Burning Issues

SUSTAINABILITY
AND MANAGEMENT
OF AUSTRALIA'S
SOUTHERN FORESTS

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CSIRO
PUBLISHING

bushfire CRC

National Library of Australia Cataloguing-in-Publication entry

Adams, Mark A. (Mark Andrew)

Burning issues : sustainability and management of Australia's southern forests/
by Mark Adams and Peter Attiwill.

9780643094437 (pbk.)
9780643103467 (epdf)
9780643103474 (epub)

Includes bibliographical references and index.

Forest fires – Australia, Southern – Prevention and control.
Forest ecology – Australia, Southern.
Sustainable development – Australia, Southern.

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634.96180994

Published by
CSIRO PUBLISHING
150 Oxford Street (PO Box 1139)
Collingwood VIC 3066
Australia

Telephone: +61 3 9662 7666
Local call: 1300 788 000 (Australia only)
Fax: +61 3 9662 7555
Email: publishing.sales@csiro.au
Web site: www.publish.csiro.au

Front cover: photo by Jason South/Fairfax Photos

Set in 10/12 Adobe Minion and Stone Sans
Edited by Peter Storer Editorial Services
Cover and text design by James Kelly
Typeset by Desktop Concepts P/L, Melbourne
Index by Russell Brooks
Printed in China by 1010 Printing International Ltd

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Original print edition:
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MIX
Paper from responsible sources
FSC® C016973

Contents

human development over ten thousand years in the Americas (Schule 1990), over tens of thousands of years in Australia (Singh *et al.* 1981; Singh and Geissler 1985) and over 1.5 million years in Africa (Schule 1990). If we were to classify these fires as exogenous, then we deny what seems to us to be obvious – that humans are as much a part of ecosystems as are plants and animals other than humans.

Disturbance is a term that is now deeply embedded in ecology. We have previously outlined the terminology that has developed around the ecology of disturbance, and we have commented on the rather subjective nature of recognising disturbance.

In fact, disturbance events cover a continuum of possibilities. For example, death and decay are normal processes – from the death and fall of a leaf, the breaking and fall of a branch, to the death and fall of a tree. In some forests – many of the tropical forests, for example – seedlings grow and advanced growth is liberated within the gaps created by treefall. Even the destruction of large numbers of trees, blown down by cyclones or hurricanes, provides conditions for the regeneration of the forest. Although we might form the subjective view that cyclones and hurricanes are major disturbances, they too – like death and decay – are part of the natural order of things.

The Australian biota has evolved under a regime of fire. A lightning strike might ignite a single tree. Depending on the weather and the moisture content of the fuels in the forest, the fire started by the lightning strike might simply smoulder and die, or it might burn a few hectares, or it might join up with fires started by neighbouring lightning strikes and burn over large areas. At what stage in this continuum do we view fire as a disturbance, rather than part of the natural order of things?

Insect attack is a major feature of many of the coniferous forests of North America. For example, some 55 million hectares of the north-eastern balsam fir forests were left dead and dying in 1970, and some 23 million hectares were dead and dying following another attack in 1983. While this seems like death and destruction, there is strong evidence that 'spruce budworm outbreaks are periodic natural occurrences that . . . recycle older fir stands to regenerating fir stands' (Ostaff and Maclean 1989). In other words, 'spruce budworm outbreaks are periodic natural occurrences that . . . recycle older fir stands to regenerating fir stands' (Blais 1983; and it is interesting to note here the description of an outbreak as an occurrence, rather than a disturbance).

Aber and Melillo (1991) sum up these important disturbances:

> *'Disturbance by fire, defoliation, or other agents is an intrinsic and necessary part of the function of most terrestrial ecosystems – a mechanism for reversing declining rates of nutrient cycling or relieving stand stagnation. The requirement for fire to reverse soil organic matter accumulation and increase nutrient cycling has been known for some time . . . In the cases of the budworm and the mountain pine beetle, stand break up, the reinitiation of succession, and the reversal of stand stagnation are facilitated by herbivory rather than fire.'*

It is interesting to compare the ecological use of the term 'disturbance' with the everyday use. The *Shorter Oxford English Dictionary* defines the verb 'disturb' in terms of agitation, disorder, frustration and even tumult and destruction. 'Disturbance' is then '1. The interruption of tranquillity, peace, rest, or settled condition; agitation. 2. Interruption of mental tranquillity; discomposure. 3. Interference with the due course of any action or process; molestation.'

While we do not want to advocate a change in terminology of disturbance in the well-established ecological literature, it is clear that the ecological meaning of disturbance is rather different from the social or legal meanings. Smaller-scale disturbances such as the fall of branches and the death and fall of trees are not disturbances at all but simply normal and regular events in the life of all plant communities.

And even at the larger scale, the recognition of disturbance is, as we stressed early in this chapter, entirely subjective. Fire has been a major factor in the evolution of Australia's biota over hundreds of millions of years. Because many species depend on the cyclic renewal of resources by fire, how then can fire be viewed as a disturbance? In fact, Vic Jurskis, Forests New South Wales, has argued compellingly that the view of fire as a disturbance is entirely inappropriate for the eucalypt forests of Australia; in total contradiction to that view of fire as a disturbance, Jurskis argues that it is the *exclusion* of fire that should rightly be recognised as a disturbance (Jurskis 2003, 2005a, 2005b).

This contradiction in views emphasises one of the greatest difficulties in the interfaces between ecology, society and politics. Long-standing ecological views of succession as a stable and self-perpetuating state have simply re-enforced the view of fire as a disturbance, with all of its social and political connotations of interference of stability, tumult and destruction. In contrast, fire is an essential part of the lives of our forests. We must accept it, and learn how to manage it so that goals for the management of diversity are achieved.

Fire and the Australian biota

Around the world, fire is recognised as 'the dominant fact of forest history':

> *'The great majority of the forests of the world – excepting only the perpetually wet rain forest, such as that of south-eastern Alaska, the coast of north-western Europe and the wettest belts of the tropics – have been burned over at more or less frequent intervals for many thousands of years' (Spurr and Barnes 1980).*

Nowhere is this dominance of ecosystems by fire more important than in Australia. It is often stated that Victoria is the most seriously affected state within Australia, accounting for some three-quarters of deaths and more than half of the economic losses due to bushfire.[11]

Australia was not always like this. Australia, in its northward drift from its Gondwanic connections 130 million years ago, became hotter and drier. The extensive cover of cool-temperate rainforest was gradually displaced by hard-leafed vegetation: by vegetation that, because of its evolution in relative isolation, is highly endemic. With increasing aridity came an increasing incidence and spread of fire from lightning. The frequency of fire in Australia increased with the coming of Aborigines some 45 000 to 70 000 years ago, and increased again with the coming of Europeans 220 years ago.

Fire played a dominant role in evolution, an evolution that produced the highly endemic genus *Banksia* and the enormous diversity of species within the genera *Acacia* (wattles) and *Eucalyptus* that now dominate our forests. Many species have characteristics that make them more, rather than less, fire-prone, supporting the hypothesis that 'fire-dependent communities burn more readily than non-fire-dependent communities because natural selection has favoured development of characteristics that make them more flammable' (Mutch 1970).

For example, the leaves of the eucalypts are rich in resins, waxes and volatile oils, the bark of some species is fibrous and stringy and of others, hangs down from the canopy in long ribbons. Many of the forests in higher rainfall areas support a rich understorey, with many species such as *Leptospermum* (ti-trees) and *Melaleuca* (paperbarks) rich in volatile oils, like the eucalypts. Seeds of many species in the genera *Banksia* and *Hakea* are held in hard fruits that open *only* after the heat of a fire.

Many species, both of eucalypts and of the understorey and shrub layers regenerate after fire by epicormic shoots or coppice shoots, or both. Leguminous species (for example, many of the acacias) are hard-seeded; heat apparently cracks the seed-coat, resulting in prolific regeneration after high-intensity fire. Flowering in the Xanthorrhoeaceae (the grass trees) and Orchidaceae and a few other families is fire-induced and gregarious, and the ancient cycad *Macrozamia reidlei* produces cones profusely and gregariously, much like the gregarious flowering of some tropical species after cyclone damage. Smoke from fire initiates and enhances germination of many plant species, and the effect of heat on the soil stimulates the growth of seedlings.[12]

Eucalypts such as *E. diversicolor* (karri) and *E. regnans* (mountain ash) regenerate only after the mature forest has been killed by fire, leaving a bare ash-bed onto which the seeds, liberated from the canopy by the heat of the fire, fall and germinate. For the BBC film 'The private life of plants', Sir David Attenborough (1995) wrote:

> *'The threat to the spectacular forests of noble mountain ash is not, in fact, fire. It is the absence of fire. If the great trees die from old age before flames have cleared the ground for their seedlings, than they will leave no successors. Paradoxically, such a forest will not survive unless much of it is first destroyed'.*

The American historian, Stephen Pyne (1991), wrote lyrically of the eucalypts:

> *'The Australian bush owes its peculiarity, more than anything else, to Eucalyptus. No other continental forest or woodland is so dominated by a single genus. Other biomes on Earth have scleromorphs, most have grasses, and few are spared wholly from fire, but none has the combination that exists in Australia and has given the bush its indelible character. Eucalyptus is not only the Universal Australian, it is the ideal Australian – versatile, tough, sardonic, contrary, self-mocking, with a deceptive complexity amid the appearance of massive homogeneity; an occupier of disturbed environments; a fire creature'.*

Malcolm Gill, CSIRO, proposed a classification of woody species to characterise their response to fire (Gill 1981); this classification is given in simplified form below. The primary level of classification recognises two classes: *seeders* – mature plants are killed by crown fire and regenerate by seed, and *sprouters* – mature plants survive crown fire and regenerate from regenerative buds underground, on the stem, or in the crown. These distinctions are not absolute – many species regenerate both from seed and by resprouting.

1. Plants in the reproductive phase killed by 100% leaf-scorch (non-sprouters, or seeders):
   a) regenerate from seed stored on the plant
   b) regenerate from seed stored in the soil.
2. Plants in the reproductive phase recover after 100% leaf-scorch (sprouters):
   c) regenerate from buds below the soil surface (rhizomes, suckers from roots)
   d) regenerate from aerial buds (epicormic shoots).

A simplified classification for the response of animals to fire is not possible; behavioural patterns and requirements for shelter and food vary greatly among species, and therefore the response of species to fire varies greatly. There are many studies of the responses of birds and mammals to fire, fewer studies of reptiles, and very few of amphibians and invertebrates.

However, of one thing we can be sure: as the cool temperate rainforests that covered Australia began to shrink and were replaced by sclerophyll forests of eucalypts and acacias, Australia's unique marsupial fauna radiated into the new habitats. 'Accordingly, the fauna may have (*and here we insert our words:* **must have**) evolved in a complex, inter-related system of increasingly dry climate, fire, and a vegetation that enhances and is enhanced by fire' (Catling and Newsome 1981).

Fire, diversity and stability

The greatest concentration of studies of responses of fauna to fire is probably in the jarrah and karri forests of south-west Western Australia, an area of great diversity. In summarising and synthesising these studies, Gordon Friend and Andrew Wayne (2003) concluded:

> *'Fire is an integral part of the ecology of the terrestrial habitats of south-west Western Australia. The mammal species of these ecosystems, like the other constituents of their communities, display a variety of physical and behavioural adaptations that have enabled them to persist in this fire-prone environment. Since the biodiversity and health of these systems are dependent in part on fire, it is not a question of whether contemporary society uses fire as a management tool for conservation, but rather how fire is best used'.*

We have previously used a most important quote:

> *'disturbance by fire . . . is an intrinsic and necessary part of the function of most terrestrial ecosystems – a mechanism for reversing declining rates of nutrient cycling or relieving stand stagnation' (Aber and Mellilo 1991).*

It follows by simple logic that diversity at the landscape level is also dependent on fire at the landscape level. A bushfire at the scale of 1 million hectares, as was the result of the 2002–2003 Alpine fire and the 2007 Great Divide fire in south-eastern Australia, results in less diversity, both in species composition and in vegetation structure within and among communities, than a series of smaller fires over many years.

All of this is nothing new. In 1970, Loucks (1970) proposed the hypothesis that diversity and productivity of forest ecosystems are maintained by random periodic disturbance. There *is* no self-generated (or autogenic) steady state, and the system depends on disturbance of stand-replacing proportions. Loucks ended his paper in the strongest way, concluding that:

> *'The elimination of disturbance by modern humans 'will be the greatest upset of the ecosystem of all time. . . . It is an upset which is moving us unalterably toward decreased diversity and decreased productivity at a time when we can least afford it, and least expect it'.*

We should again differentiate between 'disturbance' as it is used ecologically and in general society. Fire has been a major factor in the evolution of Australia's biota over hundreds of millions of years. Because many species depend on the cyclic renewal of resources by fire, disturbances by stand-replacing fires are simply part of the natural order; it is the elimination of fire that should be more rightly termed a disturbance.

All of this raises many questions. What are the aims – social and biological – of management? What is the level of diversity we should aim for? What levels of disturbance are biologically necessary, and what levels can be socially tolerated? Can we accommodate fire and destruction within the management regime of a national park? These are questions with which land managers around the world have been grappling for a long time. For example, there is

now an intensive development of strategies to manage fire as an integral part of the ecosystem in Yellowstone National Park. J.S. Rowe and G.W. Scotter (1973) placed the problem in a general context for the land manager:

> *'The management of national parks, nature reserves, and wilderness areas poses many questions about the use of fire. The near exclusion of wildfires in such places has had profound effects. If the major goal of such areas is to perpetuate samples of as many landscapes as possible with the recognition that fire is an inseparable part and natural agent in the ecology of many ecosystems, then land managers must "unsell" the false impression that all fires are bad and be prepared to use both prescribed fires and natural lightning fires in landscape management'.*

5

Fire and ecological processes

Introduction

Discussions of the use of fuel-reduction fires often go little further than (a) the effectiveness of such fires in reducing the risks of bushfire and (b) the potential effects on biodiversity.

However, in a continent as old and as dry as Australia with a substantial record of Aboriginal burning, there is a *prima facie* case that we should understand the importance of low intensity, moderately frequent fire to factors that make up a substantial proportion of ecological sustainability, namely:

- maintenance of cycles of carbon, water and nutrients
- maintenance of the processes of soil formation.

Cycles of carbon and nutrients fall generally within the field of biogeochemistry. There are several excellent reference works. Beginning with the Bormann and Likens classic (1977), and including Schlesinger (1997), Schulze *et al.* (2001), Melillo *et al.* (2003) and the account by Vitousek (2004), nearly all are written from a northern hemisphere perspective. Perhaps only *Forest Soils and Nutrient Cycles* (Attiwill and Leeper 1987) offers a view from the south.

The field of soil formation is covered by a great many texts, too many to list here. However, one of the important features of Australian soils – the contributions of charcoal (or 'black carbon' or 'pyrogenic carbon') to overall carbon content and other soil properties such as structure and nutrient retention – is seldom covered in detail but it is the subject of much recent research. While public and political attention has drifted toward manufactured 'biochar'[13] (e.g. Sohi *et al.* 2009) and converting biomass[14] to long-lived carbon amendments for soils, the more fundamental issues for Australia, given the extent of fires each year (see Figure 2.2), are: 'how much pyrogenic carbon is produced by fuel-reduction fires, what is its chemical nature, and what is its role in soil formation and carbon, water and nutrient cycles?'

In this chapter, we summarise much of what we regard as 'known' about the importance of fuel-reduction fires on water, carbon and nutrients, with particular emphasis on soil aspects. The effects of fires on above-ground attributes of forested ecosystems are mostly obvious and, in large part, a matter of straightforward accounting – how much carbon and nutrients are lost during fires, what is the effect of regrowing vegetation on the amount of water used or on amounts of carbon and nitrogen regained? Important though these may be, they are far more straightforward questions to answer compared with those around soil water, carbon and nutrients.

9

Concluding comments: fuel reduction is essential for effective fire management in Australia

10 key points: the case for fuel-reduction burning

We summarise the themes that we have developed in this book as **10 key points:**

1. **Fire is a natural element of Australia's ecology.** Australian ecosystems – the bush – have evolved with fire and are in many ways dependent on fire for regeneration and for the rejuvenation of ecological processes.
2. **The nature of fire in Australia has changed over the millennia.** Large-scale, lightning-caused fires were followed by finer-scale mosaic burning after Aboriginal settlement some 45 000–70 000 years ago. Following European settlement, larger and more intense fires ('feral fires', because of increased fuel loads and shifts in seasonal timing and frequency) have obliterated the pre-existing habitat mosaic created by Aboriginal landscape burning.
3. **This change in fire regime in conjunction with the introduction of cattle, sheep and other domesticated and feral herbivores, has caused the decline, and in some cases the extinction, of many mammal and bird species.** 'The transition from traditional Aboriginal to European fire management is a major ecological and evolutionary event that, while being different in character, is of the same significance as the Pleistocene colonisation of Australia by the ancestors of Aboriginal people' (Bowman 2003a).
4. **Given the right conditions, the Australian bush is highly flammable.** Under extreme conditions, bushfire can be so intense that no fire-fighting capabilities of any nation could stop them.
5. **We will not be able to eliminate bushfires,** whether in state forests, national parks or wilderness; given that we have forests, then we will have forest fires, and this stark reality is true, not only for our forests in Australia, but for forests over much of the world.
6. **The occurrence of wide-spread, high-intensity fires will not reduce unless we recognise the need for intensive fuel-reduction programs.** The amount of fuel is the only part of the fire triangle – ignition, fuel and weather – that we can control. With climates predicted to become increasingly hotter and drier, the case for immediate action is further strengthened (Box 9.1).
7. **The evidence for the requirement for planned management of fire (including fuel-reduction burning and lightning strikes) is overwhelming, not just in Australia but worldwide.**
8. **The technology is now available to manage fire in a way that maintains biodiversity and markedly reduces the hazard to human life and property.** The only barriers to the implementation of this technology are the provision of sufficient funding for fire management and the removal of the ideological barriers to fuel-reduction burning.

9. **We must now develop programs of fuel-reduction burning over all tenures** (national parks, reserves, wilderness areas, state forests and so forth) that are aimed not just at reducing fire magnitudes and intensities, but aim at fire regimes that include the combination of fuel-reduction burns and natural fires so that ecological diversity is maintained, if not enhanced, while the accumulation of fuels is decreased. Management *must* have well-defined aims for diversity (controlled burning in Kakadu, elsewhere in Australia's north and in many ecosystems, such as the diverse ecosystems of south-west Western Australia and the heathlands at Wilson's Promontory in Victoria, provide excellent examples for us to follow).
10. **Properly managed fuel-reduction burning causes far less damage to life and property and to diversity and ecological processes than intense and uncontrollable bushfire.** The reintroduction of large-scale fuel-reduction burning programs for the maintenance of biodiversity and for the protection of life and property demands an intensive effort by government agencies, and a major program to stimulate public awareness.

Box 9.1: 'Are Big Fires Inevitable?'

This is an extract from a larger article by Attiwill and Packham (2009).

Various management authorities are telling us increasingly that big fires are inevitable, largely due to global warming. Global warming is, however, only one part of the story.

'Are Big Fires Inevitable?' is the title of a national bushfire forum convened by the Bushfire CRC in Canberra, February 2007 . The lead paper at this forum was given by Jerry Williams, former National Director of Fire Management, US Forest Service, and was titled 'The Megafire Reality: Redirecting protection strategies in fire-prone ecosystems'.

While Williams' paper has an emphasis on the United States, its relevance to fire-prone ecosystems around the world is clear. Conventional strategies and conventional doctrine have been to increase fire fighting capacity and suppression force in line with increasing threat of bushfire. Despite the fact that limits to the effectiveness of suppression are well known, we have continued to concentrate on building our suppression force. To a very large extent, suppression has been effective, except for the few fires that have become uncontrollable and grown to become megafires.

A view from the United States

Williams puts the problem in the United States into perspective:

- In the past 15 years, there has been a three-fold increase in the fire-fighting budget. Nevertheless, the area burnt is increasing, and fire extent and severity is the worst in history. 'Megafires are not occurring due to a want in funding. The worst (bushfires) on record are coinciding with the highest preparedness budgets we've ever seen appropriated'.
- In 2006, suppression costs on federal lands alone exceeded US$1.9 billion, yet more than 3.9 million hectares were burned by bushfire.
- 'The fire protection strategy in America is expensive and promises to become more expensive . . . It has gotten to the point where – at this level of suppression spending – other work for wildlife, watersheds, forest health, and recreation is going undone. Some are beginning to fear that we are headed to an awful predicament where the cost of emergency response continues to grow without discernible progress, but, worse, reaches the point where there is not enough money remaining to ever hope of mitigating the underlying problem.'
- Of the 10 000 or so fires that the U.S. Forest Service deals with each year, close to 99% are contained at the initial attack phase. The 1% of fires that escape account for 95% of the total area burned and about 85% of the total suppression costs.
- Before 1987, bushfires greater than 2000 hectares were relatively rare. Since 1998, there have been more than 200 fires greater than 20 000 hectares.

Williams argues that the increase in megafires is a powerful indicator that the fire protection strategies we have developed are not working. We are facing three major challenges: global warming, over-accumulation of forest fuels, and growth of populations in the interface between urban and forest areas (that is, more and more people wanting to live in the bush). In meeting this challenge, should we reinforce current tactics or should we redefine strategies?

Williams' view is that the megafires in America are 'emerging as more of a land management issue than the more commonly perceived fire issue'. Forests that have been protected by minimum disturbance and by fire suppression over the years have built up huge fuel-loads that are now, together with increasingly hotter conditions, fuelling the hottest fires. The very values that we set out to protect – species habitat, catchments for water supply, and many others – are being destroyed. 'Ironically', says Williams, 'we may be inadvertently managing for high-consequence wildfires'.

How are we to deal with these increased fuel loads throughout our forests? Techniques and management of prescribed burning to maintain low fuel-loads are well developed, but in the past 30 or 40 years, public opposition to the use of fire to control fire has intensified, nowhere more so than in the increasing area of national parks throughout the world. As a society, we began to believe that doing nothing – letting Nature look after itself – was an appropriate way to mange the land. And so, according to Williams, there is an implicit bias in many of the laws that govern land management. For example, prescribed burning must comply with the Clean Air Act, the National Environment Policy Act, and many others such as the Endangered Species Act. However, Williams notes that bushfires 'remain largely exempt from these requirements, even though their consequences may be much more severe'.

Williams concluded that changes in climate, fuel-loads and the urban/bush interface present real and serious threats. Leaders must address three questions:

- 'Are big, dangerous, destructive and costly bushfires inevitable?
- Can we see these trends and act on them?
- Can we re-direct (bushfire) protection strategies?'

At the time of writing (23 October 2007) fires are raging through southern California. A state of emergency was declared as fire ripped through the Malibu area, studded with homes of the rich and famous, living in the urban/bush interface. All of this, despite the fact that California has the largest fire protection capacity of any place in the world, with a budget for fire preparedness of more than US$3 billion (from Williams).

10 key reasons (or excuses) for inadequate programs of fuel-reduction burning

The management of fuel-reduction burning within the knowledge of fire behaviour is the legacy in Australia of the fire champions of the Forestry and Timber Bureau in Canberra, Harry Luke and Alan McArthur – work that started in the 1950s and continued under Phil Cheney's direction when the Bureau was incorporated within the Division of Forestry and Forest Products, CSIRO.

At the same time as Luke and McArthur were researching fire behaviour and control in Australia, Harold Biswell was doing similar work at the University of California at Berkeley. Biswell was a powerful advocate for fuel reduction, and this was a revolution – a paradigm shift – in fire management in the western United States. Biswell faced the same opposition to fuel reduction as we are seeing today in Australia, and he lists a number of reasons (or excuses, as he called them) for not controlling fuel loads in his seminal book (Biswell 1989).

We have built on and amended Biswell's list within an Australian context.

1. **The idea that all fires are bad.** This is a long-standing and firmly-entrenched view. It is wholly understandable, given the frighteningly destructive power of a bushfire; given that experience, it is difficult to view fire as good. However, the forest manager is faced with the day-to-day task of having to control *unplanned fires* including natural fires caused by lightning that may threaten diversity, other forest assets (water, topsoil, streams and rivers) and assets on adjoining lands. On the other hand, the forest manager must plan for 'good' fires – *planned fires* lit to achieve specified outcomes such as the reduction of fuel loads that have increased as a consequence of controlling natural fires and fires lit to maintain the health and diversity of forest ecosystems or for regeneration of disturbed or degraded ecosystems (Hodgson 2004).
2. **So-called 'controlled' fires can get away.** Of course they can, and the media revels in it. We should be critical if a fire gets away due to poor management or poor planning (for example, lit at the wrong time of the year or left, not properly extinguished, or when it is a danger to assets). We are loud in our praise of our fire-fighters when they tackle bushfires of hundreds of thousands of hectares, but we are critical of them when a fuel-reduction fire, planned to reduce the intensity and spread of bushfires, covers tens or hundreds of hectares more than was planned. The risks of fuel-reduction burning are minimal, given proper planning and a well-trained and experienced crew. We agree with Biswell: 'Isn't it more dangerous to live with fire hazards through periods of low humidity and high winds in the late summer than to burn them out under prescribed conditions?'
3. **Fires produce smoke, and we don't want that.** People in the cities, especially those with respiratory problems, do not like the smoke generated by fuel-reduction burns in autumn; there is enough pollution in the cities already. Winemakers may have to battle against 'smoke-taint' in their wines. These are difficult problems. They are problems that, in one of the most fire-prone areas on Earth, we have to learn to live with. If we do not burn to reduce the fuels, then fuel loads will steadily increase to 20 or more tonnes per hectare. When these fuels burn in an uncontrolled bushfire, as they inevitably will, the smoke will be prolonged. For example, the 2002–2003 alpine fires and the 2007 Great Divide fires in Victoria each burnt for about 60 days. The Kilmore-Murrindindi fires in Victoria, on Black Saturday 7 February 2009, extended south in to the Yarra Valley fire as the grapes were ripening. Because smoke-taint in wine is at least partly due to absorption into the skins of grapes around about this critical time (veraison – the transition from growth to ripening and change of colour) it is clearly of benefit to have cooler, limited burns in autumn when the grapes have been harvested than intensive and widespread fires in late summer.

Box 9.2: Grapes versus fuel reduction: a judgement from Western Australia

A judgement[30] handed down by Justice Graeme Murphy in the Supreme Court of Western Australia on 12 March 2010 is of great interest and we have noted several of its features elsewhere. The plaintiffs were a group of winegrowers whose grapes had been tainted by smoke from a controlled burn carried out near Pemberton, Western Australia by the Department of Conservation and Land Management (now called Department of Conservation and Environment) in March–April 2004. The fact that smoke from the fire had tainted the grapes was not at issue; the issue was whether the Department owed a duty of care to the winegrowers.

As we have mentioned previously, Justice Murphy noted that an assembled group of experts had agreed that prescribed burning is a necessary part of public land management to meet biodiversity, economic, silviculture, water and community protection objectives, and that prescribed burning is the only effective way of reducing potential impacts of wildfires at a landscape level.

However, Justice Murphy went on to quote from the relevant Forest Management Plan that proposes actions at the whole of forest and landscape scale for the purpose of using and responding to fire in a manner that:

- *'optimises the maintenance of forest ecosystem health and vitality*
- *promotes the conservation of biodiversity*
- *controls adverse impacts of fire on the social, cultural and economic values of land managed by the Department and adjoining land*
- *minimises the risk of smoke emanating from prescribed burns impacting on population centres and other sensitive areas.'*

Among the actions proposed, the Forest Management Plan states that the Department will:

- maintain a competent fire management, suppression and response capability
- prepare and maintain a fire management plan and smoke management guidelines
- undertake an annual prescribed burning program in a manner that:
  a) is in accordance with the fire management plan
  b) is in accordance with the smoke management guidelines
  c) has regard to the Goals for Understorey Structural Diversity
  d) considers any special vulnerability of fauna and flora known to exist in a particular area to burning in that area
- consult with stakeholders and interested community members in a manner that seeks to develop community understanding of and support for, and enable constructive discussions and deliberations on, the planning and implementation of prescribed burning and other fire management programs.

Justice Graeme Murphy found that the case brought by the winegrowers was inconsistent with the statutory functions of the Department – that is, to carry out fuel-reduction burning 'so as to serve the overall objectives prescribed by the Forest Management Plan' – maintaining forest health, conserving biodiversity, controlling adverse effects of bushfires. Justice Murphy concluded that 'that a duty of care, as alleged by the plaintiffs, or otherwise, did not exist. If such a duty did exist, I find that it was not breached. Accordingly, the plaintiffs' action must be dismissed'.

However, atmospheric conditions in autumn are often quite stable so that the smoke is not quickly dispersed (Box 9.2).

4. **We need more research (see also Box 9.5).** We have worked in universities all our lives, and so we would never speak out against research. Research that is of high quality, and research that is innovative and needed. However, the general argument that we should not allow repeated burning to reduce fuels because we have not studied the effects on all of the biota has no scientific basis. Anecdotally, we have the ecosystems that we have because of repeated burning over millennia. Scientifically, we have many studies of key species from which we can formulate programs of fuel reduction. As well as getting on with the business of fuel reduction, we must ensure that future research is directed to key understanding in the areas of diversity and ecological processes. We should also ensure that research tackles the important question: what is the effect of excluding fire from Australian ecosystems? In the first decade of the 21st century, fire management has become disaster management. 'There can be no doubt that some styles of management are more sympathetic to biodiversity and ecosystem services than others. I believe the currently ascendant 'bushfire disaster' mode of management is ultimately more destructive of biodiversity than a program of recurrent fires to reduce fuel loads' (Bowman 2003b).
5. **There aren't enough days suitable for fuel-reduction burning.** The number of days available for fuel-reduction burning is not a given. It is determined by the rules and prescriptions and limits that are set by the management agency. Given the accountability that rests with the manager, and the knowledge that if something goes wrong the buck stops with the manager (with little or no support from the government in power), it is inevitable that the rules and prescriptions and limits will be highly conservative, and that it will certainly be true that 'There aren't enough days suitable for fuel-reduction burning'. In fact, there are so few days suitable for prescribed burning under the current prescriptions that even the small (about 2% of State land) target areas for fuel-reduction burning set by the Department of Sustainability and Environment, Victoria, have not been met. Over the years 2000–2008, the actual area burnt was only 95 262 hectares per year, or 78.6% of the target area. Fuel-reduction burning demands local knowledge and experience. The increasing centralisation of management makes choosing a good day for burning increasingly difficult. A second factor at play here is the trend established through single-species approaches to setting fire-return intervals. That trend results in ever-smaller areas to be treated by any given fuel-reduction fire, and thus much reduced availability of resources (people, trucks and equipment) on the days when fires can be set. 'The Peoples Review' (Attiwill *et al.* 2009) following the 2002–2003 and 2007 bushfires in Victoria encouraged comments from the people to see how we can improve our efforts, not just in fire suppression but particularly in fire prevention. The overwhelming view was to return fire management, including fuel-reduction burning, to the people living and working in rural Victoria; we include some recommendations from this Review (Box 9.3).
6. **Burning makes ecosystems more flammable.** We are not sure where, how and why this notion originated. It seems to be a claim coming from those who oppose any sort of management of, or interference with, the bush (apart from demanding that lightning strikes are dealt with promptly). The general idea seems to be that interference by fuel reduction, logging, and so on creates a drier, more sclerophyllous understorey. As far as we are aware, the evidence in the scientific literature for such a change is very limited. The proponents use, among other things, Judge Stretton's (1939) report: 'The fire stimulated grass growth; but it encouraged scrub growth far more.' As we have previously discussed, Stretton had very limited published science to draw upon and his comment on this is at odds with all of the evidence of the nature of forests and woodlands at the time of European settlement.

Box 9.3: Some recommendations coming from 'The Peoples' Review' (Attiwill *et al.* 2009) on the need for local experience, knowledge and expertise in all aspects of fire management

1.2.6 People's future involvement – People's Fire Forum, Fire Policy Group, and local control of prescribed burning

In many fields of endeavour, the main location of knowledge is in institutions created to maintain and develop that knowledge. In the case of fire, however, much of the basic knowledge about local topography, fire and wind conditions lies not with city-based institutions, but with the local people themselves. This is why the people need such a strong voice. The following recommendation is not directed to government but to the people of Victoria – to urge them to pick up where this People's Review concludes and carry forward the imperative that the people have a right to be heard, their views assessed and changes implemented.

Recommendation 9: The People's Review recommends the establishment of a State-wide peak fire forum for the people, which we shall call the People's Fire Forum.

The development of fire prevention and suppression policy must be in the hands of people of all ecological persuasions. There is undeniably strong anecdotal evidence that the staff of Parks Victoria and Department of Sustainability and Environment is, simply put, seen as being too green. Fire policy must broaden from bureaucratic control and city-based politics to reflect the views and aspirations of the community, especially of rural communities. After all, it is they who live in the area, respond as volunteers to fight fires and bear massive social and economic cost of bushfires.

Recommendation 10: The People's Review recommends that fire prevention and suppression policy be set and reviewed by a Fire Policy Group that includes representatives of the People's Fire Forum.

Recommendation 11: The People's Review recommends that Prescribed Burning Groups, on which local communities have at least 40 percent of the representation, decide arrangements for prescribed burning including targets, timing, location and accounting.

An associated claim is that **old-age forests are more fire resistant than younger forests.** This claim mostly refers to the wetter forests such as karri in the west and mountain ash and alpine ash in the south-east. Again, we are not aware of any evidence in the scientific literature in support of increasing fire resistance with age. Indeed, one of the ecological tragedies of the Black Saturday 2009 bushfires in Victoria was the complete killing of old-age (at least 350 years) mountain ash forest in the Wallaby Creek catchment and an almost 100% killing of similar old-age forests in the O'Shannassy catchment.

7. **We don't know enough about Aboriginal burning to have an equivalent program of fuel reduction.** Aboriginal burning of the dry sclerophyll forests and woodlands was constant. Even if we had exact knowledge of Aboriginal burning, a firestick approach is obviously inappropriate given the vastly changed patterns of occupation and settlement.
8. **Fuel-reduction burning is too costly; there is not enough money.** Whether or not there is enough money is entirely a matter of priorities. Governments around Australia have spent a great deal of money on building up the capability for fire suppression, and we do not

question the validity of that. However, the cost of fire suppression in southern Australia over the past 8 years has been enormous. In Victoria, most of the money for fuel reduction has been spent on asset protection in specific areas. In comparison, the money needed per hectare of broader-scale fuel reduction is much less than that needed in sensitive areas of asset protection. After all, it is at the landscape level that fuel loads promote the sort of crown fires that end up in a firestorm. We ask the question: 'how should governments provide funding for the landscape-scale fuel-reduction burning that is required to adequately reduce risks, free from year-to-year political pressure?' (see Box 9.4).

9. **It's all a matter of politics.** Spending money on water bombers, tankers, communications and so forth for better fire-fighting capability results in tangible and accountable assets. Spending money on fuel reduction results in good figures on a broadsheet, but it may anger city people (because of smoke) and those among the conservation and other groups who

Box 9.4: Fire, money and politics

Fire has become a political issue in recent years and is set to become more so unless significant changes are made in overall approaches to fire, especially fuel-reduction fires. The involvement of politicians and senior bureaucrats in the issues surrounding the fighting of bushfires has been in plain view.

Over the past 20–30 years, governments have sought to move costs away from the public purse where they can be legitimately passed to private individuals. This is the so-called 'user pays' principle and is enshrined in many modern policy decisions. Examples include health insurance, toll roads and bridges, and user charges for national parks. Sometimes the private sector collects payments directly, and sometimes governments collect them and pass them on to private sector contractors for the service provided.

Another example is the fire levy that people pay additional to their house insurance. This levy is used to fund fire-fighting services – both the professional metropolitan brigades and the volunteer rural brigades. There is considerable logic behind such a levy. First, it is attached to the principle of insurance – spreading the risk based on the assumption that (hopefully) not everyone suffers loss at the same time. Secondly, the greater the value of the property insured, the greater the levy and the more money that flows to fire-fighting agencies. State and federal governments also contribute to the costs of running, and especially equipping (trucks, helicopters and planes), the fire-fighting agencies, but the under-pinning by insurance levies is now an accepted and crucial part of their balance sheets. The growth in budget of volunteer-based fire-fighting organisations is testament to the success of the policy, even though it does little to ensure we have enough volunteers owing to the 'urbanisation' of the population.

However, the 'insurance and levy' approach to risk mitigation via fire-fighting stands in contrast to the equally valid and just-as-important mitigation of risks via fuel-reduction burning. For the latter, all of the costs have remained with the public purse. Consequently, there is no financial underpinning of the costs of fuel-reduction burning. Instead, each year bureaucrats from land management agencies responsible for fuel-reduction burning have to request funds from Treasury to pay for their annual program. Naturally enough, this leads to a situation where Treasury officials have to weigh up the importance of fuel-reduction burning relative to the importance of funding for hospitals, police, schools and a myriad of other competing and important community needs. Not surprisingly, fuel-reduction burning is not always high on the list of priorities, and falls in importance with the passage of time since the last major bushfire; a reduced importance that is all too easily supported by those opposed to fuel reduction on political or ideological grounds. We might compare and contrast the large infrastructure and budgets of the specialist fire-fighting agencies with now obvious lack in rural areas, of land management infrastructure, people and actions. Policies of 'benign neglect' seem more favoured, with governments only springing into action when there is a direct threat.

Two 'rules-of-thumb' might help to de-politicise fuel-reduction burning: (1) Funding provided each year for landscape-scale, fuel-reduction burning should be a matter of public record, as should its expenditure; (2) Mechanisms for the provision of those funds should be transparent, free from political influence and proportional to the risks (especially fuel loads).

The second point carries with it some problems. Removing political influence of fuel-reduction burning is made more difficult by fire ignitions many kilometres away from where they ultimately destroy property and kill people. There is overwhelming temptation to focus on risks 'over the back fence', and to describe fuel reduction at that scale as 'strategic'. Individuals might be convinced they ought contribute to costs of reducing risks within their 'neighbourhood', but it will remain difficult to convince them they should contribute to costs associated with fuel-reduction efforts even 1 kilometre distant, let alone 10, or perhaps 100 kilometres away. However, unless fuel loads are reduced across the landscape, there is little hope of containing the worst fires once they have started and, under 'catastrophic' conditions, preventing them from becoming raging infernos capable of overwhelming the modest defences 'over the fence'.

are implacably opposed to interference with our natural resources. We seem to have a major contradiction. On the one hand, private landowners are urged every year to take the appropriate steps, and to spend appropriate money, to reduce their fire risk – a clear acknowledgement that fuel reduction is (among other preventative measures) essential to reducing the risk of fire. On the other hand, government landowners have allowed fuel loads to build up to the extent that, given the right conditions, no amount of fire-fighting equipment will be successful in fire suppression. It is all a matter of politics (see Box 9.4).

10. **Let it be an act of God.** We have previously cited the following piece from Paul Collins, broadcaster, writer, and previously a priest in the Catholic Church:

'One of the most striking things about discussion of forest and bushfires is the kind of rhetoric that is often used . . . I am referring specifically to the assumed, apparently unconscious attitude that nature needs to be "managed". It is apparent in commonplace roadside signs erected by State forestry commission: "Managing the State's Forests Sustainably"—as though forests couldn't manage themselves sustainably and needed a government department to sort them out . . . The mania to manage one's entire environment is a classical symptom of the human fear of loss of control, of an inability to stand back from

nature and allow it to be itself, of a failure to show some humility toward a world that has been in evolution for millions of years and does not need us or our technology . . . A wildfire exposes the sheer impotence of humankind, and for the control-freaks among us that is almost unbearable'.

We cannot countenance Collins' view of humans as being apart from nature. We have cleared large areas of land to grow food, and we use extensive areas for grazing. We have introduced animals, both herbivores and carnivores, many species of which have become feral. We have introduced grasses, climbers, shrubs and trees, many of which have adapted superbly and are now widespread weeds. We have built dams and weirs and altered the courses of rivers and streams. We have extended settlement so that many people live surrounded by the bush. We have produced so much carbon dioxide by burning fossil fuels and by cutting and burning the tropical rainforests that we are making southern Australia hotter and drier. We have altered fire regimes. It is intolerable that we should now say: 'Good old Nature', you know best, you go and fix that lot!'

When we go walking through the forests of the Great Dividing Range, we are awed by their extent. For example, in the Central Highlands of Victoria, about 90% of the pre-1750 area of the wetter forest types and 99.9% of the pre-1750 area of cool-temperate rainforest is still there, contrary to scare-mongering views (Commonwealth of Australia and Victorian Governments 1998; Attiwill *et al.* 2001). In the south-west of Western Australia, 82% of the pre-1750 extent of karri forest in the region currently remains. Of the 13 jarrah forest types recognised in the South-West Forest region, five can be classed as more-heavily cleared (only 47% remaining) and six are less heavily cleared (53% remaining).

These forests are now our inheritance and they cannot be left to look after themselves. Nor can they be left to a bushfire regime of disaster management – wait for a disaster, and then throw our resources of people and water-bombers at it. That hasn't worked – surely we haven't already forgotten the feral fires of 2002–2003 and 2007 that burnt for 2 months, each costing hundreds of millions of dollars in fire suppression attempts, let alone the tragedy of 2009 – and it won't work in the future.

We are the current stewards and managers of the land. Aboriginal people managed fire and tamed it. Forest managers are setting the example in how to manage and tame fire in Western Australia. We have plenty of precedents to learn from. So, to finish with mixed clichés, let's bite the bullet and carry the torch. And to go back to 'The Peoples' Review' (Attiwill *et al.* 2009); the people living and working in the bush don't need all these lofty words and arguments – it's just good old, plain common sense. If you are living with a time-bomb of accumulated fuels, do something about it!

Education and research

A point we have made repeatedly is that we know enough, including knowledge of diversity, to get on with the job of using fire to reduce the risks of bushfires. We also say that we need new and better knowledge of a great many aspects of fire in our forests, including fire behaviour (largely physical science, see Chapter 3) and the role of fire in ecological sustainability (largely biological science, see Chapters 5–8). Our knowledge will steadily accumulate as a result of the practice of fuel-reduction burning. This accords closely with the view of the Royal Commission (see Epilogue).

We cannot say the same about education (and training) – education at all levels so that people can learn how to live safely with fire. This challenge encompasses aspects of education and training within schools, universities, technical colleges and fire and land management

agencies. It also encompasses continual professional development courses and public education programs.

This is not a trivial task. The events of 2009, and before that of 2006–07 and 2003, emphasise just how poorly bushfire is understood in Australia by urban planning agencies, utility companies and the general public. Some sections of emergency service agencies and land management agencies still fail to acknowledge the primacy of fire to their core business. National parks agencies, for example, still fail to properly monitor (or even attempt to measure) the impacts of bushfires on biodiversity, yet all too frequently their staff rail against the supposed 'risks to biodiversity posed by fuel-reduction burning'.

The education challenge requires recognition that we have had decades of a shift in staffing of land management agencies away from those trained in forestry schools and toward those trained in 'environmental science'. Incredibly to us, there is now an embedded 'anti-fuel-reduction burning' culture in some state government institutions.

There is now no School of Forestry anywhere within Australia. CSIRO Forestry no longer exists. Those tertiary institutions retaining an interest in forests now often deal only cursorily with practical aspects of fighting forest fires and fuel-reduction burning – this must be reversed. The natural and social histories of fire in Australia and elsewhere in the world are increasingly well documented and should be a formal component of degree courses in relevant disciplines.

School education programs must be better informed about 'living with fire'. Students must learn that using fire to reduce fuels is the only way that people can reduce risks from bushfires – and not have that message confused with or suffused by untested ideologies about the 'risks of prescribed fire'. Students must learn about the dependence of eucalypt forests on fire and their co-evolution with fire. A school education program *must* be as focused on inner urban schools as on outer urban schools. Students from the inner suburbs grow up to become part of the out-migration phenomenon and too many have almost no appreciation of the dangers or the fire ecology of the forests to which they move.

Community programs too have suffered in recent years from confused messages. Government agencies, and agencies and organisations supported by governments, have delivered messages and materials that promulgate the view that prescribed fires pose serious risks to biodiversity, yet fail to even mention how many plants or animals are killed by bushfires. Little attention has been given to education about housing and planning control. Even today, radio programs openly discuss ways by which homebuilders can 'get around' fire risk assessments and their implied building costs ('get another assessor'). If we were all better educated about the basic elements of fire behaviour, fuels, and fire ecology and dependence of eucalypt forests, then perhaps there might be fewer poor decisions about buildings and behaviour during fires.

It is vital that emergency service personnel receive much better education and training in the broader aspects of 'living with fire', in addition to their traditional base of fire-fighting skills and equipment and policies and procedures. Understanding the forests – how well they grow and produce fuel in relation to soils, topography, aspect and climate – is vital to decision making in the face of bushfires. Understanding human psychology and likely reactions to bushfires is obviously equally vital.

All of this requires resources and commitment. Books and other teaching materials must be written and prepared, lecturers must be employed, teachers must be brought up to speed with current knowledge, curricula must be changed, policies and guidelines for practises must be revised and implemented, and staff must be trained and educated.

Stephen Pyne (2007) provides a nice summary: 'A fuel array, a habitat, a landscape – nature does not determine by which prism a place might be viewed; culture does. A serious fire scholarship would begin with that irreducible fact'.