

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect

journal homepage: [www.elsevier.com/locate/envsci](http://www.elsevier.com/locate/envsci)

## Environmental circumstances surrounding bushfire fatalities in Australia 1901–2011<sup>☆</sup>

Raphaele Blanche<sup>a,b,\*</sup>, Justin Leonard<sup>a,b</sup>, Katharine Haynes<sup>d</sup>,  
Kimberley Opie<sup>c</sup>, Melissa James<sup>a</sup>, Felipe Dimer de Oliveira<sup>d</sup>

<sup>a</sup> CSIRO Ecosystem Sciences, Australia

<sup>b</sup> Bushfire Cooperative Research Centre, Australia

<sup>c</sup> CSIRO Land and Water, Australia

<sup>d</sup> Risk Frontiers Macquarie University, Australia

### ARTICLE INFO

#### Article history:

Received 24 May 2013

Received in revised form

23 September 2013

Accepted 24 September 2013

Available online 11 November 2013

#### Keywords:

Wildfire

Fatalities

WUI

Policy

Warnings

### ABSTRACT

This paper describes the development and analysis of a dataset covering bushfire related life loss in Australia over the past 110 years (1901–2011). Over this time period 260 bushfires have been associated with a total of 825 known civilian and firefighter fatalities. This database was developed to provide an evidence base from which an Australian national fire danger rating system can be developed and has benefits in formalising our understanding of community exposure to bushfire. The database includes detail of the spatial, temporal and localised context in which the fatalities occurred. This paper presents the analysis of 674 civilian fatalities. The analysis has focused on characterising the relationship between fatal exposure location, weather conditions (wind speed, temperature, relative humidity and drought indices), proximity to fuel, activities and decision making leading up to the death.

The analysis demonstrates that civilian fatalities were dominated by several iconic bushfires that have occurred under very severe weather conditions. The fatalities from Australia's 10 worst bushfire days accounted for 64% of all civilian fatalities. Over 50% of all fatalities occurred on days where the McArthur Forest Fire Danger Index (FFDI) exceeded 100 (the current threshold for declaring a day as 'catastrophic') proximal to the fatality.

The dominant location category was open air representing 58% of all fatalities followed by 28% in structures, and 8% in vehicles (6% are unknown). For bushfires occurring under weather conditions exceeding an FFDI value of 100, fatalities within structures represented over 60% of all fatalities. These were associated with people dying while attempting to shelter mainly in their place of residence. Of the fatalities that occurred inside a structure in a location that was specifically known, 41% occurred in rooms with reduced visibility to the outside conditions. Over 78% of all fatalities occurred within 30 m of the forest.

© 2013 The Authors. Published by Elsevier Ltd. All rights reserved.

<sup>☆</sup> This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-No Derivative Works License, which permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

\* Corresponding author at: CSIRO Ecosystem Sciences, PO Box 56, Hightett, Victoria 3190, Australia. Tel.: +61 392526194.

E-mail address: [Raphael.Blanchi@csiro.au](mailto:Raphael.Blanchi@csiro.au) (R. Blanche).

1462-9011/\$ – see front matter © 2013 The Authors. Published by Elsevier Ltd. All rights reserved.

<http://dx.doi.org/10.1016/j.envsci.2013.09.013>

---

## 1. Introduction

The safety of communities exposed to bushfires is influenced by resident awareness, preparedness, responses and warning systems. In Australia, the existing Fire Danger Rating System is based on the McArthur Forest Fire Danger Index (FFDI). The FFDI relates the expected fire behaviour and rate of spread in common fuel types in eastern Australia (McArthur, 1967; Luke and McArthur, 1978) to the large-scale weather conditions and was originally developed to inform fire suppression activities. Its use has been extended to include a much broader range of applications including the implementation of community warnings.

Most of the studies on impact to community have occurred during post-bushfire surveys and subsequent survey analysis to better understand the mechanisms of bushfire attack at the urban interface (e.g. Barrow, 1945; Ramsay et al., 1987). The important points of consideration in those studies were how risk of loss was influenced by building design, the immediate landscape, the type of urban interface and human activity (e.g. Barrow, 1945; Ramsay et al., 1987; Leonard, 2003; Blanchi et al., 2006; Blanchi and Leonard, 2008).

Studies of human activities during bushfire have suggested that people sheltering in their house and implementing various protection strategies have a better chance of survival than people who expose themselves to radiant heat when evacuating late (McArthur and Cheney, 1967; Wilson and Ferguson, 1984; Krusel and Petris, 1999). Also it has been shown that active defence by residents or brigade members significantly increases the chances of house survival (Wilson and Ferguson, 1986; Leonard, 2003; Blanchi and Leonard, 2008). Based on the understanding that ‘people protect houses and houses protect people’ community safety bushfire policy in Australia was established around the ‘Prepare, stay and defend or leave early’ policy position (Australasian Fire Authorities Council, 2005). Under the policy residents were advised to prepare to stay and defend their home and property against bushfire or to leave well ahead of the arrival of a bushfire (e.g. Handmer and Tibbits, 2005; Tibbits et al., 2006; Handmer and Haynes, 2008; Haynes et al., 2010; Whittaker et al., 2013).

The policy was scrutinised during the 2009 Victorian Bushfires Royal Commission because a large number of people had perished within their homes (Teague et al., 2010). The Commission concluded that the 2009 bushfires exposed weaknesses in the way the policy was applied, and recommended the adoption of the national ‘Prepare. Act. Survive.’ strategy. The core messages of the strategy are very similar to the old policy, however, it stresses the safer option of leaving early, and the dangers and significant level of preparation needed for successful defence. The Commission also noted the increased risk to life and property on the worst fire days and recommended significant improvements to risk communication, education and warnings (Teague et al., 2010). The recommendations resulted in a review of the fire danger rating system and the development of the National Framework for Scaled Advice and Warnings to the Community (Australasian Fire Authorities Council, 2009).

The implementation of this new warning framework also triggered a review process to undertake a major evaluation of the current National Fire Danger Rating system. This review process identified the need to improve our understanding of the environmental circumstances that lead to life loss in bushfires. Few studies have specifically focused on the details of fatalities during bushfires. Krusel and Petris (1999) studied the circumstances of civilian fatalities during the 1983 Ash Wednesday bushfire. In a more recent study Haynes et al. (2010) analysed 552 civilian fatalities in bushfires from 1900 to 2008. The study explored the context of bushfire related fatalities and focused on the activities, behaviour and decision making carried out at the time of death. The study was able to verify and emphasise the danger of being caught outside during the passage of a bushfire. It also demonstrated a clear gender bias, with male fatalities most often occurring outside while trying to protect assets and female fatalities occurring inside while sheltering, or trying to flee (Haynes et al., 2010). O’Neill and Handmer (2012) also undertook a detailed study of the circumstances surrounding the 172 civilian deaths during the 2009 Victorian bushfires.

These studies have tended to focus on victim behaviour rather than the spatial and environmental circumstances of civilian fatalities. Notable exceptions include studies by Harris et al. (2012) and Kilinc et al. (2013), which explored the relationship between the power of the fire and community losses. Other studies have focused on the influence of environmental circumstances on house loss for individual bushfires (e.g. McArthur and Cheney, 1967; Ramsay et al., 1987; Leonard and Blanchi, 2005) and across multiple bushfires (e.g. Ahern and Chladil, 1999; Chen and McAneney, 2004, 2010; Blanchi et al., 2010; Harris et al., 2012).

This study therefore aimed to examine the environmental circumstances of civilian bushfire fatalities across all of Australia over the last 110 years. A database (Life Loss database) was generated using a specific data set that included spatial, temporal and the localised context in which the fatalities have occurred. This paper presents and discusses findings on the relationship between exposure location, weather conditions, proximity to fuel, and fatality activity and decision making leading up to the death. The various policy implications of these results for community safety are discussed.

---

## 2. Methodology

The Life Loss database was developed by collating different available data on bushfire related life loss in Australia over the past 110 years (1901–2011). A range of circumstances leading up to the fatal exposure were also captured, including: fire arrival time and severity, weather conditions, proximity to fuels, and activity defined by the decisions made before fatal exposure.

The most comprehensive listing of past fatalities provided was the Risk Frontiers Database 2011 (which covers fatalities Australia-wide). This dataset was initially developed by Risk Frontiers as part of PerilAus database (Crompton et al., 2011) and used by Haynes to develop a dataset of civilian fatalities up until 2008 for the Bushfire CRC (Haynes et al., 2010). This

Download English Version:

<https://daneshyari.com/en/article/7468040>

Download Persian Version:

<https://daneshyari.com/article/7468040>

[Daneshyari.com](https://daneshyari.com)