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3 4 5 **Examining bushfire policy in action: Preparedness and behaviour in the 2009 Black** 6 **Saturday fires**

7
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14

15 **Abstract**

16 An important part of reducing the risk of disaster is the preparedness of the people at risk.
17 Australian bushfire authorities have policies and publicity about what households should do
18 to be prepared – which include knowledge about fire risk, awareness of one's own risk,
19 taking specific steps to reduce risk including having an emergency plan. Yet, there is sparse
20 empirical evidence about the link between preparedness and actual behaviour in the face of a
21 major disaster.
22

23 The authors had an opportunity to examine the circumstances surrounding the 172 civilian
24 fatalities which occurred in the 2009 Victorian 'Black Saturday' bushfires, through the
25 examination of a detailed fatality dataset compiled by the Victorian Bushfires Royal
26 Commission. For the first time, this dataset allows detailed examination of Victorian bushfire
27 safety policy ('Stay or go') in action on a day of extreme fire danger: from preparedness
28 (both before and on the day of the fire) to behaviour on the day of the fire itself.
29

30 This analysis presents three overarching findings. First, some aspects of 'Stay or go' appear
31 to be supported: being well-prepared to evacuate remains the safest option in a bushfire;
32 sheltering passively is very dangerous. Second, successful implementation of 'Stay or go'
33 depends on a multitude of factors, which can challenge even the most capable householders.
34 Third, events like Black Saturday challenge the 'Stay or go' approach, and indicate the need
35 for a different approach on extreme fire danger days. We conclude by reflecting on the
36 findings from this research in terms of the most recent changes to bushfire policy in Victoria.
37
38

39 **Keywords**

40 preparedness, behaviour, wildfire, safety policy, vulnerability
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42

43 **Highlights**

- 44 • Study examines preparedness and behaviour in the face of an extreme bushfire event
 - 45 • Method uses unique fatality dataset comprising police, forensic and other records
 - 46 • Preparation for bushfire requires triggers for action and contingency plans
 - 47 • Understanding preparedness to defend is important in case evacuation becomes unsafe
 - 48 • Community bushfire policy remains challenging, especially under climate change
- 49

1. Introduction

It is orthodoxy amongst Australian and international emergency service agencies that those at risk need to be well prepared in order to undertake risk mitigation behaviour. Much effort is thus expended in communicating the nature of the risk, the need to plan for local circumstances (including having a household plan) and the need for emergency kit. For bushfire, specific behaviours may be advocated including the need to modify buildings and gardens to improve safety; or the need to leave an area in order to avoid danger on high-risk days (e.g. CFA 2013). Survey data shows that some (up to half in some areas) of the households in wildfire (or bushfire) prone areas have acted on such advice, and have taken wildfire related preparedness measures, including having a household plan (Whittaker et al. 2013, McLennan et al. 2015).

Problems can arise however in the quality or appropriateness of plans, how effective the preparedness approaches are, or how thoroughly people are able to implement their plans. Much published research on householder preparedness emphasises awareness, perception and knowledge of fire risk; and on measuring specific preparatory behaviours, such as having an emergency kit or a water pump for firefighting (McLennan et al. 2014). In effect, this research typically assesses preparedness on the basis of self-assessment of plans and intentions; whereas research examining preparedness against outcomes in the event of a fire is rare.

One study that has examined the relationship between preparedness and outcomes is Haynes et al. (2010; also Blanchi et al. 2014). This Australian research drew on coronial reports of bushfire fatalities between 1900 and 2008, and showed that the majority of fatalities occurred as people were carrying out a planned action. This highlights that it is problematic to assume a direct link between preparedness (especially as measured by the proxy of having a fire plan) and effective risk-mitigation behaviour when confronted by bushfire. However, the Haynes et al. paper did not examine the most recent, and catastrophic, Australian fire. The 2009 Black Saturday bushfires killed 172 civilians, had associated costs of over \$3.5 billion, and was proclaimed as Australia's worst bushfire disaster. Scholarly work has yet to examine how the relationship between preparedness and behaviour plays out in situations of extreme fire danger. Understanding this relationship is especially important as anthropogenic climate change will impact on people's ability to manage fire risk through both extended fire seasons and more severe fire weather (Clarke et al. 2011), and increased heat wave frequency and duration (Alexander and Arblaster 2009).

Here, we examine bushfire policy in action, through an exploration of preparedness and behaviour among those who died in the 2009 Black Saturday fires. This paper arose from the authors' involvement in the 2009 Victorian Bushfires Royal Commission, a public enquiry established after the fires. The authors were asked to review the fatality data collected by the Commission immediately following the fires, and to examine 'the implications of the fatality dataset for the "Stay or go" policy and for broader community safety action and communications' (Handmer et al. 2010: 9). To do so, the Commission provided access to a fatality dataset with details for each of the 172 civilian fatalities. In this paper, we analyse the dataset using criteria for preparedness and behaviour developed from both bushfire safety policy documents and the research literature. This allowed us to examine bushfire policy in action on a day of extreme fire danger: from preparedness (both before and on the day of the fire) to actual behaviour on the day of the fire itself.

1 **1.1 The evolution of the ‘Stay or go’ policy**

2 Householders staying and protecting their property during bushfires has a very long history,
3 especially in rural Australia. Lived experience of those at risk of bushfire was that a building
4 protected people from the radiant heat, smoke and embers of a bushfire as the firefront passed
5 through the area; and that active defence of the property (for example, putting out spot fires
6 in the roof eaves before and after the firefront passed over) ensured the viability of the
7 building as a protective structure. This approach formed the basis of the policy ‘Prepare, stay
8 and defend, or leave early’; known colloquially as ‘Stay or go’: being prepared to stay and
9 defend a well prepared property, or having pre-defined triggers to leave well before the fire
10 arrived. This policy was formally adopted by all Australian fire agencies in 2005, although it
11 had long been the unofficial position in some southern states.

12
13 To be effective, the stay and defend part of ‘Stay or go’ makes a number of major
14 assumptions regarding the nature of fire risk including: that there is a single fire front which
15 passes over the building within ~20 minutes (during which people need protection from
16 radiant heat) and that the property itself, and its location, result in a defensible structure
17 (Lazarus and Elley, 1984). Academic work has shown that ‘Stay or go’ was a well-founded
18 policy for historic data, in terms of protecting householders and property from fire risk
19 (Handmer and Tibbits 2005; Handmer and Haynes 2008).

20 21 **1.2 Householder preparedness and ‘Stay or go’**

22 The UN-ISDR (United Nations Office for Disaster Risk Reduction) defines preparedness as
23 the ‘knowledge and capacities [of people and institutions] to effectively anticipate, respond
24 to, and recover from, the impacts of likely, imminent or current hazard events or conditions’
25 (UN-ISDR 2007). As well as assumptions about property defensibility, and number and
26 duration of fire fronts, the ‘Stay or go’ policy assumed a level of householder preparedness
27 (e.g. CFA 2003; Tibbits et al. 2008). In different forms these assumptions apply to most
28 natural hazards (Wisner et al. 2004).

29
30 First, ‘Stay or go’ assumed an *awareness of the fire risk*. People are unlikely to prepare unless
31 they appreciate that a risk has relevance for them or their household. People may be unaware
32 of bushfire risk if they are unfamiliar with a location: for example, if they are holidaymakers
33 or recent migrants to an area.

34
35 Second, the policy assumed some *knowledge to mitigate fire risk*. This knowledge is both in
36 preparation for, and in the event of, a fire. Preparatory activities might include modifications
37 to buildings (such as installing water tanks and pumps, or water sprinkler systems) and
38 gardens (such as cutting down overhanging trees, or planting non-flammable species) to
39 improve risk management in the event of a fire. Knowledge also includes that needed to deal
40 with an impending fire risk, such as the need to patrol the property to put out spot fires and
41 prevent ember ignition if defending a property, or carrying drinking water and a blanket in a
42 vehicle in order to more safely evacuate a fire-threatened area. Note that experience from
43 previous knowledge of fire may act to inhibit appropriate response instead of facilitate
44 effective risk-reduction behaviour: peoples’ circumstances may be very different for different
45 fire events, for example they may be much older, with an (unrecognised) subsequent
46 reduction in firefighting ability (Kates, 1962).

47
48 Third, ‘Stay or go’ assumed that people had the *capacity to actively defend their property* and
49 that vulnerabilities would be managed (VBRC 2010a). People needed to have the physical
50 and mental capacity to undertake risk-reduction behaviours for their property before and

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1 during the fire event. If this was not the case (for an acute reason, such as consumption of
2 alcohol; or for an ongoing reason, such as an long-term health issue or age), then it was
3 assumed that they would evacuate rather than attempt to defend their property. The capacity
4 to actively defend also depends on being able to defend a particular property during a
5 bushfire. Property defence is impeded by the presence of heavy fuel loads close to the
6 property (e.g. trees overhanging the house), a property on a slope of greater than 10° (uphill
7 slopes cause fire acceleration), and by large or complex property structures (for example, it is
8 more difficult to detect ember attacks in multi-pitch roofs).

9
10 Last, the policy assumed the presence of a *fire plan detailing clear, effective and appropriate*
11 *behavioural intentions in the event of a fire*. Making a fire plan requires some assessment of
12 the costs, risks and benefits of the available options, and a commitment from all involved to
13 follow a particular strategy in the event of a fire. Effective fire plans take into account
14 different likely scenarios, for example, how a fire event will be handled for both regular
15 weekday and weekend household schedules; as well as for other events (such as the presence
16 of visitors, or a sudden family illness or injury). A contingency plan should also be present
17 (e.g. what to do if the household's original intention to stay and defend becomes untenable).
18 A known clear and specific trigger is required to implement the plan.

19
20 The policy mandated two options to mitigate risk from bushfire, preparing to stay and protect
21 the building from the fire ('stay and defend') or preparing to evacuate the area early on a day
22 of predicted fire danger ('leave early'). Other options were possible, but were not endorsed
23 and are much more risky: for example, waiting to see what might happen ('wait and see') –
24 likely to lead to a dangerous last-minute evacuation in the face of a firefront (Whittaker et al.
25 2013); or sheltering from the fire without undertaking active defence ('sheltering passively')
26 and risking the refuge building catching fire.

27
28 Arguments against the approach have concerned the reality of the above assumptions - eg.
29 that a significant proportion of those at risk would defer any decision until they were directly
30 threatened by a nearby fire (Whittaker et al. 2013) - and the presumed relative effectiveness
31 of mass evacuation. The latter point being made by US researchers in particular (eg Cova et
32 al. 2009).

33 34 **1.3 Examining 'Stay or go' in a catastrophic bushfire**

35 This paper examines how 'Stay or go' was challenged by a catastrophic bushfire event,
36 through the experience of the 'Black Saturday' bushfires.

37
38 Saturday 7 February 2009 brought the worst fire danger day in the Australian state of
39 Victoria's history. The weather conditions were significantly worse than predicted with a
40 record high in the state capital's (Melbourne) CBD of 46.4°C (2.5°C hotter than the previous
41 record), higher temperatures elsewhere in the state, very strong winds, and extremely low
42 humidity (Karoly 2009). The day followed more than a decade of record-breaking hot and
43 dry weather for the state: the hottest and longest drought, and the most severe heatwave on
44 record the previous week (Karoly, 2009).

45
46 These severe weather conditions led to warnings during the preceding week that severe fires
47 were likely on February 7 2009, including the warning that the day could see the worst fire
48 danger risk ever recorded. The state Premier and the Chief Fire Officer both issued high
49 profile warnings for the weekend of February 7-8, 2009. By early afternoon on February 7,
50 these concerns were realised with several intense and fast moving bushfires across the state.

[Type text]

1 The fires claimed 172 civilian lives and about 2100 homes (VBRC, 2010a). They became
2 known as the ‘Black Saturday’ bushfires.

3
4 To conclude, the ‘Stay or go’ policy approach makes a number of assumptions, both about
5 the inherent defendability of a property, and about the level of preparedness of people
6 exposed to fire risk. We now examine levels of preparedness and behaviour associated with
7 the 2009 Black Saturday bushfires.

8 9 **2. Method**

10
11 The Victorian Bushfires Royal Commission provided a summary document for each of the
12 172 civilian fatalities. This material was based on detailed statements collected by the Police
13 as part of their investigations into the fatalities from friends, family and neighbours of the
14 deceased. These statements provided detail about the level of preparations that people had
15 attempted, both before and on the day of the fire, and about their intentions and actions on the
16 day. The summaries included details of forensic investigations (for example, where and in
17 what condition fatalities were found; whether there was evidence of firefighting equipment,
18 including its possible failure; and so on). They detailed telephone and SMS text records (the
19 mobile phone network remained operational), enabling accurate timestamps to be put on
20 particular events (such as a last known location and time before death). Medical issues
21 affecting each fatality were included. There was also detailed information on house
22 construction and the surrounding vegetation for each location where there were fatalities.
23 This was one of the more thorough datasets of deaths from a disaster triggered by a natural
24 phenomenon, nevertheless it is of uneven quality and far from perfect. See Part 1 of the report
25 to the Royal Commission: Handmer et al. (2010) for more detail.

26
27 Published material giving bushfire preparation advice is widely available from the Australian
28 fire agencies (e.g. CFA 2008, CFA 2013, NSW RFS 2015). This includes information on
29 how to prepare people and households for the risk of fire, and advice for dealing with the fire
30 itself. In addition, the policy literature on disaster and bushfire preparedness (as above) was
31 consulted. This material was used to define a pilot coding scheme for analysing the fatality
32 dataset, assisted by Damien Killalea, Director of Community Fire Safety, Tasmania Fire
33 Service, a policy expert on community fire safety. The two authors then used the pilot coding
34 scheme to undertake independent double-coding of 40 fatality cases. Each case was discussed
35 in detail, and the coding scheme further refined. The authors then single-coded the remaining
36 92 cases, with any uncertainties raised and resolved through discussion. Percentages are of
37 the total of 172 deaths. The final coding scheme is summarised below in ss2.1 and 2.2. For
38 details, see Handmer et al. (2010).

39 40 **2.1 Coding preparedness**

41 Activities were counted as preparing for the risk of fire when they were undertaken before
42 February 7, 2009, and up to 1.30pm on the day of the fires. Bushfire preparedness material
43 from the Victorian CFA (Country Fire Authority) advises that preparations are completed
44 before the day of fire arrival. However, the coding scheme recognised preparations on the day
45 as having value. The 1.30pm cutoff between preparedness and response was applied because
46 this is when the Hume Highway (the main north-south route across the state) was closed by
47 an out of control fire, and when fires started burning through towns on the northern outskirts
48 of Melbourne, rendering it too late for further substantial preparations. In assessing
49 preparedness we looked for (also see s1.2):

[Type text]

- 1 • Evidence of *awareness* of the risk (evidence required of fatalities discussing the general
2 risk of bushfire; i.e. they knew they were in an area at risk from bushfires).
- 3 • Evidence of *knowledge* of actions to mitigate fire risk (evidence of knowledge of basic
4 actions to mitigate fire risk; e.g. patrolling property to guard against ember attack, or
5 evacuating the area early in a vehicle with drinking water and a blanket). This included
6 recording evidence of whether the fatality had previous bushfire experience.
- 7 • Evidence of a *fire plan*. As a minimum, oral evidence of fatalities discussing a fire plan,
8 though ideally, a written fire plan would exist. Evidence of the existence of a fire plan but
9 with no details of what that plan contained was not sufficient.
- 10 • Evidence for a clear *intention* to act on the day (to stay and defend; leave; do nothing;
11 wait and see; stay and shelter; or whether there were no intentions evident – and a trigger
12 for action for implementing intentions); and any evidence as to why this intention
13 changed on the day.
- 14 • The *capacity* to carry out intentions, as influenced by:
 - 15 a. Presence of a chronic (e.g. mobility, heart disease) or acute (e.g. alcohol, drugs,
16 fatigue) *physical or mental disability* pre-fire arrival
 - 17 b. *Age* (those 11 years or under, or 70 years or older were assumed to have less
18 capacity. See s3.3 for the age cutoff rationale.)
 - 19 c. Likelihood of *property defendability* (were concerns raised by fire investigators
20 over property defendability, or problems with water supply?)
- 21 • Level of *preparedness*:
 - 22 a. *Well prepared to stay and defend*: Evidence of fuel management around the
23 property; appropriate fire-fighting gear and clothing (minimum of buckets and
24 mops); of an independent water supply (by one or more of a dam, tank, pool or
25 creek. If properties did not have a gravity fed water supply, evidence was needed
26 of a connected diesel or petrol pump, or an electric pump connected to a
27 generator). The 7 cases where people were well prepared for sheltering are
28 categorised here, as aspects of the preparedness are similar.
 - 29 b. *Some preparedness to stay and defend*: Evidence of some fuel management,
30 appropriate clothing and fire-fighting gear (minimum of buckets and mops) and of
31 a small independent water supply (minimum of troughs or buckets around the
32 property).
 - 33 c. *Well prepared to evacuate*: Evidence of a clearly defined destination and trigger to
34 leave.
 - 35 d. *Some preparation to evacuate*: Evidence of a potential destination, and/or a vague
36 trigger to evacuate.
 - 37 e. *No preparation*: No evidence of any prior preparations.

38 39 **2.2 Coding behaviour on the day**

40 In coding behaviour on the day, we considered (specific examples are set out in the following
41 sections of the paper):

- 42 • Whether the person was *taken by surprise* (finding out that a fire was threatening less
43 than one hour before the firefront arrived) (See s4.2 for additional detail)
- 44 • Evidence of receiving a direct and official *warning* about fire; and whether they had
45 *activated their trigger for action*
- 46 • *Action at the time of death*: sheltering passively (and in what location); undertaking some
47 (may have been potentially questionable) defence; undertaking active defence; left late
48 (whether on foot or vehicle); other activities (including doing nothing; death post-fire;
49 travelling by car). Note that the coding scheme was non-exclusive, in that it allowed for
50 multiple activities to be coded (so if there was some evidence of defence, but the fatality

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1 was found sheltering, it was coded under both ‘some defence’ and ‘sheltering’). This
2 more accurately captures the reality that many people did not simply commit to and
3 undertake a single course of action on the day (see Supplementary Material (SM), Point
4 1).

6 **3. Results and discussion: preparedness**

8 To recap, the policy assumed a number of preconditions for preparedness. First, people
9 needed to be aware that there is a risk and know what to do about it. Second, based on this
10 knowledge, they would have a fire plan (including a contingency plan and a clear trigger for
11 action) with a clear intention to carry out a particular course of action. Third, for this
12 sequence of events to be effective, those involved needed to have the mental and physical
13 capacity to act; and if the plan is to stay and protect property, the property needed to be
14 defensible. Preparedness results are summarised in Table 1.

16 **3.1 Awareness and knowledge**

17 Awareness of bushfire risk was not universal, with a quarter of fatalities (24%) not appearing
18 to have even a basic awareness that they were in an area at risk of bushfires. The fire risk
19 knowledge criterion was set at a basic level, and yet a large minority of the fatalities (38%)
20 did not appear to meet this classification. A slightly higher proportion of men held knowledge
21 than women, but the difference was small. There were significant age differences however,
22 with a strong majority of those over 30 being classified as having fire knowledge, with the
23 most knowledgeable being the over 50s (approximately 70% with knowledge). In some cases,
24 a lack of awareness may have been because fatalities were unfamiliar with the area. For
25 example, some fatalities were house-sitting, and others were visiting the area. Nevertheless,
26 there had been extensive media coverage of the danger the week before the fire. There was no
27 evidence that prior experience of bushfires was an advantage – although this would have
28 resulted in greater levels of fire knowledge. For many, the last significant bushfire experience
29 is likely to have been the Ash Wednesday fires in 1983, 26 years previously.

31 **3.2 Plans and intentions**

32 There was evidence of a fire plan for around half (47%) of the fatalities, although their
33 quality was very variable and in common with other Australian research on bushfire plans,
34 few appear to have been written. This evidence came from Police interview statements of
35 friends and/or family of those who died. Few fire plans were comprehensive enough to
36 address all the issues necessary to cope with conditions experienced on that day, and
37 contingency planning, for use when the preferred course of action failed or was blocked, was
38 not mentioned. Simply having a fire plan did not appear to be related to better decision-
39 making. Problems with fire plans included: fire plans not known by all household members;
40 plans which only took account of people who were going to defend the property (not all
41 occupants); fire plans which failed to account for the presence of visitors or other
42 contingencies; and plans which set out high risk actions (e.g. planning to shelter in
43 bathrooms). Some (12%) intended to ‘stay and defend’ despite having no fire plan. A higher
44 proportion of those with plans were prepared compared with those without plans, although
45 nearly one third with plans were categorised as having no preparedness. Plans had a weak
46 influence on intentions and actions: those with plans were more likely to intend to defend and
47 to actually do so, and those without plans were more likely to have left late, but the
48 differences especially in terms of actions were small.

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1 On intentions, a third (34%) of fatalities intended to ‘stay and defend’ their properties (about
2 the same proportion of these were well prepared (13%), had some preparations (9%), or no
3 preparations (11%)), 8% intended to ‘stay and shelter’, and a quarter (26%) intended to ‘wait
4 and see’ before committing to a particular course of action. Some fatalities intended to
5 ‘leave’ (16%), although they were often waiting for an unclear or unlikely trigger to evacuate.
6 For a sizeable minority (15%), there was no evidence of any intention to act. One fatality had
7 made a conscious decision to do nothing.

8
9 Knowledge was related to intentions in that almost all who intended to defend were classified
10 as having fire related knowledge. However, it is important to note that knowledge was not
11 correlated with other intentions or actions. (See SM Point 2.)
12
13

Preparedness capacity	% of fatalities
No awareness of the risk	24%
No knowledge of actions to mitigate fire risk	38%
Presence of a fire plan	47%
Intentions pre-fire arrival	
Stay and defend	34%
Stay and shelter	8%
Leave	16%
Wait and see	26%
Do nothing	1%
No discernible intentions	15%
Capacity to carry out intentions (questionable, due to):	
Chronic physical or mental disability	24%
Acute physical or mental disability	5%
Age (<12 years or ≥70 years)	25% (9%, 16%)
Property of questionable defendability	32%
Level of preparedness by 1.30pm on day of fire:	
Well prepared to stay and defend	20%
Some preparedness to stay and defend	14%
Well prepared to evacuate	<1%
Some preparation to evacuate	5%
No preparation	58%

14
15 **Table 1. Levels of preparedness pre-fire arrival in the fatality dataset.**

16 Note ‘Level of preparedness’ does not sum to 100% because not all cases could be categorised.
17
18

19 **3.3 Capacity to act**

20 The capacity to carry out planned intentions is influenced by other factors, including the
21 presence of a chronic or acute physical or mental disability, age, and the defendability of the
22 property.
23

24 About a quarter (24%) of all fatalities had chronic clinical health conditions that possibly or
25 definitely affected their mobility, judgment or stamina. This is broadly in line with state-wide
26 figures, suggesting that in this respect the fatalities were not significantly more vulnerable
27 than the general population (ABS 2004). Chronic physical health conditions in the dataset
28 included degenerative diseases, morbid obesity and patients in recovery from medical
29 procedures. Chronic mental health conditions included depression and post-traumatic stress
30 disorder. Some fatalities had multiple conditions. A small proportion (5%) of fatalities was
31 affected by an acute physical or mental condition acquired on the day. These conditions
32 included exhaustion from last-minute preparation in the extreme heat, and indicators of

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1 alcohol intoxication. The proportion of fatalities with these acute conditions is probably
2 under-estimated as the provision of medical evidence about people's condition on the day
3 was limited. A comparison of disability with intentions shows little difference across
4 intentions, apart from that those with a disability were slightly more likely to intend to leave.

5
6 When the disability figure is added to the percentages of those who are senior (defined here
7 as 70 or older), and children (defined as under 12), the percentage of those who are likely to
8 be vulnerable is 44% of all fatalities. Comparing the age distribution of residents in the 2009
9 fire affected area with the fatalities reveals longstanding patterns: twice as many older people
10 (in the 70 and over category) and half as many children and teenagers (under 20 years old)
11 died than would be expected (Handmer et al. 2010). There is some evidence in Police
12 interviews that younger people especially children were more likely to be evacuated from the
13 fire risk area, reducing the likelihood of juvenile deaths. Older people have long featured
14 disproportionately in bushfire fatality data (eg Blanchi et al. 2014). The road transportation
15 literature provides a rationale for the 70 year old threshold as well as possible explanations
16 for the elevated death rate in bushfires. It suggests that declining vision and cognitive
17 function (eg judgement, concentration and reaction time) may impact older adults driving
18 ability (Owsley 2004; Merke 2009), and could have played a role in increased senior deaths
19 in the 2009 fires, especially in conjunction with the increased vulnerability to heat with age
20 (Worfolk 2000). The 12 year old cutoff is based on the age most airlines allow passengers to
21 travel unaccompanied (USDT n.d.).

22
23 Note that the gender split in the fatalities also reflected historical patterns (e.g. Haynes et al.
24 2010; Blanchi et al. 2014) with more men losing their lives than women (58% versus 42%).
25 (Table 2; also see the end of s4.2.)

26
27 Police interviews and evidence from fire investigators indicated that the defendability of
28 almost a third of properties (32%) was questionable due to the proximity of fuel load, steep
29 slopes, or property structure. It is unlikely that people could successfully defend such
30 structures during the 2009 fires, even if very well prepared. In terms of intent, a slightly
31 higher proportion of people intended to leave properties of questionable defendability. There
32 was no difference between properties assessed as defendable or otherwise in terms of the
33 types of action taken. (SM Point 3.)

Age group	Black Saturday 7 Feb 2009 (n=172)	Demographics of the fire affected area (S-W Goulburn Statistical District 2006**)	Bushfire fatalities 1956–2007/08.* (n=257)	Ash Wednesday (Vic & SA).* (n=60)
0–11	9	18	8	8***
12–19	7	12	6 (12-17)	5
20–29	8	9	10 (18-29)	20
30–39	12	14	12	13
40–49	13	15	9	7
50–59	22	14	13	18
60–69	14	9	16	15
70+	16	8	14	13
Unknown	-	-	11	-
Gender	Male 58% Female 42%	Male 50.6% Female 49.4%	Male 57% Female 38% Unknown 5%	Male 60% Female 40%

35

[Type text]

1 * Haynes et al. (2008)

2 ** This statistical district which includes much of the fire affected area north of Melbourne is used as a
3 surrogate for the actual area burnt (ABS 2007).

4 *** No children lost their lives in Victoria. The under 12 deaths are from South Australia.

5

6 **Table 2. Age and gender of fatalities in the February 2009 fires and other fires, compared with the**
7 **demographics of the area burnt in February 2009.**

8

9

10 **3.4 Assessing preparedness**

11 Despite generally having intentions to act, a majority (58%) of people had made no
12 preparations, or had not actioned their plans, by the 1.30pm preparedness assessment cutoff.
13 Around a third of people were either somewhat prepared (14%) or well prepared (20%) to
14 stay and defend. However, being classified as well prepared did not mean that fire-fighting
15 plans did not have serious weaknesses: for example, fire plans were compromised by plastic
16 hosepipe (which melted in the extreme heat), or by water pump placement on flammable
17 wooden stands. Only 5% of people had prepared to evacuate, with almost all having made
18 just some preparation – just one fatality was well prepared to leave (those well prepared to
19 leave would likely have left early and survived).

20

21

22 **4. Results and discussion: Behaviour**

23

24 Taking into account levels of awareness, knowledge, fire planning and intentions – mediated
25 by capacity – what was the actual behaviour of the fatalities in the time leading up to their
26 deaths? Results are summarised in Table 3.

27

28 **4.1 Fatality behaviour**

29 Police statements indicate that there was much activity after the 1.30pm preparedness cutoff.
30 This included activities for defence (e.g. hosing down the area around the property, filling
31 roof gutters with water, clearing flammable debris from around the property, sorting out fire
32 pumps, and changing into appropriate clothing) as well as for evacuation (such as packing
33 cars with valuables, or trying to locate household pets). The ‘Stay or go’ policy assumed most
34 of these activities would have been undertaken well in advance, and not as the firefront was
35 arriving. Leaving these activities until the last minute on a 46^o day would be likely to induce
36 stress and exhaustion.

37

38 Over two thirds (69%) of the fatalities were sheltering at the time of death. Indications of
39 sheltering rather than active defence included the position of bodies (such as in the bath),
40 indicating passive sheltering rather than active defence; and that fatalities were not found
41 near evidence of a means of firefighting (such as a bucket handle, or holding a hosepipe).
42 Over a quarter (27%) of the fatalities were found sheltering in a bathroom, or other small
43 room with just one exit (such as a cool room or laundry). Police statements record some
44 fatalities being advised to shelter in the bathroom by friends, family or officials. In some
45 cases, this was a last-minute decision as the fire encroached, but for others, it appeared to
46 form part of their intentions, or was even part of their fire plan. A smaller proportion (8%)
47 was sheltering in sheds, outhouses, spas, shelters or bunkers. In some cases, although the
48 shelter itself did not burn, the people inside were overcome by toxic gases. The remaining
49 34% of fatalities were sheltering elsewhere within the house, or their exact location within
50 the property could not be determined.

51

[Type text]

1 As mentioned earlier under “method”, the coding scheme was non-exclusive, in that it
2 allowed for multiple activities to be coded. Thus, where it appeared fatalities had been
3 undertaking some defence but were found sheltering, the case was coded under both
4 ‘sheltering’ and ‘questionable/some defence’. Almost a fifth (19%) of all fatalities were
5 sheltering but had perhaps undertaken some defence. However, the evidence for defence is
6 often unclear, and defensive actions often appeared to be minimal.

7
8 A significant minority (29%) had undertaken either ‘some defence’ (24%) or ‘active defence’
9 (5%). Evidence for ‘active defence’ was found in police statements about preparation and
10 equipment checks (e.g. neighbour witness statements about checking water pumps were in
11 working order); or forensic evidence of actions being undertaken to defend property at the
12 time of death (e.g. water taps in the ‘on’ position feeding a pump and connected to a hose,
13 near to where a body was found). Indications for ‘questionable or some defence’ included
14 evidence of some fire-fighting activity in the time leading up to (but not at the time of) death
15 (e.g. a water pump failure as the fire-front arrived causing a retreat to shelter; or where
16 fatalities were found sheltering but near firefighting gear such as hoses or buckets).

17
18 A contributing factor in some deaths appears to have been lack of appropriate clothing. Some
19 people and children, especially if expecting to leave, were wearing little more than bathing
20 costumes. This left them exposed to the full force of the fire’s radiant heat and to the risk of
21 fatal burns. It highlights how preparedness behaviour for one extreme event (heat) can
22 increase risk of another (fire).

23

Behaviour	% of fatalities
Taken by surprise	30%
Received a direct and official warning	9%
Action at the time of death	
Active defence	5%
Some (or questionable) defence	24%
Evacuating by foot	9%
Evacuating in a vehicle	5%
Sheltering passively, in:	
Small room with one exit (e.g. bathroom, laundry)	27%
Inside property (general, or exact location not specified)	34%
Structure separate to property (e.g. bunker, shed, spa)	8%
Other (e.g. dealing with livestock, camping, death post-fire)	9%

24
25 **Table 3. Behaviour on the day categorised from the fatality dataset.** Note that
26 the coding scheme was non-exclusive, in that it allowed for multiple activities
27 to be coded, so ‘Action at time of death’ does not sum to 100% (see Supplementary Material Point 1).
28 “Actions..” is also a proxy for location with those defending and sheltering in or very close to their homes.

29 30 **4.2 Comparing intentions and behaviour**

31 The difference between intentions and behaviour indicates a number of issues that prevented
32 plans from being fully implemented. These factors included: being taken by surprise; having
33 an inadequate trigger to implement plans; inadequate planning or changed circumstances; a
34 disability acquired on the day; and last-minute disagreements over planned actions.
35 Regardless of intention, most sheltered. The proportion of those who carried out their
36 intentions is highest among those intending to defend and those intending to shelter (Table 4).
37 These are also the people with the highest level of preparedness.

[Type text]

Intention	Action			
	Some defence	Active defence	Leave late	Shelter
Defend	25	9	3	39
Leave	2	0	4	23
Shelter	6	0	0	13
Wait & see/No intentions	9	0	17	43

Table 4: Intentions versus actions. Number of cases.

There is considerable evidence of fatalities being taken by surprise either by a threatening fire's existence, or by the fire arriving much sooner than expected. A significant minority (at least 30%) were taken by surprise by the existence of a threatening fire (defined as less than an hour between finding out and time of death), despite some of those fatalities having made a fire plan and having been classified as 'well prepared'. It is likely that a significantly larger proportion was surprised by the fire's intensity, rate of spread and the length of time taken for the front to pass (Whittaker et al. 2013). This is particularly the case for the fatalities that occurred following the late change in wind direction and sudden arrival of the firefront from a different direction. Whilst the wind change was well forecast, there was just 18 minutes from the wind change to the average time of the 34 deaths in the town of Marysville (VBRC 2010b). There was no significant difference between level of preparedness and being surprised. However, there was a difference with surprise and the action taken: with those defending being less likely to be surprised, and those leaving being more likely to be surprised. (See SM Point 4.) It appears that those defending were more aware of the fire environment.

Those over 30 years old mostly intended to defend or "wait and see". The main action however, across all age groups, was to shelter. A small proportion defended. (See SM Point 5.) We know that those who intended to defend were on the whole better prepared, and male (SM Point 6).

Activation requires some sort of trigger, which may be a specific warning or a high level of perceived threat. It appears that many people did not fully activate their plans, even disregarding the 1.30pm preparedness cutoff criterion. There was a widespread assumption that people would receive an official warning, or that they could obtain help by calling the national emergency number, triple zero. On the day of the fire, 72 % of emergency calls went unanswered (VBRC 2009: 294), with few (if any) receiving assistance after calling. Just 9% of fatalities appeared to have received a warning about the fire directly from an official source. However, nearly all were warned by neighbours, friends or relatives, or saw signs of a large fire approaching, and there had been extensive high profile media coverage of the risk over the preceding few days.

There is evidence of household disagreements as the fire approached. In virtually all cases this was between women who wanted to leave, and men who wanted to stay and defend. In some cases it appears that the differences were long standing, in other cases it was occurred when the fire was imminent. This finding aligns with work showing that gender is important in bushfire risk management in rural Australia (Eriksen et al. 2009), and with long standing research on gender and risk taking (Byrnes et al. 1999). Most of those who intended to stay and defend were men, and a majority of those who intended to leave were women. In terms

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1 of action, there was no gender difference with those who left late and those who sheltered,
2 but more men undertook defence. (See SM Point 6.) Last-minute disagreements and changes
3 of plans can undermine plans and preparations and lead to late evacuation, which is a
4 dangerous option (Handmer and Tibetts 2005).

5. Conclusions

8 The authors had an opportunity to examine the circumstances surrounding bushfire fatalities,
9 through the examination of a detailed fatality dataset compiled by the Victorian Bushfires
10 Royal Commission. This dataset has enabled an investigation of householder preparedness
11 and behaviour in the face of a devastating bushfire; and to examine bushfire public policy in
12 action – in the context of an extreme set of fires on a day of extreme heat. There are three
13 main conclusions with regard to the ‘Stay or go’ approach.

15 First, some aspects of ‘Stay or go’ appear to be supported by this analysis of the fatality
16 dataset. The almost complete absence of fatalities that were well-prepared to evacuate
17 suggests that this is the safest option in a potential bushfire situation, especially in extreme
18 conditions. The high proportion of fatalities apparently sheltering passively indicates that this
19 is a highly dangerous option. And, there were few deaths of people undertaking active
20 defence – so we may conclude that alert and capable well-prepared people can save
21 themselves and their properties from bushfire. These findings align with those of Haynes et
22 al. (2010).

24 Second, successful implementation of ‘Stay or go’ depended on some challenging
25 assumptions: those at risk understanding the risk and their limitations, knowing what to do,
26 being well prepared physically and mentally, being alert for sudden changes, being decisive,
27 and having fall-back or contingency plans. Properties needed to be well prepared and
28 defensible, and agencies needed to provide timely warnings and information on appropriate
29 action. All this needed to be accomplished without formal training for those at risk. The
30 findings presented here show that there are many links in the chain of preparedness, and any
31 one of them breaking can lead to fatal consequences. In particular, the considerable number
32 of fatalities found sheltering passively in a bathroom or similar indicates an area where public
33 education is required. Other actions could include fire agencies supporting those who are
34 especially vulnerable, including those for whom staying is not an option even in minor fires.
35 Individualised advice on property defendability, as has occurred in Tasmania, is also
36 important. One aspect of this is the vulnerability of older people who were twice as likely to
37 die as would be expected, and the gendered dimension of fatalities with men being
38 considerably more likely to die.

40 Last, the severity of the Black Saturday fires challenged the ‘Stay or go’ approach. Despite
41 warnings stressing the severity of the risk, there was a lack of appreciation that the state faced
42 exceptional conditions. Many people could not develop and implement appropriate effective
43 preparations and action, because of a mismatch between their plans and capacities and the
44 conditions on the day, because of the defendability of their properties, or because of a lack of
45 contingency plans if their preferred plan became untenable. This situation is especially
46 pressing in light of the likelihood of longer fire seasons and more extreme fires under climate
47 change (O’Neill and Handmer 2012).

49 The analysis also shows weak links between fire plans, preparedness, intentions and actions.
50 There are many obstacles to the development and implementation of high quality plans

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1 including people's idea of planning and plans, the priorities of day to day living, appreciation
2 of personal risk, and personal capacity.

3 4 **6. Policy reflections**

5
6 The Victorian Bushfires Royal Commission presented its final report in 2010, and many
7 changes to bushfire risk management have occurred since. Several of their Recommendations
8 have relevance for the discussion in this paper: first, that people with identifiable
9 vulnerabilities should be supported by fire agencies; second, that 'unacceptably high bushfire
10 risk' locations be abandoned; and third, that warnings should be improved. Warnings were
11 changed by fire agencies before the Commission issued its recommendations, however, the
12 first two recommendations have seen little change. Australian fire agencies committed
13 themselves to issuing public warnings, and changed the fire danger scale to give more
14 attention to extreme conditions. Standard warning messages were agreed for each level of the
15 scale, with a stronger emphasis on evacuation and safety (AMEC 2009).

16
17 Policy changes have also occurred in response to the fires and the Commission's
18 recommendations. The 'Stay or go' approach was changed to emphasise leaving early and the
19 importance of thorough preparation with the catch phrase: 'Prepare, act, survive'. The
20 approach was still essentially binary though and had trouble coming to grips with the
21 everyday complexity of living in a fire risk area (Rhodes 2014, Proudley 2010) and safety
22 related actions (Whittaker et al., 2013). For example, survey data from the time around Black
23 Saturday show that while most people knew that they were expected to leave early on
24 exceptionally severe fire risk days ("Code Red" days in Victoria), only around 2% actually
25 did so (Whittaker and Handmer 2010). Recent analysis shows little change in the proportion
26 of people who actually leave early on exceptionally risky days (McLennan et al., 2015).

27
28 In 2014, the Victorian approach to community bushfire safety changed again, to 'Leave and
29 live'. This is a clear change of emphasis to leaving early as the safest option. However,
30 challenges remain. People still need to be prepared, to have clear triggers to leave, and not to
31 'wait and see' how the situation develops. A challenge for policy and fire agencies is to
32 ensure people maintain preparedness to stay as a contingency plan, in case they cannot leave
33 due to a sudden fire or access closure. A major challenge to 'Leave and live' is that
34 (especially if days of very high fire danger become more frequent under climate change),
35 leaving early 'just in case' on all days of extreme danger becomes seen as too disruptive to
36 peoples' lives and livelihoods and so people increasingly risk staying in the fire danger area.

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15

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