Fuel reduction burning in southern Australia's forests:

A review of its effectiveness as a bushfire management tool

VICTORIAN lands alliance

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Prepared by the

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Cover: *Main Ridge Flora Reserve, Mornington Peninsula, Victoria*
Top: Long unburnt forest with 'extreme' overall fuel hazard
Bottom: Forest with reduced fuel load from previous prescribed burn

Ref: Overall Fuel Hazard Guide, (Third Edition) by McCarthy, Tolhurst, and Chatto, Fire Management Research Report No. 47, Department of Natural Resources and Environment, Victoria (May 1999)

Table of Contents

Executive Summary

This report challenges the misconception that there is little evidence that prescribed fuel reduction burning is an effective bushfire management tool. It also examines the potential for improving Victorian bushfire outcomes if a substantially expanded program of prescribed burning was to be implemented.

A review of Victorian and Western Australian land management literature identified a range of information which details the benefits of fuel reduction burning. This includes:

- *27 case studies where prescribed burning has improved bushfire outcomes;*
- *scientific research into the relationship between forest fuel loads and fire behaviour, including retrospective scenario modelling under hypothetical fuel management regimes;*
- *bushfire severity analysis under differing fuel loads; and*
- *analyses of past wildfire and prescribed burning statistics in WA.*

Although it was not reviewed for this report, there is a likelihood that similar information resides amongst the NSW, Tasmanian, SA, and southern Queensland land management literature.

Most of the above-mentioned information has been prepared by land management agencies and remains 'unpublished' (in the academic sense). Opponents of prescribed burning have used this to justify either ignoring it or dismissing its significance. Nevertheless, it provides compelling evidence that extensive fuel reduction burning is a critically important bushfire management tool.

Fire researchers agree that reduced fuel loads are highly effective in limiting bushfire behaviour and spread under fire danger conditions varying from 'low' to 'very high'. There are varying views about the respective influence of fuel loads and prevailing weather on the behaviour of bushfires burning under 'extreme' conditions.

As an estimated 95% of Victorian bushfire burns under less than 'extreme' conditions when fuel loads are a significant determinant of fire behaviour, prescribed burning can play an important role in reducing the bushfire threat by enabling the vast majority of fires to be quickly and safely controlled. This is illustrated by the more proportionally extensive prescribed burning program in the forests of south west WA which has been integral to the region's 50-year avoidance of the sort of mega-fires that have afflicted Victoria three times in the past seven years.

The WA experience shows that to be most effective, prescribed burning programs must be sufficiently extensive that a substantial portion of the forest is maintained in a low fuel state. Victoria would need to substantially increase its current prescribed burning program if it is to attain a similar level of protection and significantly improve on recent bushfire outcomes.

Background

The practice of fuel reduction burning in Australian forests has polarised emotions and opinions within the community for decades.

In the aftermath of Victoria's "Black Saturday" bushfires in February 2009, public discourse about the merits of fuel reduction burning has reached new heights. Reportedly, it is by a large margin, the most discussed topic in public submissions made to the ongoing Victorian Bushfires Royal Commission.

In broad terms, community attitudes to forest fuel reduction burning can be grouped into three categories:

- **Strong support** – including support for increasing the area burnt each year as part of a professionally conducted program.
- **Conditional support** – subject to small, targeted burn areas with a lengthy time between burns and increased research into its environmental impacts.
- **Opposition** – based on a view that prescribed burning is environmentally destructive, unnecessary, and ineffective.

It is significant that support for fuel reduction burning is strongest amongst those who work within or who have lived in close proximity to forests for many years and have a practical appreciation of the link between fuel level and fire threat. This includes bushfire scientists, and forest and farm land managers.

Conversely, enthusiasm for fuel reduction burning is lowest amongst those who live in places where there is little or no bushfire threat. This includes those actively working for or supporting environmental groups. While some within this demographic are totally opposed to fuel reduction burning, the formal position adopted by Australia's most prominent environmental NGOs is one of 'conditional support' for limited burning. However, they have almost always advocated this position alongside qualifying statements deriding the effectiveness of the practice as a bushfire management tool.[1]

While such questioning of the benefit of fuel reduction burning has been around since the mid-1980s, it has been resurrected in recent public discussion about the bushfire threat since 'Black Saturday'. Invariably, those who dismiss prescribed burning irrationally deride it for not preventing bushfires, and then claim that:

- there is little or no documented evidence that it is an effective bushfire management tool; and that
- it cannot significantly improve outcomes under extreme conditions such as those experienced on 'Black Saturday'.

This paper examines the veracity of these assertions by drawing on the available body of documented evidence for a variety of forest types in southern Australia.

[1] *Planned burns and clearing will not stop catastrophic fire events: report,* September 10th 2009. Media Release by the Victorian National Parks Association to launch a report jointly commissioned by the VNPA, The Wilderness Society, and the Australian Conservation Foundation entitled '*Victorian February 2009 Fires – A Report on Driving Influences and Land Tenure Affected*', by Chris Taylor.

Fire in the southern Australian landscape

Fire has been a feature of the Australian landscape for tens of thousands of years. It is generally accepted that Aboriginal burning (or 'firestick' farming as it is often referred to[2]), together with lightning-ignited 'natural' fire, has meant that most Australian ecosystems have evolved in an environment subject to regular or periodic fire. Indeed, many elements of the flora appear to have developed a dependency on fire for their long term renewal and survival.[3]

Prior to European settlement, frequent and extensive natural fires and Aboriginal burning created a mosaic of frequently burned areas carrying light fuels that limited the intensity and spread of fire even under severe weather conditions.

Since European settlement began more than 200 years ago, vast changes have been visited upon the southern Australian landscape. These include the:

- loss of Aboriginal influence over land management;
- the replacement of huge swathes of forests and other vegetation with farmed pastures and crops; and
- the replacement of the Aboriginal culture of nomadic wandering with the Western culture of land ownership, permanent settlement, and institutionalised land management.

These changes have had a profound influence on forest fire – how it is regarded, and the need for it to be managed. With millions of people now living in permanent dwellings located in and around forests where there were previously few or none, fire can no longer be left to take its own course as it did prior to European settlement.

So, while there is now a societal imperative to quickly extinguish all potentially damaging forest fires, this actively excludes the natural agency of renewal and survival for the remaining native vegetation (mostly on public lands); and, not withstanding that there will always be summer fires that cannot be quickly extinguished, it allows forest fuels to accumulate to levels that inevitably drives intense summer conflagrations in large tracts of long-unburnt forest.

Accordingly over time, the threat of fire to Australian communities and ecosystems has progressively increased as a consequence of the thickening of formerly open forests with regrowth encouraged by a lack of regular fire, plus the associated accumulation of flammable fuels.

Prescribed burning aims to redress this threat by deliberately re-introducing fire under mild weather conditions at cooler times of the year, when it can be more easily controlled. This mimics the natural process of burning required to maintain (or restore) environmental integrity. It also reduces the potential intensity of unplanned summer bushfires by lessening the quantity of fuel available to be burnt, thereby improving the protection of human life and property in adjacent farming lands and settlements.

[2] *Burning Bush – A Fire History of Australia*, by Stephen J. Pyne, Henry Holt and Co (1991), Chapter 6, pp. 85-104.

[3] *Bushfires in Australia*, by R.H. Luke and A.G. McArthur, CSIRO Division of Forest Research (1978), Chapters 1 and 2, pp. 1-22

A brief history of fuel reduction burning in Victoria

Since the earliest days of European settlement in the early to mid-1800s, uncontrolled forest fire has been feared for its destructive potential. However, early pastoralists also appreciated fire as a management tool that could help clear the land and promote favourable grazing for their stock. Indiscriminate burning of pastoral lands and adjacent forests became a problem that extended beyond the ratification of the *Forests Act* in 1907.

With the establishment of the Forests Commission in 1918, major efforts were made to exclude fire from publicly reserved forests and educate the public in its safe use on adjacent lands, but with only moderate success.

As early as 1923, Victorian foresters were warning that fire would always be a major threat and was indeed "a tragedy waiting to happen". Nevertheless, small advances were being made to fire management, but these were focused on improving the capability to locate fires (including from the air) and develop effective fire-fighting tactics using the best available technology of the time.[4]

Around this time, there were two schools of thought regarding the use of fire as a forest management tool. Most field-based forestry personnel believed that regularly using fire to 'clean up' the forest floor and maintain a light fuel load was the key to controlling bushfires. However, this was heresy to the academically-trained professional foresters – particularly those with European training and experience – who believed that bushfires would largely vanish when the tangled wilderness was converted to an organised, tended forest.[5]

The result of this confusion was that some burning was done but not in accord with any strategic plan or organised approach. This ineffectual strategy continued until 1939, when the huge 'Black Friday' conflagrations burnt over 1.5 million hectares of Victorian forest, razing many settlements and killing 71 people.

The subsequent Stretton Royal Commission placed the blame for these fires squarely on the human mismanagement of deliberately lit fires, especially those lit at the most inopportune times. Judge Stretton recognised the absurdity of claims that fire could ever be excluded from Victoria's forests and saw the sense in using fire against itself. He concluded that the problem was not controlled burning itself, but poorly done controlled burning.[6]

The *Forests Act* was subsequently revised and strengthened thereby increasing the powers of the Forests Commission in regard to fire protection.[7] But, it was not until after WWII, under a new generation of foresters, that there was real reform.

Noted fire historian Stephen Pyne credits the 1951-52 fire emergency in the NSW Snowy Mountains as the catalyst for forestry authorities in eastern Australia to firmly adopt preventative controlled fuel reduction burning – rather than emergency bushfire suppression – as the basis for protecting its forests and wildlands.[8] So began the modern era of prescribed burning which was rooted in a sensible recognition and acceptance of:

- the adaptation to fire of the country's indigenous flora and fauna;

[4] *The Dynamic Forest: A history of forestry and forest industries in Victoria*, by FR. Moulds, Lyndoch Publications (1991).
[5] *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), pp.54-56
[6] *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.57
[7] *The Dynamic Forest: A history of forestry and forest industries in Victoria*, by FR. Moulds, Lyndoch Publications (1991).
[8] *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.58

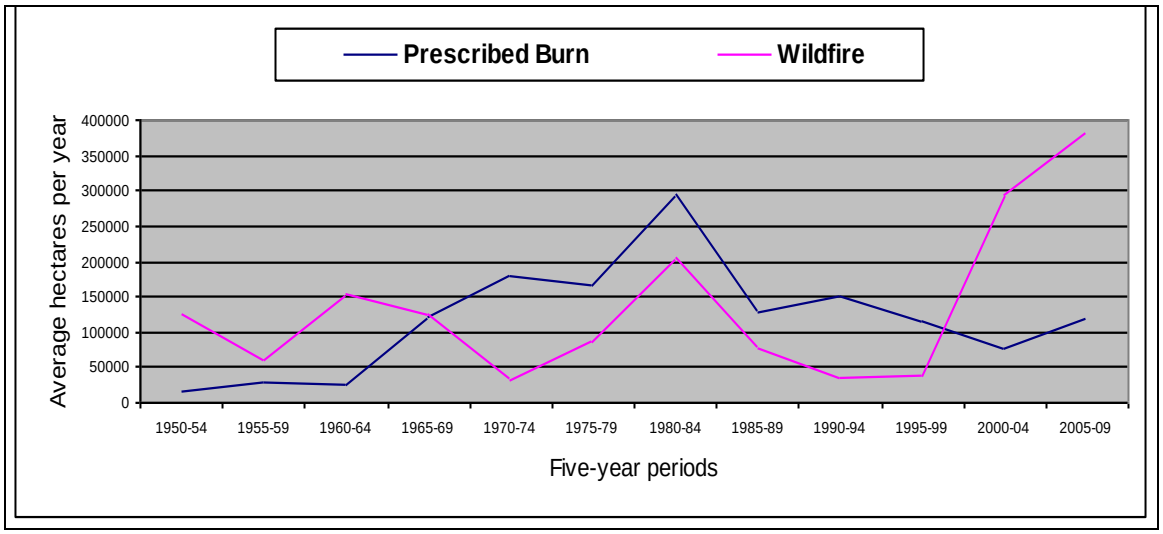
- the long tradition of Aboriginal burning;
- the on-going use of burning in other rural land uses; and
- an admittance that Australia could not afford a paramilitary campaign against fire such as was then emerging in North America.[9]

In Western Australia, a similar path was trodden after decades of serious fires culminated in the bushfire disaster of 1960-61 which led to the subsequent adoption of fire management policies incorporating broadacre prescribed burning to reduce forest fuels. As integrated bushfire management programs were adopted around the country, the development and use of aerial incendiaries was, by the mid-1960s, enabling large areas to be lit quickly and inexpensively when conditions were right.

In Victoria by the early 1980s, prescribed fuel reduction burning had become a finely-honed core activity of the state's foresters who at that time were responsible for the management of nearly all of the public forests. Since then, the annual area burnt for fuel reduction has significantly declined due to a variety of political, social and demographic factors.[10] During the prolonged drought of the past decade, this decline has coincided with a dramatic increase in the area burnt by hot summer wildfires (see Figure 1).

The Victorian Government's *Inquiry into the 2002-03 Victorian Bushfires* acknowledged this decline, particularly during the 1990s, but would do no more than ponder that it may have been due to '*either a reduction in resources available for the delivery of burn programs (for example, a reduction to staff numbers and budget) and/or a strategic diversion of resources to other activities deemed to be more important.*'[11]

Figure 1: Fire in Victorian public forests during the modern era of prescribed burning



Notes:
Plotted lines are based on the approximate average area burnt per year within each of the specified five-year periods.
The data of areas burnt by wildfire and prescribed burn are approximations derived from Figures 1 (p.6) and 2 (p.7) of the Submission by Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, conducted by the Victorian Parliamentary Environment and Natural Resources Committee (May 25th 2007). More recent data obtained from DSE Annual Reports

[9] *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.58

[10] Institute of Foresters of Australia - Submission to the 2009 Victorian Bushfires Royal Commission, May 2009, pp. 7-12. It can be accessed at www.forestry.org.au > Submissions

[11] *Report of the Inquiry into the 2002-03 Victorian Bushfires*, chaired by Bruce Esplin, Emergency Services Commissioner, Department of Premier and Cabinet, Victorian Government (October 2003), p.96 s.10.36.

Studying the effectiveness of prescribed fire and the notion of what constitutes acceptable evidence

Anyone who has fought an Australian bushfire knows that low intensity fires burning in light fuels are far easier and safer to control than fires burning in heavy fuel accumulations.

However, while the principle of fuel reduction burning as a bushfire management tool is well established, scientifically quantifying and formally documenting its effectiveness has been problematic.[12] This is due to an array of inter-related variables which both determine the effectiveness of fuel reduction burning yet present difficulties for controlled experimental study (see p.7).[13] Accordingly, there is a relative paucity of academic papers on this topic.

In the public discussion about fire management following 'Black Saturday', those who lack enthusiasm for, or are opposed to fuel reduction burning, have seized on this problem to claim that there is little evidence that it improves the suppression of bushfires or their outcomes. This view was articulated in recent statements from several mainstream environmental NGOs:

- "*Environmental groups want to see the science that supports the current fuel reduction program, including a scientific justification for so-called hazard reduction burns ……. Environmental groups are particularly concerned about the lack of impact assessment of these programs on biodiversity, particularly given their uncertain benefits to reduce the extent, frequency and severity of fire"* – The Wilderness Society [14]
- Referring to Victoria's current annual fuel reduction burning target – "*Indeed, the current target of 130,000 hectares per year, so far as we know, is also not derived from any clear scientific analysis*" – Phil Ingamells, Victorian National Parks Association[15]
- "*In particular, the suggestion that having had more fuel reduction burning over larger areas more frequently during the drought of the last decade in Victoria would have prevented these fires – and by extension that doing even more of it is essential in the hotter, drier climate we are moving into – is not backed up by the best available science*" – Andrew Campbell, quoted by the Australian Conservation Foundation[16]

The veracity of these views depends largely what is perceived to be acceptable evidence. If the criteria is limited only to independent, peer-reviewed papers prepared by university academics and published in prestigious scientific journals, then there may be merit in claims that the benefits of prescribed burning are as yet unproven. (Conversely, it should be acknowledged that there is no published research showing that prescribed burning has no impact on bushfire intensity or spread).

However, reliance on such a purely academic definition of what constitutes acceptable evidence is narrow-minded and dangerous. It effectively dismisses decades of unpublished in-house applied research and documented case studies by government scientists working for Australian forest and fire agencies (including the CSIRO), and unfairly denigrates its integrity. If applied research and case studies are accepted as evidence, it becomes clear that there is a considerable body of knowledge within land management agencies which shows that prescribed burning plays a critical role in

[12] Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Chapter 2: Prescribed burning in Victoria – The effectiveness of fuel reduction burning (p. 81), Victorian Parliamentary Environment and Natural Resources Committee (June 2008)

[13] *Quantifying the effectiveness of fuel management in modifying wildfire behaviour*, by WL. McCaw, JS. Gould, and NP. Cheney, presented at the International Bushfire Research Conference, Adelaide Convention Centre, September 2008.

[14] *A Bushfire Action Plan which protects people, property and nature* – The Wilderness Society website: http://www.wilderness.org.au/articles/bushfire-action-plan

[15] *Rethink fuel reduction burns*, by Phil Ingamells, The Weekly Times, August 26th 2009

[16] ACF Submission to the Victorian Bushfires Royal Commission (May 2009). Can be accessed at the ACF website: www.acfonline.org.au/

mitigating bushfire extent and damage.[17] Furthermore, this evidence supports the observations of every experienced fire-fighter.

Having developed and honed the practice of prescribed burning, it has been entirely logical for Australian forest agencies to take the lead in investigating and documenting the science, particularly given their responsibility as custodians of the public lands on which damaging bushfires occur. Conversely, the very nature of fire and where and when it occurs has traditionally presented difficulties for university-based academic study.

This situation has changed to some extent in recent years with the creation of the Bushfire Cooperative Research Centre (Bushfire CRC) which is fostering and coordinating research partnerships between universities and responsible government agencies. This should result in more academic papers about fire being added to the public record over time.[18]

Not withstanding the lack of pure academic papers, the evidence for prescribed burning as an effective bushfire management tool has been garnered over a lengthy period and comes in a variety of forms. Some of Australia's leading fire researchers recently concluded that drawing on this broad range of information was necessary to quantify the effectiveness of fuel management programs, including fuel reduction burning.[19]

They categorised this available information into four forms:

- **Empirical scientific study** of the relationship between fuel characteristics and fire behaviour, and associated **scenario modelling**.
- **Case studies** illustrating the effects of different fuel conditions on bushfire behaviour, environmental values, and suppression difficulty.
- **Landscape-scale remote sensing** monitoring the varying severity of bushfires on vegetation in areas subject to recent and older prescribed burns or areas that have been long unburnt.
- **Statistical trends and analysis**.

The value of such a comprehensive analysis accords with the Esplin *Report of the Inquiry into the 2002-03 Victorian Bushfires* which noted that there is currently no one "*unequivocal and immediate choice of an appropriate measure for* (quantifying) *the effectiveness of prescribed burning*"[20]

As shall be shown in the following pages, the sum of the various forms of available information suggests that there is considerably more underpinning evidence of the benefit of prescribed burning than most of its critics are aware of or care to admit.

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[17] Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Chapter 2: Prescribed burning in Victoria – The effectiveness of fuel reduction burning (p. 79), Victorian Parliamentary Environment and Natural Resources Committee (June 2008)

[18] Bushfire CRC website: www.bushfirecrc.com/

[19] *Quantifying the effectiveness of fuel management in modifying wildfire behaviour*, by WL. McCaw, JS. Gould, and NP. Cheney, presented at the International Bushfire Research Conference, Adelaide Convention Centre, September 2008.

[20] Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Chapter 2: Prescribed burning in Victoria – The effectiveness of fuel reduction burning (p. 83), Victorian Parliamentary Environment and Natural Resources Committee (June 2008)

Brief review of supporting evidence for fuel reduction burning as a bushfire management tool

The following review of existing Australian research findings and case studies is by no means exhaustive. However it clearly demonstrates that fuel reduction burning plays a key role in bushfire mitigation and that this view is supported by far more than just casual observations and anecdotes.

Empirical scientific study of the relationship between fuel conditions and fire behaviour, including scenario modelling

Australia's most comprehensive scientific study of forest fire behavior was known as Project Vesta. It was a collaborative research project undertaken by the CSIRO in partnership with the WA Department of Environment and Conservation, with support from most of Australia's other land management and emergency services agencies.

Project Vesta began in 1996 and ended with the release of a final report in 2007.[21] Its findings are based on data generated from lighting and monitoring over 100 experimental fires in eucalypt forests in south western WA during the summers of 1998, 1999 and 2001. These fires were lit in 4 hectare plots under dry summer conditions of moderate to high forest fire danger. These experimental burn plots were located at two sites with differing understorey fuels ranging in age from 2 to 22 years.

The key findings of Project Vesta with regard to the effectiveness of prescribed burning were that:

- Hazard reduction by prescribed burning will reduce the rate of spread, flame height and intensity of a (subsequent) bushfire and its potential for spotting, by changing the structure of the fuel bed and reducing the total fuel load.
- The persistence of this effect will be determined by the rate of change in fuel characteristics over time, but a measurable benefit may last for up to 20 years in some forest types.
- Stimulation of understorey shrub regeneration after burning will not increase the rate of spread of a fire until such time as a significant near-surface fuel layer accumulates.
- Younger fuels produce fewer firebrands (i.e. flying pieces of burning bark) because fire intensities are low and less bark is consumed than in older fuel types.

Project Vesta researchers have since acknowledged the inherent difficulties of measuring the relationship between fire behaviour and fuel loads during wildfires. These include uncertainty about actual pre-fire fuel loads, absence of accurate records of previous wildfire and its intensity. In areas previously burnt by prescribed fire, the date of the burn is usually known but there is usually no record of the extent to which the prescribed burn has actually reduced fuels across the treated area, or the subsequent rate of fuel accumulation in the interval between the prescribed burn and the bushfire. Also, accurate measurements of prevailing climatic conditions during bushfires are rarely obtained. This has made accurate determinations of the rate of fire spread in relation to fuel quantity extremely difficult.[22]

Despite its imperfections, empirical study of fuel dynamics and fire behaviour has enabled the creation of predictive models that have been applied retrospectively to past major fire events to examine likely outcomes under various fuel management regimes. Two examples are examined:

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[21] *Project Vesta – Fire in Dry Eucalypt Forest: Fuel Structure, Fuel Dynamics, and Fire Behaviour*, by Jim Gould (Ensis Bushfire Research), Lachie McCaw (WA Department of Environment and Conservation), Phil Cheney, Peter Ellis, Ian Knight, and Andrew Sullivan (October 2007) 218 pp.. Can be accessed from the CSIRO website: www.csiro.au/resources/VestaTechReport.html

[22] *Quantifying the effectiveness of fuel management in modifying wildfire behaviour*, by WL. McCaw, JS. Gould, and NP. Cheney, presented at the International Bushfire Research Conference, Adelaide Convention Centre, September 2008.

Deans Marsh fire (1983)

Tolhurst (2007) has briefly summarised the restrospective application of his Bushfire CRC-funded PHOENIX fire characterisation model to the Deans Marsh fire which burnt through the eastern Otway Ranges on 'Ash Wednesday', February 1983.[23] This fire ultimately burnt more than 40,000 hectares of forest, destroyed 780 structures and took three lives.[24]

Prior to 'Ash Wednesday', less than 1% of the eastern Otway forests had been burnt in the 44 years since the 1939 'Black Friday' fires, so the Deans Marsh fire represents a bushfire outcome achieved on an area almost entirely burdened with a heavy pre-fire fuel accumulation.

The PHOENIX model simulated the path of the fire burning under the same weather conditions but using three other fuel management regimes as follows:

- Forests fuel reduced on a 10-year burning cycle, i.e. 10% of their area is prescribed burnt per annum. Under this scenario, the modelling suggests that the Deans Marsh fire would have been only about 50% as extensive, with the forests burning at a significantly lower and patchy intensity, thereby inflicting far less environmental damage.
- Forests fuel reduced on a 20-year burning cycle, i.e. 5% of their area is burnt per annum. Under this scenario, the extent of the Deans Marsh fire would have been reduced by about 33% – with significantly less severely burnt areas.
- Forests fuel reduced on a 40-year burning cycle, i.e. 2.5% of their area is burnt per annum. Under this scenario, the extent of the Deans Marsh fire would have been reduced by about 20% with significantly more of the affected area burnt at low intensity by patchy fire compared to what actually occurred.[25]

This simulation clearly demonstrated the benefits of regular fuel reduction burning, even on a lengthy cycle, compared with the spectre of long unburnt forests with heavy fuel accumulations.

Mundaring-Karragullen fire (2005)

A similar retrospective analysis was undertaken by Cheney on the Mundaring-Karragullen fire which burnt nearly 30,000 ha of forest near Perth in January 2005 (see also the case study, p.12). This fire was prevented from entering Perth's outer eastern suburbs largely by the presence of low fuels from recent fuel reduction burning which transformed an unmanageable headfire to a controllable intensity.

Using fire spread equations developed during Project Vesta, Cheney was able to reconstruct the path of the fire under an alternate scenario where the forest fuels had been left unburnt for 20 years. He found that under the weather conditions that prevailed at the time, the fire would have been uncontrollable and predicted that it would have burnt deep into the residential suburbs of Roleystone and Gosnells with a likelihood of severe impacts on human life and property.[26]

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[23] Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne, May 25th 2007 - Submission to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria conducted by the Victorian Parliamentary Environment and Natural Resources Committee. Submissions can be accessed at: www.parliament.vic.gov.au/enrc/inquiries/bushfires/default.htm

[24] *Burning Bush – A Fire History of Australia*, by Stephen J. Pyne, Henry Holt and Co (1991), Epilogue, pp. 410-419.

[25] Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne, May 25th 2007 - Submission to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria conducted by the Victorian Parliamentary Environment and Natural Resources Committee, pp. 11-13. Submissions can be accessed at: www.parliament.vic.gov.au/enrc/inquiries/bushfires/default.htm

[26] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

This analysis again demonstrates the effectiveness of fuel reduction burning in reducing bushfire intensity and making them more controllable, particularly where regular burning is undertaken over areas of sufficient size to constitute a genuine barrier to running headfires.

Case studies

Opponents of fuel reduction burning have tended to dismiss case studies for being observational rather than scientific. However, veteran WA forest fire manager, Rick Sneeuwjagt, believes that the difficulties associated with empirical scientific study have heightened the importance of case studies in developing an understanding of fire behavior under different fuel types and ages despite them being descriptive and lacking replication.[27]

Victorian case studies

There are documented case studies of past forest fires in Victoria which deal specifically with the role of past prescribed burning in assisting bushfire suppression. Several are summarised below.

Ten significant Victorian fires (1978 – 83)[28]

Rawson et al (1985) examined ten significant Victorian bushfires which occurred from 1978 – 83. Their paper was prepared immediately after a decade of the most extensive prescribed burning recorded thus far when the annual fuel reduced area averaged almost 100,000 hectares more than the current burn target. Presumably, the influence of this burning on bushfire mitigation would have been more apparent than now.

They documented five cases (Lorne-Anglesea, 1983; Mt Macedon, 1983; Stawell, 1980; Barkstead, 1980; and Dimboola, 1980) where private assets directly threatened by bushfire were saved when fire-fighting was assisted by the presence of fuel reduced areas. In some of these cases, fuel reduced areas had stopped bushfire spread, while in other instances it reduced fire intensity to an extent that allowed firefighters to undertake effective asset protection work. These benefits occurred despite these fires being uncontrollable in adjacent areas carrying heavier fuel loads.

Rawson et al (1985) also nominated the inter-related factors which determine the effectiveness of a previously fuel-reduced area in mitigating a subsequent bushfire threat. These include:

- the nature of the fuel reduction treatment in terms of:
  - the proportion of the treated area that has actually burnt; and
  - the degree to which it reduced fuel quantities and other hazardous fuel properties.
- the size and distribution of fuel reduced areas;
- the time since they were fuel reduced (and therefore the extent to which new fuel has accumulated); and ultimately
- the intensity and size of the approaching bushfire.

They also noted that, compared to instances of private asset protection, it has been more difficult to quantify the impact of extensive fuel reduction treatments in bushfire mitigation. However, they

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[27] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

[28] *Effectiveness of fuel reduction burning (10 Case Studies)*, by R. Rawson, P. Billing, and B. Rees, Department of Conservation Forests and Lands, Research Report No. 25 (October 1985). Can be accessed from the Department of Sustainability & Environment website: www.dse.vic.gov.au >Fire and other emergencies>Publications and Research> Fire research reports

noted several instances where extensive fuel reduced areas played an important role in mitigating the spread of multiple fires in remote country.

One example cited was when more than 60 fires were simultaneously ignited by lightning in rugged country in the Eastern Highlands during January 1978. Extensive areas of fuel reduced forest minimised the spread of many of these remote fires during the lengthy period before suppression forces could reach them.

Extensive fuel reduced areas also assisted the control of fires burning under 'moderate' to 'high' fire danger conditions near Cann River in 1982/83, by:

- reducing fire intensity and spread to a level that allowed direct control work to be undertaken close to the fire edge; and
- creating low fuel zones where control lines for back-burning could be safely constructed.

They also acknowledged several instances (at Mt Disappointment and Mt Elizabeth in 1982) where extensive fuel reduced areas had had no substantial impact on bushfire mitigation and speculated that this was related to an unsatisfactory level of fuel-reduction achieved in the first instance.

Four fires in western Victoria (1990 – 91)[29]

Grant and Wouters (1993) examined the effects of fuel reduction burns on four bushfires ignited in the Little Desert and Grampians area of western Victoria during the 1990/91 fire season.

They noted that fuel reduction burns conducted from several months to 3-years earlier had prevented each of these fires from attaining a much larger size, thereby saving considerable suppression resources and, in one case, avoiding damage to private property. Also, as three of the studied bushfires were burning on a day when there were 17 going fires, the fuel reduction burns provided a considerable strategic benefit by freeing-up suppression resources which could be diverted to other, more dangerous fires.

Their paper also noted that:

- the successful containment of each of the four studied bushfires showed that, for at least two years, a fuel reduced area in heath and heathy woodland can be effective in restricting fire spread under a Fire Danger Index (FDI) of up to 40 (i.e. 'very high'); and that
- a fuel reduction burn in Brown Stringybark (*E.baxteri*) woodland can reduce bark hazard for up to 10 years thereby reducing spotting potential, which greatly assists bushfire suppression.

Bemm River fire (October 1988)[30]

Buckley (1990) examined a 5,700 hectare bushfire in East Gippsland which burnt under 'very high' to 'extreme' fire danger conditions (i.e. FDI up to 82 with measured rates of fire spread of up to 4 km/hr) in mixed eucalypt forest with an aerated, highly flammable shrub layer, and a total fine fuel load of ~ 20 tonnes per hectare.

[29] *The effect of fuel reduction burning on the suppression of four wildfires in western Victoria,* by S.R. Grant and M.A. Wouters, Department of Conservation and Natural Resources, Research Report No. 41 (December 1993). Can be accessed from the Department of Sustainability & Environment website: www.dse.vic.gov.au >Fire and other emergencies>Publications and Research> Fire research reports

[30] *Fire behaviour and fuel reduction burning – Bemm River wildfire, October 1988,* by A. Buckley, Department of Conservation & Environment, Research Report No. 28 (September 1990). Can be accessed from the Department of Sustainability & Environment website: www.dse.vic.gov.au >Fire and other emergencies>Publications and Research> Fire research reports

Several fuel reduced areas were impacted by the 1988 Bemm River bushfire. This enabled the following conclusions to be drawn:

- Dramatic protection of forest was achieved under 'very high' fire danger conditions in areas which had been prescribed burnt one-and-a-half years earlier.
- Similar protection was achieved under 'high' fire danger conditions in areas which had been prescribed burnt 6 months and two-and-a-half years earlier.
- A measurable protective effect was still apparent in areas which had been prescribed burnt seven years earlier compared to areas which had been unburnt for long periods.
- To provide a protective benefit, fuel reduction burns conducted in East Gippsland's coastal forests need to achieve more than 50% coverage of treated areas.

Buckley's conclusions were reached by comparing documented fire history against the level of crown scorch mapped in the aftermath of the bushfire.

Western Australian case studies

There have been numerous WA examples where the fuel reduction program has assisted in the control of major bushfires. This has prevented or minimised impacts to lives, properties and environmental values.

Nine WA fires (1969 – 84)[31]

Underwood et al (1985) documented nine case studies of fires in south west WA during the period from 1969 to 1984. These fires varied in size from 40 to 8,000 hectares and were selected for detailed analysis based on providing a representative sample of forest and fuel types, fire behaviour, and damage potential. The control of all fires had been advantaged by the presence of areas which had been prescribed burnt within the previous six years.

The paper concluded that in each case these fires would have had serious social and economic consequences in the absence of extensive fuel reduced areas.

It also noted that an extensive program of fuel reduction is needed to optimise its benefit in bushfire mitigation. In the forests of south west WA, it suggested an eight-year rotational program to ensure that at any time, 50% of the forest fuels are four years old or younger. This would provide an excellent aid to bushfire suppression under 'difficult' conditions.

Cyclone Alby fires (1978)[32]

A celebrated example of the effectiveness of fuel reduction burning occurred in 1978 when 92 fires burned out-of-control in south west WA. These fires were associated with the passage of Cyclone Alby and were pushed by winds of up to 130 km/hr with rates of spread of up to 8 km/hr being recorded with extensive spotting.

Although more than 54,000 hectares was eventually burnt, only 7,000 hectares of this was in State Forest due to low fuel levels maintained by earlier prescribed burning. The fire intensity and rate of spread was so reduced in these forests that suppression resources were able to be freed-up for deployment to other more threatened areas.

[31] *The contribution of prescribed burning to forest fire control in WA: Case Studies*, by R.J. Underwood, R.J. Sneeuwjagt, and H.G. Styles (1985). In: Fire Ecology and Management of Western Australian Ecosystems, WA Institute of Technology, Environmental Studies Group Report No. 14 of Symposium Proceedings, Perth, WA (May 1985)

[32] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

Mt Cooke fire – January 2003[33]

This 18,000 hectare fire was ignited by lightning in a forested Conservation Park where fire had been excluded for 17 years. Under severe weather conditions (maximum temperature – 36^{o}, low humidity, and gusty winds of 25 – 35 km/hr) the blaze quickly escalated into a crown fire which killed the vast majority of mature jarrah and marri trees it encountered within long unburnt forests.

Eventually the fire slowed when it reached forest blocks which had been prescribed burnt 7 years earlier. Even though the severe weather conditions persisted, the fire was able to be directly attacked in these fuel reduced forests and was eventually contained when it reached areas that had been fuel reduced from three to five years earlier.

Mundaring-Karragullen fire – January 2005[34]

This fire arose from seven deliberately lit (arson) ignition sites on public lands within 20 km of the Perth Hills suburbs. A detailed analysis of its behaviour was undertaken by CSIRO fire scientist Phil Cheney who found that the fires burned vigorously in forest fuels varying from 16 to 26 years since last burnt. Rates of spread in the first 24 hours after ignition varied from 600 to 1600 metres per hour.

Some 36 hours after ignition the fire came under the influence of a strong north east wind which pushed it towards several outer Perth suburbs at a rate of spread of 900 metres/hr. Fortunately it soon ran into two to four year old fuels resulting from recent prescribed burning. In these lighter fuels, the fire was either stopped completely or slowed to a degree that made it easy to control.

In addition, other parts of the fire were slowed by a landscape-scale mosaic of low fuel zones created by fuel reduction burning conducted during the previous six years. As a result of past fuel reduction burning, a fire that could have destroyed hundreds of homes and threatened lives was able to be contained with minimal property loss or damage.

Landscape-scale remote-sensing of fire severity

Following each of the three major Victorian bushfires that have occurred since 2002, the Department of Sustainability and Environment has used remote sensing data to undertake landscape-scale mapping of fire severity based on levels of tree crown scorch.

Tolhurst and McCarthy used this mapping to study the effect of previous fires on areas burnt by the 2003 bushfires. They found that bushfire intensity was significantly lower in recently burnt areas where fuels were relatively light, and noted a measurable reduction in fire severity in areas that had been burnt up to 10 years earlier.[35]

In addition, they found that the effect of recent burning in reducing bushfire severity extends beyond the treated areas themselves in the form of downwind 'shadows' which also burn at a relatively low intensity. These can be quite large areas – they identified low fire intensity 'shadows' from 15 to 30 km long and 10 km wide.

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[33] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

[34] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

[35] *Effect of prescribed burning on wildfire intensity – a case study from the 2003 fires in Victoria*, by K.G.Tolhurst and G.J.McCarthy for the Department of Sustainability & Environment (unpublished)

These findings strongly emphasise the value of fuel reduction burning in lessening the damage to environmental values by reducing fire intensity.

Statistical trends and analysis

Statistical trends have long been cited as evidence of the effectiveness of fuel reduction burning in bushfire mitigation.

One of the earliest and most compelling statistical trends to support the effectiveness of prescribed burning was noted in a Western Australian comparison of forest fire activity before and after the disastrous 1960-61 fire season. The exceptional severity of that season sparked a revision of WA forest fire management which was largely reflected in a dramatically increased rate of annual prescribed burning. This resulted in a significant reduction in the number of unplanned bushfires, and a huge fall in the average area which they burnt each year (see Table 1).

Table 1: Comparison of forest fire activity in south west WA before and after the revision of fire management in response to the disastrous 1960-61 bushfires [36]

	Pre-1960-61 (1953 – 1960)	**Post-1960-61** (1961-70)	**Change (%)**
Average area of prescribed burning	148,000 ha/yr	360,000 ha/yr	+ 140%
Average number of bushfires	350 per year	290 per year	– 17%
Average area burnt by bushfire	24,000 ha/yr	7,000 ha/yr	– 250%

The findings shown in Table 1 were reinforced in the mid-1980s when Tasmanian fire scientist, Tony Mount, compared wildfire statistics for similar forest types in WA and Tasmania over the previous thirty years. He found that whilst WA bushfires averaged just 15 hectares in size, Tasmanian fires averaged 270 hectares. He presumed this was primarily due to the far more extensive use of prescribed burning in WA.[37]

The effectiveness of WA's extensive use of prescribed burning was also supported by Underwood et al (1985) who noted that the average sizes of Victorian and NSW bushfires up to the mid-1980s was respectively 12 and 13 times greater than the average WA bushfire in comparable climate, terrain, and forest types.[38]

Lang, who analysed fire patterns in the jarrah forests of the Collie District in south west WA from 1937 to 1987, also found that there was a rapid decline in unplanned bushfires once the prescribed burning program began to treat more than 10,000 hectares per year (or 6% of the district's forest).[39]

Similarly Abbot (1993), in studying the history of prescribed burning and wildfire in an area near Manjimup in south west WA from 1940 to 1990, found that there was a dramatic decline in the size

[36] Data taken from *Bushfires in Australia*, by R.H. Luke and A.G. McArthur, CSIRO Division of Forest Research (1978), Chapter 18, pp. 244-245

[37] *The case for fuel management in dry forests*, by A.B. Mount (1985) Paper prepared for Research Working Group No. 6 ON Fire Research, Hobart 1985

[38] *The contribution of prescribed burning to forest fire control in WA: Case Studies*, by R.J. Underwood, R.J. Sneeuwjagt, and H.G. Styles (1985). In: Fire Ecology and Management of Western Australian Ecosystems, WA Institute of Technology, Environmental Studies Group Report No. 14 of Symposium Proceedings, Perth, WA (May 1985)

[39] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

and number of serious bushfires after the introduction of prescribed burning by the Forests Department in 1958.[40]

Arguably, one of the most comprehensive examinations of fire statistics to support the effectiveness of prescribed burning has been undertaken by Boer et al (2009).[41] They examined wildfire and prescribed burning records dating back to the early 1950s in the ~1 million hectares of forest in the Warren Region of south west WA.

Their principal finding was that the area treated annually by prescribed fire had had a significant effect on the annual number and extent of unplanned bushfires over a 52-year period. During this period, an average of more than 80% of the annual burnt area was attributable to prescribed fire. They also concluded that a six-year cycle of prescribed burning significantly reduced bushfire hazard.

Figure 2: Low intensity prescribed burn in the Wombat State Forest (DSE/K. Tolhurst)

[40] *Ecology of the pest insect jarrah leaf miner (depidoptera) in relation to fire and timber harvesting in jarrah forest in WA*, by I. Abbot (1993), Australian Forestry 56(3)

[41] *Long term impacts of prescribed burning on regional extent and incidence of wildfires – Evidence from 50 years of active fire management in SW Australian forests*, by M.M. Boer, R.J. Sadler, R.S. Wittkuhn, L. McCaw, and P.F. Grierson, Forest Ecology and Management 259 (2009) 132-142

The effectiveness of prescribed burning in improving the outcome of bushfires burning under 'extreme' fire danger conditions

In view of the range of evidence cited in previous pages, prescribed fuel reduction burning is indisputably a valuable bushfire mitigation tool. However, recent public discussion about its merits has focused on whether or not it improves bushfire outcomes under the 'extreme' fire danger conditions which drove the 'Black Saturday' catastrophe.

While many experienced forest fire experts and a range of community groups are advocating increased levels of fuel reduction burning in Victorian forests, this is being opposed by others, including the mainstream environmental groups and some academics, who claim this would do little to protect human life and property from future catastrophic fires.

There is general agreement amongst fire researchers that light fuel loads created by recent prescribed burning are highly influential in limiting bushfire behaviour and improving controllability under 'low' to 'very high' fire danger conditions.[42] Tolhurst estimates that for around 95% of the time, Victorian bushfires burn under these conditions meaning that low fuel loads can greatly assist the vast majority of bushfires to be quickly and safely controlled.[43]

However, there are slightly divergent views about the influence of fuel loads on the behaviour of bushfires burning under 'extreme' conditions. Tolhurst believes that there are some 'extreme' fire conditions where fuel modifications have little effect as fire behaviour becomes driven by the prevailing weather conditions.[44] On the other hand, Cheney and others believe that fuel (rather than weather) provides the energy for a fire and is therefore always the main driver of its intensity, not withstanding that weather (i.e. wind) can certainly increase its rate of spread.[45]

While the Cheney view strengthens the case for more prescribed burning, some have seized on the Tolhurst view to undermine the value of the practice. However, this is extremely short-sighted because:

- By improving the ability to quickly control the vast majority of fires, low fuel loads created by prescribed burning can minimise the likelihood of there being active, going fires when 'extreme' fire danger conditions arise. For example, the presence of extensive low fuel areas in the Bunyip State Park may have enabled the Bunyip Ridge Track fire (which was ignited several days earlier) to be made safe prior to 'Black Saturday' rather than being still active when extreme conditions arose on that day. This may have averted property losses at places like Labertouche and freed-up a substantial array of suppression resources for deployment elsewhere.
- The presence of extensive areas of light fuels throughout the forested landscape can help ease demands on suppression forces and thereby, even on days of 'extreme' fire danger, can enable their efforts to be concentrated in areas of greatest threat to life and property. An example from 'Black Saturday' is the White Timber Spur fire near Dargo which was ignited

[42] *The effectiveness of fire-fighting first attack operations, DNRE (Victoria), 1991-92 to 1994/95*, by G.J. McCarthy and K.G. Tolhurst, Fire Management Branch Research Report No. 45, Department of Natural Resources and Environment, Victoria

[43] Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne – Submission to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, conducted by the Victorian Parliamentary Environment and Natural Resources Committee (May 25th 2007), p.11

[44] Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne – Submission to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, conducted by the Victorian Parliamentary Environment and Natural Resources Committee (May 25th 2007), Figure 8, p.11

[45] Roger Underwood, pers comm based on discussions with CSIRO fire researcher Phil Cheney.

the previous day and burnt through low fuel areas previously burnt by wildfire several years earlier. Although this fire eventually burnt 13,000 hectares of forest, it required only minimal suppression effort and freed-up resources for deployment to more troublesome places.

- In lighter fuels created by prescribed burning there is less spotting and this reduces the rate of fire spread compared to fires burning in long unburnt forests with heavy fuel accumulations.
- Insufficient fuel reduction burning which allows the development of heavy fuel loads, makes fires burn more intensely under any conditions and thereby increases risks to human life and property on days when conditions are less than 'extreme'.

It must be acknowledged that not all prescribed burning is equally as effective in bushfire mitigation as it is subject to a range of variables (see p.9). The experience from south west WA suggests that to be most effective, prescribed burning programs must be extensive enough that there is always a substantial proportion (i.e. 25-50%) of the forest estate carrying light fuels from recent prescribed burning.

That this was far from the case in the huge areas burnt by Victorian bushfires since 2003, may partially explain the doubts being expressed in Victoria about the value of prescribed burning. Since 'Black Saturday', critics have put forward several examples where recent fuel reduction burns (conducted only one to two years previously) had no obvious effect on that fire. However, if fuel reduced areas are small and isolated, and surrounded by long unburnt areas with heavy fuel loads, intense wildfires will easily pass over or around them..

The proportionally more extensive WA prescribed burning program in which around 8% of the forest is targeted for treatment each year, has been found to substantially reduce the extent and threat of the vast majority of unplanned summer bushfires, and through this, has provided demonstrable assistance in reducing the threat of unplanned fires occurring under 'extreme' fire danger conditions.

Despite this, it must be stressed that not even extensive prescribed burning on such a scale is a 'silver bullet' which can prevent damaging bushfires. This is particularly the case in relation to Victorian forest types (such as tall wet sclerophylle ash forests) which are difficult to fuel reduce under mild conditions, yet will periodically burn with tremendous ferocity in hot summer conflagrations generally during drought years.

Townships and suburbs located within or adjacent to such forests are bound to ultimately experience a catastrophe. Some of these areas have just been affected by the 2009 fires, and others remain under constant threat in or adjacent to high rainfall parts of the Dandenong, Otway, and Strezlecki Ranges, as well as remaining unburnt parts of the Central Highlands.

Discussion

There is no doubt that a significant expansion of Victoria's program of annual prescribed burning is integral to improving bushfire outcomes. Indeed, this was a key recommendation of the Victorian Parliamentary Environment and Natural Resources Committee which released its *Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria* in June 2008.[46]

The report's recommendation that the prescribed burning program be tripled from the currently targeted 130,000 ha/annum up to around 385,000 ha/annum, was subsequently accepted only in principle (with no commitment made to act) by the Victorian government just two months prior to 'Black Saturday'.[47] Given our recent bushfire history, there is now an urgent need to act on this recommendation.

Expanding prescribed burning in Victoria

The south west WA experience suggests that constantly maintaining a substantial part of the forest estate under light fuel loads can significantly decrease the annual extent and damage caused by unplanned summer bushfires. This is being achieved by targeting about 200,000 hectares (or 8%) of the region's forests for prescribed burning each year.[48] [49]

Undertaking a similarly proportioned program in Victoria would be more difficult. Not all Victorian forest types are suited to fuel reduction burning, but after accounting for these, Tolhurst estimated that around 6.2 million hectares should be included in the prescribed burning program.[50] This is around 2.5 times larger than the public forest estate in south west WA. In addition, there is a greater degree of landscape variability in Victorian forests which would presumably further increase the difficulty of burning on a cycle similar to that which used to be regularly achieved in WA.

Consequently, some of the doubt surrounding the capability of prescribed burning to improve bushfire outcomes in Victoria may not so much be questioning the effectiveness of the practice, but instead reflect doubts about whether the physical and logistical practicalities of undertaking a sufficiently extensive burning program can be overcome.[51]

Clearly, Victoria's current prescribed burning program is of insufficient size to consistently aid in suppressing major bushfires, although it is undoubtedly randomly beneficial in helping to prevent some fires from growing to larger size. The current annual burning target of 130,000 hectares per year equates to just 2% of the suitable Victorian forest. This is just a quarter of what is proportionally being targeted to optimise fuel reduction effectiveness in south west WA.

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[46] Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Victorian Parliamentary Environment and Natural Resources Committee (June 2008)

[47] Victorian Government's response to the Environment and Natural Resources Committee's Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Department of Sustainability and Environment, 4th December 2008. Can be viewed on the DSE website: www.dse.vic.gov.au

[48] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

[49] This target was being regularly met in the past, but for a range of reasons during the past decade it has been more common for only around half of it to be achieved. When the target was being met, it was maintaining around a third of the forest under very light fuels loads – Roger Underwood, WA Bushfire Front, pers comm., January 2010

[50] Report of the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, Chapter 2: Prescribed burning in Victoria – The effectiveness of fuel reduction burning (p. 30), Victorian Parliamentary Environment and Natural Resources Committee (June 2008)

[51] *Fire risk will never be eliminated*, by Professor Ross Bradstock, Director of the Centre for Environmental Risk Management of Bushfires, University of Wollongong. In: *The Sydney Morning Herald*, February 18th, 2009.

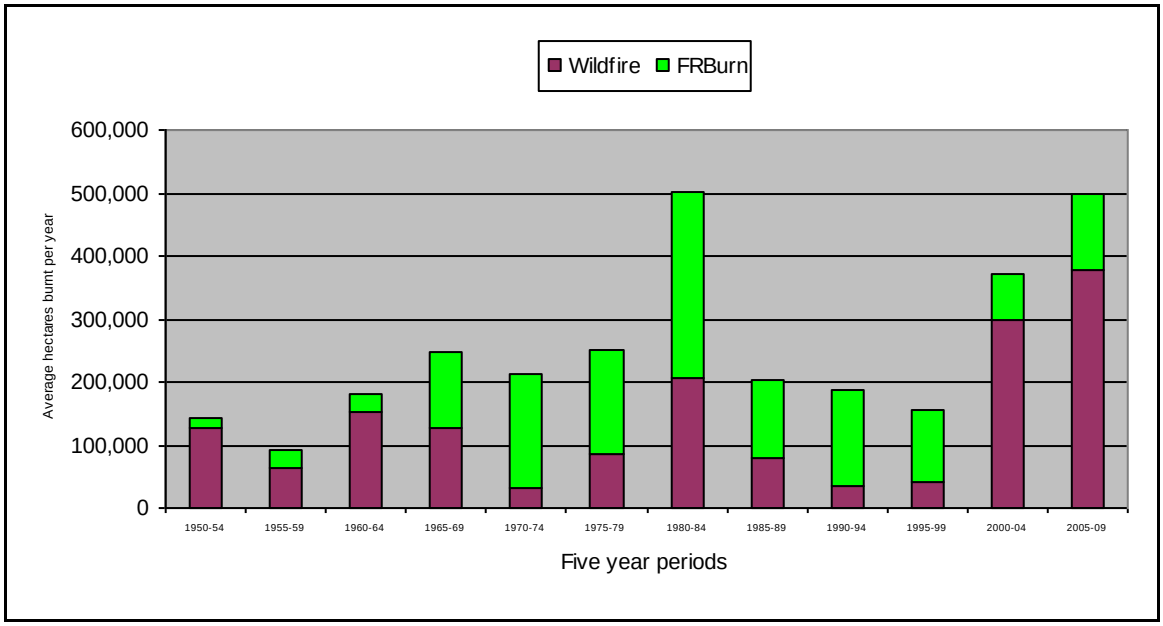
Increasing Victoria's prescribed burning program to the recommended 385,000 hectares per year would equate to around 6.2% of Victoria's suitable forest area being treated each year on a 16-year burning cycle. Whilst still significantly less than optimal, such an expanded program should nevertheless be far more effective in mitigating the extent and damage of unplanned Victorian bushfires than is currently the case.

The wisdom of Victoria aspiring to a more extensive prescribed burning program is supported by the fact that for around 50 years, south west WA has avoided the sort of mega-fires that have afflicted Victoria in 1983, 2003, 2006 and 2009.

Since the early 1960s when WA seriously adopted fuel reduction burning, its success in improving bushfire outcomes has been underpinned by maintaining the average ratio of area annually burnt by prescribed fire compared to unplanned wildfire to better than 80:20.[52] Conversely, in Victoria since the mid-1950s, the annual ratio of prescribed fire to unplanned wildfire has averaged around 50:50. For a period during and after our most extensive prescribed burning (from about 1970 – 1999), Victoria's prescribed fire to wildfire ratio improved to around 70:30. However, over the past decade it has dramatically declined to around just 20:80 (see Figure 3).

Clearly, a persisting ratio of this magnitude indicates that the bushfire threat to human life and property and the impact on environmental values, is unacceptably high. Substantially increasing the rate of prescribed burning is the key to redressing this huge imbalance.

Figure 3: Indicative ratio of average prescribed fire to wildfire in Victorian public forests during the modern era of prescribed burning (starting in the early 1950s)



Notes:
Plotted lines are based on the approximate average area burnt per year within each of the specified five-year periods.
The data of areas burnt by wildfire and prescribed burn are approximations derived from Figures 1 (p.6) and 2 (p.7) of the Submission by Dr Kevin Tolhurst, School of Forest and Ecosystem Science, University of Melbourne to the Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria, conducted by the Victorian Parliamentary Environment and Natural Resources Committee (May 25th 2007). More recent data obtained from DSE Annual Reports: www.dse.vic.gov.au

[52] *Prescribed burning: How effective is it in the control of large bushfires?* by Rick Sneeuwjagt (2008). In: Fire, Environment and Society: From Research to Practice, Bushfire CRC; The Australasian Fire and Emergency Service Authorities Council, Adelaide, SA, pp. 419-435

The value of the prescribed fire to unplanned wildfire ratio as an indicator of the success of bushfire management is further emphasised by NSW experience documented over the 10-year period from 1993-94 to 2002-03 (see Table 2).

Table 2: Comparative success of bushfire management in NSW State Forests and National Parks during the 10-year period from 1993-94 to 2002-03[53]

	NSW public lands	
	National Parks	**State Forests**
Average % of total area prescribed burnt per year	0.4%	3%
Average area prescribed burnt per year	20,500 ha/yr	73,000 ha/yr
Average area burnt by wildfire per year	250,000 ha/yr	70,000 ha/yr
Prescribed burn : unplanned wildfire ratio	**< 10:90**	**~ 50:50**

This stark difference in the success of bushfire management between NSW State Forests and National Parks aligns with respective land management philosophies. In NSW National Parks, prescribed burning during that period was primarily focused on community protection and restricted to boundary areas in close proximity or adjacent to urban and rural communities. Conversely, in State Forests, prescribed burning was undertaken for a broader range of values and was both more extensive and more widely spread across the landscape.[54]

It could be argued that a far lower than optimal amount of prescribed burning was being undertaken in the NSW State Forests during this period. Nevertheless, more than half of the fire which occurred in the State Forests each year was applied with a degree of planning and control. Conversely, less than 10% of the annual fire in National Parks was controlled, meaning that over 90% was unplanned wildfire burning out of control, often in hot summer conditions, when threats to both neighbouring communities and in-park infrastructure and environmental values was maximised.

The fact that far better bushfire outcomes were achieved in the NSW State Forests compared to adjacent National Parks under the same weather conditions and over the same period, is another powerful indicator that a land management philosophy which minimises the area and extent of fuel reduction burning is incapable of effectively managing bushfire threat.

Environmental values and prescribed burning

A detailed consideration of the environmental issues associated with prescribed burning lies outside the primary scope of this document. However, it is worth at least a passing mention because environmental concerns seem to be the primary motivation of most of those opposed to an expansion of prescribed burning; and it is another case where they have downplayed the level of existing knowledge. In so doing, they are seeking to suspend prescribed burning at current (or lesser) levels until more research is undertaken.

There is probably no limit to what can be learned about the environmental implications of both wildfire and prescribed fire given the hugely variable array of Australian ecosystems. Accordingly, there is an ongoing need for research. However, there is also much that is already known after almost

[53] *Fire management in Australia: the lessons of 200 years,* by V. Jurskis, B. Bridges, P. de Mar. In: Proceedings of the Joint Australia and New Zealand Institute of Forestry Conference, 27 April–1 May 2003, Ministry of Agriculture and Forestry, Wellington/ Queenstown, New Zealand, pp. 353–368.

[54] *Fire management in Australia: the lessons of 200 years,* by V. Jurskis, B. Bridges, P. de Mar. In: Proceedings of the Joint Australia and New Zealand Institute of Forestry Conference, 27 April–1 May 2003, Ministry of Agriculture and Forestry, Wellington/ Queenstown, New Zealand, pp. 353–368.

40 years of study and arguably this is more than enough on which to base a responsible fire management policy.[55]

There are several other observations to be made about concerns for the environmental impacts of prescribed burning:

- Many in the wider community seem to have a mistaken perception of prescribed burning as being akin to the images of black devastation regularly shown after events like 'Black Saturday'. Fuel reduction is not akin to total fuel removal.

  There is clearly an under-appreciation of the reality that prescribed burns are planned as low intensity, slow-moving fires lit within nominated boundaries at cooler and wetter times of the year. They generally burn in a patchy manner and therefore leave scattered remnant habitat from which flora and fauna can recolonise adjacent burnt ground. This is very different to unplanned summer bushfires which can be hugely more intense and fast-moving, quickly burning everything in their path over extensive areas.

- There is insufficient community understanding of the benefits of prescribed fire in reducing the environmental disturbance of hot summer fires. Some of the impacts of the series of Victorian mega-fires since 2003 will take decades to repair – if they are repairable – particularly disturbance to soil values, and biodiversity. Yet few seem to appreciate that areas within these fire areas which had been prescribed burnt in the previous ten years were much less damaged.

If the community was better educated in these matters there may well be far more support for an expanded prescribed burning program in Victoria. On the other hand it seems likely that some 'environmentalists' are unlikely to ever be convinced that there is ecological benefit in deliberately disturbing Australian forests by regularly burning them.

One of the most comprehensive studies dealing with these concerns is the ongoing Wombat Fire Effects Study. The Summary Report prepared after the first 15-years of research in central Victoria's mixed species foothill forests, provides a range of findings about the ecological impacts of prescribed burning.[56] These findings include:

- Over a 14-year period, no plant species were either lost or gained as a result of up to four successive spring or three successive autumn fires (Note: This is a far greater fire frequency than that being proposed in most Victorian forests under an expanded prescribed burning program).
- In the absence of fire there were subtle changes to forest understoreys. Whilst only small on a year-to-year basis, they can amount to significant changes over a period of a decade or more.
- No long term changes were noted in the activity or abundance of invertebrates following a single low intensity prescribed burn.
- Three low intensity prescribed spring burns within eight years had no impact on litter arthropods.
- None of several studied reptile species was favoured by a particular burning treatment.

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[55] *Ecological effects of repeated low-intensity fire in a mixed eucalypt foothill forest in south eastern Australia: Summary Report (1984 – 1999)*, Fire Research Report No. 57, Department of Sustainability and Environment (December 2003)

[56] *Ecological effects of repeated low-intensity fire in a mixed eucalypt foothill forest in south eastern Australia: Summary Report (1984 – 1999)*, Fire Research Report No. 57, Department of Sustainability and Environment (December 2003), Executive Summary. This report can be accessed from the DSE website: www.dse.vic.gov.au

- Unburnt microhabitats (particularly logs, deep beds of leaf litter and areas frequently not burned by low intensity fire such as damp gullies) provide important refuges and food, shelter and oviposition sites in the post-burn period.
- No particular burning treatment favoured either of two small mammal species which were studied.
- Populations of the Brown Antechinus (*Antechinus agilis*) were significantly higher two to three years after prescribed burns than in long unburnt areas.
- Some birds respond positively to fire and some species may depend on it. Fuel reduction burning provides ephemeral patches of bare ground habitat at the landscape scale which may be advantageous.
- Low intensity prescribed fires repeated at intervals of ten years can be expected to lead to a decline in soil organic matter and soil fertility. At intervals of 10 years or greater, there was little if any change in carbon and nitrogen levels, indicating that such a strategy would maintain soil organic matter in the long term.

Whilst the trial found that prescribed burning on three to five year frequencies could be ecologically undesirable, regular burning on frequencies in excess of ten years appears to have no adverse implications given the rate of ecosystem recovery after low intensity fire. Indeed, there are likely to be more adverse ecological implications if forests are left unburnt for considerable periods.

This supports the expansion of Victoria's prescribed burning program to a 16-year cycle in which around 6% of the suitable forests are treated each year as recommended by the government's Environment and Natural Resources Committee in June 2008.

Arguable, the study's most pertinent finding was that post-fire recovery of flora, fauna and soils is far more rapid and complete following low intensity fires (such as prescribed burns) compared to high intensity fires (such as unplanned, hot summer bushfires). This is because high intensity fires tend to remove a greater proportion of the tree canopy, a much greater part of woody debris from the forest floor, more of the tree bark, and more of the potential refuge areas such as damp gully vegetation. In addition, they induce greater soil heating and plant death, and by moving faster, can cause higher fauna mortality.

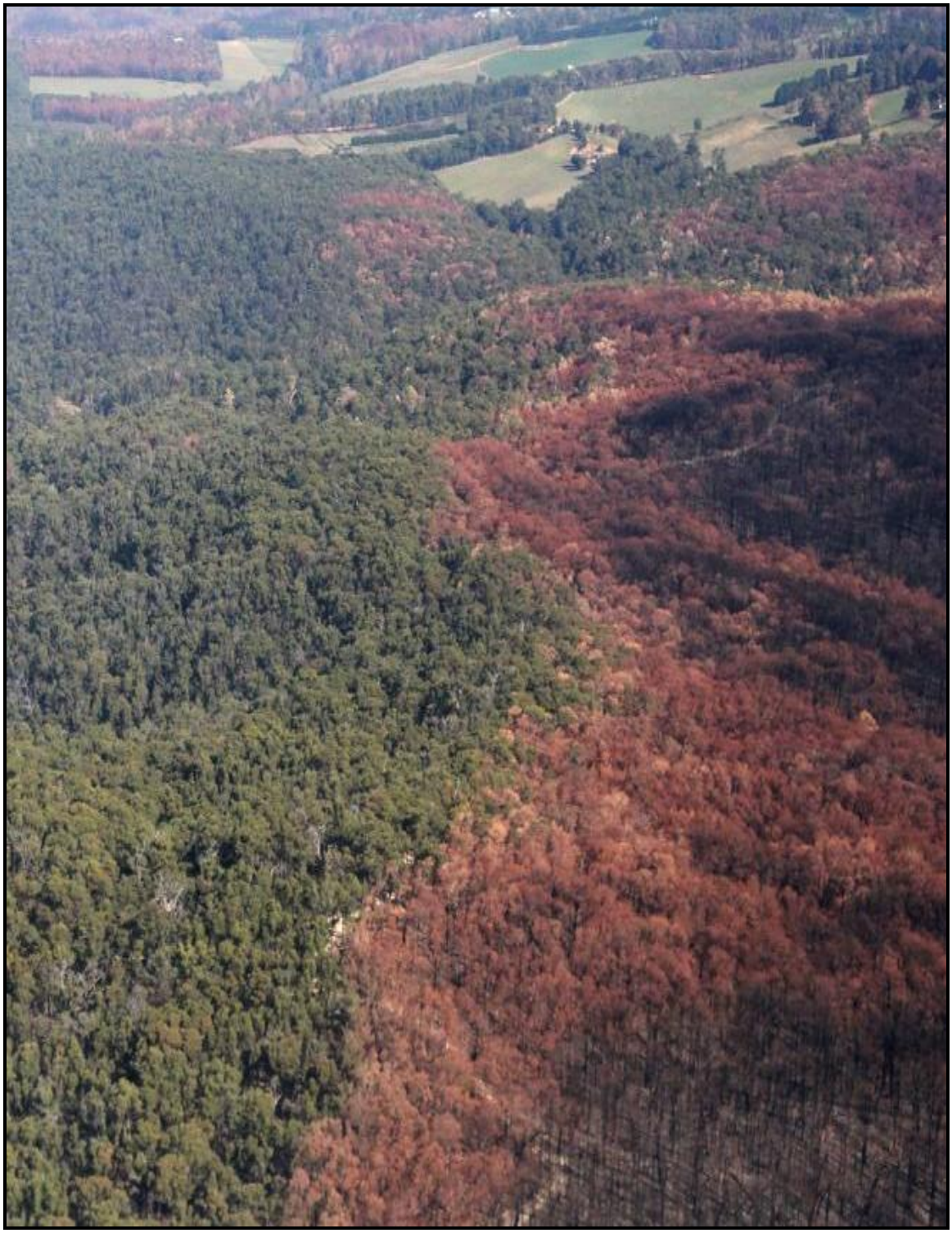
Supporting this finding about the far greater destructiveness of hot summer bushfires is that the 2003 Alpine fire, which burned around 1.7 million hectares of land in Victoria, NSW and the ACT in just 59 days, killed an estimated 370 million reptiles, birds, and mammals.[57] In addition, it killed substantial areas of forest, some of which will not regenerate back to its pre-fire form. It was also predicted that post-fire forest regeneration in the most severely affected half of the burnt area will reduce inflows to the Murray River headwaters by 430 billion litres per year until 2050.[58]

In so far as low intensity prescribed burning plays a significant role in mitigating the severe ecosystem damage of high intensity summer bushfires, those who would oppose it are hardly acting in the best interests of the environment.

[57] Former CSIRO scientist, Noeline Franklin

[58] Predicted water loss attributed to the CRC for Catchment Hydrology (2003) in the National Association of Forest Industries / Timber Communities Australia joint submission to the National Water Initiative, April 2004.

Figure 4: Demonstrated impact of extensive low fuel loads on wildfire control. Forest at North Kinglake burnt on February 7th 2009 (on the right of the photo). Green forest canopy (on the left) is area that was burnt in the 2006 Kinglake fire which provided an extensive barrier to the spread of the 2009 fire (MF Ryan, IFA).



Conclusions

There is an abundance of Victorian and Western Australian evidence that fuel reduction burning is a critical bushfire management tool.

However, to be optimally effective it needs to be applied throughout the forest at a sufficient scale to ensure that a substantial portion of the landscape is maintained under a low fuel state.

In south west WA where forest management has been demonstrably more successful in avoiding the sort of mega-fires that have recently afflicted Victoria, this has been achieved by targeting 8% of the forest for prescribed burning each year.

Currently in Victoria, just 2% of the forests regarded as being suitable for prescribed burning are planned for treatment each year. That this is insufficient was identified by the Victorian Parliamentary Environment and Natural Resources Committee, who in June 2008, recommended a tripling of the burn target which would see around 6% of the suitable forests treated each year on an approximately 16-year cycle. This substantially upgraded program now needs to be implemented.

It is inevitable that a substantial area of Victorian forest will burn each year. However, the WA experience shows that to a large extent we have the capability to influence how and when it burns and its consequent environmental and human impact – notwithstanding that there will always be occasional fires which are simply uncontrollable and very damaging.

We can either burn more forest under prescribed conditions at cooler times of the year when fires burn slowly at low intensities causing little damage; or we can allow fuels to build and consequently consign our forests to greater areas burnt by periodic unplanned wildfires during hotter times of the year when they move quickly with high intensity and are infinitely more damaging to both ourselves and the environment.

After recent disastrous bushfire seasons and including recent prescribed burning, Victoria currently has over 3.5 million hectares of public forest (or more than 50%) with fuels of seven years old or younger. This should provide an excellent platform on which to build a significantly expanded prescribed burning program which would be expected to significantly improve bushfire outcomes.

How to address the logistical and resourcing issues associated with a substantially expanded prescribed burning program is an important and difficult question. However, it cannot begin to be answered until:

(i) the Victorian community embraces the concept of prescribed burning as an effective bushfire management tool and accepts the need to do far more of it; and

(ii) the Victorian government demonstrates leadership by adopting a policy which commits it to a far more extensive prescribed burning program.

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