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Bushfires: Is Fuel Reduction Burning the Answer?

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Bushfires: Is Fuel Reduction Burning the Answer?

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Major Issues

Bushfires have been and will remain a significant component of the Australian landscape due to eucalypt species being the predominant species in most southern Australian forest ecosytems. Since the available forest fuel determines the amount of heat that potentially can be released in a bushfire, low intensity burns to reduce the fuel loading in a forest (fuel reduction burning) is one component that can be modified by land managers to reduce fire risk.

Research has found that doubling the fuel in the forest will double the rate of spread and quadruple the fire intensity. While low intensity fires will tend to burn dead fuels below six millimetres in diameter, medium to high intensity fires will burn young trees, thick twigs and branches, bark and deep litter. Fuel reduction burning can reduce the hazard of spotting from eucalypt bark, in some cases for up to seven to ten years.

While fuel reduction burning is the principal means to reduce the risks of bushfire, under extreme conditions bushfires can burn across land with very low fuel loads, which would have been halted under milder conditions.

Fuel reduction burning should not be applied uniformly, in terms of frequency or extent, across Australia because of the diversity of forests, topography and climates in southern Australia as well as the different priorities that different land managers have in developing specific burning regimes.

In order for fuel reduction burning programs to be effective they need to be designed to be applied to specific vegetation types and implemented by properly trained and resourced staff. Proper assessment of these burns need to be carried out to show whether the results meet the objectives of the program. Burning regimes are planned in advance with the knowledge that some fuel reduction burns may not proceed due to poor weather. Therefore the difficulties in carrying out fuel reduction burning because of the need to burn in optimal conditions should not be used as an excuse not to burn. There is normally an opportunity for a fuel reduction burning program to be carried out if the land manager has allocated adequate planning and resources to the program.

Topography is a significant component in determining the rate of spread of a bushfire. The rate of spread of a fire doubles with every ten degrees of increase in slope. This is especially important for the movement of fires in heavily bisected country as occurs in the Sydney region where fires can quickly run up from gullies to engulf houses at the top of

the plateau. Bushfires there pose a different sort of risk compared with bushfires in forests growing in the more gentle topography that is found for example in the southwest of Western Australia.

Priority needs to be given to strategic fuel reduction burning to protect housing located near the relevant land manager's boundaries. It is absolutely essential that all land managers (public and private) are obliged to design and implement their fuel reduction programs to protect life and property within and beyond their land boundaries.

Fuel reduction burning in the vicinity of urban areas are under more constraints than those in isolated forested areas. The issue of air pollution from smoke of fuel reduction burns increasing pollution levels in urban areas is a significant limiting factor on when such burns can be carried out. Burning can be unpleasant, reduce amenity, kill plants and wildlife, and cause pollution so there is a built-in political resistance to increasing the frequencies and proximity of the burns.

Introduction

Bushfires can drastically affect people, property and the environment but they are also part of the natural variability of environmental events and can be an important driver in changing or maintaining certain ecological communities. Ever since they first arrived in Australia, humans have altered the fire regime of particular areas of this country to protect resources and to favour particular plants and animals.

The present drought conditions foreshadow a serious bushfire season for southeastern Australia. After last summer's severe bush fires in New South Wales there were calls for more frequent and extensive use of fuel reduction burning of forests and other areas to enable firefighting agencies to protect life and property. The frequency and intensity of these fires to achieve this aim will have impacts on biodiversity, air and water quality and aesthetic values of the natural environment and there is always a balance of positive and negative impacts of any active burning regime.

This paper will briefly examine the use of prescribed burning regimes (fuel reduction or hazard reduction) in the forests of southern Australia to protect people and their property from bushfires and at the same time to maintain natural ecosystems. It will look at the trade-offs that may be necessary and comment on the potential reduction in bushfire risk arising from fuel reduction burning.

A briefing paper was prepared earlier this year by the New South Wales Parliamentary Library which gives an outline of the history of fire and bushfire in Australia. It discusses the legislative framework for bushfire control, bushfire hazard reduction works and the planning system in NSW and provides a summary of the 2001–02 NSW bushfires.[1]

The New South Wales Parliamentary Joint Select Committee on Bushfires issued a Report on the Inquiry into the 2001–02 Bushfires.[2] One of the terms of reference related to hazard reduction and other fire prevention measures. Appendix 1 contains the Committee's recommendation that specifically relate to hazard reduction burning. The hearings and the report of the Inquiry are drawn on for some of the examples used in this paper, which have some relevance for the rest of Australia.

Fire in Australia

Fire has been a significant part of the Australian landscape even prior to the arrival of humans in Australia 50 – 100 000 years ago. Lightning caused serious wildfires when the

conditions were right, such as during drought and when there was sufficient vegetation to act as fuel to carry the fire. Humans brought anthropogenic (human caused) fire to Australia and as a result, the number and frequency of wildfires increased dramatically. The eucalypt forest of 100 000 years ago formed a significant part of the forest vegetation but with the subsequent increase in the occurrence of wildfire in the Australian landscape these eucalypt forests expanded dramatically at the expense of the araucarias and *Casuarina*[3]. In his book *Burning Bush*, Stephen Pyne stated:

> By the time of European discovery forests and woodlands comprised about 25 per cent of the Australian land surface; perhaps 70 per cent of those lands could be classified as pure eucalypt forest. Eucalypts claimed about 16 per cent of the tropical eucalypt and paperbark biomes, and an estimated 11 per cent of the cypress pine biome.[4]

The extent of fire lighting by indigenous Australians was significant, with one estimate being that forty people inhabiting 3000 hectares (ha) would light an average of 5000 fires annually.[5] They developed firestick farming which created a variety of habitats to meet a variety of needs: hunting, removing woody regrowth, and protecting rainforest and specific habitats. Aborigines in Central Australia burnt to produce a mosaic of plant communities in different stages of fire recovery as protection against wildfires.[6] However some fires would escape their expected path and become wildfires. Pyne noted that:

> What made such fires tolerable was the nomadism of the Aborigine and the millennia of burning that shaped the fuels. Without a fixed habitat, the Aborigines could accommodate an unusually large fire.[7]

The time between fires in forests varied between type of forests, with estimates of the average interval between fires in dry sclerophyll forests (sclerophyll means 'hard leaves'—referring to the small, tough evergreen leaves) being as short as three years, while fires in Mountain Ash forests on the mainland had an average fire interval of 100 years. The average fire interval for temperate rainforests in Tasmania may have been 300 years.[8]

With the coming of Europeans the fire regimes changed as European fire practices developed by trial and error and with different aims depending upon the user of the fire:

> The fire practices of the grazier did not synchronise with those of the farmer, and both challenged the fire expectations of the forester. The miner burned everyone's lands indiscriminately. The urbanite understood only the terror of the bushfire. Each of these groups so evolved, moreover, that practices suitable for one time and place were unacceptable at a later time.[9]

Fire Regime Development

While the farmer and grazier used fire to clear bush, burn off old grass or reduce the fire hazard on the farm, the development we now refer to as hazard or fuel reduction burning evolved in the twentieth century with the practices of forest managers who were trying to protect native forests from wildfires that damaged the quality of their forests as sources of

timber. The foresters found that protecting the forests by excluding fire was a recipe for catastrophic fires, so they developed a regime for regularly using low intensity fires to reduce the fuel loads in the understorey of the forests. This practice was started in the 1920s in the jarrah forests of southwest Western Australia as part of a fire protection system[10] where prior to European settlement there was an average interval between fires of 3.4 years.[11] Subsequently the use of aerial ignition for fuel reduction burns to create mosaics of burned forests developed in State Forests across the country[12]. Such burning regimes varied with regions; it is not possible to carry out fuel reduction burning in some forests, notably wet sclerophyll forests or rainforests, except in the karri forests of southwest Western Australia.

The use of fuel reduction burning regimes is now well embedded as part of fire protection systems throughout Australia. It is used in forests managed by government authorities such as forestry agencies, conservation bodies, local councils, as well as by private property owners.

Bushfires

Fire regimes vary in different parts of Australia due to climate and vegetation type. The fire intensities depend upon weather and fuel load. The rate of spread of a fire is affected by a variety of issues including wind speed, moisture content of the fuel, fuel particle size, vegetation height, fuel bulk density, percentage of dead fuels, and topography.[13] The amount of fuel determines the amount of heat that may be released in a fire but the rate at which that heat is released is determined by properties of the fuel, weather, wind direction and topography.[14] The McArthur forest and grassland meters have been developed to predict fire spread rate in eastern Australia while Forest Fire Behaviour Tables were developed for conditions in Western Australia. Such prediction equations have their limitations in that they are fuel-type specific.[15] However such predictors of fire spread are being upgraded with increased knowledge.

Fire intensities vary and are the product of the heat yield of the fuel, the amount of fuel per unit area and the rate of spread of the fire. A 'low' intensity fire would produce less than 350 kilowatts per metre (kW/m) of fire edge, 'high' would be 350–3500 kW/m, 'very high' would be 3500 – 35 000 kW/m, and 'extreme' would be greater than 35 000 kW/m.[16] There is a great variation of a fire's impact on the forest, depending upon the intensity. Whereas a low intensity fire may only scorch the leaves of the lower forest crown, higher intensity fires will completely defoliate the entire crown of the forest.[17] The effects of a fire are only partially related to fire intensity. A fast moving grass fire in a forest, which is as intense as a slower moving fire burning dense shrub understorey, will not have the same impact on the forest overstorey because of a lower total heat load from the fire.[18]

As mentioned above, topography is a significant component, along with wind speed, direction and fuel dryness, of the rate of spread of a fire. The rate of spread of a fire will double with every ten degrees of increase in the slope.[19] This has implications for the

movement of fires in heavily bisected country as occurs in the Sydney region where fires can quickly run up from gullies to engulf houses at the top of the plateau. This poses a different sort of risk compared with forests growing in the more gentle topography that is found for example in the southwest of Western Australia.

It is also possible that 'spotting' from a fire, where flaming bark and twigs are thrown into the air and ignite fires ahead of the fire front, may increase a fire's spread rate and affect the fire suppression efforts. However the main influence of spotting is to overcome the discontinuities of fuel and topography. Fuel reduction burning can reduce the hazard of spotting from eucalypt bark, in some cases for up to seven to ten years.[20]

Complexities of Fuel and Fire

As mentioned above the amount of the available fuel determines the amount of heat that potentially can be released in a fire. Therefore fuel loading in a forest is the only component of the mix that can be modified by land managers. This is the rationale behind the use of fuel reduction regime in forests to protect life and property. However not all the plant material in a forest is potential fuel for a fire under normal circumstances. Also the amount of fuel consumed in a fire increases with increasing intensity, assuming the fuel is dry. While medium to high intensity fires will burn young trees, thick twigs and branches, bark and deep litter, low intensity fires will only burn dead fuels below six millimetres in diameter.[21]

However the size of the fuel component consumed depends on the moisture levels. In extremely dry conditions even low intensity burns can consume all the fuel on the forest floor and damage forest trees. This is the reason that fuel reduction burns need to be carried out under conditions when the lower layers of the litter bed are moist so the low intensity fire only burns the smaller diameter fuels on the forest floor.[22]

Eucalypts shed a great deal of material, leaves, bark and branches, which supplies the bulk of fuel in dry and wet sclerophyll forests. While live shrubby fuels of less than four millimetres in diameter contribute four tonnes per hectare (t/ha) in Jarrah forests, the dead bark on the tree trunks may add another 10 t/ha.[23] Fuel accumulates increasing with time since the last fire until it reaches some sort of equilibrium quantity. For example in tall shrub land it will take 20 years to reach the maximum fuel potential.[24] Ranges of accumulation of such quasi-equilibrium fuel levels vary between 11 and 24 t/ha while those in the wet forests in WA reach equilibrium levels at around 35 t/ha.[25] It should be noted that research has found that doubling the fuel in the forest will double the rate of spread and quadruple the fire intensity.[26]

The quantity of fuel on the forest floor and in any vegetation layer below the eucalypt overstorey or crown is essential to determining whether the fire will burn into the upper levels of the forest. Dr Phil Cheney of the CSIRO told the New South Wales Bushfires Inquiry that:

> In stratified fuel types, such as forest fuels, some fuel strata burn in the flame front when they are preheated by convention from fire in fuels below them. Thus as the weather conditions worsen, and fire intensity increases, increasingly elevated layers of fine fuels eventually including the tree crowns will be involved in the flame front … Independent crown fires do not occur in tall eucalypt forests Luke (1961), Luke and McArthur (1978) because fire in the crown alone cannot preheat adjacent crowns by convection and lateral heat transfer by radiation is insufficient to maintain combustion.[27]

Fuel reduction burning is the principal means to manage the risks of bushfire but the New South Wales Parliamentary Bushfire Inquiry Report noted that under extreme conditions bushfires will burn across land with very low fuel loads, which would have be halted under milder conditions and the effects of fuel on fire behaviour will differ depending on the type and structure of the vegetation, fuel arrangements and moisture, and the type of terrain.[28]

In discussing the relationship between fuels and fire behaviour Dr Cheney told the Inquiry that:

> In terms of rate of spread, the important fuel factors are those that affect the flame length and the rate of ignition. These include fuel fineness, the bulk density of the fuel bed—which is a combination of the total fuel load and the height of the fuel bed—the continuity or spacing of fuels, particularly if they are clumped as are many natural fuels, and the fraction of dead and green material within the fuel bed.[29]

He indicated that these factors are difficult to measure so that in the past available fuel load (fuels below six millimetres in diameter) was used as a measure. The CSIRO is currently working on a numerical index to replace fuel load in order to give a better predictor of fire spread.

Prescribed Burning Regimes

Fuel reduction burning is carried out by a variety of land managers on both public and private land. The requirements and aims of each of these burning regimes will be different depending on what priorities the land manager has. This has led to significant differences in the frequency and quantity of fuel reduction burning that is carried out. As a result there are calls from different sections of the community that a particular land management agency is carrying out too much or too little burning. The debate surrounding the fuel reduction burning issue sometimes results in simplistic solutions being put forward to deal with a complex problem.

The following statement by the New South Wales National Parks and Wildlife Service (NPWS) indicates the fundamental issues of concern in developing and implementing a fuel reduction program:

> Our objectives in relation to fire management are **first and foremost** the protection of life, property and community assets. We also have objectives in relation to the

> maintenance and enhancement of biodiversity and the protection of cultural heritage which influence our approach to fire management.[30]

This shows that fundamentally fuel reduction burning comes down to protection of life and property but that other priorities of the land manager (whether government or private) may influence how that aim is implemented. Unfortunately it is those other priorities that cause the debate that there is too much or too little burning carried out.

It should be noted that fuel reduction burning is part of a fire management program that also includes fire prevention activities, other forms of hazard control such as maintenance of fire trails and fire breaks, and fire suppression activities. All these activities are essential.

Effectiveness of Fuel Reduction Burns

There are two points to note in relation to the effectiveness of fuel reduction burning. Does the burning actually reduce the fuel in the forest to the desired levels and will the reduction in fuel levels achieve the aim of being able to control bushfires. Fuel reduction burns will not necessarily halt the spread of bushfires.

While it is intended that fuel reduction burns will be successful in reducing fuel levels with the minimum of damage to the forest, this is not always the case. Post burn assessments of the effectiveness of prescribed burns in the Blue Mountains in the period 1990–97 found that 30 per cent of the burns had a negative result, 40 per cent were sub-optimal, and 30 per cent could be rated as effective burns.[31] The negative results occurred when there was more "creation of fuel" than reduction of fuel, with "creation" of fuel being the fire's curing of fuels rather than consumption of them. The conclusions of the study stated:

> The results indicate that the City of Blue Mountains is not an optimal area for prescribed burning to be a successful strategy: the climate of a large proportion of the dissected tilted plateau is not conducive to the achievement of effective burns. The climatic window of opportunity—outside the declared bushfire danger season—seems to be quite narrow for successful burning. …While the majority of burns were quite effective in removing understorey fuels below 0.5 metres in height, in most cases shrubs above this height tended to be cured rather than consumed.[32]

The above study indicates that fuel reduction burning may not be as successful as desired in some forest localities so this needs to be taken into consideration with any fire risk management assessment.

The effectiveness of fuel reduction burning is related to the fire lighting pattern and there is a need to train people to carry this out using the most efficient techniques. Dr Cheney of CSIRO is of the opinion that prescribed burning in New South Wales will not be successful until organisations approach the problem in a truly professional manner using

burning guides for specific vegetation types and a professional team to implement the burning in a planned and systematic manner with highly trained staff.[33]

Fuel reduction burns may not halt bushfires under severe conditions. However, they do have some moderating effect on the fire and allow for control when conditions improve. In order to put fuel reduction in context with fire fighting under extreme conditions, John Fisher of New South Wales State Forests told the New South Wales Bushfires Inquiry that:

> The opponents of fuel reduction burning fail to realise the operational difficulty of fighting a wildfire in extreme conditions. The only option or tool that State Forests NSW has available is the manipulation of fuel in the fire triangle (heat/ignition, air, fuel) … There is no question that on extreme fire days we would not attempt a direct attack in heavy fuels. Even in a fuel reduced area on extreme days there is no question that fires would burn through those fuels as well, but the moderating effect of that fuel reduction activity is quite profound and is quite useful in the periods of the day when those extreme fire behaviours wane. We use that through the nightshift to effect further fuel reduction burnings or back-burns, as you have seen, and that provides us with a safe and effective means to control fires on our estate.[34]

Opportunity to Carry Out Fuel Reduction Burning

There are a number of factors which decide the timing of fuel reduction burning, the weather being the most significant one. Fuel loads need to be dry enough to effectively carry out hazard reduction burning without the conditions being so severe that the burn risks getting out of control. Fuel reduction burning normally takes place in spring and autumn. In Western Australia most of the burning is carried out in spring while in NSW it occurs in autumn. There is normally an opportunity for a fuel reduction burning program to be carried out if the land manager has allocated adequate planning and resources to the program.

John Fisher of New South Wales State Forests told the Inquiry how the fuel reduction burns carried out in autumn produce a favourable result:

> Our aim with fuel reduction burning is to burn a proportion of the landscape during autumn when fuel moisture levels are sufficiently high, and sensitive environments, particularly rainforest gullies, stream sides, buffers et cetera that are sensitive to fire, are not impacted by fuel reduction burning. That allows us to constrain fuel reduction burning in that period of time to the areas that are short-term fire-dependent ecosystems—blackbutt ridges, et cetera. That breaks up the fuels in the landscape and allows an effective suppression effort. Our research demonstrates that this has been quite effective.[35]

Environmental Effects

Burning regimes, including total exclusion of fire, will have a significant impact on the species composition of a forest ecosystem. While no species of sclerophyllous vegetation

has been made extinct as a direct result of burning, some plant species have been eliminated from local areas due to frequent burning,[36] whether by wildfire or prescribed burning (or both). Frequent low intensity burning will alter the composition of the understorey plant species in dry sclerophyll forests even if no species is lost. Some plant species require a high intensity fire to regenerate.

Fuel reduction burning on a regular basis will alter the vegetation and affect the animals living there. Studies have shown that frequent controlled burns will adversely affect birds which favour shrubby undergrowth (Golden Whistler) or dense leaf litter (Red-Winged Fairy-wren, Pilot-bird) and where that burning opens up the vegetation, will favour birds that require a relatively open understorey.[37]

While specific fire regimes carried out by conservation authorities may entail regular burning to facilitate conservation of specific species or ecological communities, fuel reduction burning regimes are aimed at reducing fuel levels and not at maximising or maintaining biodiversity. Such regimes can have significant effects on the continued survival of plant species in an area.[38]

Avoiding the implementation of any sort of a fuel reduction burning regime so that 'natural' ecosystems can be maintained (except where such regimes are inadvisable, e.g. rainforest) is not really an option except possibly in remote areas. The fact that many significant conservation reserves are relatively close to settled areas necessitates action by conservation authorities to minimise potential fire risk to life and property.[39] However, fire regimes, especially in conservation regimes, need not be uniform across habitats and it has been suggested that:

> Across temperate Australia, creating a uniform habitat can be avoided by mosaic burning with a range of fire regimes, with protection of long unburnt areas and ensuring provision of such areas. The scale and pattern of burning needs to be adjusted to the area of vegetation within each habitat type, the extent of isolation and the habitat requirements of target species or communities. Such management has been recommended across a range of Australian environments, often with an emphasis on threatened species.[40]

The problem with such a scheme is that it needs to be properly funded and the nature conservation agencies have not to date allocated sufficient funds to carry out such a fire regime.

Some scientists believe that burning forests too often poses a serious threat to biodiversity and that their cumulative effect may be as profound as high intensity fires.[41] In evidence to the Bushfire Inquiry, Professor Rob Whelan made the statement that he was surprised at the emphasis given to frequent hazard reduction burning and that it implied a pretence that the bushfire problem was a simple one that could be met with a simple solution, frequent hazard reduction burning. He told the Inquiry that fire ecology researchers have accepted

that frequent broad scale burning of forests, whether by fuel reduction burns or bushfires, had detrimental impacts on biodiversity conservation.[42]

However other scientists have argued that this may be based on false perceptions of widespread frequent and uniform burning. They argue that prescribed fires will be patchy in coverage with different environments having different frequencies of low intensities from annual to never.[43] Low intensity fires will not consistently burn gullies. While NSW State Forests aim to achieve up to 60 per cent coverage of gross burning area, in some years this may average down to 20 per cent.[44]

The New South Wales Parliamentary Bushfire Inquiry Report referred to the lack of relevant scientific research on the impact of hazard reduction burning. It cited the State Forests submission saying that it was not valid to extrapolate the findings of research on flora and fauna life cycle analysis and responses to fire *in general,* to the impact of fuel reduction burning.[45]

Escapes of Burns

Any fuel reduction burning operation runs the risk of escaping control and causing a bushfire. This is why fuel moisture, weather conditions, control lines and ignition points must be carefully considered. Such escapes can and do occur under the supervision of both government and private land managers and can cause significant environmental and economic damage. In April 2002 10 000 ha of Wyperfeld National Park were damaged when a controlled burn escaped the containment lines of the Victorian Department of Natural Resources and Environment.[46]

However the actual percentage of escapes of fuel reduction burns may be quite small, for example the escapes of wildfires caused by escapes from burns implemented under the supervision of the Western Australia Department of Conservation and Land Management (CALM) was 7.5 per cent in 1989–90, six per cent in 1990–91, five per cent in 1991–92 and three per cent in 1992–93.[47]

Where People Live—Prescribed Burns and Blackened Bush

More and more suburban housing is expanding into bushland settings and there is a need to protect these buildings and their inhabitants from bushfires. However, having native vegetation close to houses makes it difficult to protect. CSIRO scientist Dr Cheney said that if your house is 200 metres from the fire edge you have two per cent chance of your house being caught alight and thinks that 100 metres between housing and the bush is a safe margin. This safe distance increases with slope because fire speed doubles with every 10 degrees increase in slope.[48] In talking about the effectiveness of fuel reduction burning he said:

> For the first 18 months to two years [after hazard reduction] the fire will stop on a prescribed burn. After two years it will continue to burn through it, but it will burn at a

> lower and manageable intensity, and as the years go by the intensity builds up as the fuel builds up. Prescribed burning is not designed to stop fires. It is designed to reduce their intensity, so the impacts are lower and you have a sporting chance of suppressing it, even under extreme conditions.[49]

New South Wales NPWS fire ecologist, Ross Bradstock, said that to protect Sydney housing:

> We have worked out you have to burn 20 per cent of the landscape per annum to significantly reduce the size of wildfires, fires under severe weather.[50]

The magnitude of such a burning program around Australian cities such as Sydney is immense if the aim is to significantly reduce the bushfire potential in circumstances such as those of December 2001 – January 2002. The following factors would need to be considered in such a burning program. The Warringah Pittwater Bush Fire Management Committee's Bush Fire Risk Management Plan covers land managed by the National Parks and Wildlife Service, Council Reserves and Community Land, Vacant Crown Land and Crown Reserves and private property. Under this plan there are a number of matters to consider when proposing a fuel reduction burning regime:

- any environmental assessment requirements that must be carried out prior the burning
- use of appropriate fire regimes which mean that fire should be excluded from mangroves and rainforests, fire frequency should not exceed two fires in 25 years in tall open forests, fire frequency should not exceed two fires in quick succession each five years or greater than 30 years, and fire frequency should not exceed two fires in quick succession each eight years, three fires in quick succession each fifteen to thirty years or be greater than thirty years in tall shrubland/heathland
- smoke management to ensure that smoke from burns does not contribute to hazardous levels of particulate air pollution in the Sydney area or that smoke drift is minimised into smoke sensitive areas such as roads and/or settlements
- catchment protection so as to protect soil and water values to ensure that riparian vegetation cover is maintained which can be effective soil and ash traps after bushfires
- pest and weed management where weed spread can be facilitated by fire, and
- protected lands (lands on slopes steeper than 18 degrees or with 20 metres of specified rivers, creeks and lakes) need to have their vegetation cover protected to protect soil and water quality.[51]

The above list shows the complexity of deciding how, when and where to carry out a program of fuel reduction burning where the aims are to protect life, property and the environment within the area and also to protect, maintain and where possible enhance the

natural and cultural values of the area through the management of appropriate fire regimes.[52]

The issue of air pollution from smoke of fuel reduction burns increasing pollution levels in urban areas is a significant limiting factor on when such burns can be carried out. In 1995 smoke from the largest controlled burn in more than 10 years driven by southerly winds caused pollution levels to reach extremely high levels comparable to that endured during the 1994 bushfires.[53] Private property owners require a permit for bush fire reduction burning and this would be automatically suspended where a No Burn Day is declared by the NSW Environment Protection Authority.[54]

The fundamental issue in carrying out fuel reduction burning close to urban areas is that many of the inhabitants prefer living in green leafy bushland. Burning can be unpleasant, reduce amenity, kill plants and wildlife, and cause pollution so there is a build-up political resistance to increasing the frequencies and proximity of the burns. Obviously after severe bushfires such resistance will diminish but will then increase over time from the last bushfire. Most summers are not severe bushfire seasons, for example in New South Wales approximately 40 per cent of fire seasons are mild, 40 per cent are moderate and 20 per cent are serious.[55] It is essential that research is carried out to show the efficacy of the frequency and extent of a burning regime as well as its environmental impact in specific forest types in different regions.

What Frequency for Fuel Reduction Burning

Pyne cited estimations by McArthur in the 1960s of the extent that prescribed burning should be practised in the States in the forests of southern Australia:

> Granted a five year rotation, he estimated that New South Wales could get by with perhaps five per cent of its protected forests burned annually, Victoria with probably 6–7 per cent, and Western Australia with 10–25 per cent; he implied that Tasmania might need as little as 1–2 per cent. Converting these annual quantities to the total forest fraction burned during the whole cycle, he put the figure at 25 per cent for New South Wales, 33 per cent for Victoria, 50–100 per cent for Western Australia, and perhaps 5–10 per cent for Tasmania. Thus he thought it 'unlikely, and perhaps highly undesirable, that prescribed burning in eastern Australia should ever approach the scale practised in the dry jarrah forests of Western Australia'.[56]

These estimates are just that, estimates, and they were made forty years ago. They also relate to State forests rather than conservation reserves or forested private or crown land which may have different priorities for frequency of burning, property protection or conservation and biodiversity aims. In Western Australia fuel reduction burning policy is for burning to be carried out at 3–6 year intervals in drier forests and 7–9 year intervals in wetter forests so that approximately 70 per cent of State forest is rotationally burnt.[57]

Map: Major Public Lands in the Sydney Region

Source: Map derived from base maps produced by the NSW National Parks and Wildlife Service
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Are Government Bodies Carrying Out Enough Fuel Reduction Burns?

The question of frequency of fuel reduction burning was discussed in the New South Wales Parliamentary Bushfires Inquiry Report where evidence was given that State Forests carried out annual hazard reduction burning in about four per cent of its tenure area while the figure for the National Parks Service and Wildlife Service was about one per cent.[58] Part of the reason for this disparity could be that State Forests has a financial interest in protecting the wood values in its standing crop while the National Parks and Wildlife Service is more concerned about protecting biodiversity.

The New South Wales NPWS manages seven per cent of the State and four per cent of the fires start in national parks. In the past five years less than 10 per cent of fires that started in the national parks escaped the park while 20 per cent of the fires in national parks start in private property or other lands.[59] The Director-General of NPWS stated that NPWS is committed to hazard reduction but does not tick off quotas for burning and it is not feasible to burn all parkland adjacent to private property because of the danger involved. Intense fires such as happened in Como and Jannali only needed 10 metres of unburnt fuel to destroy properties. He cited examples where hazard reduction burns were useful in giving firefighters time to save houses (Tarabaga Ridge in the Blue Mountains National Park) and another example where they made little difference (at Warragamba Dam.)[60] (see Map)

The New South Wales NPWS was only able to carry out six days of fuel reduction burning prior to the 2001–02 bushfires because of weather conditions.[61] As mentioned earlier such problems with carrying out the burning program should be planned for to ensure necessary strategic burning is completed, since the burning program is carried out every year. Therefore the question arises: what priority is given by individual departments responsible for land management to ensuring that adequate time and resources are allocated to the burning program? NPWS has spent $9 million since 1994 on upgrading and buying fire management equipment.[62] How much was spent over that time on its fuel reduction burning program? Dr Cheney commented to the Inquiry that land management agencies must be adequately funded to do both their own fire protection and their own fuel management.[63]

It is quite likely that State Forests gives a higher priority to the burning program than does NPWS because it specifically burns to meet its management objective to protect its timber assets.[64] It should be noted that fuel reduction burning is but one method of hazard reduction employed by State Forests and the area grazed for hazard reduction is six times the area burned on an annual basis.[65]

However both authorities take a strategic approach to fuel reduction burning. Appearing before the Bushfire Committee, Dr Tony Fleming of New South Wales NPWS stated that:

> When we talk about strategic hazard reduction burning, we really are talking about focusing our attention on the assets that we need to protect, recognising that that must be

> our primary responsibility, and ensuring that our hazard reduction burning and other forms of activity are focused on achieving the protection of those areas … we have done about 22,000 hectares of hazard reduction activity within this (Southern) directorate over the past four years. Our program for this year is still under way. We do that in conjunction with various other forms of hazard control, such as slashing and maintenance of cleared fire trails and fire breaks in certain areas.[66]

Comment

There is no simple answer to the issue of fuel reduction burning because of the diversity of forests, topography and climates in southern Australia as well as the different priorities that different land managers have in developing specific burning regimes.

While the first priority in any fuel reduction program is to protect life and property, it is the other priorities that land managers have, such as biodiversity protection or protection of wood values, that will probably ultimately determine the size and frequency of the program. Therefore it needs to be considered whether or not sufficient priority is being given to strategic burning to protect housing located near the relevant land manager's boundaries. The Bushfire Inquiry Report did not refer to this specific issue but concentrated on whether fuel reduction burning was being done and at what frequency. This was a major defect in the report. It is absolutely essential that all land managers (public and private) are obliged to design and implement their fuel reduction programs to protect life and property within and beyond their land boundaries.

In order for fuel reduction burning programs to be effective they need to be designed to be applied to specific vegetation types and implemented by properly trained and resourced staff. Proper assessment of these burns need to be carried out to show whether the results meet the objectives of the program.

While it is difficult to carry out fuel reduction burning because of the need to burn in optimal conditions, this should not be used as an excuse not to burn. Burning regimes are planned in advance with the knowledge that some fuel reduction burns may not proceed due to poor weather. Therefore the difficulties in carrying out fuel reduction burning because of the need to burn in optimal conditions should not be used as an excuse not to burn. There is normally an opportunity for a fuel reduction burning program to be carried out if the land manager has allocated adequate planning and resources to the program.

Is it possible that lack of resources, or resource allocation priorities, limit the scope of fuel reduction burns by land managers such as nature conservation agencies rather than the weather? Other land management agencies, such as forestry authorities, with a financial interest in protecting their wood resources assets, manage to carry out a significantly larger burning program.

The topography of the Sydney region makes the potential fire hazard far greater than for some other urban areas. Fuel reduction burning in such areas is also far more difficult and

may prove less effective. It is unlikely that a fuel reduction burning regime of 20 per cent of the region, as suggested as necessary by one researcher, could be implemented noting the issues that must be considered for such burning in an urban area. Therefore answers to addressing the fire risk for this region need to be dealt with in a variety of ways, such as planning regimes and firefighting capacity, in addition to fuel reduction burning.

Lastly, there needs to be more specific research on the impact of fuel reduction burning on biodiversity conservation in different forest types and regions so that burning regimes can be developed which protect life and property and minimise their impact on fauna and flora on and off nature conservation reserves.

Appendix 1. New South Wales Parliament Joint Select Committee on Bushfires Report on the Inquiry into the 2001–02 Bushfires: Recommendations that Relate to Aspects of Hazard Reduction Burning[67]

1.2 Recommendations—Hazard Reduction.

1. That all public and private owners and/or managers of land in bushfire prone areas of New South Wales are made aware of their responsibilities to protect their own and neighbouring properties from bushfire through active implementation of appropriate hazard reduction regimes and the application of appropriate standards in building construction and maintenance.

2. That by 30 March 2003, all state land management agencies should prepare schedules, identifying those areas within their tenures where hazard reduction activity has been planned but postponed in the previous 36 months.

3. That all state land management agencies apply the necessary resources to ensure that their annual planned programs of hazard reduction are achieved in each reserve OR, where planned hazard reduction by means of controlled burning is postponed more than twice in any reporting year, that contingency/catch-up plans are developed and implemented within a reasonable time-frame to be negotiated with the appropriate Bushfire Management Planning Committee.

4. That the Bushfire Coordinating Committee should develop a Statewide communications strategy to generate and disseminate educational and information materials about the bushfire management process for the general public and for all stakeholders involved in bushfire management. The strategy should accommodate specialised information activities related to bushfire management undertaken by individual land management agencies in NSW.

5. That the National Parks and Wildlife Service should develop and implement a Statewide strategy for community information, education and engagement in regard to the responsible management of parks and reserves, including the training of key personnel in large group facilitation and consultation.

6. That the NSW Rural Fire Service should offer assistance to local government bodies to assist in catch up activities, such as mapping and hazard reduction. Where individual councils seek to apply a levy to undertake such work, the Department of Local Government should give such applications sympathetic consideration.

7. That implementation of the Government's strategy to streamline the approval process for hazard reduction be evaluated by December 2003 by a review panel convened by the Commissioner of the NSW Rural Fire Service. The review panel membership is to include (but is not limited to) representatives of volunteer fire fighters, private land holders, local government representatives and other Government stakeholders.

8. That the reporting procedures by all land managers for the implementation of hazard reduction be standardised and adopted by the Bushfire Coordination Committee.

9. That performance audits of implementation of Bushfire Risk Management Plans be undertaken by the Commissioner of the NSW Rural Fire Service in accordance with a Strategic Audit Plan to be approved by the Minister for Emergency Services.

10. That consistent with the emphasis on coordinated bushfire fighting, there be ongoing cooperation between the planning and operational arms of the land management agencies and the firefighting authorities in the implementation of hazard reduction plans as well as in firefighting activities.

11. That all developments approved in fire prone areas from the date of proclamation of the Rural Fires and Environmental Assessment Legislation Amendment Bill 2002, should make provision for a property protection zone within the area of the proposed development in accordance with the planning guidelines in the *Planning for Bushfire Protection* booklet.

12. That land management agencies, including National Parks and Wildlife Service, State Forests and Department of Land and Water Conservation, develop Village Protection Strategies as part of their Bushfire Management Plans for all settlements adjacent to their lands.

13. That the Minister for the Environment, in appointing community members to NPWS parks advisory committees, consider amending the criteria for community membership to ensure that each committee has a member with firefighting knowledge and experience.

2.2 Recommendations—Biodiversity

1. the New South Wales Government endorse the zoning approach involving Asset Protection Zones, Wildfire Strategic Advantage Zones and Heritage Management Zones, as defined in Bushfire Risk Management Plans and Reserve Fire Management Planning, for bushfire hazard reduction.

3.6 Recommendations—Responsibilities of Property Owners

4. The committee recommends that the NSW Rural Fire Service prepare and distribute information about the statutory requirements of the hazard reduction approval process and potential legal and liability issues for individual land owners in the conduct of hazard reduction burning on their own property.

5. The committee recommends that the legal responsibility of owners and occupiers for any loss or injury arising out of those persons performing hazard reduction in accordance with the Rural Fires Act be referred to the Crown Solicitor for advice. The extent of the cover provided by the usual house and contents policy of insurance for this type of loss or injury should be investigated.

6. The committee recommends that the NSW Rural Fire Service examine and report to the Minister upon the availability of members of the NSW Rural Fire Service or other protected persons, including officers of local councils, to carry out hazard reduction work on behalf of owners and occupiers so as to afford them the protection contained in s.128 of the *Rural Fires Act 1997* or s.731 of the *Local Government Act 199*3.

4.4 Recommendations—Training

2. That all active firefighters be encouraged to participate in hazard reduction burning exercises in order to obtain practical experience in fire behaviour.

Endnotes

1. Stewart Smith, *Bushfires,* Briefing Paper 5/2002, New South Wales Parliamentary Library, 2002.
2. Joint Select Committee on Bushfire 2002, *Report on Inquiry into 2001/2002 Bushfires,* Legislative Assembly, Sydney NSW, June 2002.
3. S. J. Pyne, *Burning Bush: A Fire History of Australia,* Allen and Unwin, North Sydney, 1991, p. 16 .
4. ibid.
5. ibid., p. 93
6. P. Latz, *Bushfires and Bushtucker: Aboriginal Plant Use in Central Australia,* IAD Press, Alice Springs, 1995, p. 31
7. ibid., p. 101
8. A. M. Gill and P. C. Catling, 'Fire regimes and biodiversity of forested landscapes of southern Australia' in *Flammable Australia: The Fire Regimes and Biodiversity of a Continent,* eds, R. A. Bradstock, J. E. Williams, and A. M. Gill, Cambridge University Press, Cambridge, 2002, pp. 351–69.
9. S. J. Pyne, op. cit., p. 185
10. ibid.
11. M. C. Gill and P. C. Catling, loc. cit.
12. S. J. Pyne, op. cit.
13. W. Catchpole, 'Fire properties and burn patterns in heterogeneous landscapes' in *Flammable Australia: The Fire Regimes and Biodiversity of a Continent,* eds, R. A. Bradstock, J .E. Williams and A. M. Gill, Cambridge University Press, Cambridge, 2002, pp. 49–75.
14. A. M. Gill and P. C. Catling, loc. cit.
15. W. Catchpole, loc. cit.
16. A. M. Gill and P. C. Catling, loc. cit.
17. ibid.
18. W. Catchpole, loc. cit.
19. A. M. Gill and P. C. Catling, loc. cit.
20. P. Cheney, 'The Effectiveness of Fuel Reduction Burning for Fire Management' in *Fire and Biodiversity: The Effects and Effectiveness of Fire Management,* Proceedings of a Conference

held 8–9 October 1994, Footscray, Melbourne, published as Biodiversity Series, Paper No 8 Biodiversity Unit, Department of Environment, Sport and Territories, Canberra, 1996, pp. 9–15.

21. W. Catchpole, loc. cit.
22. Dr Phil Cheney. December 2002 Personal Communication
23. A. M. Gill and P. C. Catling, loc. cit.
24. Joint Select Committee on Bushfire 2002, op. cit., p. 48.
25. ibid.
26. S. J. Pyne, op. cit. p. 354.
27. P. Cheney, loc. cit.
28. Joint Select Committee on Bushfire 2002, op. cit. p. 47.
29. ibid.
30. A. Fleming, Transcript of 22 April 2002, Joint Select Committee on Bushfire 2002, op. cit., p. 12 .
31. S. G. James, *Evaluation of the effectiveness of prescribed burns: a simple methodology for post-burn assessment of the achievement of fire management objectives,* Australian Bushfire Conference, Albury, July 1999.
32. ibid.
33. Dr Phil Cheney. December 2002 Personal Communication
34. J. Fisher, Transcript of 3 June 2002, Joint Select Committee on Bushfire 2002, op. cit., pp. 5–6.
35. J. Fisher, loc. cit., p. 5.
36. K. Tolhurst, 'Effects of fuel reduction burning on flora in a dry sclerophyll forest' in *Fire and Biodiversity: The Effects and Effectiveness of Fire Management,* Proceedings of a Conference held 8–9 October 1994, Footscray, Melbourne, published as Biodiversity Series, Paper No 8 Biodiversity Unit, Department of Environment, Sport and Territories, Canberra, 1996, pp. 97–107.
37. J. C. Z. Woinarski and H. F. Recher, 'Impact and response: a review of the effects of fire on the Australian avifauna' in *Pacific Conservation Biology,* vol. 3, 1997, pp. 183–205.
38. C. Tran and C. Wild, *The Review of Current Knowledge and Literature to Assist in Determining Ecologically Sustainable Fire Regimes for the South East Queensland Region,* Griffith University and the Fire and Biodiversity Consortium, August 2000.
39. ibid.
40. J. C. Z. Woinarski and H. F. Recher, loc. cit.
41. E. M. Tasker, 'Australia wrestles with fires control', *Australian Geographic News,* 11 November 2002.

42. Joint Select Committee on Bushfire 2002, op. cit., p. 51.
43. V. Jurskis, *Fire management for conservation: reconciling theory and practice* in Proceedings Bushfire 2001, Australasian Bushfire Conference, Christchurch 3–6 July 2001, pp. 190–4.
44. ibid.
45. Joint Select Committee on Bushfire 2002, op. cit., p. 53.
46. AAP, *Bushfire damages 10,000 ha of national park,* AAP Story No 3238, 11 April 2002.
47. R. Sneeuwjagt, 'Fighting Fire with Fire' in *Government Risk Management,* Issue No 4, December 2001.
48. A. Wahlquist, *Living with the natural enemy* in The Weekend Australian, 5 January 2002
49. ibid.
50. ibid.
51. Warringah Pittwater Bush Fire Management Committee, *Warringah Pittwater Bush Fire Management Committee Bush Fire Risk Management Plan,* Approved Draft, 30 September 1999.
52. ibid.
53. D. Lewis, 'EPA bans controlled burn-off after air pollution goes sky-high'*, The Sydney Morning Herald*, 8 November 1995.
54. Warringah Pittwater Bush Fire Management Committee, op. cit.
55. S. J. Pyne, op. cit., p. 277.
56. S. J. Pyne, op. cit., p. 354.
57. J. C. Z. Woinarski and H. F. Recher, loc. cit.
58. Joint Select Committee on Bushfire 2002, op. cit., p. 42.
59. B. Gilligan, 'Shared Responsibility' in *The Land*, 24 January 2002, p. 11.
60. ibid.
61. ibid.
62. B. Gilligan, loc. cit.
63. P. Cheney, Transcript of 3 June 2002, Joint Select Committee on Bushfire 2002, op. cit., p. 7.
64. Joint Select Committee on Bushfire 2002, op. cit., p. 41.
65. ibid.
66. A. Fleming, op. cit., p. 18.
67. Joint Select Committee on Bushfire 2002, op. cit.