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INTRODUCTION

Bushfire Safety is Volume 427 in the ‘Issues in Society’ series of educational resource books. The aim of this series is to offer current, diverse information about important issues in our world, from an Australian perspective.

KEY ISSUES IN THIS TOPIC
Bushfires and grassfires are common events throughout Australia, a land with a hot, dry climate. Every year bushfires occur across Australia, often taking human life and damaging property. Major firestorms such as Ash Wednesday and Black Saturday have left scars on the national psyche and are stark reminders of the destructive power of bushfires.

The impacts of climate change are clear with the emergence of more extreme fire weather in recent years; increasingly, many Australians are exposed to potentially catastrophic bushfires. Understanding bushfires and the risks they pose to whole communities is critical if we are to be resilient to these most common and destructive of natural disasters.

This book explores the basics of bushfires, how and where they occur, the threats they pose and the hazards they bring. The book also explains in detail how to effectively prepare your home for a bushfire, and when to safely leave. Future bush fires are expected to get worse. Learn now how to prepare, act and survive.

SOURCES OF INFORMATION
Titles in the ‘Issues in Society’ series are individual resource books which provide an overview on a specific subject comprised of facts and opinions.

The information in this resource book is not from any single author, publication or organisation. The unique value of the ‘Issues in Society’ series lies in its diversity of content and perspectives.

The content comes from a wide variety of sources and includes:

- Newspaper reports and opinion pieces
- Website fact sheets
- Magazine and journal articles
- Statistics and surveys
- Government reports
- Literature from special interest groups

CRITICAL EVALUATION
As the information reproduced in this book is from a number of different sources, readers should always be aware of the origin of the text and whether or not the source is likely to be expressing a particular bias or agenda.

It is hoped that, as you read about the many aspects of the issues explored in this book, you will critically evaluate the information presented. In some cases, it is important that you decide whether you are being presented with facts or opinions. Does the writer give a biased or an unbiased report? If an opinion is being expressed, do you agree with the writer?

EXPLORING ISSUES
The ‘Exploring issues’ section at the back of this book features a range of ready-to-use worksheets relating to the articles and issues raised in this book. The activities and exercises in these worksheets are suitable for use by students at middle secondary school level and beyond.

FURTHER RESEARCH
This title offers a useful starting point for those who need convenient access to information about the issues involved. However, it is only a starting point. The ‘Web links’ section at the back of this book contains a list of useful websites which you can access for more reading on the topic.

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CHAPTER 1
Understanding bushfire risks

BUSHFIRE BASICS

GEOSCIENCE AUSTRALIA explains the fundamentals of bushfires

WHAT IS A BUSHFIRE?

Bushfires and grassfires are common throughout Australia. Grassfires are fast moving, passing in five to ten seconds and smouldering for minutes. They have a low to medium intensity and primarily damage crops, livestock and farming infrastructure, such as fences. Bushfires are generally slower moving, but have a higher heat output. This means they pass in two to five minutes, but they can smoulder for days. Fire in the crown of the tree canopy can move rapidly.

Bushfires are an intrinsic part of Australia’s environment. Natural ecosystems have evolved with fire, and the landscape, along with its biological diversity, has been shaped by both historic and recent fires. Many of Australia’s native plants are fire prone and very combustible while numerous species depend on fire to regenerate.

Fire is both feared and harnessed. Indigenous Australians have long used fire as a land management tool and it continues to be used to clear land for agricultural purposes and to protect properties from intense, uncontrolled fires.

In the years between 1967 and 1999, major Australian bushfires have cost A$2.5 billion according to the Bureau of Transport and Economics report: Economic Costs of Natural Disasters in Australia, 2001. This corresponds to an average of about 7.1 per cent of the cost of all major natural disasters in Australia during those years. In the same period, Australian bushfires resulted in the deaths of 223 people and injuries to another 4,185, accounting for 39 per cent of deaths and 57 per cent of the injuries from all major Australian natural disasters in the period. Several major fires have affected Australia since 1999, including the 2009 Victorian fires (173 deaths and more than 2,000 homes lost), the 2006 Eyre Peninsular fires (nine deaths and 110 people injured) and the 2003 Canberra fire (four deaths, more than 100 people injured and around 500 homes lost).

WHAT CAUSES BUSHFIRES?

The basic factors which determine whether a bushfire will occur include the presence of fuel, oxygen and an ignition source. More specifically, fire intensity and the speed at which a bushfire spreads will depend on ambient temperature, fuel load, fuel moisture, wind speed and slope angle.

Fuel load

Generally speaking, the greater the fuel load, the hotter and more intense the fire. Fuel which is concentrated with adequate spacing will burn faster than heavily compacted or scattered fuel sources. Smaller pieces of fuel such as twigs, litter and branches burn quickly, particularly when they are dry and loosely arranged. Some types of grasses burn very rapidly, while larger fuels, such as tree trunks, do not burn as easily. The natural oil within Eucalypt trees promotes the combustion of fuel.

Fuel moisture

Dry fuel will burn quickly, but damp or wet fuel may not burn at all. As a consequence, the time since rainfall and

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the amount of rain received is an important consideration in assessing bushfire danger. Often a measure of the drought factor, or moisture deficit, will be used as an indicator of extreme bushfire weather conditions.

**Wind speed**
Wind acts to drive a fire by blowing the flames into fresh fuel, bringing it to ignition point and providing a continuous supply of oxygen. Wind also promotes the rapid spread of fire by spotting, which is the ignition of new fires by burning embers lofted into the air by wind. Spotting can occur up to 30km downwind from the fire front. There is a threshold wind speed of around 12 to 15km/h which makes a significant difference in the behaviour of bushfires in the open. When wind speeds are below this threshold, fires with heavy fuel loads burn slowly. However, even a slight increase in wind speed above this threshold results in a significant increase in fire behaviour and advancement. The width of a fire front also has an influence on the rate of spread and a wind shift can immediately widen the forward edge of a fire.

**Ambient temperature**
The higher the temperature the more likely it is that a fire will start or continue to burn. This is because the fuel is closer to its ignition point at high temperatures and pre-heated fuel loads burn faster.

**Relative humidity**
Dry air promotes a greater intensity fire than moist air. Plants become more flammable at a low humidity because they release their moisture more easily.

**Slope angle**
Fires pre-heat their fuel source through radiation and convection. As a consequence of these heat transfer effects, fires accelerate when travelling uphill and decelerate travelling downhill. The steepness of the slope plays an important role in the rate of fire spread. The speed of a fire front advancing will double with every 10-degree increase in slope so that on a 20-degree slope, its speed of advance is four times greater than on flat ground.

**Origins**
Bushfires can originate from both human activity and natural causes with lightning the predominant natural source, accounting for about half of all ignitions in Australia. Fires of human origin currently account for the remainder and are classified as accidental or deliberate. Fires lit deliberately can be the result of arson or designed to achieve a beneficial outcome but experience sudden adverse weather conditions which results in their uncontrollable spread.

Unfortunately deliberate and accidentally lit fires are more prevalent near populated areas and have a disproportionately higher risk of infrastructure impact. Arsonists place people and property at serious and unnecessary risk, particularly when igniting fires on extreme fire weather days. **Interesting fact:** More bushfires occur on Sunday than any other day.

**WHERE DO BUSHFIRES OCCUR?**
The Australian climate is generally hot, dry and prone to drought. At any time of the year, some parts of Australia are prone to bushfires with the widely varied fire seasons reflected in the continent’s different weather patterns (see map on page 5). For most of southern Australia, the danger period is summer and autumn. For New South Wales and southern Queensland, the peak risk usually occurs in spring and early summer. The Northern Territory experiences most of its fires in winter and spring.

Grassland fires frequently occur after good periods of rainfall which results in abundant growth that dries out in hot weather. Bushfires tend to occur when light and heavy fuel loads in eucalypt forests have dried out, usually following periods of low rainfall.

The potential for extreme fire weather varies greatly throughout Australia, both in frequency and severity. When potential extreme fire weather is experienced close to populated areas, significant loss is possible. In terms of the total area burnt, the largest fires are in the Northern Territory and northern areas of Western Australia and Queensland. Most loss of life and economic damage occurs around the fringes of cities where homes are commonly in close proximity to flammable vegetation. **Interesting fact:** A fire front advances more quickly when travelling upslope and slows travelling downslope. The speed of a fire front advancing will double for every 10-degree increase in slope so that on a 20-degree slope, its speed is four times greater.
Bushfires in Australia are frequent events during the warmer months of the year, due to Australia’s mostly hot, dry climate. Each year, such fires impact extensive areas. On one hand, they can cause property damage and loss of human life. On the other hand, certain native flora in Australia have evolved to rely on bushfires as a means of reproduction, and fire events are an interwoven and an essential part of the ecology of the continent. For thousands of years, Indigenous Australians have used fire to foster grasslands for hunting and to clear tracks through dense vegetation.

Major firestorms that result in severe loss of life are often named based on the day on which they occur, such as Ash Wednesday and Black Saturday. Some of the most intense, extensive and deadly bushfires commonly occur during droughts and heatwaves, such as the 2009 Southern Australia heatwave, which precipitated the conditions during the 2009 Black Saturday bushfires in which 173 people lost their lives. Other major conflagrations include the 1983 Ash Wednesday bushfires, the 2003 Eastern Victorian alpine bushfires and the 2006 December bushfires. Global warming is increasing the frequency and severity of bushfires.

Categories

The term ‘bushfire’ builds on the concept of ‘the bush’, referring to sparsely-inhabited regions. Bushfires in Australia are generally defined as uncontrolled, non-structural fires burning in a grass, scrub, bush, or forested area. Australia, being a geographically and meteorologically diverse continent, experiences many types of bushfires. There are two main categories, depending on local topography.

- **Hilly/mountainous fires** – burn in hilly, mountainous or alpine areas which are usually densely forested. The land is less accessible and not conducive to agriculture, thus many of these densely forested areas have been saved from deforestation and are protected by national, state and other parks. The steep terrain increases the speed and intensity of a firestorm. Where settlements are located in hilly or mountainous areas, bushfires can pose a threat to both life and property.

- **Flat/grassland fires** – burn along flat plains or areas of small undulation, predominantly covered in grasses or scrubland. These fires can move quickly, fanned by high winds in flat topography, and they quickly consume the small amounts of fuel/vegetation available. These fires pose less of a threat to settlements as they rarely reach the same intensity seen in major firestorms as the land is flat, the fires are easier to map and predict, and the terrain is more accessible for firefighting personnel. Many regions of predominantly flat terrain in Australia have been almost completely deforested for agriculture, reducing the fuel loads which would otherwise facilitate fires in these areas.

Common causes of bushfires include lightning, arcing from overhead power lines, arson, accidental ignition in the course of agricultural clearing, grinding and welding activities, campfires, cigarettes and dropped matches, sparks from machinery, and controlled burn escapes.

Downloaded from [https://en.wikipedia.org/wiki/Bushfires_in_Australia](https://en.wikipedia.org/wiki/Bushfires_in_Australia) on 17 October 2017.
Worst bushfires in Australia’s history

Bushfires have accounted for over 800 deaths in Australia since 1851 and the total accumulated cost is estimated at $1.6 billion. To date, the five most severe Australian bushfires were:

1. **Black Saturday bushfires (Victoria)**
   - **Date:** 7-8 Feb – 14 March 2009
   - **Human deaths:** 173 fatalities
   - **Properties damaged:** 2,029+ homes; 3,000+ other structures
   - **Area burned:** 450,000+ha
     - Black Saturday is one of Australia’s worst recorded natural disasters.
     - Record-high temperatures and strong winds after a season of intense drought set the bush alight across the state.
     - A series of fires that began on Saturday 7 February 2008 swept through Victoria during extreme bushfire weather conditions.
     - Many towns northeast of Melbourne were badly damaged and some were completely destroyed.
     - 78 townships were affected and 7,562 people were displaced.
     - 11,800 head of livestock perished in the fires.
     - The Bushfires Royal Commission estimated the disaster suffered a loss of AUD $4.4 billion (2010 value).

2. **Ash Wednesday bushfires (Victoria and South Australia)**
   - **Date:** 16-18 February 1983
   - **Human deaths:** 75 fatalities
   - **Properties damaged:** 2,400 homes
   - **Area burned:** 418,000+ha
     - The Ash Wednesday bushfires were a series of fires that tore across south-eastern Australia on 16 February 1983, in a time of widespread drought, gale-force winds, high temperatures and low relative humidity.
     - More than 180 fires caused widespread destruction across South Australia and Victoria in just twelve hours.
     - Accidents and arsonists started most of the fires, which spread rapidly through scenic residential regions near Melbourne and Adelaide.
     - In Victoria, 47 people died and in South Australia, 28 died.
     - Over 3,700 buildings were destroyed, 2,545 homes were damaged and loss of livestock was extremely high (approx. 358,000).
     - The total damage caused cost both states well over $400 million AUD (1983 value).

3. **Black Friday bushfires (Victoria)**
   - **Date:** December 1938 – January 1939
   - **Human deaths:** 71 fatalities
   - **Properties damaged:** 3,700 homes
   - **Area burned:** 2 million ha
     - Drought conditions and water shortages preceded Black Friday.
     - A combination of high temperatures, strong winds, and low humidity triggered fires in bush communities near Melbourne.
     - Locals and graziers exacerbated the problem by attempting controlled burns to protect themselves from disaster.
     - A Royal Commission investigation into the fires led to increased fire awareness and prevention efforts throughout Australia.

4. **Black Tuesday bushfires (Tasmania)**
   - **Date:** 7 February 1967
   - **Human deaths:** 62 fatalities
   - **Properties damaged:** 1,293 homes
   - **Area burned:** approx 264,000 ha
     - The 1967 Black Tuesday fires were the most deadly bushfires that Tasmania has ever experienced.
     - Forest floors were covered with abundant spring litter, providing fuel for the bushfire season. Strong northerly winds and high temperatures combined to fuel over 80 different fires across southern Tasmania, which came within 2km of central Hobart.
     - 62 people died, 900 were injured and over 7,000 people were left homeless. About 62,000 livestock were killed.
     - The fires destroyed 2,640 square kilometres of land in Southern Tasmania within five hours.
     - 80 bridges, 4,800 sections of power lines, 1,500 vehicles and over 100 other structures were destroyed.
     - The total damage estimate amounted to $40 million AUD (1967 value).

5. **Gippsland fires and Black Sunday (Victoria)**
   - **Date:** 1 Feb – 10 March 1926
   - **Human deaths:** 60 fatalities
   - **Properties damaged:** 1,000 homes
   - Large areas of Gippsland caught fire, culminating in the fires on Sunday 14 February that killed 31 people in Warburton.
   - Over the two-month period, a total of 60 people were killed.

**SOURCES**

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BUSHFIRE WEATHER

FACT SHEET INFORMATION FROM THE BUREAU OF METEOROLOGY

Fire weather warnings
The Bureau of Meteorology issues Fire Weather Warnings when the Fire Danger Index (FDI) is expected to reach or exceed a value of 50 (38 in Tasmania) either today or the next day. Warnings are broadcast on radio and television. In most States and Territories, fire authorities declare a Total Fire Ban based on a range of criteria including the Forecast FDI from the Bureau.

The bushfire threat
Large areas of Australia suffer from the threat of bushfires. The Australian climate is generally hot, dry and prone to drought. In the southeast, occasional strong winds often associated with summertime cold fronts can lead to extreme fire danger. The amount of rain in preceding months affects the amount of dry grasses. If good spring rains have resulted in abundant plant growth, late summer grass fires can be intense.

Many of Australia’s native plants burn easily. The eucalypts’ high oil content makes them particularly fire prone. The vast areas of dry grass common in mid-to-late summer also burn readily.

Most loss of life and property damage occurs around the fringes of the cities where homes are sometimes surrounded by flammable vegetation.

Varied fire seasons reflect different weather patterns. For most of southern Australia, the danger period is summer and autumn. For New South Wales and southern Queensland, the peak risk usually occurs in spring and early summer. Northern Australia experiences most of its fires in winter and spring.

Weather and fire
Low relative humidity, high winds and lack of rain all

Fire seasons across Australia

Source: Bureau of Meteorology cited in Lindesay (2003), Figure 4.2.

Figure 1

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contribute to increased fire danger. Sunshine and high temperatures rapidly dry timber and grass (fuel) which burn very quickly. Hot air can lower the moisture content of forests and grasslands to around 5 per cent and in extreme cases to 2-3 per cent, greatly increasing the speed of the fire.

Humidity: Relative humidity is the most commonly used measure of atmospheric moisture and is defined as the ratio of the amount of water vapour actually measured to that which air could hold at saturation. Very low relative humidity of, say, less than 20 per cent, causes fuels to dry out and become more flammable.

Wind: Air movement provides the oxygen the fire needs to keep burning. Higher winds mean more oxygen and more intense flames. Doubling the wind speed will quadruple the rate of spread of the fire. However above about 50 km/h this relationship begins to break down, and above 80 km/h the rate of spread in grasslands reduces. This occurs because the head fire breaks up into narrow tongues, many of which become self extinguishing. Winds also carry burning embers downwind, which can start new fires. This is known as spotting.

Rainfall: Dry grass, parched native shrubs and dead leaves and twigs are fire’s basic fuel. During droughts and in very hot, windy weather, even heavy fuels like large logs and the green leaves and smaller branches of large trees can become dry and flammable.

Anatomy of a fire danger day
By world standards, Australia has a low and very unreliable rainfall, and droughts are a significant feature of the Australian climate. Dry spells create a high fire risk, particularly if the dry spell follows a period of good rain that has encouraged lush growth.

Temperature, relative humidity, wind speed, drought and the amount of fuel can be combined into a fire danger index.

Weather systems like the highs, lows and cold fronts that appear on weather maps control the temperature, humidity and wind. Because Australia spans a large range of latitudes, from tropical to temperate, these weather systems work differently in different regions of the country. Each part of Australia has its own special combination of weather systems that produces severe bushfire conditions, but in all cases these conditions result from hot, dry winds blowing from Australia’s central arid region.

In southern Australia, cold fronts are probably the most powerful influence on our fire weather. Cold fronts occur at the junction of warm and cold air masses where the strong temperature contrast provides the energy source that generates the frequently associated strong winds.

As a cold front passes, the wind direction will often swing about 90 degrees. Usually, the winds ahead of a cold front are hot northwesterlies (Figure 2), while cooler southwesterlies follow the front (Figure 3), with significant effects on the behaviour and structure of existing fires.

High risk weather patterns – southeast Australia
Summer and autumn are the most dangerous times of year in southeast Australia. The highest temperatures occur during these seasons and in most years the grass and forests have dried out by mid-summer.

A typical dangerous fire situation occurs in southeastern Australia when a vigorous cold front approaches a slow-moving high in the Tasman Sea, causing very hot, dry, northwesterly winds. Figure 4 shows the situation associated with the Victorian Ash Wednesday fires of 16 February 1983. The passage of the cold front can cause the winds to suddenly change direction, shifting fire direction abruptly.

Fires driven by a strong, steady wind are usually long
and narrow. When the wind changes with the passage of a cold front, the long side of the fire can suddenly become the fire front.

High risk weather patterns – New South Wales and southern Queensland

The fire season for most of Australia’s east coast extends from spring to mid-summer. The greatest danger occurs after the dry winter/spring period, before the onset of the rainy weather common in summer. The worst conditions occur when deep low-pressure systems near Tasmania bring strong, dry, westerly winds to the coast, as occurred in the major New South Wales fires in January 1994 (Figure 5).

High risk weather patterns – Western Australia and the Northern Territory

The northern Australian fire season occurs during the warm, dry and sunny winter and spring, when the grasses are dead and the fuels have dried. In summer, a strong high pressure system over South Australia can bring strong southeast to northeast winds that increase the fire danger in the southern parts of western Australia (Figure 6).

The third dimension – the vertical profile of a severe fire day

A layer of warm air sitting over a layer of cold air is called a temperature inversion. Inversions are common during the night and early morning when cool night air collects close to the ground (Figure 7).

As the sun heats the ground during the day, the inversion weakens and strong winds may begin to blow near the ground. This is one reason why many bushfires burn more fiercely in the afternoon, as happened with the fires in Hobart in 1967.
FIRE WEATHER WARNINGS

The Bureau of Meteorology explains the warnings it issues to alert the public when fire weather conditions are likely to be dangerous

Wind, temperature, humidity and rainfall are weather elements that affect the behaviour of bushfires. In Australia there is a system of assessing these in conjunction with the state of the available fuels to determine a measure of “fire danger” or the difficulty of putting out any fires which may occur. The Bureau of Meteorology issues Fire Weather Warnings to alert the public when conditions are likely to be dangerous. Fire agencies in each jurisdiction determine Fire Danger Ratings and in some cases declare (Total) Fire Bans.

National Fire Danger Rating System

In 2010, State and Territory governments adopted a National Fire Danger Rating System. The Bureau provides fire agencies with forecasts based on the McArthur Mk V Forest and modified CSIRO Mk IV grassland fire danger meters to assist them in calculating the Fire Danger Ratings for each State and Territory. However, the agencies consider other factors in their determination of the Fire Danger Ratings which are disseminated to the public.

The new Fire Danger Ratings

The highest category of Fire Danger Rating is Catastrophic except in Victoria where it is called Code Red. Tasmania depicts the Catastrophic FDR with the colour Black. Consult the fire agency website in your jurisdiction for further details about Fire Danger Ratings.

Fire weather warnings

The Bureau of Meteorology issue Fire Weather Warnings when weather conditions are conducive to the spread of dangerous bushfires. Warnings are generally issued within 24 hours of the potential onset of hazardous conditions. Warnings are also broadcast on radio and television.

Fire agencies determine Fire Danger Ratings. In most States and Territories, fire agencies declare fire bans based on a range of criteria including forecast weather provided by the Bureau.

The information contained in Fire Weather Warnings includes:

- The office which issued the warning
- The local time, day and date that it was issued
- A description of the relevant meteorological conditions and Fire Danger Rating
- The area where weather conditions are conducive to the spread of dangerous fires
- The time period for which it will be in effect.

Fire Weather Warnings are distributed through the media, fire agencies and other key emergency service organisations. Warnings are normally issued in the afternoon for the following day so to be available for evening television and radio news broadcasts. Warnings are renewed at regular intervals and generally at the same time major forecasts are issued. However, warnings may be issued or amended and reissued at any time if a need is identified.

In each State the issue of a Fire Weather Warning has different impacts on restrictions for lighting fires. Check with the fire authority and/or local council in your area for details.

Total fire bans

The Bureau of Meteorology does not have the power to declare a Total Fire Ban. This responsibility resides with designated fire agencies in each State and Territory. Check with your fire agency if there are any fire bans or other restrictions currently in force in your area.

The areas covered by fire bans do not align with Bureau forecast districts in New South Wales, Tasmania and the Northern Territory. Check with the local fire authority and/or council about fire ban boundaries in your area and the obligations associated with adhering to Total Fire Ban restrictions.

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Bushfires are a natural, essential and complex part of the Australian environment and have been for thousands of years, according to this guide from the Australian Academy of Science.

They can start with just a spark and can burn for months, affecting landscapes and lives for years. Bushfires are a natural, essential and complex part of the Australian environment and have been for thousands of years. Our country’s first inhabitants lived seemingly hand in hand with fire, having developed complex fire management practices that complemented their deep understanding of the country and landscape in which they lived. Our ecosystems have evolved to be fire dependent, and require the periodic presence of fire. Herein lies the complexity: Australia is a land of fire where people have chosen to live.

Since European settlement, bushfires have been an event to be endured, a natural disaster with sometimes catastrophic effects. Research efforts have focused on how to predict and control bushfires in order to best protect lives and infrastructure, as well as understand the role that fire plays in the Australian landscape.

HOW DOES FIRE WORK?
What actually makes a fire burn?
We all know that if you gather up a bunch of dry twigs, grass and leaves and put a lit match to them, they'll burn. Add some more sticks and bigger bits of wood and you’ve got a raging fire, ready for marshmallows. But why? How does fire actually work?

Fire is the result of applying enough heat to a fuel source, when you’ve got a whole lot of oxygen around. As the atoms in the fuel heat up, they begin to vibrate until they break free of the bonds holding them together and are released as volatile gases. These gases react with oxygen in the surrounding atmosphere. This chemical reaction causes a lot of heat, so much heat, in fact, that it can keep driving the reaction – as long as there’s enough fuel and oxygen still present, the reaction will become self-sustaining. The actual flames of the fire are the release of some of the heat energy as light.

These components have led to the development of the ‘fire triangle’ of fuel, oxygen and heat. Remove any one of these and fire cannot sustain itself.

And why does water put it out?
The primary role water plays in putting out a bushfire is cooling it down so there’s no longer enough heat to sustain the fire. When you pour water onto a fire, the heat of the fire causes the water to heat up and turn into steam. This is a very energy-intensive reaction, and it sucks away the heat energy of the fire. This leaves the fire without enough energy to keep burning.

Less significant is the role water can play in ‘smothering’ a fire, depriving it of the oxygen that it also needs to burn.

PREDICTING BUSHFIRES
Predicting when and where bushfires are likely to occur is obviously an important and useful part of bushfire management. It will be particularly important across many parts of Australia where the number of days of extreme fire danger are projected to increase under climate change.

Current thinking around predicting bushfires incorporates four ‘switches’ which all need to be ‘on’ for a fire to occur.

Fuel to burn
The Australian bush, though it has a reputation for being dry and scrubby, varies greatly from place to place around the country. There are regions of open woodlands, grassland savannas, dense rainforest. A bushfire will burn anything that it finds in its path,
but different types of vegetation burn differently. Generally, fuel is classified as being fine (grasses and twigs that are less than 6 millimetres in diameter) or heavy (branches, logs or stumps). Finer fuels burn more easily, feeding the spread of the fire, but heavier fuels burn with greater intensity, creating more heat and making the fire more difficult to put out.

Fuel loads accumulate in different types of vegetation at different rates. In Western Australia, jarrah (Eucalyptus marginata) forests build up fuel at a rate of around 1-2 tonnes per hectare per year, while karri (Eucalyptus diversicolor) forests accumulate around 3-4 tonnes of fuel per hectare per year.

**Dryness of fuel**

Another key factor is fuel moisture, or how dry the bush is. The drier the fuel, the more easily it will burn. Fuel fits into two main categories: live and dead. Live fuels contain moisture that is regulated by the plants’ physiology as well as the amount of recent rainfall. Dead fuel’s moisture content tends to reflect the atmospheric moisture content – the relative humidity and level of moisture in the soil. These depend on recent rainfall and temperatures.

Researchers are developing methods of using remote-sensing data from satellites or aircraft to detect the relative dryness of the bush. One way satellites can estimate fuel moisture is by picking up changes in the greenness of vegetation, an indicator of vegetation dryness. This is particularly important in grasslands. The key controls on the dryness level in fine fuels are relative humidity, temperature and recent rainfall.

**Weather conditions**

Certain weather conditions fuel a fire and help it burn. Long-term seasonal weather patterns, such as periods of drought or rainfall, can affect the availability and moisture content of vegetation and the fuel available for a fire to burn. A fire is much more likely to ignite, and continue to burn, in hot, dry and windy weather.

**Source of ignition**

Lightning strikes can provide the initial spark that sets off a bushfire, and cause around half of Australia’s bushfires. Other causes can be faulty electrical wires, a cigarette carelessly tossed out of a car window, a hazard reduction burn gone wrong, arson, or accidental ignition.

**BUSHFIRE BEHAVIOUR**

The primary influences upon how bushfires move through the landscape are humidity, geography, wind and temperature.

**Humidity and temperature**

The effects of ambient temperature and humidity on a fire are pretty obvious. The hotter the air temperature, the closer any fuel is to its ignition point, and dry fuel will burn more easily. The lower the humidity, the drier the air is, again helping fuels burn as they release their moisture into the air more readily.

**Slope of the land**

The slope of the landscape is also important. Just consider a match and how much faster it burns when you hold it so that flame is burning up the stick (and towards your fingers!) than down. Similarly, fires burn much faster uphill than down. This is because the radiation and convection a fire creates preheat the fuel source, and this is much more readily done upslope than down. A 10-degree increase in slope usually results in a doubling of the speed of the fire. Fire will spread up a 20-degree slope four times as fast as it will along flat ground.

1. **Going uphill**
   Fire moves faster uphill because there is less space between the flames and new fuel to burn. Also, the radiant heat caused by the fire pre-heats the fuel, making it easier to ignite. Fire spreading at 100m/hr on flat terrain will speed up to around 400m/hr when it travels up a 20-degree slope.

2. **Going downhill**
   The increased distance between flames and new fuel means fires spread more slowly when moving downhill (unless the slope of the land creates unusual air currents). Fire spreading at 100m/hr on flat terrain will slow down to around 25m/hr when it travels down a 20-degree slope.

**How wind spreads fire**

Generally, as long as wind speeds are below 12-15 km/h, a fire will burn slowly. However, if wind speeds are even slightly higher than this, they will have a significant impact on the fire movement. A change in wind, often from a cold front, can activate the side of a fire, making it broader. In general, a wider fire will burn faster than a very narrow one.

Fires also create their own weather; the heat of a fire can result in whirlwinds and turbulent air currents. These can drive the fire sideways, broadening the fire front. Wind can also cause spotting – carrying pieces of burning fuel, like twigs, leaves or small embers, ahead of the fire, igniting more small fires.

**Fire intensity**

Fire intensity is described in terms of the number of kilowatts of energy each metre of the fire front generates. A controlled hazard-reduction fire usually produces less than 500 kilowatts per metre of energy, while an extreme bushfire can generate more than 100,000 kilowatts per metre. Once a fire’s intensity exceeds around 2,000 kilowatts per metre it can no longer be safely managed by firefighters working on the ground.
A number of computer models have been developed to help predict the spread and shape of fires across the landscape. The most widely used of these is Phoenix Rapidfire, developed by the Bushfire CRC, the University of Melbourne and various fire agencies. Western Australian authorities used Aurora, a model developed by the University of Western Australia, Landgate and the Bushfire CRC, and CSIRO has developed a new model called Spark.

These models take into account all the factors discussed above that influence the behaviour and spread of the fire. They incorporate meteorological data as well as geographical landscape data like the slope of the land, vegetation type, and the presence of unburnable features like roads or water bodies. Phoenix Rapidfire also incorporates components that deal with spotting and fire suppression options.

When a fire becomes a firestorm

If a fire gains enough momentum, it generates so much heat that it creates its own wind currents, and becomes a raging inferno sometimes known as a firestorm. The fire’s heat creates an extremely strong updraft of air. The air at ground level around the fire is then drawn in strongly towards the fire’s centre to replace the rising air. The turbulence this creates can result in fire whirls which spiral and dart around, burning as they go.

The heat of the fire can cause thunderstorms or pyrocumulus clouds. These can produce lightning strikes, which can start new fires. With the right combination of atmospheric conditions, fire tornados can be created. These can have wind speeds of greater than 250 km/h and are extremely destructive.

Controlling a bushfire

A number of techniques are used to contain and extinguish bushfires. Smaller fires are fought directly, by firefighters applying water to the flames, either from the ground or the air. Fuel breaks can be created using hand tools such as rakes and hoes.

Another way to try and contain a fire is to deliberately burn sections of the fuel in its path, so that there’s no flammable material left to fuel it. Because these small fires are intended to ‘burn back’ to the fire front, this process is known as ‘backburning’. It’s used to try and stop a fire in its tracks, and also to protect particular areas, such as houses or other infrastructure, by creating a fuel break between them and the fire front.

Water bombing is another method used to control large fires. We’ve seen the footage on the news of helicopters flying over raging fire fronts, tipping what look like small buckets of water onto the flames. To the untrained eye, it doesn’t look all that effective. But the point of water bombing is not so much to douse the flames as to increase the humidity in the surrounding air. The water tipped out from the helicopter turns to steam, or water vapour, which makes it harder for the fire to continue burning.

Sometimes the water incorporates a gel which also helps put out the flames, or a chemical fire retardant, often dyed red so the areas where it’s been dropped are clearly visible. The retardant inhibits the fire’s ability to ignite fuels, and remains on the vegetation after water has evaporated.

Aeroplanes are also used to drop water or retardant on the fire. These can vary in size from relatively small to very large, such as the DC-10.

WARNING AND SURVIVAL

Being able to predict bushfires means we can more effectively warn people, prevent loss of life and avoid
Australia has a national fire danger rating system that was originally developed in the 1960s. It is based on weather conditions and local fuel loads. The Australian Bureau of Meteorology provides weather forecasts and fire weather warnings to both media agencies and local fire authorities to help inform their decisions about issuing fire danger ratings. Meteorologists are also directly involved with decision making on the ground.

Following the Black Saturday bushfires in Victoria in 2009, the States and Territories modified the warning levels to include a higher level: Catastrophic (referred to as Code Red in Victoria). Current efforts are updating the science underpinning the danger rating system and developing a standardised fire danger rating system that will apply across the country.

Surviving a fire
Recent research has revealed some interesting information about how people lose their lives in bushfires. Most people were killed when out in the open, with nearly three-quarters of these within 200 metres of their home. Around one-third of all bushfire deaths occurred within a house, and these mostly occurred on days with Catastrophic (Code Red) fire conditions. More than 90 per cent of these deaths occurred in rooms that did not have a door leading outside.

The most important thing for people living in bushfire-prone areas to do is to create a survival plan, and to practise it.

Preparing for bushfires
Detailed information and advice can be found in the checklists and information sheets that have been produced by governments and fire authorities around the country to help people prepare for, and survive, bushfires.

Australian Capital Territory

New South Wales

Northern Territory

Queensland

South Australia
www.cfs.sa.gov.au/site/prepare_for_a_fire.jsp

Tasmania
www.fire.tas.gov.au/Show?pageId=colbushfirePrepareActSurvive

Victoria

Western Australia

The common advice from the various authorities is to be prepared, and to either leave early, or stay and defend. Prepare, Act, Survive is the nationally accepted approach. An understanding of the risks of staying to defend a home during a bushfire, or evacuating to a safe place, is essential. All agencies agree that if you choose to leave, you should leave early, usually the day before, or before 10am on the day of risk. If you choose to stay, you must be both physically and mentally prepared. Look at the information from the various sources above to find out how best to prepare yourself or your property for the risk of bushfire.

In terms of protecting yourself, one of the most dangerous aspects of a bushfire is the radiant heat it releases. At times, this heat can be so intense it can kill people who are quite far from the fire. The most effective protection from radiant heat is distance, or a solid barrier, like a wall or an embankment. Next best is covering up – putting on protective clothing like long pants and a shirt, or overalls made from natural fibres, not synthetics. The suits firefighters wear are not simply a fashion statement. Even a blanket is better than no protection.

Other risks are dehydration, smoke inhalation and heat stroke, which can cause people to lose consciousness. The fumes from burning materials, particularly houses or cars, can be toxic, and breathing them in can lead to disorientation or death. In many cases, the fumes are heavier than air so they sink to the lowest part of the landscape or building. This is one of the reasons why sheltering in a cellar or ‘bunker’ under a house is not recommended.

The effects of fire
Clearly, all fires have an effect on the ecosystem, and research is ongoing to determine both the negative and positive consequences of fire. In the Australian Alps, wildfires have a greater impact on Alpine Ash forests than managed fires. However, it’s worth noting that a burn regime of less than 30 years could wipe out these forests. The Alpine Ash only produces seeds after it reaches maturity at an age of 30 years or more; fires occurring at a frequency of less than 30 years would therefore kill trees before they could produce seeds.

But there are also cases in which fires actually help plants regenerate. The survival of the Mountain Ash depends on the occurrence of fires. Mountain Ash can only regenerate from seeds, and fire is essential to provide the right conditions for their germination. However, if fires occur before the young trees reach maturity and produce seed (at 50 years old), the species may be completely wiped out. It may then be replaced by other species better adapted to that fire regime.

Some plant species, such as eucalypts, regenerate from lignotubers, which are stimulated by fire to develop shoots. Also, smoke from plant material promotes seed germination in more than 400 species of Australian plants.

It’s not just wildlife and plant species that can be affected by fire. Researchers at the University of Melbourne are exploring the effects of bushfires on water supply. Bushfires can have important consequences for water supply, by increasing erosion and dirtying water, making it unsafe to drink.
some bushfires, townships have been forced to boil water to make it safe to drink. Along with a degradation of water quality, in some forests, particularly the Mountain Ash forests of Victoria, bushfires can reduce the amount of water available for drinking. This is because the forests use more water as they grow back after fire.

**Australia’s most devastating fires**

Between 1900 and 2011, 866 people in Australia were killed by bushfires. The most destructive of these occurred fairly recently.

The Ash Wednesday bushfires of 16 February 1983 that swept through southern Victoria and South Australia were devastating. Seventy-five people lost their lives – 47 in Victoria and 28 in South Australia. More than 300,000 hectares of land were burnt and 3,000 houses and other buildings were lost.

Ten months of dry weather and a hot summer produced a dry landscape, primed for fire. Temperatures were in the high 30s to mid-40s, the air was dry and there were gale-force winds.

There were already 104 fires burning that Wednesday, but by the afternoon several more were burning throughout southern Victoria. It’s not known exactly how all these fires started, but some were caused by powerlines clashing with each other and with trees. Some were deliberately lit.

The Ash Wednesday fires were the deadliest on record in Australia until the Black Saturday fires of February 2009.

Once again, there were hot, dry conditions, with extremely high temperatures and strong winds. On 7 February 2009, around 400 fires started in Victoria. Temperatures in the region reached the mid-40s and winds were stronger than 100 km/h. Around 12:30 pm, powerlines fell in Kilmore East, sparking a fire that went on to become a firestorm that devastated the communities of Kinglake, Strathewen and St Andrews.

Most fire activity occurred during the afternoon and early evening of Black Saturday. Although evening brought a cool change to the region, it was accompanied by winds stronger than 12 km/h. Burning a total area of around 445,000 hectares of land, the fires moved at an average speed of 12 km/h, with some fires travelling up to around 72 km/h. One hundred and seventy-three people were killed in the Black Saturday fires. More than 400 people were injured and 2,100 homes were lost.

The amount of energy released by the fires was estimated to be equivalent to around 1,500 Hiroshima atomic bombs. In some situations, the fires produced sufficient radiant heat to kill people 400 metres away.

A Royal Commission was established to examine the causes and consequences of the Black Saturday fires. Its final and interim reports are a valuable source of information on the impact of bushfires in Australia.

**BUSHFIRES AND CLIMATE CHANGE**

As described above, four things need to be in place for a bushfire to occur: fuel must be available; the fuel must be dry; weather conditions need to be hot, dry and windy; and there needs to be a source of ignition. So, is climate change likely to affect any of these?

As plants use carbon dioxide (CO₂) from the atmosphere to generate their energy, it’s possible that higher atmospheric CO₂ concentrations will lead to an enhanced plant growth in some areas. This is known as the CO₂ fertilisation effect, and it will ultimately create more fuel for a potential fire. However, this effect only improves plant growth when there are sufficient amounts of other nutrients and water. Warmer temperatures at night and during winters will also increase the growing season of many plants.

The drier the fuel, the more likely it is to burn. Increased average temperatures caused by climate change will contribute to fuel dryness. Rainfall will also influence how dry (or wet) the fuel is. While the predictions for changes in rainfall are not as definitive as those for temperature, it is expected that there will be less rainfall in much of Australia in the future, particularly in the south-eastern and south-western regions.

The weather conditions are part of the criteria used to assess the degree of fire risk on any given day. An increase in warmer and drier weather means a higher number of days of high or extreme fire risk. Indeed, we’ve already seen an increase in high and extreme risk days in Australia over the past four decades. Along with more days of higher risk, climate change will also bring an extension of the fire season.

It is inevitable that Australia will always have large fires but, with better land management and improved understanding of bushfire behaviour, hopefully the catastrophic loss of life that has occurred in the past can be avoided.
Firestorms: the bushfire/thunderstorm hybrids we urgently need to understand

We need to undertake targeted studies to help us estimate the future risk of extreme bushfires, and how to most effectively confront these growing fire threats, cautions Jason Sharples

Fire has been a driving force across Australia for millennia. Indeed, the health of many of our ecosystems is intrinsically dependent on fire. But bushfires are also one of our most frequent natural hazards, with a total cost estimated at A$340 million per year.

In the past decade or so, extreme bushfires in southeastern Australia have burned more than a million hectares, claiming more than 200 lives and over 4,000 homes. Similar losses in other major urban areas have prompted questions about whether we are seeing a shift towards a significantly more hazardous fire regime, characterised by increasing fire frequency and intensity, and the development of catastrophic ‘firestorms’.

While these extreme bushfires account for only a very small percentage of fire events, they are responsible for the lion’s share of bushfire-related losses.

In contrast to typical bushfires, which spread across the landscape as well-defined burning fronts with smoke plumes perhaps a few kilometres high, extreme bushfires exhibit deep and widespread flaming and produce smoke plumes that can extend 10-15 km into the atmosphere.

At these altitudes, bushfire plumes can actually develop into thunderstorms (hence the term ‘firestorm’). As such, extreme bushfires become much more difficult for emergency services to handle, making them all but impossible to suppress and their spread difficult to predict.

BEYOND HOT, DRY AND WINDY

Like other dangerous bushfires, firestorms are driven by hot, dry and windy weather. But to spawn a firestorm, a range of other conditions must also be met; these can include a rugged landscape, particularly nasty weather events that produce ‘spikes’ in fire danger, and conditions in the upper atmosphere that allow fire plumes to grow to considerable heights.

While previous studies have considered past and projected changes in the hot, dry and gusty aspect of fire danger, less research has been done on the future projections for these other types of conditions. This means that we have quite a poor understanding of how extreme bushfires might affect us in the future.

As part of a series of reviews produced by the Australian Energy and Water Exchange initiative, my colleagues and I have taken a closer look at the most catastrophic bushfire cases and the factors that drive them, beyond the usual hot, dry and gusty weather.

There has been an overall increase in the frequency of major bushfire events in southeastern Australia since the mid-19th century. In particular, in the past 15 years a major fire event has occurred every 5 years or less. While some of this increase is due to changes in land use since European colonisation, there is also strong evidence of climate-driven changes.

We found that besides increases in dangerous surface fire danger conditions, upper atmospheric conditions have also become more conducive to explosive fire growth. High levels of the c-Haines index, which signals greater potential for a fire’s plume to rise high into the atmosphere, have become considerably more prevalent since the 1980s. The effects of droughts and widespread heatwaves have also contributed to the occurrence of extreme bushfires.

Looking into the future, high c-Haines values are projected to grow more prevalent still, albeit more gradually than over recent decades. Frontal weather patterns associated with particularly bad fire days are also projected to become more frequent during this century, and rainfall is projected to decrease over southwest and southeastern Australia.
All of this suggests that extreme bushfires will become a more common occurrence into the future.

**WHAT WE STILL DON’T KNOW**

Our methods for assessing fire danger do not explicitly account for the effects of extended drought and heatwaves on larger fuel elements such as branches and logs, and so may not properly account for their effects on fire spread and heat release into the atmosphere.

There is also considerable uncertainty about how fuel loads will change into the future. It is possible that the higher fire intensities expected to result from the direct effects of a warmer, drier climate may be offset by lower fuel loads.

Our understanding of extreme fire occurrence is also hampered by the lack of long-term and prehistoric climate data, which makes it hard to work out what the ‘normal’ level of extreme bushfires has been in the past. While charcoal records show promise in this regard, we still don’t know enough about how charcoal is generated, deposited and subsequently preserved during extreme fires.

To predict the future occurrence of extreme bushfires, we also have more work to do in understanding how the trends forecast by global climate models will play out in terms of creating regional-scale fire weather conditions. And we still need to figure out the likely effects of other large-scale patterns such as El Niño.

Given the relatively recent advances that have been made in understanding the key drivers of extreme bushfires, the field is now ready for targeted studies that will help us estimate the future risk of extreme bushfires – and how best we can confront the threat.

The journal ‘Climatic Change’ has published a special edition of review papers discussing major natural hazards in Australia. This article is one of a series looking at those threats in detail.

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**Extreme bushfires exhibit deep and widespread flaming and produce smoke plumes that can extend 10-15 km into the atmosphere.**

Jason Sharples is Associate Professor, School of Physical, Environmental and Mathematical Sciences, UNSW.

Assoc Prof. Sharples receives funding from the Australian Research Council and the Bushfire and Natural Hazards Cooperative Research Centre.

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CSIRO analysis has found that, between 1901 and 2011, 733 civilians and 92 firefighters died in bushfires; just over 11,000 homes were destroyed. Of the deaths that occurred outside, around 60% of these people died within 100 metres of their home, reports Bianca Nogrady in this article first published in ECOS eNews.

More than 60 per cent of people who perished outdoors in Australian bushfires over the last century did so within sight of their own homes. This is one of many sobering insights from CSIRO’s analysis of data on property and human lives lost to bushfire, between 1901 and 2011.

Until recently, much of what was known about the circumstances surrounding the people who lost their lives and the homes that were razed was based on the stories of survivors and of witnesses, and on anecdote.

But now, examining the wealth of data that is available, researchers have revealed some surprising – and often disturbing – patterns in how, when and where lives and homes have been lost to bushfire. During this period, a total of 733 civilians and 92 firefighters lost their lives in bushfires, and just over 11,000 homes were destroyed.

**Getting caught out close to home**

The analysis found that, during this period, 733 civilians and 92 firefighters died in bushfires, and just over 11,000 homes were destroyed.

But one figure in particular stood out. A graph of the number and location of deaths that occurred outside the home showed that around 60% of these people died within 100 metres of their home.

What does this discovery reveal about human behaviour?

“There are lots of accounts of people talking about their intentions to wait and see and to stay with their house, but then when the effects of fire start building up around them they have a sudden change of heart and decide to flee,” says CSIRO research leader Justin Leonard.

“Of course there are the education programs which are trying to say don’t wait and see, don’t freak out at the last minute, but human nature is still taking people down that path.”

The finding came as a surprise to the research team, because until now they had no sense of how common that behaviour was. Furthermore, 80% of outside deaths outside the home happened within 500 metres of home, which, as Leonard points out, wouldn’t even reach the farm gate in rural areas, or to a safer place in the neighbourhood.

Leonard spells out the implications: “What this emphasises is, if you’re not already in a safe location well before the fire has started bearing down on the area, it’s definitely too late to think about getting to one of these other places because if you’re going to die, you’re most likely going to die either in or within a few hundred metres of your home.”

**Having a plan, and a backup plan**

The finding reinforces the importance of making plans to get out of the area well before the weather worsens, and sticking with those plans, says Leonard.

“We have to learn to say I’m going to put down the things I hoped I was going to achieve today and just head into the city and do something different and be in a non-bushfire-prone area before 10am that day,” he says. “People really need to lock in on that idea.”

However, no plan is complete without backup plans, he adds. So it is just as important to recognise when the time has passed for you to safely make this journey.

**Urban sprawl and the gender shift**

The data also showed changing patterns in bushfire-related fatalities over time.
A significant gender shift that happened around the 1960s, where deaths changed from being predominantly male, to being roughly equal between men and women. The shift reflects an earlier rural scenario, says Leonard, where it was the men who went to fight the fires or save livestock and were caught out in the open. As urban development pushed ever further into the bush, this has changed to a scenario in which everyone is at risk, whether they are inside the home or out in the paddock.

**Catastrophic conditions are the big killers**

The second significant discovery supports the decision made following the devastating 2009 Black Saturday bushfires to create the new fire danger rating level of ‘Catastrophic’.

When researchers looked at the conditions on days where lives and properties were lost, 60-70 per cent of these losses happened on days that would now be classified as catastrophic.

Current building regulations are only designed to be effective only up to ‘extreme’ conditions, so, as Leonard puts it: “All bets are off, even for a regulated house when you get to catastrophic.”

“In a sense, we’re resigning ourselves to the inevitability that when we have those days we’re going to lose thousands of houses and hopefully only a handful of people.”

**Future-proofing our homes, now**

This scenario may become even less palatable as the changing climate brings an increase in the likelihood of catastrophic weather conditions.

For many parts of Victoria, catastrophic weather conditions are roughly 1-in-20-year conditions, meaning that in any one bushfire season there is about a 5 per cent likelihood that such catastrophic bushfire conditions will arise.

By 2050, that likelihood could increase to about 15 per cent, says Leonard, and by 2100 about 30 per cent.

“The inevitability that a big fire will run on that day is nearly absolute – it just depends where in the landscape it’s going to turn up,” he says.

This inevitability begs the question: Why are we not building now to anticipate the greater threat?

There is no engineering reason why houses can’t be built to deal with catastrophic bushfire conditions, Leonard says.

“The numbers of houses we expect to lose into the future will reach a point where it won’t be tolerated by society, and they will change but we should be thinking about that change now, not reacting when it reaches this point.

“It pretty much requires a paradigm shift to achieve what we’re talking about here.”

Accepting the inevitability of fire is the first step, then building and maintaining a house and surrounding landscape that is capable of withstanding fire is the logical next step.

This change in mindset would open a range of opportunities – to embrace fire as a tool and a welcome occurrence that renew the landscape around our homes – and create a landscape that will be far less of a problem when fire arrives on that next catastrophic fire weather day.

**FURTHER READING**


© CSIRO.
The number of bushfires per week in Australia increased by 40 per cent between 2008 and 2013, according to a new study, but experts say it is too early to link this to climate change. An ABC News report by Anna Salleh

However the modelling, which blends NASA satellite data on bushfires with a host of other environmental data, could be used by fire authorities in the future to predict whether a fire will ignite in any given area that week, said the study’s authors.

“We found that the bushfire frequency is increasing,” said first author Dr Ritaban Dutta, a data scientist from CSIRO Data61, whose study was published in the Royal Society journal Open Science.

Dr Dutta said NASA data, which gave the latitude, longitude and intensity of fires across the world, showed that in 2013 there were 4,595 fires per week across Australia.

The most seriously affected areas were tropical and subtropical areas in Queensland and Northern New South Wales, he said.

The researchers found there had been a 40 per cent increase in fires from 2008.

Dr Dutta and colleagues from the University of Tasmania combined bushfire frequency data with measurements of factors such as temperature, humidity, wind speed and soil moisture, which are known to impact on the flammability of landscapes.

The resulting computer model links actual fire data with flammability factors that could be used to give fire authorities a heads up on likely fires.

“You could have a map showing bushfire hotspots with 15-metre resolution,” Dr Dutta said.

Too soon to know if climate change is to blame

Climate scientists said the period of time covered by the study was too short to determine if the increase was due to climate change or part of natural variability.

Dr Will Steffen from the Climate Council said previous research found an increase in bushfire frequency in forested regions of south-eastern Australia over the past 35 years, and an increase in high fire danger weather. However, he said obtaining reliable data was a challenge when it came to studying bushfire frequency and he welcomed the new study using the remote sensing data from NASA.

“That gives you a very internally consistent data set,” he said.

Dr Steffen said longer studies would be needed to be sure whether climate change was influencing bushfire frequency.

“In terms of climate change, my rule of thumb is you need about three decades as a minimum worth of data to start to see a longer term trend,” he said.

“I would say that’s a reasonable comment,” said senior author of the new study Dr Jagannath Aryal, a senior lecturer of spatial sciences in the School of Land and Food.

But he said the model linking environmental conditions with bushfire frequency would still be useful in developing a tool to give people early warning for fires, saving lives and property.

“At this stage we can definitely say this is proof of concept,” Dr Aryal said.

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True or false? Facts and myths about bushfires and climate change

In this fact sheet, The Climate Institute considers some common statements about bushfires and climate change caused by carbon and other greenhouse gas pollution. Their fact checks are drawn from the latest Australian and international research, which is referenced throughout.

BUSHFIRE RISK IS RISING

TRUE

• Extreme fire weather has increased, and the fire season has lengthened, across large parts of Australia since the 1970s.¹
• The annual cumulative Forest Fire Danger Index (FFDI), which represents the occurrence and severity of daily fire weather across the year, increased with statistical significance at 16 of 38 climate reference sites across Australia from 1973 to 2010, with non-statistically significant increases at the other sites.²
• There was a rapid increase in the annual cumulative FFDI at many locations around the country in the late 1990s and early 2000’s.³
• By 2050, compared with the climate of 1980 to 1999, the number of extreme fire-weather days is projected to grow in southern and eastern Australia; by 10 to 50 per cent for a low greenhouse gas emissions scenario (assumes strengthening global action to limit climate change, in line with the 2015 Paris Agreement) and by 100 to 300 per cent for high emissions (assumes greater climate change due to higher levels of carbon pollution or a climate system more sensitive to greenhouse gases).⁴
• NSW – The impacts of climate change include: the frequency of occurrence of days of very high to extreme fire-risk may increase by 3 to 50 per cent by 2050 in all regions and the fire season is likely to be extended in most regions.⁵
• Victoria – Instead of a ‘catastrophic’ blaze every 30 years or so, on average, it could face the prospect of a ‘Black Saturday’ level event every two or three years.⁶ With low global emissions, these events are projected to occur every 16 years.
• Tasmania – Under a high global warming scenario, the total number of days per year categorised as ’Very High Fire Danger’ is projected to increase by at least 120 per cent. This is about a 10 per cent per decade increase to 2100 characterised by: a steady increase in fire danger, especially in spring; a lengthening of the fire season; and more days at the high fire danger ratings.⁷
• South Australia – In Adelaide, the annual cumulative FFDI is likely to increase by between 2 and 8 per cent for 2020 and 3 to 25 per cent for 2050.⁸

FALSE

• Western Australia – The number of days per year with severe fire danger weather is projected to nearly double in south-west Western Australia by 2090 under higher global warming scenarios.⁹

CLIMATE CHANGE ISN’T INFLUENCING BUSHFIRES

• The average temperature of the continent has risen by almost 1°C since Federation, while rainfall in the south has fallen. The mix of warmer and drier weather is raising the risk of severe, extreme and catastrophic fire weather conditions in south-eastern Australia.
• Australian average surface air temperature has increased by 0.9°C since 1910, and increasing greenhouse gases have contributed to this rise.¹⁰
• Extreme fire weather days have increased ... from 1973 ... due to warmer and drier conditions.¹¹
• There is high confidence that projected warming and drying in southern and eastern Australia will lead to fuels that are drier and more ready-to-burn, with increases in the average FFDI and a greater number of days with severe fire danger.¹²
• The fire season is spreading further into spring and autumn.¹³ Record-breaking spring temperatures in 2015, strongly influenced by climate change, contributed to an early start to the 2015-2016 bushfire season in Australia.¹⁴
• The increasing length of the fire season will reduce the window of opportunity for hazard reduction

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at the time when the need for hazard reduction becomes greater.\textsuperscript{35}

- Fire authorities added two new danger ratings in response to the Victorian ‘Black Saturday’ bushfires of 7 February 2009 – Extreme (above an FDI of 75) and Catastrophic/Code Red (above 100).\textsuperscript{36} Extreme fire weather days have become more frequent over time.\textsuperscript{37}

**FUEL IS ALWAYS THE MAIN FACTOR IN FIRE RISK**

**FALSE**

- Fuel load and human activity are clearly important factors in the risk of fire. However, weather conditions including drought, high winds and extreme temperatures are often a major influence on the number, size, and intensity of bushfires in southern Australia.\textsuperscript{18}

**RECENT HOT WEATHER IS WITHIN NORMAL BOUNDS**

**FALSE**

- 2013 was Australia’s hottest year on record, with many places smashing local records.\textsuperscript{19} 2015 was the 5th hottest with eight out of the ten hottest years occurring since 2002.\textsuperscript{20} And, globally, 2015 was the hottest year on record.\textsuperscript{21}

- Climatologists from the University of Melbourne came to the clear conclusion (less than 90 per cent certain) that climate change caused by human activity had a substantial influence (fivefold increase in risk) on the record extreme summer temperatures over Australia in 2012-13. They concluded that natural climate variation alone was unlikely to explain the record summer temperatures which followed prolonged La Niña-neutral conditions which are ordinarily correlated with cooler summers.\textsuperscript{22}

- More extreme events have been recorded over the latter half of the 20th century, coinciding with changes to climate over that time. Higher maximum and minimum temperatures, more hot days and fewer cold days, and more intense rainfall events have all been observed and are expected to increase with future climate change.\textsuperscript{33}

**AUSTRALIA’S CLIMATE IS CHANGING**

**TRUE**

- Australia is becoming hotter. The continent’s average temperature is now nearly 1°C higher than it was in 1910.\textsuperscript{24} 2013 was Australia’s hottest year on record.\textsuperscript{25}

- The duration, frequency and intensity of heatwaves have increased across many parts of Australia, based on daily temperature records since 1950.\textsuperscript{26}

- Over the past 15 years, the frequency of very warm months has increased five-fold and the frequency of very cool months has declined by around a third, compared to 1951-1980.\textsuperscript{27}

- Since 2001, the number of extreme heat records in Australia has outnumbered extreme cool records by almost 3 to 1 for daytime maximum temperatures, and almost 5 to 1 for night-time minimum temperatures.\textsuperscript{18}

- Australian land and sea surface temperatures have now warmed about 1°C, with the majority of the warming occurring since 1950.\textsuperscript{30} Warming surface temperature has been apparent in all seasons and all states and territories since 1950.\textsuperscript{30}

- Cool season rainfall in the south of the country, particularly in the south-west and the south-east has fallen significantly since the early 1970s (south-west) and 1990s (south-east). Southern drying trends throughout the 20th century were characterised by a 10 to 20 per cent reduction in cool season (April to September) rainfall across the south of the continent.\textsuperscript{37}

**THE COSTS OF BUSHFIRES AND OTHER WEATHER-RELATED DISASTERS ARE MOUNTING**

**TRUE**

- From 1966, the total insured loss from bushfires alone is equivalent to $5.6 billion in today’s money, the Insurance Council of Australia suggests. This translates to an average annual loss of approximately $160 million over the period.\textsuperscript{32}

- The cost to the community of Victoria’s ‘Black Saturday’ bushfires in February 2009 was estimated to be more than $4 billion by the subsequent Royal Commission. This figure does not include health
The mental and social tolls of bushfires impose substantial additional costs on communities, aside from the physical injury from heat, flames and smoke. The cost in the treatment and lost productivity associated with mental disorders is already estimated at nearly $8 billion annually. Mental health problems also tend to coalesce with economic and social ones, meaning that the overall toll is likely to be larger still.\(^35\)

ENDNOTES


2. Ibid., 8.


4. CSIRO and The Bureau of Meteorology, 2014, op cit., 15. [Note: by 2100, the low emissions scenario would see warming of roughly 2 to 3°C, which broadly reflects expected outcomes under current global Paris pledges as at the end of 2015.]


8. J.M. Balston, and A. Williams, 2014, Modelling Bushfire Changes for South Australian Regions, Department of Environment, Water and Natural Resources South Australia, Adelaide, South Australia, 45.


10. CSIRO, 2015, Climate Change in Australia Technical Report, 42.

11. Ibid., 8.

12. Ibid., 139.


17. CSIRO, op cit., 51.


23. Fox-Hughes et al., op cit., 4.

24. CSIRO, op cit., 42.


27. Ibid., 4.

28. CSIRO, op cit., 43.


30. CSIRO, op cit., 42.

31. Ibid., 44.


1. **Record-breaking spring temperatures in 2015, exacerbated by climate change, have driven an early start to the bushfire season in Australia.**
   - The maximum temperatures in Melbourne on October 5th and 6th were the hottest ever recorded for the first week of October while temperatures were at least 12°C above average for most of southern Australia on at least one day during that week.
   - Globally, seven months this year have broken their monthly temperature records and 2015 is very likely to surpass 2014 as the hottest year on record.
   - Longer, hotter and more intense heatwaves, and more frequent and severe droughts, are driving up the likelihood of very high bushfire risk, particularly in the southwest and southeast of Australia.

2. **North America has faced a deadly bushfire season in 2015.**
   - The North American bushfires have been driven by years of severe drought in combination with warmer temperatures, a situation Australia is likely to face with increasing frequency in future.
   - Between January and October of 2015, over 50,000 bushfires burned over 38,000 km² of land – an area more than half the size of Tasmania, making it one of the worst bushfire years on record in the US.

3. **Australia’s bushfire preparedness is at risk from climate change as bushfire seasons increasingly lengthen and overlap with fire seasons in the Northern Hemisphere.**
   - Large areas of southeast and southwest Australia are facing above-average bushfire potential for the 2015/2016 summer. Most of the southeast coast of Australia is expected to experience above normal bushfire potential due to a long-term rainfall deficit, relatively low soil moisture, and relatively warm conditions predicted for the summer.
• Globally, the length of the fire weather season increased by nearly 19% between 1979 and 2013. Longer fire seasons will reduce opportunities for controlled burning and increase pressure on firefighting resources.

**Longer fire seasons will reduce opportunities for controlled burning and increase pressure on firefighting resources.**

• Some of Australia’s key firefighting aircraft are leased from overseas and are contracted to North American firefighting services during their summer. The fire seasons of the two hemispheres – and the demand for these critical shared firefighting aircraft – will increasingly overlap, challenging such arrangements.

• During the past decade, State fire agencies have increasingly needed to share personnel and other firefighting resources during peak demand periods. This pressure will continue to intensify and the number of firefighters will need to double by 2030 to meet demand.

4. **Stronger climate change action is needed to reduce bushfire risk.**

• Australia’s emissions reduction target of 26-28% on 2005 levels by 2030 is not sufficient to protect Australians from worsening bushfires and extreme weather events.

• Australia must cut emissions more rapidly and deeply to join global efforts to stabilise the world’s climate and the vast majority of Australia’s fossil fuel reserves must stay in ground.

CHAPTER 2
Bushfire preparation

FUTURE BUSHFIRES WILL BE WORSE:
WE NEED TO ADAPT NOW

Justin Leonard cautions that we need to adapt our building practices and landscape design to match the fire-prone land we live in.

The devastating fires that struck Wye River in Victoria on Christmas Day are, from an emergency response perspective, a success story. Despite the loss of 116 houses in the coastal town and nearby Separation Creek, nobody was killed.

The fire may have destroyed homes and in some cases livelihoods but the community presented a united front in terms of supporting one another and heading the evacuation warning, which was issued in plenty of time.

I spent the first part of January working with fire agencies to surveying the damage to houses in a bid to understand the impact of the fire. The community is truly thankful that no lives were lost in this terrible event.

The debate now shifts to how the community will rebuild to withstand future fires and other issues such as land instability.

Other communities have not been so lucky. The town Esperance in Western Australia was hit by fire in the 15th of December resulting in four lives and two homes lost. Two lives and 91 homes were lost in a fire north of Adelaide South Australia on the 25 of December and two lives and 121 homes were lost in the township of Yarloop in Western Australia on the 6 January.

As we look back over this summer’s fires and reflect on how communities and emergency services responded, we need to consider how the risk of fire is changing in a warming world.

FIRE SAFETY IS EVERYONE’S RESPONSIBILITY

Evacuation works well when there is sufficient warning and everyone decides to leave. It is reasonable for authorities to pick a threshold and say “it’s time to leave your home”.

But when this happens, the community has to act as one. Wye River did that very well; there wasn’t anyone left in the affected area except firefighters. This reflects a sense of shared responsibility for community safety between residents and fire authorities.

In Australia between 1900 and 2010, a total of 674 civilian lives were lost in 260 bushfires. Analysis of these deaths has focused on the relationship between where people were killed, weather conditions, proximity to fuel, activities and decision-making leading up to the
death. We now know that most deaths occurred under very severe weather conditions.

A number of recommendations came out of the Royal Commission into the February 2009 Black Saturday bushfires in Victoria, including the need for an enhanced warning system. This resulted in a new, “code red” warning level on the bushfire weather severity scale.

For code red days, people in bushfire-prone areas are encouraged to listen to advice from agencies and leave their homes either the day before or early in the morning on the day the weather approaches this level. This has been adopted in many regions across Australia as an accepted strategy.

Bushfires on code red days dominate loss statistics. 70% of house losses and 60% of deaths occurring on days which reach this level. Thankfully none of our towns and cities have experienced a code red day this summer.

Mass evacuations will not necessarily always be the easiest or most practical solution for all bushfire circumstances. In Victoria, you can’t forcibly evacuate someone from a property where they have a personal interest in protecting that property.

In Wye River, the evacuation warning worked and people were more inclined to leave than stay and try to protect their homes. The warning work because it was issued well ahead of the fire. The community had previously considered their approach to the threat of bushfire and formed a unified approach to warnings.

In other areas the communities response to warnings may be more diverse. With the introduction of code red warnings, it is likely more people will evacuate following a warning.

What’s concerning is people who do decide to stay with their homes despite an evacuation call may be in more danger than ever before. They could be the only resident left in their street fighting to protect their home, potentially making them more vulnerable.

In the past, residents needed to plan for a range of fire weather scenarios and decide at what level of fire weather severity they would leave. This also includes planning for how to defend their home, if for some reason they do not leave or a fire arrives on a less severe day.

Now residents need to also consider the extent to which the rest of their community is likely to leave the area.

**FIRE IN THE FUTURE**

At the start of a bushfire season we don’t know if one or more code red days will occur. A code red day can only be reliably predicted in the week leading up to it.

Unfortunately we are likely to see more code red days in the future. Typically on a code red day there are hundreds of fires in the landscape and firefighters battle to put most or all of them out. It’s an amazing task and they do an excellent job. But obviously there’s a chance that some could grow to a size that becomes impossible to control.

Have we seen the worst fire weather that is technically possible? Nobody knows for sure, but probably not.

Climate change projections indicate that south eastern Australia is likely to become hotter and drier in future.

A 2007 study examined the potential impacts of climate change on fire-weather at various sites in south east Australia. It found that at all locations the likelihood of code red days occurring will increase. For some sites the change is minor by 2020 but for other sites such as Bourke, Melbourne Airport, and Mildura the frequency will more than double.

As we approach 2050 the news is far worse, with some areas such as Bourke, Melbourne Airport, Mildura, Moree and Wagga increasing in likelihood by more than five times. The study also found that fire seasons will start earlier and end later while being generally more intense throughout their length. This effect will be the most pronounced as we approach 2050 although it is likely to be apparent now.

By 2050 we can expect to see more uncontrollable fires in our landscape under the more severe weather conditions. A lot more of the landscape will be burnt.

In many regions major fires will be frequent enough to constantly remind people of the risks associated with them. With these observations we need to consider new ways of accepting the inevitability of these fires and adapt.

By adaptation I mean a combination of building practices and landscape design that match the fire-prone land we live in. Perhaps one day instead of lamenting the losses from bushfires, we will be able to feel content as the environment recovers around us.

Justin Leonard is Team Leader, Bushfire Urban Design, CSIRO. Justin receives funding as a CSIRO research scientist from various government agencies via grants and contracted research via agreements between CSIRO and those agencies.

**THE CONVERSATION**

BUSHFIRES: BE PREPARED

As bushfire season approaches, it is important to ensure that you have taken the necessary steps to protect yourself, your family and your property from danger. Well-prepared homes are better protected from bushfires. A guide for schools from the Australian Institute for Disaster Resilience

Planning for a bushfire

The bushfire season in Australia is usually during summer and autumn, but in the north of Australia it is during the dry season, which is in winter. Before the bushfire season, it is important to take steps to protect your home for the coming season.

Steps to take when planning for the bushfire season

- Store all flammable material clear of the house (wood, paint, chemicals, fuel, piles of newspaper/paper).
- Remove rubbish from the gutters, rake the dry leaves and dispose of them thoughtfully, and also trim hedges and mow all grass.
- Fit wire screens to doors, windows and vents. Enclose all gaps, roof eaves and under the house.
- Keep a ladder handy for roof access inside and outside.
- Have an emergency survival kit and make sure your family can access it.
- Create a household plan to either leave early or to stay and protect the property during a bushfire. Include this plan in the emergency kit with emergency numbers.
- Check that you are insured for bushfire.
- Mark all water sources as this assists emergency services should they need them. Ensure all hoses reach the house and garden.

Some local government authorities have regulations referring to the control of the planning and building of home and other buildings in bushfire prone areas.

This includes having mandatory firebreaks around the house, installing water-pumps, the use of specific materials, and boundaries surrounding the buildings.

Emergency survival kit

Creating an emergency survival kit is important for your survival during a bushfire.

In the box below you will find a list of what you should include in your emergency survival kit.

When the fire approaches

At this point you should have decided whether you are staying to defend your house or evacuating, or authorities may have ordered you and your family to leave the premises.

The precautions you should take are listed below:

- Notify the fire brigade of the fire. Do not assume that they know about it: call 000.
- Fill baths, sinks and buckets with reserve water and turn off the gas and electricity.
- Access your emergency survival kit.
- Remove curtains and move furniture away from windows and entrance ways.
- Wear long wool or heavy cotton clothing, solid shoes/boots, leather gloves, a hat or woollen balaclava.
- Plug pipes and fill gutters with water.
- Hose down the house and garden, focusing on the fire front and watch for spot fires.
- Close all doors and windows to stop smoke from seeping in and block all gaps. When the fire front comes, stay inside away from windows until it passes (usually 5 to 15 minutes).
- Quickly extinguish any fires which may have started in/on/under/around the house and check inside the roof as well.
- If the house is alight and the fire cannot be extinguished – move to safe burnt ground. Do not leave the area. Wait for help.
- Listen to the battery-operated radio for official information.

If caught in a bushfire while driving

- Do not drive into or near a bushfire.
- Do not drive through flames or smoke.
- Stop at a clearing or roadside with low vegetation.
- Switch off ignition and turn hazard lights and headlights on.
- Stay inside unless near safe shelter.
- Keep vents windows and doors closed.
- Lie down below window level under a woollen blanket until the fire front passes.

If caught in a bushfire on foot

- Cover exposed skin.
- If on a slope – move across it then down towards the rear of the fire and find a clearing or already
Emergency survival kit

Prepare an emergency survival kit before the bush fire season starts. Having a prepared kit means having easy access to things that can help you survive a bushfire or other natural disaster. It will be in one handy location. This kit will help you regardless of whether you are going to leave, or stay and actively defend your home.

Some of the things you might include are:
- Portable battery-operated radio
- Waterproof torch
- Spare batteries
- First aid kit with manual
- Candles with waterproof matches
- Woollen blankets
- Emergency contact numbers
- Waterproof bag for valuables.

Before you leave, you should add:
- Cash, ATM cards, credit cards
- Medications, toiletries and sanitary supplies
- Special requirements for infants, elderly, injured, disabled
- Mobile phone and charger
- Combination pocket knife
- Important documents, valuables and photos (in a waterproof bag)
- Change of clothes for everyone
- Drinking water (at least three litres per person per day).

Keep your Emergency Survival Kit in a waterproof storage container in a location that is easy to get to and that the whole family knows about. This will make it quick and easy to find when you need it. Remember to prepare for your pets as well. Make sure your pet is wearing an identification tag. If you’re leaving, take a leash, basket, medication, food and a familiar toy for your animal. It will help reduce stress.


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burnt area.
- Do not attempt to outrun a fire, or go through low flames unless you can see a safe clearing.

If you cannot avoid the fire
- Protect yourself by lying face down in a rocky area, under an embankment or in a hollow.
- If possible get into a pool, pond, dam, and stream – but not in a water tank.

Remember:
- Be prepared for a bushfire.
- Have an emergency plan and survival kit in the house and the car.
- You are safer in a house or car, rather than out in the open.
- Stay in a safe place until the fire front passes.
- Stay there unless advised by authorities.
- A pure, heavy wool blanket and a flask of water are the basic requirements for surviving a bushfire and being protected against heat, dehydration and asphyxiation.

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GET READY FOR A BUSHFIRE

FOUR SIMPLE STEPS TO MAKING YOUR BUSHFIRE SURVIVAL PLAN FROM THE NSW RURAL FIRE SERVICE

Getting ready for a bushfire is easier than you think. By taking 20 minutes with your family to discuss what you’ll do during a fire, you could save their lives, as well as your home.

DO YOU KNOW YOUR RISK?
Where you live is one of the things that determines if both you and your home are at risk of bushfire, and what kind of fire you might experience.

Think about the area you live in:
- Bush. If you live in an area that’s close to or surrounded by bush you’re at risk. Bushfires can be hot, intense and throw burning embers towards your home.
- Grasslands. If you live in an area where grasslands meet built up areas or homes, you’re at risk. Grass fires can start easily and spread quickly.
- Coastal. If you live along the coast near scrub, you’re at risk. Fires in coastal scrub can be hot and move fast.
- Paddocks. If you live on a farm or near paddocks, you are at risk. Fires can spread quickly over great distances.
- On a hill. If you live at the top of a hill, you’re at risk. Fires travel uphill faster. For every 10 degrees of slope, the fire can double in speed.

Around 90 per cent of homes destroyed in a bushfire are lost because of burning embers. Embers can travel many kilometres from the fire, so even if you’re a few blocks back from the bush you may be at risk.

4 SIMPLE STEPS
Preparing for a bushfire is easier than you think. It’s your responsibility to prepare yourself, your home and your family.

There are four simple steps to get ready for a bushfire:
1. DISCUSS what to do if a bushfire threatens your home.
2. PREPARE your home and get it ready for bushfire season.
3. KNOW the bushfire alert levels.
4. KEEP all the bushfire information numbers, websites, and the smart phone app.

NSW Rural Fire Service strongly recommends that everyone in your home has a conversation about exactly what they’ll do in a bushfire. It should take just 20 minutes. Use our discussion guide. Many households find that having a discussion over dinner works best as everybody is together and focused.

STEP 1: Discuss what will you do in a bushfire? Plan now.
Get the whole household together and discuss your plan. This fold out takes you step-by-step through the process.

DECIDE TO STAY, BUT BE PREPARED

EQUIPMENT CHECKLIST
Defending your home from a bushfire can be challenging and you will need the right equipment.

Check off all the equipment you will need in a bushfire emergency.

Remember, while firefighters and emergency services will do everything they can to help you, there’s no guarantee that there will be a fire truck available when you need it. If you decide to stay with your property, it’s your responsibility to be prepared.

[ ] Firefighting equipment we will need:
- A hose, or hoses, that can reach all around the house
- Water supply of at least 10,000L e.g. water tank, dam, pool
- Petrol/diesel water pump and fuel in a safe, accessible place
- Ladders to access inside the roof
- Buckets and mops
- Shovels and metal rakes.

[ ] Protective clothing
- Wide-brimmed hat
- Eye protection goggles
- Moistened facemask or cloth
- Loose, long sleeved cotton shirt
- Gloves
- Long cotton pants/jeans
- Sturdy leather shoes or boots.

We will make sure that we have all the equipment we need by: ___/____/____

If you have not ticked off all of the items above you are not prepared to tackle a major fire.

DECIDE TO STAY, BUT BE PREPARED

ACTION CHECKLIST
Defending your home can be physically and mentally demanding. It’s important that everyone knows exactly what to do if a fire happens.
LEAVING EARLY OR PREPARING TO STAY?

One of the most important things to do before a bushfire is to decide what you’ll do if one should start. This guide can help you make that decision, and assist you with the steps in preparing yourself, your home and your family. Once you’ve had the discussion and made a decision, get your family to sign this document.

WHAT SHOULD YOU DO?

LEAVE EARLY, YOUR SAFEST CHOICE.

When will we leave?
What will be your sign to leave? It could be smoke in your area, or as soon as you find out there’s a fire near you.

Where will we go?
Where’s a meeting place that’s safe and away from a fire area? It might be a friend or relative’s place, or even a shopping centre.

How will we get there?
What road will you take? What’s your backup plan in case the road is blocked?

What will we take?
Make a list of what you’ll take in the event of a fire. Remember to include pets, identification and irreplaceable items like photos or documents.

Who will we call to tell that we’re leaving and that we’ve arrived safely?
Who will we call to let them know we’re leaving and that we’ve got there safely?

What is our backup plan?
What if things don’t go to plan? Identify a safer location nearby such as a neighbour’s home that is well prepared, or a place of last resort. Is there a Neighbourhood Safe Place nearby?

Neighbourhood Safe Places are a place of last resort, such as a sports ground or local building that has been specially identified for use during a fire.

Not all areas will have a Neighbourhood Safe Place so check www.rfs.nsw.gov.au/nsp for locations.

We have discussed and agreed with the entire household we will:

| Leave early | Decide to stay |

Signed: ______________________ ______________________ ______________________

DECIDE TO STAY. ONLY IF YOU’RE WELL PREPARED.

Before you start, ask your household:
• Is your home well prepared to make it as safe as possible during a fire?
• Check the Step 2 property protection checklists.
• Are we putting anyone in our family at risk by staying?
• For example children, the elderly, or people with asthma.
• Will we cope in an emergency situation? In a fire, it will be hot, smoky and physically draining. Even trained firefighters can find it challenging.

If you’re not sure or aren’t prepared, you should leave early.

Do we have all the equipment we need?
Go through all the items on the Decide to Stay checklist and see what’s missing. Make a commitment to get all equipment by a specific date.

When there is a fire, what is our sign to start defending our home?
It could be as soon as you find out there’s a fire near you. Do not wait for an official warning.

Do we know what to do BEFORE, DURING and AFTER a fire?
Study the Decide to Stay action checklist.

Do all members of our household KNOW WHAT TO DO in all situations?
Give specific roles to each person.

What is our backup plan?
Consider unexpected events such as if one of us is home alone, if we aren’t home, if the fire moves faster than expected or if the phone lines and electricity are down.

It’s not safe to stay with your property under some circumstances, like:
• If the fire danger rating is Catastrophic.
• There is an Extreme fire danger rating and your home is not specially designed or constructed for bush fires.
• Your property is not well maintained.
• You or the people in your home aren’t mentally and physically fit and ready.

Under these circumstances, you should leave early.

Remember that bush and grass fires can move quickly and catch you off guard.
If you are caught in a fire, protect yourself from the heat. The safest option is to leave early before the fire reaches you.

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Bushfire Safety
BEFORE (well before the fire has arrived)

OUTSIDE:
[ ] Turn off gas mains and/or bottle
[ ] Move flammable items away from the house
[ ] Block drain pipes with socks full of sand and fill gutters with water. Don’t get on the roof to hose it down
[ ] Move animals to a well-grazed or ploughed area away from the house and wind
[ ] Patrol the house well before the fire arrives to put out embers and spot fires
[ ] As the fire approaches, wet the side of the house and garden that faces the fire
[ ] Move your firefighting equipment to a place where it won’t burn inside.

INSIDE:
[ ] Close doors, windows and vents
[ ] Fill baths, sinks, buckets and bins with water
[ ] Confine pets to one room
[ ] Place ladder next to roof access hole so you can check for spot fires
[ ] Soak towels and rugs and lay them across external doorways
[ ] Move furniture away from windows.

DURING (as the fire is upon you)

[ ] If flames are on top of you or the heat become unbearable move inside until the fire front has passed (usually 5-10 minutes)
[ ] Patrol the inside of the house, including roof space, looking for sparks and embers
[ ] Shelter in a room on the opposite side of the house from the approaching fire and ensure you have clear access to an exit.

AFTER (immediately after the fire has passed)

[ ] Check the house both inside and out for fires, including roof cavity, under the house, deck, stairs, windowsills etc
[ ] If possible, and safe to do so, check all your neighbours are OK
[ ] Contact relatives or friends to tell them you are safe
[ ] Patrol your home for several hours, looking for small fires and burning embers

Drink lots of water throughout so that you don’t dehydrate.

PROTECTIVE CLOTHING

[ ] Wide-brimmed hat
[ ] Eye protection goggles
[ ] Moistened facemask or cloth
[ ] Loose, long sleeved cotton shirt
[ ] Gloves
[ ] Long cotton pants/jeans
[ ] Sturdy leather shoes or boots

FIREFIGHTING EQUIPMENT WE WILL NEED:

[ ] A hose, or hoses, that can reach all around the house
[ ] Water supply of at least 10,000L e.g. water tank, dam, pool
[ ] Petrol/diesel water pump and fuel in a safe, accessible place
[ ] Ladders to access inside the roof
[ ] Buckets and mops
[ ] Shovels and metal rakes

We will make sure that we have all the equipment we need by:

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STEP 2: Prepare your home and get ready
*The top 5 actions to make your home safer*

There are some simple things you can do around your home to prepare it for a bushfire. You need to prepare well beforehand as leaving it to the last minute is too late. Here are five simple things you can do before and during the bushfire season.

1. **TRIM** overhanging trees and shrubs. This can stop the fire spreading to your home.
2. **MOW** grass and remove the cuttings. Have a cleared area around your home.
3. **REMOVE** material that can burn around your home (e.g. door mats, wood piles, mulch, leaves, paint, outdoor furniture).
4. **CLEAR** and remove all the debris and leaves from the gutters surrounding your home. Burning embers can set your home on fire.
5. **PREPARE** a sturdy hose or hoses that will reach all around your home. Make sure you’ve got a reliable source of water.

Join others in your neighbourhood in completing these top 5 actions to protect your home.

**MORE PERMANENT PROTECTION FOR YOUR HOME**

[ ] **Tick as you complete**

[ ] Block up areas where embers can enter the house
[ ] Install metal fly screens on all windows and vents
[ ] Install metal gutter guards
[ ] Position gas cylinders on side of house and away from trees and gardens
[ ] Direct any pressure valves away from house
[ ] Move garden beds away from house
[ ] Replace wood fences with metal fences
[ ] Use stones instead of mulch

*MORE PERMANENT PROTECTION FOR YOUR HOME*

**PREPARE YOUR RURAL PROPERTY**

[ ] **Tick as you complete**

[ ] Remove overhanging branches from power lines
[ ] Ensure that a fire tanker can access your property
[ ] Clear fire breaks along paddock boundaries
[ ] Store petrol, diesel and gas away from home
[ ] Keep a well-maintained area around the home and sheds
[ ] Place water pipes from dams underground and install pump to the house
[ ] Make sure hoses have spray nozzles
[ ] Keep water tanks full and connect them to pumps.

A cleared area around your home can slow a fire spreading and give firefighters a safe area to work.

STEP 3: Know the bushfire alert levels

If there is a fire in your area you will find its alert level on the NSW RFS website, on the radio and in the ‘Fires Near Me’ app. You need to keep track of the alert level so you know what you should do.
ADVICE A fire has started. There is no immediate danger. Stay up to date in case the situation changes.

WATCH AND ACT There is a heightened level of threat. Conditions are changing and you need to start taking action to protect you and your family.

EMERGENCY WARNING An Emergency Warning is the highest level of Bushfire Alert. You may be in danger and need to take action immediately. Any delay now puts your life at risk.

Fire danger ratings
Before a fire even starts, monitor the Fire Danger Ratings daily at www.rfs.nsw.gov.au/fdr. The higher the fire danger rating, the more dangerous a fire is likely to be. Under catastrophic conditions leaving early is the only safe option.

When it’s SEVERE you should only stay if your home is well prepared and you’re ready to defend it.

At EXTREME, only stay if your home is prepared to the very highest level and is specially built to survive a bushfire.
CATASTROPHIC is as bad as it gets – no homes are built to withstand a fire in these conditions. Leaving early is your only safe option.

**STEP 4: Keep key information**

In a bushfire, it’s important that you stay up to date on conditions in your area. The NSW Rural Fire Service strongly advises saving these numbers, links and apps now:

- In an emergency call Triple Zero (000). For information on bushfire, call the Bush Fire Information Line 1800 NSW RFS (1800 679 737).
- NSW Rural Fire Service Website: rfs.nsw.gov.au
- ‘Fires Near Me’ Free smartphone app.
- Local radio, local ABC/emergency broadcaster frequency, TV, newspapers.
- Facebook.com/nswrfs, Twitter.com/nswrfs

During a bushfire, you could lose power and telecommunications. Do not rely on just one source of information.

It’s a fact. If you and your home are well prepared, you stand a better chance of surviving a bushfire. Join with everyone else in ensuring that your home and family are protected by following the Four Simple Steps to getting ready for a bushfire.

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When your home or community is threatened by a bushfire it can be terrifying. People who haven’t experienced it before can underestimate how stressful it can be. Most people are not able to think as clearly as usual when they are under severe stress, and this can affect their decisions and reactions. You might already know that about yourself, and have noticed it in others.

Research shows that you are more likely to stick with a household plan if you have also prepared psychologically for a bushfire. Being able to manage your emotions in an emergency (that is, being psychologically prepared), can save your life and potentially the lives of others.

HOW TO PREPARE PSYCHOLOGICALLY: A 3-STEP PROCESS

Once the household emergency plan has been set and you’ve prepared emergency kits, planned your evacuation strategy, and practised your plan, it is then time to prepare psychologically.

1. ANTICIPATE that the situation will be stressful
How do you think you will react to the stress? How do you usually react to highly stressful situations? Although these reactions are very natural, they can get in the way of other necessary preparations.

If you understand your usual reactions you can learn ways to manage them better when they happen.

How you feel in highly stressful situations is strongly affected by the way you cope with the physical signs of anxiety and the thoughts running through your head. Our physical and emotional responses in dangerous situations are referred to as “fight or flight”. That is, you either fight for your life, or run for your life.

2. IDENTIFY your typical physical and emotional responses, and any frightening thoughts that might be adding to your fear
In highly stressful situations, the body usually shows signs of anxiety, such as a racing heart, shortness of breath, dizziness and sweating. Where do you expect you will notice it most when you are experiencing a serious threat?

What are some typical thoughts that you might be having that could be making things harder?

Typical thoughts and emotions might be:
- I can’t cope
- I’m so scared
- We’re going to die
- This is awful
- I don’t know what to do
- We’re going to lose everything
- I can’t bear it
- I wish this wasn’t happening
- I can’t deal with it.

Remind yourself that strong bodily sensations and frightening thoughts are normal reactions to stress but they are not helping you to stay calm and clear-headed. Don’t get too critical of yourself though!

3. MANAGE your feelings and thoughts with simple breathing and self-talk
We can find ways to MANAGE any changes to our body, mind and thoughts through some simple breathing and self-talk strategies. These strategies can help you to feeling more in control, and better able to make decisions about how to stay safe.

Slowing down your breathing can help calm down your body’s fear response. Focus on your out breath and extend it for as long as is comfortable for you. It is best to breathe through your nose if you can. Then let the in breath come in of its own accord. It will happen! It happens all the time without us thinking about it.

Replace anxious thoughts and images with more helpful ones, those that will support you more at this time. While concentrating on breathing out slowly, say to yourself things like ‘Relax’, ‘Stay calm’, or ‘It’s OK, I’m managing OK’, ‘I can handle this’, ‘Focus on what has to be done’ or ‘No need to panic’. Try not to dwell on the bad things that might happen, but instead tell yourself that the calmer you are, the better you’ll be at managing exactly what needs to be done.
Fires in Western Australia this week have killed four people after catastrophic fire conditions in the region near Esperance. All the victims reportedly died in vehicles.

This fire season is shaping up to one of the of the most serious in a long time, after an exceptionally dry and warm spring, amid a strong El Niño and a cool southern Indian Ocean that is choking off rain-bearing westerly winds. Much of eastern Australia from Queensland to Tasmania, and much of Western Australia, is facing above normal fire risk.

Australians are still underprepared for bushfires. And with fire seasons getting longer thanks to climate change we need to look at why people are still dying in fires, and what you can do to get prepared.

**Prepare, act, survive**

Each Australian State fire service issues its own bushfire planning guide. These are all based on a national policy to “prepare, act, survive”. Last week the Tasmanian Fire Service released and updated plan for the current fire season.

Plans such as these are critical to help people avoid serious injury and possible death, and to protect homes and businesses from destruction.

However, one troubling message from these plans is that many communities in bushland settings across southern Australia are primed for disaster because they do not meet the basic levels of preparedness. Let me explain why.

At the core of the prepare-act-survive policy are two related concepts:

- Creating defensible space around a house so it can survive a bushfire
- Getting individuals to predetermine a well thought-through trigger as to when they should leave an area because of bushfire threat.

The reason these concepts are related is because the state of preparedness of your home affects when you need to evacuate. Each State has slightly different interpretations of the national policy, so be sure to check your local guide in your State or Territory.

**Preparing your home**

The standards for preparing defensible spaces depend on where you live and each State provides slightly different advice so check your State agency website.
Further, many homes have insufficient water supplies available for fire fighting, and water pumps that are dependent of mains power which is likely to fail in a bushfire disaster.

**When to leave**

The level of preparation of homes also influences the trigger for people to evacuate their homes.

Under Catastrophic fire conditions all residents in fire-prone areas are advised to leave hours before any threat and be prepared to remain away for up to 24 hours.

This is because under these conditions the risk to life is so great given the destructive potential of bushfires and their unpredictability. Another reason to evacuate early is because strong winds present the additional hazard of fallen trees blocking escapes routes.

Dangerous but less destructive bushfires (during the Extreme, Severe and Very High fire danger categories) also demand residents decide whether to attempt to defend their property or leave. These decision points are context specific and hinge on the mental and physical capacities of residents and how well their defendable spaces and structures have been prepared. Where there has been no preparation the advice is to leave early.

The question of exactly when to leave is also context specific. Because of the unpredictability of bushfires and their potentially rapid escalation there is a real chance that official warnings may not be provided at all, or provided just before a bushfire is threatening a residential area when it is too dangerous to leave.

For this reason the guidelines highlight the need for residents to have high levels of situational awareness during the bushfire using a wide variety of information (website, media) and cues (smell of smoke, strong winds and high temperatures). Therefore residents need to make their own informed decision about when it is safe to leave.

One consequence of this is that it is likely residents of fire-prone areas will need to accept “false alarms” several times each summer. This could involve staying away from their homes for up to 24 hours at a time regardless of whether a bushfire starts in their community.

Fire agencies appreciate the challenge of getting community traction on the bushfire threat, and are deploying diverse strategies and technologies to upskill the community and prod people into action.

Nonetheless it is clear that Australians are lagging in the necessary preparations during this current bushfire season. I suspect the disconnection between the official advice and the on ground implementation results from a combination of time pressure, economic costs, misjudging the threat, and a naïve belief it will work out.

One solution may be to introduce training for people living in bushfire-prone areas to help them work through the decision-making process inherent in prepare-act-survive policies. Ultimately if bushfire weather conditions continue to deteriorate under climate change it may be necessary to introduce licenses for people living in fire-prone landscapes, much as we would for people driving cars.

David Bowman is Professor, Environmental Change Biology, University of Tasmania.

WHERE TO TAKE REFUGE IN YOUR HOME DURING A BUSHFIRE

If you need to shelter from a fire in your house, know where your exits are and be aware of surrounding vegetation, advises Douglas Brown

When you live in a bushfire-prone area you can’t ignore the danger. Most individuals and families address this necessity by preparing a bushfire survival plan. The best way to survive a bushfire is not to be there when it arrives.

For most Australian fire agencies the “leave early” policy has largely replaced the previous “stay and defend or leave early” one. This reflects an emphasis on preserving human life during a bushfire event – an emphasis that has strengthened since the 2009 Black Saturday bushfires.

Even when planning to leave early, unexpected events can occur. Not being able to find a child or family pet may delay departure until it’s no longer safe to travel. Taking refuge in your home then becomes a last resort, a worst-case scenario. But this contingency is worth considering as part of your bushfire survival plan.

If you do need to take refuge inside your home during a bushfire, which parts are likely to be the safest? As part of my PhD research, I asked 252 residents living in bushfire-prone areas which parts of their houses they would shelter in during a bushfire, which parts they would avoid, and why. I then analysed the features of these locations against the known places where people died in their home during bushfires in Australia from 1901 to 2011.

Determining the safer places to shelter is further complicated as all houses are not the same. There are many different types, with large variations in design, construction materials, location and surrounding vegetation. It is therefore not possible to give absolute answers on where people should take shelter in their homes.

Look at all the external ground floor doors (while remembering that glass doors can be dangerous because of their vulnerability to radiant heat), and determine which of them provide access to adjoining outside paved, gravel, concrete or other non-combustible areas.
WHERE ARE THE SAFER SPACES TO SHELTER?

Upstairs is generally a more dangerous space to seek shelter during a bushfire. Upstairs levels are more difficult to escape from. Often they have large windows and sliding glass doors which are designed to capture views, but due to radiant heat and strong winds can crack and implode. Upper levels are often constructed of lightweight materials that are more flammable and vulnerable to direct flame contact from burning trees.

The ground floor is generally a safer space to shelter. The ground level usually has more external doors from which the occupant can escape. On a sloping block, however, the easiest level from which to exit may be the first floor. The ground level often has smaller windows (except those leading to entertainment areas). From the ground floor it is easier to get to the driveway and closer to an external water source such as a water tank.

People often suggest the bathroom as a good place to shelter during a bushfire. However, the bathroom can also be dangerous. During a bushfire, mains water is often cut or the pressure is reduced to a trickle. Despite having tiled walls, non-combustible fittings and a water supply, bathrooms like other rooms are vulnerable to the collapse of a burning ceiling when embers have ignited in the roof cavity.

Most bathrooms do not have an external door that residents can use to exit the house. In a bathroom it can be difficult to see the progress of a fire. And as bathrooms are small enclosed spaces they may be more vulnerable to carbon monoxide poisoning.

My advice is to look at all the external ground floor doors (while remembering that glass doors can be dangerous because of their vulnerability to radiant heat), and determine which of them provide access to adjoining outside paved, gravel, concrete or other non-combustible areas. You should also see if there is a small window from which you can observe the progress of the bushfire, and if there is a sink close by to store water. Where possible consider installing a fire alarm that has a carbon monoxide sensor with audible and visual alerts.

When you have identified the most suitable place in the house to actively shelter during a bushfire, follow the bushfire preparation activities provided by fire authorities. Some of these will include looking out of a window to follow the progress of the fire and being aware of current bushfire updates on the radio and via mobile phone. There is no such thing as passive sheltering.

Being inside your home as the fire passes offers more protection than being outside. But it should be seen as a last resort, with leaving early the preferred action. Fire agencies work hard to inform residents of days when bushfires are likely, and to provide updates on fires that do break out. Residents in bushfire-prone areas should take these warnings and updates seriously and leave their properties when advised to do so, especially when catastrophic fires are expected.

The advice given in this article is general and may not suit every circumstance.

Douglas Brown is a PhD candidate (approved), University of Sydney.

DISCLOSURE STATEMENT

Douglas Brown is the Principal of Bushfire Architecture, a research consultancy which provides design advice to building professionals with clients in bushfire-prone areas. He also works as a casual academic at Western Sydney University. He was the recipient of a PhD scholarship from Bushfire CRC.

The fire season has started early. Homes were destroyed last month in bushfires near Lancefield, Victoria, while buildings and lives have been lost as fires continue to sweep through southern Western Australia.

Alongside the devastating loss of life and properties, many properties potentially in the path of Australian bushfires are inadequately insured.

While we have known about high rates of non-insurance and under-insurance across Australia for some time, there is surprisingly little solid data on the issue. We recently set out to address this gap at both the national and regional level.

Early findings from a national survey (which we will be presenting at the 2015 TASA conference later this month) indicate 13% of those surveyed are without insurance cover for their assets – 9% of home owners are without house insurance and 41% of tenants do not have contents insurance.

Approximately one-quarter of those who are insured may also be inadequately covered.

**Under-insurance: a hot topic**

These new findings strengthen our understanding of some already troubling figures on insurance in Australia.

After bushfires destroyed or severely damaged 500 homes in Canberra in 2003, estimates for national rates of under-insurance varied from 27 to 81%. The 2009 Victorian Black Saturday bushfires destroyed over 2,000 homes, with about 13% of all property losses not insured.

The average uninsured loss for each Australian natural disaster between 2004 and 2011 is estimated to be nearly one billion dollars. Yet the lessons of Black Saturday and other disastrous events appear slow to sink in.

For some, the purchase of adequate insurance cover is simply not an option. Bushfire-prone urban fringes are increasingly populated by low-income earners and households where English may be the second or third language. The affordability and perhaps cultural understanding of insurance stand as obstacles to obtaining adequate coverage.

Informing people of the risks of under- or non-insurance, along with fear mongering or peer pressure, are unlikely to be effective strategies for change. Even when money is not as tight, more information does not necessarily result in behavioural change.

This was found in interviews with at-risk residents in New South Wales. Everyday priorities, care-providing roles, and trade-offs between environmental risks and benefits are all factors that influence risk tolerance and safety behaviour.

Interviews we undertook with “tree changers” living on the outskirts of Hobart, Tasmania also highlight the uncertainty associated with taking out insurance cover. While affordability is not an issue for this cohort, public mistrust in insurance companies, and their lack of transparency certainly is.

**Insurance as one part of an integrated disaster strategy**

Losing one’s biggest material asset without the means to re-build or repair certainly exacerbates the personal trauma of disasters. It also contributes to the financial burden borne by governments and communities in the process of recovery.

However property insurance should not be seen as a panacea for the next Black Saturday. Insurance alone cannot prevent floods or fires, and without a broader support network in place it is unlikely to be as effective as proactive disaster mitigation.

Alongside the devastating loss of life and properties, many properties potentially in the path of Australian bushfires are inadequately insured.
In fact, our research suggests that house and contents insurance works best as one aspect of an integrated disaster preparedness and recovery plan. With some governments leaning towards the privatisation of risk, insurance can appear as the disaster management mechanism of choice.

Insurance can help in the aftermath of a disaster only if it is coupled with collective clean-ups, infrastructure repair, government assistance, and community outreach.

Yet re-building a house (if one has adequate insurance cover) does not, on its own, re-build lives and communities. Insurance can help in the aftermath of a disaster only if it is coupled with collective clean-ups, infrastructure repair, government assistance, and community outreach.

A call to action
As the fire season kicks off, it’s not only about individual responsibility for adequate insurance coverage. Affordability is clearly important for those who are most vulnerable in the face of property loss. Insurers also need to bring more transparency to premium pricing.

Governments have a vital role to play here, too. By providing greater accountability for payout decision-making, they could increase consumer confidence that money spent on insurance will actually deliver dividends. Only through the development of robust prevention and recovery strategies can communities and households be adequately safeguarded against future disasters.

Kate Isabel Booth is Research Fellow in Urban Geography, University of Tasmania. Bruce Tranter is Professor of Sociology, University of Tasmania. Christine Eriksen is Senior Research Fellow, University of Wollongong.

THE CONVERSATION

The Australian bush is iconic and beautiful. However, for those who live in its midst, it also brings the risk of bushfires, which can often have devastating impacts. People who live in or near the bush (including highly-settled urban areas) have a personal responsibility to construct their own bushfire plans and be prepared to implement them in case of a fire. Along with this, a central component of bushfire prevention and the mitigation of damage caused by bushfires is land management.

Although catastrophic bushfires can lead to untold damage, fire can benefit the Australian bush as well. Today’s prescribed burning practices – where fires are purposefully lit under controlled conditions and closely monitored – are conducted with the aims of not only reducing fuel loads to prevent catastrophic fires, but also improving ecological systems.

**INDIGENOUS FIRE MANAGEMENT**

The Australian continent has a long history of fire, with records showing that wildfires occurred here as far back as 400,000 years ago. Sediment records show an increase in the presence of charcoal which has been attributed to the burning practices of Indigenous Australians.

The traditional relationship between Australian Aboriginal people and the land is underpinned by caring for country; a reciprocal relationship for land management. Fire management is at the very heart of this relationship. There are long-established practices of burning the landscape in all areas of Australia, sometimes known as firestick farming or firestick ecology.

Fire can be seen as a ‘cleansing agent’, leaving a landscape that’s clean and primed to bloom again. Many areas would be purposefully burned at regular intervals to maintain areas of grassland, preventing the vegetation from becoming too thick and woody. Some historians have even suggested that many areas of dense bushland that are now carefully preserved would actually have been viewed as ‘dirty country’, land that had ‘run wild’.

Not only did these practices reduce fuel loads, meaning that catastrophically intense fires were less common, careful management and timing encouraged the growth of particular types of plants, providing habitats for certain animals. Fires were also used as a hunting tool, for example by using small lines of fire to drive animals such as kangaroos towards hunters.

As the timing and location of fires would be carefully managed, the landscape would become patterned in a ‘mosaic’ of areas of varying degrees of regeneration. This patchy landscape supported a variety of wildlife species. These practices also supported certain species of plants, such as in Cape York, where fire encourages the growth of eucalypts.
in areas that would otherwise be dominated by rainforest. Elsewhere in the monsoon tropics, the native conifer *Callitris intratropica* was maintained by managed burning.

Different indigenous groups had different burning practices, according to the various landscapes in which they lived and moved through. Men’s methods differed from women’s because they had different purposes underlying their burning practices.

As described by a member of the Nyungar people from southwestern Western Australia:

“Karl (fire) is at the very heart of our culture. In our language, karl not only describes fire, but also our immediate or nuclear family. … An extension to this is karlup, the name given to my home country. Literally translated, it is the place of my fire, my family place, my home.” Glen Kelly

The Nyungar people use two types of fire: cool fire (low intensity) and higher intensity burns. Cool fires are used to clear the undergrowth, particularly with the aim of improving access and movement through the bush. They also are used to promote new growth, as the first plants to reappear after a fire tend to be those highly valued as food sources. Cool fires are also used in careful patterns to promote grass growth to maintain grazing areas for native animals and reduce flammable fuel load.

Cool burning involves lighting small fires on areas of wet ground. The small fires go out quickly, but create small firebreaks. Continued burning of small patches creates larger firebreaks, where regrowth of grass encourages grazing animals like kangaroos. The small firebreaks join up to make a ring around areas that can then be subjected to a stronger burn.

Fires of greater intensity are used to maintain adequate growth within certain areas of vegetation. Thickets of spearwood, or Wattan, need a high germination rate to maintain their density. After 10-15 years the thickets begin to lose their dense structure and a hot fire is required to spur on regeneration and new, thick growth. These areas must be protected from cool fires, as they will simply damage the thicket before a sufficient seedbed has been established.

Another effect of these managed burns was the long-term maintenance of grassland until it degenerated to a point where it was no longer very nutritious for animals. Grasslands would then be cultivated elsewhere and the degraded grassland allowed to rejuvenate.

Critical to Aboriginal burning practices was the timing. Different Aboriginal people across Australia have their own seasonal calendars based on local indicators such as the flowering of particular plants that are used to identify the time of year to carry out burning.

**CONTEMPORARY PRESCRIBED BURNING**

Prescribed burning is the practice of lighting managed fires according to a fire plan. Prescribed burning is undertaken to achieve different outcomes, either for public safety (hazard reduction burning) or for maintaining the ecological health of bushland and forests.

A fire can’t burn if it doesn’t have enough fuel, so one of the ways of minimising the impact of bushfire is through fuel reduction. An effective way to remove fuel is to burn it. This is termed hazard reduction burning, and is done under controlled conditions. Areas of bush are deliberately set alight during the cooler months, with the aim of reducing fuel loads, helping to mitigate bushfires by reducing their intensity and enabling easier suppression.

For instance, as part of its annual prescribed burn season, the Department of Parks and Wildlife in Western Australia burns up to 100,000 hectares of the state’s south-western forests. The department says prescribed burns also help maintain the biodiversity of ecosystems across the state, and rehabilitate vegetation after disturbances such as timber harvesting and mining.
Following the devastating bushfires in Victoria in 2009, the Victorian Bushfires Royal Commission recommended a prescribed burn target of 5 per cent of public land each year. However, this has since been modified. Rather than pursuing a target number of hectares of land to burn each year, the Victorian Government is opting for a risk-reduction approach, with a strategic focus on hazard reduction in areas closer to houses or infrastructure.

Prescribed burning is a contentious issue. Not everyone believes that it’s an effective land management tool, and some say that the smoke it produces can be hazardous to other industries, particularly agriculture. Others argue that even greater areas should be burnt.

There is a risk of prescribed burns escaping, causing loss of property. Even when successfully conducted, there is no guarantee they will reduce the risk of bushfires occurring. This is particularly true on days of very strong winds when long-distance spotting is a problem.

The effectiveness of prescribed burning is an active field of investigation, with many scientists currently examining it from a number of different perspectives. One area of research is the effect of repeated burns on animal and plant species. It’s believed that inappropriate fire regimes (or indeed, a complete lack of a fire regime except for unmanaged wildfires) since European settlement have already been responsible for the extinction of two bird species – the Kangaroo Island Emu and the Northern Scrub-robin – as well as endangering many other bird varieties.

Large wildfires have also led to a drop in wildlife populations. The fires in 2005 and 2006 in the Ngarkat Conservation Park in South Australia were damaging to the habitat and populations of the already threatened Western Whipbird and Mallee Emu-wren. On the other hand, there is evidence that shows that the exclusion of fire from some forests results in the decline of the eucalyptus overstorey.

All this means we need to better understand the fire regimes for each ecosystem in order to ensure continued ecological health, while maintaining community safety.

Another tricky issue is deciding how often we should carry out prescribed burns. A long-term study in the tropical savannas of Kakadu National Park by CSIRO raised concerns that overburning is leading to the disappearance of native wildlife. The study suggested that some native mammal populations needed to be fire free for up to five years to ensure their long-term survival.

Just one example of a contemporary approach to controlled burning is the guidelines established by the Queensland Government listing the preferred intervals for prescribed burns for a large range of ecosystems. These intervals range from 2.5-3 years, to 4-10 years, to up to more than 30 years, depending on the ecosystem type and its dominant plant species. The guidelines also include information on the best time of year to conduct the burn, and its optimum intensity.

### NORTHERN SAVANNAS
#### FIRE MANAGEMENT

The tropical grassy savanna regions of Australia’s north are very prone to fire. The monsoon rains that fall during the summer result in the rapid growth of grasses, which cure rapidly during the dry season that follows. This creation of fuel, along with the hot, windy conditions of the dry season, make for a fire-prone region.

The emissions from severe fires in the savanna region can contribute to up to 3 per cent of Australia's greenhouse gas emissions. The carbon dioxide (CO2) released into the atmosphere is thought to be (re)sequestered by the growth of grasses in the following season, but other greenhouse gases, such as methane (CH4) and nitrous oxide (N2O) are not so readily removed from the atmosphere, and will accumulate. More intense fires, that burn substantial, woody fuel, release even greater amounts of methane and nitrous oxide. These fires tend to occur towards the end of the dry season.

Aboriginal people’s traditional ecological knowledge (TEK) dictates a season-long pattern of burning according to nuanced seasonal cues, varying from region to region. Combining this with satellite data, the Northern Australian Indigenous Land and Sea Management Alliance’s Carbon Project oversees carefully managed burning of the savanna regions. These burning regimes create firebreaks that help prevent large-scale wildfires.

A number of Aboriginal groups in Northern Australia have restored their traditional burning practices, and also developed ‘carbon farming’ projects. This not only improves habitat diversity and cultural values but also mitigates the emission of greenhouse gases. Partnerships between indigenous land managers and other stakeholders have had excellent results in reducing emissions, while at the same time building scientific and social collaboration in the region.

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**EXPERT REVIEWERS**

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Australian Academy of Science.  
Bushfires 2: Managing landscapes.  
EXPECTATIONS AND HARSH REALITY: WHY BUSHFIRE WARNINGS FAIL

We need to act early, responsibly and with the best available information, writes Vivienne Tippett

The recent catastrophic fires at Yarloop in Western Australia and Wye River in Victoria have raised the issue of how authorities communicate emergency warnings.

In Yarloop, where two people died, debate has arisen about the use of SMS-based warnings, which reportedly may have arrived after the fire had reached the township. The Western Australian government will investigate the fire.

On Victoria’s Great Ocean Road, towns were successfully evacuated so no people died. However, more than 100 properties were lost.

As we examine the losses to life, property, infrastructure and community from the most recent events, many questions will be asked about how we might have avoided such extensive loss.

The truth is that sometimes, even with the best services, most rapid response and most effective communications and co-ordination, the consequences exceed what we think is acceptable as a community.

One question often canvassed after events such as the recent fires is: “Why didn’t we know how bad it was going to be earlier?”

Despite sophisticated weather monitoring and arrangements for response activation and co-ordination in Australia, it’s not always possible to predict the ferocity, speed or scope of events. Many of the factors that determine these things are outside our control.

Information overload

Emergency services agencies provide early warnings to communities to provide the information people need to be able to take action that avoids or reduces their exposure to the hazard. These messages are always provided via multiple channels – SMS, television and radio and social media forums such as Twitter and Facebook.

As we examine the losses to life, property, infrastructure and community from the most recent events, many questions will be asked about how we might have avoided such extensive loss.

However, being able to use this information effectively very much depends on an understanding of what the information means for us personally. Terms such as “leave early” and be “well prepared” are not as simple as they might first appear.

FIRE DANGER

Despite sophisticated weather monitoring and arrangements for response activation and co-ordination in Australia, it’s not always possible to predict the ferocity, speed or scope of events. Many of the factors that determine these things are outside our control.

Another challenging question often relates to the actions of the individuals affected by the event. When we discuss the perceived effectiveness of emergency communications we need to take several things into account.

The first thing is that under pressure humans don’t always behave in the way we expect. Risk assessment and risk-taking behaviour change when people are stressed. The ability to absorb information and act constructively can become flawed.

For example, research has demonstrated that emotional stress can impact how we make decisions by interfering with how we find information. As a result we may make simpler decisions, ones we wouldn’t consider if we weren’t under pressure. We are also influenced by the behaviour of those around us and by our personal past experience.

We’re in this together

Society is now exposed to a great deal more content from many more sources than ever before. In Australia, there are many real-time media feeds contributing information to both the affected and broader
community during significant events.

In addition to constant feeds on television and radio, increasingly we have become reliant on electronic messaging and social media such as Twitter and Facebook. While we are typically information-hungry during these events, the volume of information we can access requires us to make several important decisions.

What sources do we trust? How do we determine what is the most up-to-date information? How should we pull all the sources together to inform our decision-making? How well do we understand the messages we do receive?

Humans are also known to experience information fatigue, especially during hazardous events.

We must appreciate that emergency warnings can be designed either to inform or to advise or instruct. Messages such as “evacuate now” appear to be fairly clear.

But we are highly likely to have other people, livestock, pets and property to consider and these assets may not be in the same location as we are. Co-ordinating an evacuation under these circumstances is understandably stressful. Recent coverage of the Western Australian fires reveals the awful anxiety associated with not knowing where loved ones are.

Clearly, making sound decisions under threatening circumstances is extremely challenging.

We have to fight fires on all fronts: by preparing the environment (i.e. burnoffs and fuel reduction), preparing our organisation, preparing ourselves and our homes, and communicating effectively. In Australia, emergency services agencies, working with experts and researchers, are making persistent efforts to improve our collective ability to protect lives and property.

We have to fight fires on all fronts: by preparing the environment (i.e. burnoffs and fuel reduction), preparing our organisation, preparing ourselves and our homes, and communicating effectively. In Australia, emergency services agencies, working with experts and researchers, are making persistent efforts to improve our collective ability to protect lives and property.

Success in the fight against fires must be a collective responsibility. As individuals and communities we must accept the part we play in risk mitigation and management by concentrating on risk reduction. Understanding the complexity of making the right decision under threat, we need to act early, responsibly and with the best available information.

Vivienne Tippett is Professor, Faculty of Health, School – Clinical Sciences, Queensland University of Technology.

Understanding loss of life in bushfires

Researchers from the CSIRO have analysed environmental factors associated with past bushfire fatalities in order to inform bushfire safety policies and programs

THE CHALLENGE

Understanding the environmental circumstances that lead to loss of life in bushfires

The safety of people in communities exposed to bushfires is influenced by their awareness, preparedness, responses and decision making, and by 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 to the large-scale weather conditions. It was originally developed to inform fire suppression activities, but its use has been extended to include a much broader range of applications including community warnings.

The 2009 Victorian Bushfire Royal Commission recommended significant improvements to risk communication, education and warnings. 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.

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. While there have been studies on fatalities behaviour during bushfire, this review process identified the need to improve our understanding of the environmental circumstances that lead to life loss in bushfires.

Between 1901 and 2011 there have been 260 bushfires in Australia associated with a total of 825 known civilian and firefighter fatalities.

OUR RESPONSE

A comprehensive bushfire fatality database

Between 1901 and 2011 there have been 260 bushfires in Australia associated with a total of 825 known civilian and firefighter fatalities. We used data on bushfire-related life loss over this period to develop the Life Loss database.

This database is the most comprehensive data set of its kind, linking information about loss of life in bushfires with environmental factors including:
• Location – was the person sheltering in a building, sheltering in a vehicle, or out in the open?
• Fire weather – what was the forest fire danger index (FFDI)?
• Proximity to fuel – how far away was the nearest forested land?
• Activity and decision making – were the victims sheltering, defending their properties or attempting to leave?

Fuel and fire weather
Our analysis of the database suggests that fire weather (as represented by the FFDI) and proximity to fuel are strongly related to loss of life in a bushfire: over three-quarters of all fatalities occurred within 30m of the forest and half of all fatalities occurred on days with an FFDI greater than 100 (the current threshold for declaring a day as ‘catastrophic’).

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 per cent of all civilian fatalities.

Location, activity and decision making
We also found that 58 per cent of fatal bushfire exposures occurred out in the open while leaving early or defending a property and 28 per cent inside buildings.

When bushfires occurred in weather conditions with an FFDI value greater than 100, over 75 per cent of all fatalities occurred within buildings. These are associated with people dying while attempting to shelter, mainly in their place of residence. When the FFDI is lower, more people are caught outside while defending their properties. The number of fatalities where people sheltered inside a building rose from 6 per cent for the time period 1901-1965, to 40 per cent for 1965-2011.

The fatalities from Australia’s 10 worst bushfire days accounted for 64 per cent of all civilian fatalities.

Male and female civilian fatalities within structures were evenly represented, while male fatalities out in the open were approximately three times greater.

Most civilian fatalities (82 per cent) occurred close to or within their homes, with 82 per cent of the ‘in structure’ fatalities being in their place of residence, and 61 per cent of other fatalities were within 100m of their residence. Of the fatalities which occurred inside structures in a location that was specifically known, 41 per cent occurred in rooms with reduced visibility to the outside conditions (mainly bathroom).

The better understanding of the location of fatalities within structures raises several questions in relation to egress, sheltering and the rate of loss of tenability of houses.

THE RESULTS

Safer bushfire strategies

58 per cent of fatal bushfire exposures occurred out in the open while leaving early or defending a property and 28 per cent inside buildings.

The message highlights the importance of preparation well ahead of the fire, the need to take action on the forecast daily fire danger rating, and stresses the importance of contingency planning and alternative options if the fire or personal circumstances prevent planned preparations and actions.

This strategy asks residents to evaluate the risk in the event of a bushfire and decide on the appropriate response, but it is only effective if residents fully understand the risks they are facing and the implications of their decisions and actions.

Our findings will help the responsible agencies to provide better warnings and information to the public, and to develop policies, programs and advice that will increase community safety during bushfires.

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Bushfires Kill, but Knowing Exactly How Might Make Them Less Deadly

Whether leaving early or staying to defend, a reliable and adaptable bushfire survival plan is a must, writes Justin Leonard

The latest round of bushfires, which claimed 27 homes in the Adelaide Hills, has once again highlighted the importance of planning for the worst. Mercifully, no human lives were lost, and it will be important to learn whatever lessons we can to avoid future tragedies.

My colleagues and I analysed 825 deaths in 260 Australian bushfires from 1901 to 2011, and our research has revealed some compelling evidence to help guide residents to plan for future bushfires.

When a fire arrives at a property, the house will experience ‘ember attack’. This attack is strongest as the main fire arrives and will persist for a long time after it has passed, and may also start to happen before the fire actually arrives.

Most people (58%) lost their lives when caught out in the open. Strikingly, 72% of those people were within 200m of their own homes (this statistic is based only on cases where details are accurately known).

I encourage you to imagine what circumstances and decisions might have led to these outcomes. Do a large number of people simply wait to see if the fire is really going to arrive on their doorstep?

Bushfire deaths within a house are most prevalent during our most severe fire events, representing 75% of all fatalities during bushfires that occurred on days with ‘catastrophic’ (code red) fire danger conditions. This is despite them representing only 27% of all bushfire deaths.

Of those who died inside homes, 92% were in rooms that did not have a door that led directly to the exterior of the house (once again, this is based only on cases where circumstances are accurately known). This raises uncomfortable questions: why did these people apparently not try to leave the home as the house fire developed? Were they monitoring the conditions outside as the fire passed? Had they thought about which exit was the safest?

HOMES UNDER ATTACK

When a fire arrives at a property, the house will experience ‘ember attack’. This attack is strongest as the main
fire arrives and will persist for a long time after it has passed, and may also start to happen before the fire actually arrives. If the house is close enough to the bush it may also be affected by radiant heat, and if very close then direct flame contact is possible, although most houses are lost without any direct interaction from a bushfire front – which goes some way to account for the seemingly random loss patterns that occur.

Given the timing and intensity of ember attack, it is no surprise that our data show that houses can ignite before, during, and after a fire front’s passage – with the most likely time being during and immediately after the fire front has passed.

For the relatively small number of houses that ignite before the fire front arrives, the occupants may be faced with life-threatening conditions both inside and outside at the same time. There are also a few cases were houses are built so close to the bush or other combustible elements that even the low-level fire that persists after the main fire front has passed is too intense to survive outside.

Nevertheless, for the vast majority of homes that burn in bushfires, it is likely that at any given time, conditions would be survivable either inside or outside the house. That means that, with the right strategy, lives should not be lost.

DESIGNING A LIFESAVING STRATEGY

It is interesting to note that the current building codes for bushfire-prone areas include specific fire weather severity limits beyond which these standards may no longer be effective. The standards aim to reduce the risk that a building will catch fire, but they also rule out any guarantee that it won’t. The code also doesn’t address the issues of how fast burning homes might succumb, or of how to provide a safe or effective exit path from the building.

So even if your bushland home is fully up to code, you need to plan for a wide range of scenarios. Fire agencies across Australia have stressed the importance for people living in bushfire-prone areas to develop a fire survival plan, and your local fire agency is the best place to start on developing a plan and educating yourself about the specific local fire conditions you might face.

Once a plan has been developed I encourage residents to test their fire plan by checking whether it answers the following questions:

- Do you understand the local potential fire severity for weather conditions below this level?
- For any given circumstances, what are the signs or triggers that indicate that it is no longer safe to evacuate to a non-bushfire prone area? For some isolated communities this will be when fire weather severity passes a certain level; for other, less isolated residents it will be when they are no longer certain that the roads are moving freely and fire will not impact their travel route.
- What and where is your personal protective equipment and firefighting tools?
- Is the property free from combustible items under or adjacent to the home?
- Is the home in an acceptable state of repair to survive a bushfire?
- Which areas would be the safest external location to move to if it becomes impossible to stay in the house?
- What and where is your personal protective equipment and firefighting tools?
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Regenerating communities after a bushfire

This article from the Australian Red Cross asks: what happens when a bushfire has swept through your town, the media has disappeared to follow the next story and you’re left to pick up the pieces?

A new study into the psychological effect of the 2009 Black Saturday bushfires in Victoria has found a quarter of those in the worst-affected areas are still suffering serious mental health issues.

The Beyond Bushfires study, led by the University of Melbourne, surveyed over 1,000 survivors of the Black Saturday bushfires. The disaster is considered Australia’s worst recorded bushfire and claimed 173 lives, including 35 children.

Not knowing the fate of your friends and family can have a significant effect on your mental health both during and after a disaster.

The study found that people benefited from stronger social ties.

The National Coordinator of Red Cross Emergency Preparedness, John Richardson was involved in the study and says he agrees social ties are vital.

“Red Cross worked with those affected by the bushfires to help rebuild their lives. We introduced programs that really encouraged the community to come together. We could see the difference they made. The community begins to regenerate while the trees around them also come back to life,” Mr Richardson said.

The Beyond Bushfires study also showed that not knowing the fate of your friends and family can have a significant effect on your mental health both during and after a disaster.

John Richardson says Red Cross supports the report’s recommendation that authorities implement the ‘Red Cross Register. Find.Reunite.’ service as soon as possible during an emergency (https://register.redcross.org.au)

“This service is so important because concern about loved ones is one of the most stressful issues during an emergency. ‘Register. Find.Reunite.’ is a great resource that connects people during a disaster situation when it can be so easy to lose each other.”

Mr Richardson says preparation is another key factor when it comes to recovering from an emergency.

“We know it’s easier to rebuild your life after a disaster if you have prepared in advance for an emergency – whether it’s a bushfire, cyclone, storm or flood.”

“We know it’s easier to rebuild your life after a disaster if you have prepared in advance for an emergency – whether it’s a bushfire, cyclone, storm or flood. If you have your loved ones, your important documents, your insurance papers, your financial details and your identification, it gives you a great head start,” Mr Richardson said.

Just go to the Red Cross RediPlan site to prepare for a disaster and create your personal emergency plan: www.redcross.org.au/campaigns/prepare.aspx

Red Cross is there to help communities plan for an emergency. We’re there when an emergency hits and we’re there to help rebuild communities in the days, weeks and years that follow.

More information regarding the Beyond Bushfires study can be found at: www.beyondbushfires.org.au

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BEYOND BUSHFIRES: COMMUNITY RESILIENCE AND RECOVERY

Recommendations from a University of Melbourne report based on a study exploring individual and community capacity in dealing with bushfires

ADVICE FOR INDIVIDUALS AND FAMILIES

• Consider mental health planning – When planning for bushfire emergencies, be mindful that your decision will impact on both your physical and mental health. Exposure to a bushfire for you and your family can increase risk of mental health problems.

• Plan ahead for how to find each other – Separation from family members during a disaster is highly stressful. This stress can have a lasting impact, even when everything turns out (relatively) okay. Have a plan about where or how you will reconnect, especially if communication and road systems are affected. The Australian Red Cross provides the Register.Find.Reunite service.

• Be kind to yourself and others – It can take more than five years for some people to recover from a disaster experience and its aftermath, particularly in high impact communities.

• Be open to the possibility of positives – Positive outcomes can come from a disaster experience, even for those who have had the most severe losses. This is referred to as posttraumatic growth.

• We are all different – People can respond differently to the same experience and have different recovery needs, including within families.

• Remember the children – Even very young children can be affected by the disaster and what is happening around them for years afterwards. Ensure children and young people of all ages feel safe and stable, and involve them in recovery decisions and activities in age appropriate ways.

• Adaptive parenting – You may find parenting changes as you accommodate your own and your child’s reactions to the disaster trauma and subsequent disruptions. Remember other parents have felt this way too, sometimes it’s about doing the best you can in tough situations.

• Community groups can make a difference – Being involved in community groups leads to better mental health outcomes. However, share the load: Don’t leave it to just a few people to make sure these local groups keep going. Local groups need leaders and members to survive, and those who do “too much” might become overburdened.

• Relocating can help for some – The decision to stay living in a disaster-affected community or to move somewhere else is offset by two contrasting forces in people’s lives: connection to the community, and post-disaster disruption. Those who decide to stay are likely to feel more connected to their community. For those who decide to move away from the disaster-affected community, the impacts of post-disaster disruptions to income, accommodation and relationships are likely to be lessened.

• Changes in the natural environment can influence recovery – Many people find watching the bush regrow and recover helpful for their own wellbeing.

• Go online – Many people find online connections a helpful way to gather information and share experiences.

RECOMMENDATIONS TO GOVERNMENT AND SERVICE PROVIDERS

• Government mental health and wellbeing planning – Department of Health and Human Services (DHHS) include consideration of disaster impacts in the broader mental health and wellbeing support service planning, including the 10-year Mental Health Plan.

• Government disaster planning for schools – Department of Education and Training maintain the current working group of senior staff and key academics to ensure emerging evidence in relation to the impact of disasters on children, staff and schools is incorporated into government emergency planning and resilience building activities and resources for schools.

• Something for parents – Municipal Association of Victoria, in collaboration with the Department of Health and Human Services and Emergency Management Victoria, provide a guide to local government on how to provide additional post-disaster support to parents through existing services such as immunisation sessions, maternal and child health, and mobile libraries. Providing childcare will enable parents to participate in recovery activities as well as taking time for their own wellbeing. Department of Education and Training provide evidence-informed, timely services and support to parents through schools and early childhood settings.

• Communication register – A communication register be established of people who relocate from disaster-affected communities and others who are not community members but are highly impacted (e.g. family members of those who died). Australian Red Cross to consider the potential for this to be coordinated through the Register.Find.Reunite Service.
• Five-year recovery plan – Emergency Management Victoria include psychosocial recovery up to five years post-disaster in the Relief and Recovery Reform Strategy. Consultation with the DHHS Emergency Management Psychosocial Reference Group is recommended in development of this aspect of the Reform Strategy. Mental health risk screening and referral to individual, social and community level support services should be available within affected communities for managing trauma and for anger management, as well as providing specific services to reduce the impact of major life stressors (e.g. loss of income, change in accommodation and relationships). Support in managing trauma should be extended to those not living in affected communities – with information disseminated through the proposed communication register (see above).

• Involvement of local government and community – Government disaster recovery taskforces engage with Municipal Association of Victoria on the best way to recognise and involve local government and community in decision making and service delivery to ensure continuity beyond the immediate recovery period.

• Local emergency management plans – Local governments engage different sectors of the community in emergency planning and recovery processes, including children and young people, and account for psychosocial impacts in addition to physical safety and asset protection.

• Online information – Emergency Management Victoria provide timely information about emergency management and services online and through social media throughout response and recovery periods to support community members in making informed decisions. Government departments and agencies involved in providing recovery support services also provide online information but continue to deliver services by phone and in person.

• Screening for risk – Phoenix Australia: Centre for Posttraumatic Mental Health provide training to trauma and recovery service providers in recognising and addressing key risk factors for poor mental health outcomes including living in a high impact community, fear of dying at the time of the disaster, loss of someone close (including friends and community members), separation from family members at the time of the disaster, experiencing major life stressors after the disaster, intense anger, and living alone.

• Invest in community groups – Department of Health and Human Services, Emergency Management Victoria, Municipal Association of Victoria and local government continue to recognise and support community groups as critical influences on social connection and individual and community level recovery, and to promote inclusion and facilitate wide participation.

• Recognise community leaders – Local government continue to recognise community leaders as an important resource to guide local action and communication, and this connection be recognised and supported by State and national agencies including Emergency Management Victoria, Department of Health and Human Services, Australian Red Cross and Municipal Association of Victoria in any locally based preparedness, response or recovery initiatives.

• Parks and recreation facilities – Local governments and Parks Victoria prioritise restoration of community parks and recreation facilities as an important post-disaster support to mental health and wellbeing.

Permission granted by the University of Melbourne.

WORKSHEETS AND ACTIVITIES

The Exploring Issues section comprises a range of ready-to-use worksheets featuring activities which relate to facts and views raised in this book.

The exercises presented in these worksheets are suitable for use by students at middle secondary school level and beyond. Some of the activities may be explored either individually or as a group.

As the information in this book is compiled from a number of different sources, readers are prompted to consider the origin of the text and to critically evaluate the questions presented.

Is the information cited from a primary or secondary source? Are you being presented with facts or opinions?

Is there any evidence of a particular bias or agenda? What are your own views after having explored the issues?

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Brainstorm, individually or as a group, to find out what you know about bushfire safety.

1. What is a bushfire, and what are their most common causes in Australia?

2. What is a bush fire survival plan, and what steps should be taken to make one?

3. What is the difference between ‘bush fire alert levels’ and ‘fire danger ratings’? (provide examples)

4. What does the term ‘ember attack’ refer to, and why can it be dangerous?
Complete the following activity on a separate sheet of paper if more space is required.

“Some local government authorities have regulations referring to the control of the planning and building of home and other buildings in bushfire-prone areas. This includes having mandatory firebreaks around the house, installing water-pumps, the use of specific materials, and boundaries surrounding the buildings.”

Australian Institute for Disaster Resilience, *Bushfires: Be Prepared.*

Use the internet to research and identify local government planning and building regulations in a bushfire-prone area near you. Identify whether the area in which you live is bushfire-prone, and if relevant, use the area in which you live, otherwise identify a bushfire-prone area in your State/Territory. Write a few paragraphs identifying why that area is bushfire-prone, and list at least three (3) steps that must be taken when planning or building a house in that area. Ensure you include the area, the local council, the regulations and requirements, and how you feel those requirements will assist to keep the property safe during a bushfire (include your sources).
Complete the following multiple choice questionnaire by circling or matching your preferred responses.

1. Fire requires which of the following three (3) essential elements?
   a. Water
   b. Heat
   c. A vaccum
   d. Oxygen
   e. Ice
   f. Fuel

2. A fire front will advance more quickly under which of the following conditions? (select one answer)
   a. When travelling down a slope
   b. When travelling across already burnt ground
   c. When sprayed with water
   d. When travelling up a slope
   e. When it reaches a large body of water (e.g. a lake or dam)
   f. When wind speeds are below 12-15 km/h

3. The ‘Black Saturday’ bushfires in February 2009 occurred in which State/Territory?
   a. Queensland
   b. New South Wales
   c. Tasmania
   d. Victoria
   e. Western Australia
   f. Northern Territory
   g. Australian Capital Territory
   h. South Australia

4. The Ash Wednesday bushfires tore across south-eastern Australia, affecting both Victoria and South Australia. In what year did these bushfires occur?
   a. 1901
   b. 1926
   c. 1939
   d. 1967
   e. 1983
   f. 2009

5. How far back do records show that wildfires have been occurring on the Australian continent?
   a. 40 years
   b. 400 years
   c. 4,000 years
   d. 40,000 years
   e. 400,000 years
   f. 4,000,000 years

MULTIPLE CHOICE ANSWERS
\[ a = 5 ; b = 1 ; c = 3 ; p = 2 ; r \{ q = 1 \]
Some plant species, such as eucalypts, regenerate from shoots. Also, smoke from plant material promotes seed germination in more than 400 species of Australian plants (ibid). (p.12)

The most effective protection from radiant heat is from natural fibres, not synthetics (ibid). (p.12)

Indigenous Australians have long used fire as a land management tool and it continues to be used to clear land for agricultural purposes and to protect properties from intense, uncontrolled fires (Geoscience Australia, Bushfire Basics). (p.1)

More bushfires occur on Sunday than any other day (ibid). (p.1)

A fire front advances more quickly when travelling upslope and slows travelling downslope. The speed of a fire front advancing will double for every 10-degree increase in slope so that on a 20-degree slope, its speed is four times greater (ibid). (p.2)

Bushfires have accounted for over 800 deaths in Australia since 1851 and the total accumulated cost is estimated at $1.6 billion (Various sources, Worst bushfires in Australia’s history). (p.4)

The Bureau of Meteorology issues Fire Weather Warnings when the Fire Danger Index is expected to reach or exceed a value of 50 (38 in Tasmania) either today or the next day (Bureau of Meteorology, Bushfire Weather). (p.5)

Hot air can lower the moisture content of forests and grasslands to around 5% and in extreme cases to 2-3%, greatly increasing the speed of the fire (ibid). (p.6)

The fire season for most of Australia’s east coast extends from spring to mid-summer. The greatest danger occurs after the dry winter/spring period, before the onset of the rainy weather common in summer. The worst conditions occur when deep low-pressure systems near Tasmania bring strong, dry, westerly winds to the coast (ibid). (p.7)

The highest category of Fire Danger Rating is Catastrophic except in Victoria where it is called Code Red. Tasmania depicts the Catastrophic FDR with the colour Black (Bureau of Meteorology, Fire Weather Warnings). (p.8)

Fire has three essential requirements: fuel, heat and oxygen. Deprive it of any one of these and it will go out. (Australian Academy of Science, Bushfires 1: Understanding bushfires). (p.9)

Fires create their own weather; the heat of a fire can result in whirlwinds and turbulent air currents. These can drive the fire sideways, broadening the fire front (ibid). (p.10)

The most effective protection from radiant heat is distance, or a solid barrier, like a wall or an embankment. Next best is covering up – putting on protective clothing like long pants and a shirt, or overalls made from natural fibres, not synthetics (ibid). (p.12)

Some plant species, such as eucalypts, regenerate from lignotubers, which are stimulated by fire to develop shoots. Also, smoke from plant material promotes seed germination in more than 400 species of Australian plants (ibid). (p.12)

The Ash Wednesday fires of 1983 were the deadliest on record in Australia until the Black Saturday fires of February 2009 (ibid). (p.13)

173 people were killed in the Black Saturday fires. More than 400 people were injured and 2,100 homes were lost. The amount of energy released by the fires was estimated to be equivalent to around 1,500 Hiroshima atomic bombs (ibid). (p.13)

More than 60% of people who perished outdoors in Australian bushfires over the last century did so within sight of their own homes (Nogradly, B, Learning from 100 years of bushfire loss data). (p.16)

The number of bushfires per week in Australia increased by 40% between 2008 and 2013 but experts say it is too early to link this to climate change (Salleh, A, Number of bushfires per week in Australia ‘increased by 40 per cent’ between 2008 and 2013). (p.18)

The continent’s average temperature is now nearly 1°C higher than it was in 1910. 2013 was Australia’s hottest year on record (The Climate Institute, True or False? Facts and myths about bushfires and climate change). (p.20)

The total economic cost of natural disasters in Australia, including bushfires, was estimated to have exceeded $6 billion in 2012. These costs are expected to double by 2030 and to rise to an average of $23 billion per year by 2050, even without any consideration of the potential impact of climate change (ibid). (p.21)

After bushfires destroyed or severely damaged 500 homes in Canberra in 2003, estimates for national rates of under-insurance varied from 27 to 81%. The 2009 Victorian Black Saturday bushfires destroyed over 2,000 homes, with about 13% of all property losses not insured (Booth, KI, Tranter, B and Eriksen, C, Properties under fire: why so many Australians are inadequately insured against disaster). (p.39)

The Australian continent has a long history of fire, with records showing that wildfires occurred here as far back as 400,000 years ago (Australian Academy of Science, Bushfires 2: Managing landscapes). (p.41)

Fires were also used as a hunting tool (by indigenous peoples), for example by using small lines of fire to drive animals such as kangaroos towards hunters (ibid). (p.41)

58% of fatal bushfire exposures occurred out in the open while leaving early or defending a property and 28% inside buildings (CSIRO, Understanding loss of life in bushfires). (p.47)

Bushfire deaths within a house are most prevalent during our most severe fire events, representing 75% of all fatalities during bushfires that occurred on days with ‘catastrophic’ (code red) fire danger conditions. This is despite them representing only 27% of all bushfire deaths (Leonard, J, Bushfires kill, but knowing exactly how might make them less deadly). (p.48)

Of those who died inside homes from bushfires, 92% were in rooms that did not have a door that led directly to the exterior of the house (ibid). (p.48)
**Back-burning**
A fire started intentionally from a prepared line or other barrier to burn an area of flammable material in the path of an advancing fire.

**Bushfire**
A general term which is uniquely used by Australians to describe a fire burning out of control in vegetation, i.e. anywhere outside the built-up urban environment. Bushfires include grass fires, forest fires and scrub fires. Referred to as a “wildfire” in the United States and “forest fire” in Asia and Europe.

**Bushfire management**
All activities directed to prevention, detection, damage mitigation and suppression of bushfires.

**Bushfire risk**
The chance of a bushfire occurring that will have harmful consequences to human communities and the environment. Bushfire risk is usually assessed through consideration of the likelihood of ignition; and its threats and consequences.

**Bushfire threat**
Term used to describe and analyse the danger that a bushfire poses in a particular place, or to specified values. The four main aspects are: 1. the likelihood of a fire starting and of it becoming uncontrollable; 2. the values that will be lost or damaged if a bushfire starts and gets out of control; 3. the extent of the damage that could be caused; 4. the resources that can be brought to bear on a fire and their effectiveness.

**Contained**
A fire is contained when its spread has been halted, but it may still be burning freely within the perimeter. Further work is required to bring it to a ‘controlled’ status.

**Disaster**
A serious disruption to community life which threatens or causes death or injury in that community and/or damage to property which is beyond the day-to-day capacity of the prescribed statutory authorities and which requires special mobilisation and organisation of resources other than those normally available to those authorities.

**Extreme bushfire weather**
Extreme bushfire weather occurs when the temperature is high, the wind strength is high, the drought index is high, the relative humidity is low, and the fuel moisture is low. These conditions can occur every summer in southern Australia. A bushfire occurring under extreme conditions moves rapidly and generates intense heat and is very difficult or impossible to suppress.

**Fire behaviour**
The way in which a fire reacts to variables in fuel, weather and topography.

**Fire Danger Rating**
An index which combines all the factors that determine the likelihood of a bushfire starting, spreading and causing damage to identified values, and the difficulty of control. Used for daily preparedness planning by land managers and on signs warning the public of the daily fire danger on a six-level scale of low, moderate, high, very high, extreme and catastrophic.

**Fire intensity**
A measure of the heat energy released at the fire front.

**Fire season**
Period of the year during which bushfire is likely to occur, spread and do sufficient damage to warrant organised control.

**Fire suppression**
All work and activities associated with fire fighting.

**Fire triangle**
Diagrammatic expression of the three elements that are necessary for a fire to continue to burn: fuel – heat – oxygen. The removal of any one of these will extinguish a fire.

**Forest fire**
A fire mainly in forest or woodland area.

**Fuel reduction burning**
Application of fire to an area to reduce its fuel load and minimise the negative effect of potential bushfire.

**Grassfire**
A fire predominantly in grass country.

**Hazard**
A source of potential harm or a situation with a potential to cause loss; a potential or existing condition that may cause harm to people or damage to property or the environment.

**Mitigation**
Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment.

**Preparedness**
Measures to ensure that, should an emergency occur, communities, resources and services are capable of coping with the effects; the state of being prepared.

**Prescribed burn**
A general term indicating the planned application of fire to achieve specific land management objectives. ‘Prescribed burn’ replaces the old term ‘controlled burn’.

**Total Fire Ban**
A period of time when fires may not be lit in the open.

**Wildfire**
An American term used to describe an unplanned fire, started by lightning strike, arson or accident, now also used throughout the world. It is a generic term that may include forest fires, scrub fires and grass fires. The uniquely Australian term is “bushfire”.

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Websites with further information on the topic

Australian Academy of Science  www.science.org.au
Australian Institute for Disaster Resilience (schools education site)  https://emschools.org.au
Bureau of Meteorology  www.bom.gov.au
Commonwealth Scientific and Industrial Research Organisation (CSIRO)  www.csiro.au
Geoscience Australia  www.ga.gov.au
The Climate Council  www.climatecouncil.org.au

State and Territory fire agencies
Country Fire Authority (Victoria)  www.cfa.vic.gov.au
Department of Fire and Emergency Services (WA)  www.dfes.wa.gov.au
New South Wales Rural Fire Service  www.rfs.nsw.gov.au
Northern Territory Police, Fire and Emergency Services  www.pfes.nt.gov.au
Rural Fire Service Queensland  www.ruralfire.qld.gov.au
South Australia Country Fire Service  www.cfs.sa.gov.au
Tasmania Fire Service  www.fire.tas.gov.au

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