushfire safety long adopted by Australians, while emphasising the dangers of late evacuation.

A number of studies have documented the dangers associated with late evacuations (e.g. Wilson and Ferguson, 1984; Krusel and Petris, 1992; Handmer and Tibbits, 2005). Late evacuations are typically triggered by the appearance of flames and/or heavy smoke nearby. By this time it is likely that driving a vehicle will have become very difficult, with flames, smoke, strong winds, fallen trees, traffic and the urgency of the situation increasing the likelihood of accidents (Tibbits and Whittaker, 2007). An analysis of recorded bushfire fatalities in Australia between 1900 and 2008 (Haynes et al., 2010) found that late evacuation was the most common activity at the time of death, accounting for around one-third (32%) of all fatalities. Another 11% was found to have been travelling through fire affected areas at the time of death. For example, in the 2005 Eyre Peninsula bushfires in South Australia, eight of the nine fatalities occurred in or near cars after attempts to flee the fire (Deputy State
Coroner, 2005). Similar evidence has been compiled in the United States. Mutch (2007), for example, notes that many of the 22 residents who died in the 2003 southern Californian fires were attempting to flee.

Research has shown that well-prepared houses can be successfully defended by occupants and provide safe refuge during the main passage of a fire front (e.g. Lazarus and Elley, 1984; Wilson and Ferguson, 1984, 1986; Ramsay et al., 1987; Cohen, 2000; Handmer and Tibbits, 2005). Studies have found that embers – rather than direct flame contact or radiant heat – are the most common source of building ignition before, during and after the passage of a bushfire (Leonard and McArthur, 1999; Leonard, 2003). Consequently, some research has shown that residents can shelter inside well-prepared houses during the main fire front, going outside to extinguish small ignitions before and after. For example, a study of the 1983 Ash Wednesday fires in Victoria’s Otway Ranges found that residents ‘were able to save their houses by extinguishing small ignitions of the house itself before these fires became uncontrollable’ (Ramsay et al. 1987, p. 50). At Mt Macedon, also during the Ash Wednesday fires, Wilson and Ferguson (1984) recorded a 90% survival rate for houses that were actively defended by able-bodied occupants, compared to 82% for attended but not actively defended houses, and just 44% for unattended houses. Considering the risks associated with late evacuations, they concluded that: ‘provided they are adequately informed of the danger and risks involved, mature, able-bodied residents can minimise loss of life, and probably save their houses, by staying within the safety of their homes’ (Wilson and Ferguson 1984, p. 235). Further evidence that people can and do protect their homes by staying to actively defend them has been compiled by Handmer and Tibbits (2005; see also Tibbits et al., 2008).
Alternatives to wildfire evacuation have also been debated in the United States. A 1995 issue of *Wildfire* magazine presented a number of perspectives on evacuation under the header ‘Fight or flee?’ At issue was whether residents should have the option to stay and defend their homes from wildfire, which some U.S. citizens had done in the past, or whether the practice of mandatory evacuation should prevail. Queen (1995) argued that several of the fatalities in the 1991 Oakland firestorm could have been prevented if the victims had waited until the fire front had passed before leaving the area. He went on to note that: ‘What may work in Australia may not work in the U.S. However, evacuation is clearly not the only option. The decision to evacuate is a difficult one to make. The responsibility of making this decision rests with the occupants, not the firefighter’ (Queen, 1995, p. 23). In contrast, McMeekin (1995) outlined an approach to ‘population protection’ that, despite involving greater community engagement and planning, is largely focused on facilitating agency-led evacuations. Decker (1995) emphasised the needs for residents to ‘… create defensible space around their homes and to respond immediately to evacuation orders rather than waiting until the last moment’. More recently, the National Fire Protection Association published a feature article presenting arguments for and against the PSDLE approach in the USA (see Schorow, 2011).

The Australian approach has served as a reference point for debates over alternatives to evacuation in the United States. Scholars have generally agreed that ‘Prepare, stay and defend’ may be a viable alternative to evacuation in some situations, but that contextual differences – including the characteristics of wildfires and populations at risk – may mean that it is inadvisable in some locations (Paveglio *et al*., 2008; McCaffrey and Rhodes, 2009; Stephens *et al*., 2009). Another key difference is that, in Australia, the PSDLE approach arose from a tradition of rural self-reliance and household firefighting practices, rather than
policy. Significant institutional challenges have also been identified – such as redefining agency roles and responsibilities, educating and building the capacities of communities, and promoting ‘shared responsibility’ for wildfire risk – that would need to be overcome for the strategy to be successful (Paveglio et al., 2008; McCaffrey and Rhodes, 2009). Unlike in Australia, where it has been emphasised that staying requires active defence, passively ‘sheltering-in-place’ has been considered an alternative to evacuation (Cova et al., 2010). In southern California, for example, Rancho Santa Fe has been actively promoted as a community that is designed to enable residents to ‘shelter-in-place’ during wildfires (Paveglio et al., 2008).

Although the PSDLE policy had not undergone formal evaluation prior to the Black Saturday fires, fire services and many residents considered it a sound approach for reducing losses of life and property. Nevertheless, a number of studies had identified problems concerning its implementation. In a study of residents’ understandings of the policy, Rhodes (2005) found that while most people believed that ‘stay and defend’ was a viable strategy for protecting property, most did not see it as a strategy for protecting life. He argued that this is why most people prefer to ‘wait and see’ what a fire is like before they decide whether to stay or leave, which creates the potential for late evacuation. Tibbits and Whittaker (2007) found high levels of awareness and support for the policy following the 2003 Victorian bushfires, but identified two critical issues concerning its implementation. First, there was considerable confusion over the meaning of ‘leave early’, with many residents unsure of when to leave and unable to recognise when leaving was no longer a safe option. Second, many of those who had planned to stay and defend were not fully committed to doing so. They consciously or subconsciously retained late evacuation as an option despite recognising the dangers of this strategy. Research reported in this paper and elsewhere identifies ‘wait and see’ strategies as
a fundamental challenge for implementation of the policy (see Whittaker and Handmer, 2010).

3. Methods

The Bushfire CRC established the ‘2009 Victorian Bushfires Research Taskforce’ to provide the Royal Commission and Australian fire and emergency services with an independent analysis of the factors that contributed to the fires’ severity and impacts. The scope of the Taskforce was determined by the Bushfire CRC, Country Fire Authority (CFA) and Department of Sustainability and Environment (DSE). The research covered three key areas: fire behaviour; human behaviour and community safety; and building and planning issues.

The human behaviour and community safety research was designed with distinct qualitative and quantitative phases. The qualitative phase involved semi-structured, in-depth interviews with residents; the quantitative phase involved a mail survey of households within fire-affected areas. A team of researchers began interviewing residents on 12 February, with more than 600 interviews conducted over a 12 week period (see Whittaker et al. 2009a). The mail survey comprised a range of questions concerning community safety issues, including awareness of bushfire risk prior to Black Saturday, the information and warnings people received, actions taken to plan and prepare, intended and actual responses to the fires, impacts of the fires on households, and basic demographic information (see Whittaker et al. 2009b). Surveys were mailed to 6000 addresses in areas affected by the bushfires in October 2009. Addresses that fell within the ‘burnt area’, as defined by DSE, were extracted from the Vicmap database (see State Government of Victoria, 2012). Residents were given three weeks to complete and return the survey. A response rate of 25% was obtained, with 1314 surveys received from residents within each of the major fire complexes. Men and women
were more or less equally represented in the sample (53% women), with the majority of
respondents (59%) aged between 35 and 54. Ethics approval was obtained from RMIT
University’s Human Ethics Research Committee, with measures taken to ensure the safety
and rights of participants and researchers.

This paper focuses on the results of the mail survey. Results are presented for five key factors
influencing community bushfire safety: pre-fire awareness of bushfire risk; planning and
preparedness; intended responses; warnings; and actual responses to the fires.

4. Research findings

4.1 Pre-fire awareness of bushfire risk

The survey results suggest high levels of bushfire awareness prior to the Black Saturday fires.
It is important, however, to recognise that hindsight bias - where outcome information
influences people’s recollections of their prior knowledge or beliefs (Bradfield and Wells,
2005) – is likely to have influenced these results. More than three-quarters (78%) of
respondents reported they had previously thought it likely or very likely that a bushfire could
occur in their town or suburb and more than two-thirds (67%) said they had perceived a high
or very high level of threat. The proportion of respondents that thought it unlikely that a
bushfire would occur in their town or suburb (22% overall) was considerably higher in the
Horsham (72%) and Bendigo (53%) fires. Fires impacted on the suburban fringes of these
regional cities, where many residents did not have past experience of bushfires and did not
consider themselves at risk.
These high levels of reported hazard awareness did not necessarily translate into high levels of preparedness or protective action. As discussed below, many respondents were aware of the risk, yet did little to plan and prepare.

4.2 Planning and preparedness

More than two-thirds of respondents (69%) claimed to have had a ‘firm’ plan for what they would do in the event of a bushfire. Again, results suggest considerably lower levels of awareness and preparedness in Bendigo and Horsham, where around half (56% and 50%, respectively) of all respondents had not considered what to do in the event of a bushfire, or had decided they didn’t need to do anything. Of all respondents, most (78%) reported discussing their intended response with other members of their household and more than two-thirds (68%) had planned for what each household member would do. Fewer respondents had considered how things could change if members of the household were not at home during the fire (42%) or had written down important things to do and remember (26%).

Residents had taken a range of actions to physically prepare their homes and properties. The most common preparations were actions normally undertaken as part of general property maintenance, such as clearing leaves, grass and other debris from around the house (92%), clearing leaves from gutters (88%) and obtaining and preparing equipment such as ladders, buckets and mops (73%). Many residents had moved combustible materials such as firewood and garden furniture away from their homes (70%) and obtained and prepared firefighting equipment such as water pumps and hoses (66%). Less common were actions to protect vulnerable points on houses from ember attack, such as installing seals and draft protectors around windows and doors (35%), covering gaps and vents (31%), installing gutter protection (25%) and covering underfloor spaces (20%).
Survey results concerning planning and preparedness should be interpreted with caution. Respondents’ assessments of their preparedness are inevitably framed by their degree of knowledge about bushfires and of how to prepare, as well as their capacity to implement preparatory measures effectively. Almost half of the survey respondents (46%) rated their level of preparedness as high to very high, with the remainder assessing their preparedness as average (36%) or low to very low (17%). Despite this, almost three-quarters (72%) acknowledged that they could have been better prepared.

4.3 Intended responses

A broad range of factors influenced intended responses, including: age; physical capacity, mobility and health; responsibility for children, the elderly and others who require assistance; responsibility for pets and livestock; the location of property; perceptions of preparedness and capacities to defend; and the presence or absence of household members during the fire. Respondents were asked what, prior to February 7 2009, they had thought they would do if confronted by a bushfire. Half reported their intention to stay and defend throughout the fire (50%), while less than a fifth (19%) intended to leave before they came under threat (i.e. ‘early’). Just 22 respondents (< 2%) had intended to leave their homes because it was a day of high fire danger (regardless of whether a fire had started).

Analysis revealed a gender dimension to intended responses. A greater proportion of men (56%) intended to stay and defend throughout the fire than women (42%), who more often wanted to leave as soon as a fire was threatening than men (23% and 11%, respectively). A chi-square test confirmed that the association between these variables was statistically significant, $X^2 (7, N = 1134) = 50.25, p = < .0001$. These findings are consistent with research
on gendered responses to bushfire, which has found that women are more likely to want to evacuate when confronted by bushfire (see Eriksen et al., 2010).

Significantly, more than one-quarter of survey respondents (26%) were effectively undecided, intending to stay and defend but leave if they felt threatened (17%) or to wait and see what the fire was like before deciding to stay or leave (9%). Those who were not fully committed to leaving early or staying to defend were effectively adopting a ‘wait-and-see’ strategy. ‘Wait-and-see’ strategies greatly increase the risk of late and dangerous evacuations. As noted above, the opportunity for safe evacuation is likely to have passed once a fire has reached or is in close vicinity of a person’s home or property.

4.4 Warnings

Warnings played a pivotal role in household responses to the fires. As noted above, the extreme fire weather experienced on February 7 had been accurately forecast, and authorities had warned of the potential for the worst fire danger in Victoria’s history. Indeed, 99% of survey respondents claimed to have known that February 7 was a day of Total Fire Ban. However, interviews revealed that these warnings did not necessarily lead to greater alertness or pre-emptive action (see Whittaker et al. 2009a).

While the majority of respondents (62%) did not receive an ‘official’ warning from police, fire or emergency services, many (63%) received an ‘unofficial’ warning from family, friends or neighbours. Environmental cues such as seeing flames and smoke were also important in alerting people to the fires. However, the extreme heat on February 7 appears to have reduced people’s receptiveness to warnings and environmental cues, with many taking shelter from the heat inside their darkened, air-conditioned homes.
4.5 Actual responses

The majority of respondents (53%) stayed to defend their homes and properties from the fires. Of these, around one-third left during the fire because of perceived danger, failure of equipment or utilities, or because the house caught fire. 43% of respondents left their homes or properties either before or when the fires arrived in their area. A small proportion (4%) reported that they sheltered inside a house, in a structure other than a house, in a vehicle, or somewhere outside.

Those who left

A greater proportion of women (54%) left their homes and properties before or during the fires than men (35%). Just over half of these respondents (54%) considered themselves to have left late or very late, with 16% leaving within 20 minutes of the fire arriving and one quarter (25%) leaving once the fire had arrived. The vast majority (80%) perceived the level of danger to be high or very high when they left, with many experiencing difficulties associated with smoke (55%), poor visibility (35%), traffic (30%), embers (29%), flames (26%) and fallen trees (16%).

The vast majority of those who undertook late evacuations arrived at their destination unharmed. Consequently, most indicated they would take the same action if there was a similar fire in the future (74%). They often explained that life is more important than property, and that staying to defend is not worth the risk. Importantly, however, most did express an intention to leave earlier. Those who said they would stay and defend against future fires often explained that their circumstances had changed (e.g. no longer responsible for children or the elderly) or that they were now better prepared and able to defend.
Those who stayed

Reflecting the data on intended responses, a greater proportion of men (62%) stayed and defended than women (42%). Most stayed to protect assets from the fires (83%); however, some stayed because they felt it was too late to leave (9%) or because their attempts to leave were unsuccessful (3%). Those who stayed because it was too late to leave, or because they were unable to leave, suffered double the rate of house destruction (31%) than those who stayed because they wanted to protect their house and other assets (16%), highlighting the importance of prior planning and preparedness. Nevertheless, most had felt confident they could do what was required to protect themselves and others (78%) and their house and property (69%).

Many of those who stayed to defend received help from members of their household (50%), family, friends and neighbours (48%) and/or fire and emergency services (13%). Such help appears to have influenced patterns of property loss, with higher rates of house destruction among those who did not receive help (3 in 10 destroyed) than those who were helped by household members (1 in 10), family, friends and neighbours (1 in 10) and fire and emergency services (3 in 100).

One-third (38%) of those who stayed to defend left at some stage while their property was under threat. The most commonly cited reason for leaving a house or property was that it was too dangerous to stay and defend (44%). Other reasons were that there were flames in the immediate vicinity of the property (33%) and to remove other household members or visitors from danger (26%). One-quarter left because utilities or equipment failed (26%) and/or because their house caught fire (18%). Many of these residents reported encountering the
same dangers as those who evacuated late, such as smoke (74%), embers (59%), poor
visibility (56%), flames (56%) and fallen trees (37%).

The majority of respondents who stayed with their home or property indicated that they
would take the same action if there was a similar fire in the future (76%). This is reflective of
the success of the PSDLE approach for most people during the February 7 fires, and the fact
that many now feel better prepared and more capable of defending against bushfire. Those
who said they would leave in the future tended to have negative experiences of staying, and
were not willing to risk their or others’ lives to protect property.

Relationship between intentions and actions
Figure 2: Action taken, by intention²

² Percentages may not total 100% due to rounding.
Figure 2 charts intended responses against actual responses to the February 7 fires. The majority of those who intended to stay and defend throughout the fire did so (72%). Importantly, the majority of those who intended to stay and defend but leave if threatened ended up leaving (79%). Similarly, most of those who intended to see what the fire was like, or wait for advice from emergency services, left once the fire had arrived (63% and 52%, respectively). Those who intended to leave as soon as they became aware of a fire most often left, either before or when the fire arrived (48% and 43%, respectively). It is significant that the majority of those who intended to leave on all high fire danger days (n=22), regardless of whether there was a fire, left before the fire arrived (91%).

Relationship between household response and house damage

One-third (33%) of survey respondents reported that their house was destroyed in the fires, with the highest rates of destruction (the percentage of houses lost in each area) in the Murrindindi (47%), Churchill (39%) and Kilmore East (33%) fires.
Figure 3: House damage, by household action³

Rates of house damage and destruction were considerably lower among households where residents stayed and defended (Figure 3). In households where at least one person stayed and defended, just two in ten houses were destroyed. In households where all householders left, or sheltered without defending, five in ten houses were destroyed. A chi-square test confirmed that the association between these variables was statistically significant, $X^2 (3, N = 1264) = 167.01, p = < .0001$.

5. Discussion and conclusions

The findings in this paper largely reinforce past bushfire research, while providing new insights into a range of community safety issues. Arguably the most important debate following the Black Saturday fires concerned the appropriateness of the PSDLE policy and its implementation by authorities and residents. The fact that 113 of the 173 fatalities

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³ ‘Stay and defend’ includes households where at least one person stayed and defended, while ‘Leave / shelter’ includes households where all members left and/or sheltered without defending.
occurred inside houses meant that the policy and its evidence base were scrutinised. Critics argued that the policy, as implemented, had contributed to fatalities by encouraging people to stay and defend homes that were not defendable under such extreme conditions. However, critics typically assumed that those who died had been defending at the time of death. Subsequent analysis of the fatalities found that more than two-thirds (69%) had been sheltering passively when they perished (Handmer et al. 2010). While some of these people may have attempted to defend before taking shelter, ‘… few fatalities were found near evidence of the means of firefighting… and positions of bodies, such as bodies found in a lying position, or in the bath, suggest passive sheltering rather than active defence’ (Handmer et al. 2010, p. 25). More broadly, the analysis revealed a lack of fire risk awareness among those who died, and a limited degree of planning and preparedness (Handmer et al. 2010).

Results presented in this paper suggest varied levels of awareness, planning and preparedness among those affected by the fires. As has already been noted, these results must be interpreted cautiously due to the possible effects of hindsight bias (Bradfield and Wells, 2005) and highly varied perceptions of what constitutes adequate planning and preparedness. Most respondents claimed they had previously thought it likely that a bushfire would occur where they lived (78%) and rated the threat as high or very high (67%). Lower levels of bushfire awareness were recorded in more suburban locations (e.g. in or on the outskirts of towns or regional cities) where many residents did not have prior experience or knowledge of bushfire and had not considered themselves at risk. These results probably exaggerate awareness levels prior to Black Saturday and certainly say little about people’s understandings of bushfire risk. In any case, research has shown that awareness of risk does not necessarily spur planning and preparedness (Berringer, 1998; McGee and Russell, 2003; Eriksen and Gill, 2010; Prior, 2010).
Findings related to planning and preparedness are similar to those for awareness, with most respondents assessing their preparedness level as ‘high’ to ‘very high’ (46%) or ‘average’ (36%). Clearly, these findings obscure considerable variation in the quality of people’s plans and preparation, which was apparent in the qualitative component of the research (see Whittaker et al., 2009a). As has been found in other studies (e.g. Bushnell et al., 2007; Rhodes 2007), the most common preparations undertaken by residents were low-cost and ‘easy to do’ actions such as clearing leaves and grass from around the house and obtaining equipment such as ladders, buckets and mops. These actions are often part of general property maintenance and may not be undertaken with the intent of preparing for bushfire. It is significant that almost three-quarters of the survey respondents thought they could have been better prepared.

Media coverage and public debate after the fires understandably focused on the many deaths and property losses. Less prominent were the stories of people who stayed and successfully defended their homes and properties. The research reported in this paper revealed a survival rate of 77% for houses that were defended by one or more household members, and 44% for houses that were unattended. These results are comparable to the house survival rates recorded by Wilson and Ferguson (1984) in the Ash Wednesday fires at Mt Macedon (90% for houses that were actively defended; 82% for attended but not actively defended houses; and 44% for unattended houses). There are, of course, many other factors that influence house survival in bushfires. Research has identified links between house loss and weather conditions (e.g., Bradstock and Gill, 2001; Blanchi et al., 2010), fire severity (Wilson and Ferguson, 1986), distance to bushland (Crompton et al., 2010) and the design and

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4 These figures exclude the small proportion of houses that sustained major damage (4% of defended and 2% of unattended houses).
construction of buildings (e.g. McArthur and Lutton, 1991; Blanchi and Leonard, 2008).

While in-depth investigation of these factors is beyond the scope of this paper, resident planning and preparation was investigated as a means for reducing risks to property. Results indicate a higher rate of house survival among households where there was a firm, pre-existing intention to stay and defend. Houses were also more likely to survive when defended by more than one person. The fact that 77% of those who stayed to defend were able to protect their house from the fires reinforces that ‘stay and defend’ is a viable alternative to evacuation when residents have undertaken appropriate planning and preparation, and are assisted by others.

Clearly, however, the results of this study highlight a number of problems and challenges for the PSDLE approach and for community bushfire safety more broadly. Although late evacuation is an inherently dangerous response to bushfires (Wilson and Ferguson, 1984; Krusel and Petris, 1992; Handmer and Tibbits, 2005; Haynes et al., 2010), it was an effective response for the majority of those who did so in the Black Saturday fires. Most of those who undertook late evacuation arrived at their destination unharmed, despite 80% perceiving the danger to be high or very high when they left and more than half encountering dangers associated with flames, embers, smoke and fallen trees. Importantly, however, 24 (14%) of those who perished in the fires were fleeing on foot or by car (Handmer et al., 2010), highlighting that late evacuation remains a dangerous response to bushfire.

The viability of the PSDLE policy was a key issue for the Royal Commission. It acknowledged that ‘… the central tenets of the stay or go policy remain sound’ but concluded that the February 7 fires had exposed weaknesses in the way it was applied’ (Teague et al., 2010, p. 5). The Commission found that the policy did not account for ‘ferocious’ fires, and
recommended greater emphasis on the increased risks to life and property ‘on the worst days’ and on leaving early as the safest option. These are now key messages in the national ‘Prepare. Act. Survive.’ strategy (AFAC, 2009). To better communicate the risks to life and property on the days of highest fire danger, the Commission also recommended that Fire Danger Ratings be revised to include a rating beyond ‘Extreme’. This led to the development of the ‘National Framework for Scaled Advice and Warnings to the Community (AEMC, 2009) and the introduction of the ‘Catastrophic/Code Red’ rating. In Victoria, the CFA has developed ‘scaled advice’ to more clearly communicate what residents can expect and what they should do for different levels of fire danger (CFA, 2012). Residents are advised that homes are not designed or constructed to withstand fires burning under ‘Catastrophic’ conditions, and that leaving high bushfire risk areas the night before or early in the day is the safest option.

The tendency for people to wait until a fire arrives before deciding whether to stay and defend or leave is a perennial challenge for fire services (Rhodes, 2005; Whittaker and Handmer, 2010; Teague et al., 2010). This study found that around a quarter of respondents adopted a ‘wait and see’ strategy in the Black Saturday fires, a strategy that greatly increases the likelihood that people will undertake late and dangerous evacuations or become trapped in a shelter that cannot be defended. Importantly, the Royal Commission recognised that the binary approach of ‘Prepare, stay and defend or leave early’ does not adequately reflect the reality of what people do during bushfires: ‘… the reality [is] that people will continue to wait and see, and a comprehensive bushfire policy must accommodate this by providing for more options and different advice’ (Teague et al. 2010, p. 5). In response, the CFA and Victorian local governments have designated ‘Neighbourhood Safer Places’ as places of last
resort, while the Australian Building Codes Board is developing standards for the design and construction of bushfire bunkers for personal use.

Many of the changes initiated by the Royal Commission have the potential to increase community bushfire safety. However, they are no panacea. As this and other research has shown, having an intention to leave early does not necessarily mean that people will do so. Confusion over the meaning of ‘leave early’ and difficulty recognising when it is too late to leave (Tibbits and Whittaker, 2007) means that many of those who intend to leave early undertake late evacuations. ‘Code Red’ warnings were introduced to alert residents to the potential for catastrophic bushfires and to encourage them to leave early. However, research following a Code Red declaration a year after Black Saturday found that very few residents actually left their homes in the absence of a fire (see Whittaker and Handmer, 2010). The frequency of high fire danger days in summer, and the relative infrequency of bushfires, means that leaving when there is no fire is impractical for most residents (Tibbits and Whittaker, 2007; Johnson et al., 2012). The introduction of community refuges and personal bunkers may have expanded the range of options available to residents in high bushfire risk areas; however, the possibility of last minute evacuation to a nearby place of refuge may serve to discourage appropriate planning and preparation.

The results presented in this paper indicate that staying to defend or leaving when threatened, while not without their risks, were effective responses for most people in the Black Saturday fires. Nevertheless, 173 people did lose their lives, including many inside houses. The results of this study highlight that people who are inadequately prepared and who take action at the last moment are more likely to be forced into dangerous responses such as late evacuation, untenable defence and passive shelter.
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