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representing private forest growers

Australian Forest Growers
ABN 39 000 694 904

29 July 2009

The Secretary
Senate Select Committee on Agricultural and Related Industries
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Parliament House
CANBERRA ACT 2600

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SUBMISSION TO INQUIRY INTO BUSHFIRES IN AUSTRALIA

INTRODUCTION

Australian Forest Growers (AFG) is the national association representing around 1200 small private forest growers from 22 regional branches across Australia's forest growing regions. AFG is the only national organisation representing and promoting the interests of private commercial forestry and farm tree growers. Members of the association include small-scale tree growers with only a few trees to some of the largest private growers in Australia as well as forestry service providers. Since the 1997 inception of *Plantations for Australia: the 2020 Vision* the sectors that are represented by AFG have been responsible for some 85% of the expansion in the Australian plantation estate. There are also several million hectares of private native forestry in Australia, whose owners' interests in forestry are represented by AFG. Thus, AFG represents landholders with very substantial assets, in the form of plantations and private native forests. These assets are vulnerable to fire and to decisions made by government agencies and others.

AFG provides, through insurance partners, a plantation insurance scheme. This scheme has a close relationship with major plantation insurers operating in Australia. AFG maintains a watching brief over plantation fire losses in Australia, and therefore has an excellent understanding of factors affecting fire risk and loss.

AFG publishes a quarterly magazine for its members 'Australian Forest Grower'. Each year one edition focuses members' attention on the coming fire season with relevant articles about fire preparedness, fire suppression techniques, fire research findings and equipment updates. The 2009 Autumn issue of Australian Forest Grower has a Special Liftout by Phil Cheney (Honorary Research Fellow with CSIRO and former Project Leader of the CSIRO Bushfire Research Group) titled "Taking responsibility for fire suppression and fuel management". A copy is attached to this submission (Attachment B).

BACKGROUND: FIRE MANAGEMENT IN AUSTRALIA

Bushfires are a natural part of the Australian environment, and a major theme in Australian history. Aboriginal people use fire as a legitimate land management technique, and have done so for thousands of years. Fire management in Australia has been characterised in the past decade or more by disputes regarding the impacts of

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prescribed burning on ecosystems, including whether burning equates to vegetation clearance (as it does under South Australian native vegetation laws). This dispute has resulted in an increasingly cautious approach towards active fire management, particularly on the part of the government agencies responsible for management of the public estate. The consequence of a lack of prescribed burning is a build-up of fuel loads to levels which often make it impossible to manage a fire, even under relatively mild conditions.

When high fuel loads combine with Australia's often hot, dry, low humidity and windy summer conditions a lethal combination is created.

The devastating impact on ecosystems, human life and assets from wildfires that have burnt into areas of high fuel loads has been illustrated in Victoria and previously in the ACT, New South Wales, South Australia (Eyre peninsula, Mt Gambier) and Tasmania. The enormous damage caused by these fires has resulted in a reappraisal of the active versus passive fire management debate in Australia.

The nomination of fire regimes (including fuel reduction burning) as a key threatening process to Australian biodiversity under the EPBC Act (1999) is of concern to AFG. The concept that planned use of mild intensity fire is a threat to biodiversity is a significant reason for the decline in the level of fuel management and fire preparedness in Australia. This ignores the counter argument that appropriately managed fuel loads can significantly reduce catastrophic fire events that have a much greater deleterious impact on biological communities (threatened or otherwise).

AFG seeks that the Federal Government address this issue recognising that if fuel reduction burning does not occur, intense fires inevitably do, and this is a far worse situation in terms of threat to biodiversity and ecosystems, not to mention human life and social and economic infrastructure. As Roger Underwood states in his paper *Australian Bushfire Management: a case study in wisdom versus folly,* 'In the Australian bush if you do not manage fire, you cannot manage for anything else'.

AFG recognises several key bushfire management principles:

- Fire is a natural part of the Australian environment. It is also an agent for regeneration and releases nutrients locked up in litter on the forest floor.
- Fires differ in intensity depending on weather conditions, fuel type and dryness and the amount of fuel available.
- Land managers have a duty of care to society and the environment. Because fires occur each year through natural or manmade causes there is a need to put in place programs that operate continuously. It means that fuel loadings must be actively managed, access maintained and adequately trained personnel made available on a continuing basis.
- Fires do not recognise cadastral boundaries. It has been clearly demonstrated on many occasions that there is a need to develop active fire management strategies across vegetation types rather than state borders or tenure boundaries.
- There is a need to educate the community living in bush fire prone areas about actively managing fuel loads and fire management and this should be extended to those in the large cities who influence political policies.

SUMMARY OF RECOMMENDATIONS

Australian Forest Growers:

1. recognises that land managers have a duty of care to actively manage for fire mitigation;
2. seeks recognition that active fuel reduction programs in appropriate vegetation types is a necessary means of reducing the risk of landscape scale mega-fires;
3. seeks that fire tracks across land tenure are maintained and accessible throughout summer months;
4. calls for a higher level of national coordination and standardisation of fire suppression authorities;
5. calls for the development of a process for assessing and authorising management plans to minimise bureaucratic intervention in implementation;
6. seeks that fire management teams be appropriately resourced and trained with more resources committed to research into fire behaviour in an Australian context; and
7. seeks the creation of a National Fire Audit Office (NFAO) to report on preparedness for coordinated fire suppression; and which is empowered to enforce fuel-reduction targets.

AFG strongly advocates that the following issues are addressed in the future management of bushfire in Australia.

SOCIETAL CHANGES

Recent experience suggests that there has been a change in the philosophy that underpins fire management over the last 25 years. This may be due to a societal change from one where nature was something to be fought or controlled - a hard taskmaster, to one where the environment is perceived as fragile and benign. In the general community there is poor understanding and little empathy for active fuel load and bushfire management. There is a disconnect with the wider community and the practical realities of fire management and control. This needs to be scientifically and rationally addressed.

This change in broad philosophy has been accompanied in the field by a change in the land managers. In the past, most state forestry land was managed by foresters with fire experience and training. More recently, these people have been replaced by graduates in various forms of environmental sciences with much shallower knowledge of fire behaviour. There is no better school of bushfire management than that of active fire control. AFG considers it essential that all public service fire managers be qualified by considerable practical experience before attaining a fire management position.

The process of skilling a firefighter does not come only through the legal requirement of passing training modules, but also requires experience, judgment, prudence and sagacity. They need continual monitoring and mentoring by more experienced staff while undertaking fire suppression activities. And, above all, they need frequent exposure to a considerable range of fire behaviour that can only be obtained by deliberate lighting of prescribed fire.

Phil Cheney, Australian Forest Grower Vol 26 no 3, Spring 2003

The nature of volunteer fire fighters has changed. In the past, fire fighters were farmers, logging contractors and forestry workers with years of fire experience and accustomed to hard work. As more native forest areas have been withdrawn from forestry management, and as farms have become bigger and more mechanised requiring less labour, the pool of physically fit, healthy and experienced fire fighters has diminished. There has also been a loss of suitable equipment such as heavy bulldozers and skilled operators for rapid construction of fire-lines, reinforcement of existing firebreaks and creation of back burning lines.

There are two completely incompatible forces in "the fire debate". The physics of fire and the science of the biological world can be the only logical arbiter in this complex discussion. Whilst society might seem to demand that environmental fundamentalist principles are heeded, they cannot be allowed to overshadow the sound scientific reasoning that underpins active management of fire risk. This science must also be allowed to continue to evolve, and to this end public funding must continue to be available.

AFG recommends that the issue of experience and training be taken up by the Federal Government and recommendations be made to ensure greater depth of knowledge and experience of fire behaviour in those managing fuel reduction programs, especially in National Parks and reserves, and decision makers at the fire ground.

AFG recommends the vigorous pursuit of philosophical agreement for the active management of fire in Australia that can be applied practically with a minimum of bureaucratic intervention.

AFG supports more resources being provided for research into fire behaviour and downstream technology transfer of this research in an Australian context.

FUEL REDUCTION

Fire intensity is related to a combination of weather conditions, slope, atmospheric stability and fuel. Of these variables, only fuel loads can be managed. Extreme fire behaviour often results when fires burn into areas of high fuel loads such as the fires that devastated Victoria in 2003, 2006/7 and 2009, and in the ACT and NSW in 2003.

There has been a trend over the last ten years for more cautious approaches to prescribed burning by public authorities, partly as a result of the fear of litigation in the event of a fire escape, partly as a result of community concern about smoke, partly as a result of fire management practices that lead to loss of life and injury, and partly because many managers of public land are philosophically opposed to burning. This so-called precautionary approach has lead to fewer burns being undertaken each year resulting in a gradual build up of fuel loads in native vegetation, to a point where actively managed fuel reduction has become almost impossible in some areas.

An example in the change in fire management regimes and the resultant associated risks is the town of Cooktown in Far North Queensland. Grassy Hill is a tourist stop outside of Cooktown, so named by Captain Cook in around 1770 when he was

stranded at Cooktown for a few weeks while repairing his ship. In order to work out a route out through the reefs, he climbed the steep hill overlooking the area. He named the rise "Grassy Hill" because that's what it was – a hill covered in grasses. It was grassy because of a very long term regime of burning by our native inhabitants. If you look at Grassy Hill today, you find it covered in thick native vegetation and it poses a real fire hazard risk to Cooktown. This risk is because fuel reduction burning is now limited in Far North Queensland.

In some States it is very difficult to get permission for hazard reduction burning, particularly in a timely manner. Often those with the authority to approve prescribed burning plans have little understanding of fire behaviour and a philosophical objection towards using fire as a land management tool. Current processes impede management because they require bureaucratic intervention at every step.

To restrict the frequency of high intensity wildfires, fuel reduction using prescribed burns on private land should be encouraged and impediments to reasonable measures removed. Greater attention, through the use of publicly reported performance indicators, should be paid to actual fuel reduction rather than to planning.

A further barrier is the absence of good fire behaviour data for some bushland types, and lack of prescribed burning guides. It is essential that more resources are put into developing burning guides and training people in their use.

AFG recommends that more encouragement be given to fuel reduction using prescribed burns on private land in all States; and that impediments to reasonable hazard reduction be removed.

AFG recommends that greater attention be paid to actual fuel reduction rather than developing plans that are not implemented. It is essential that publicly reported performance indicators are used to ensure that fuel reduction programs are meeting targets.

AFG calls for a sustained public education program on the need for proper management of fuel loads at local and in urban areas so there is support and recognition for the need for fuel reduction burning.

TIMING OF ATTACK ON BUSHFIRES

There is a pertinent need to attack fires rapidly with the aim of keeping them small. The ACT fires of 2003 could have been extinguished on the first day if the crews attending had been allowed to work overtime that night. As stated in the final report of the McLeod Inquiry, 'the Inquiry spoke to some individuals who had travelled to the fires on that first evening but did not conduct any firefighting operations. One person who had gone to the Bendora fire appeared unable to explain this approach, other than to say that they were directed off the mountain without having initiated any firefighting activity'.

In addition, it took until day three of the bushfires to get bulldozers into the national park areas where there were already existing unmaintained roads and tracks from past harvesting activities, and so the fires intensified. Subsequently the fires were allowed to build to such an extent that virtually the entire ACT Forests pine plantations were

destroyed along with 500 houses in Canberra and most disturbingly there were four fatalities. Attacking fires early is still a very effective fire management strategy that has been used (mostly successfully) in the last 40 years in the Green Triangle. The deployment of crews immediately in the event of possible fires, and withdrawal of them if later there is no need, is preferable to waiting until there is a large bushfire event before deploying a large fire fighting force.

AFG advocates that it is imperative that bushfires are attacked early, rapidly, and by fire-fighters who are well resourced to prevent potentially catastrophic fires from occurring.

EQUIPMENT

There has been a recent trend to use very expensive equipment (such as large water tanker helicopters). While it is recognised that aerial attack of fires has been a beneficial change over the last 15 years it is essential for cost benefit analyses to be applied to equipment purchases. Results of such analyses may reveal a need for more on-ground equipment and less expensive aerial bombers (fixed wing or smaller helicopters) being deployed. Benefits of early intervention in fire outbreaks are well canvassed. In many circumstances, the initial response, by whatever means, to a fire outbreak will dictate the impact it may have. Use of direct on-ground intervention supplemented by strategic aerial support are likely to provide a capacity to control fire soon after outbreaks. It is also evidenced that use of aerial and ground attacks combined in highly valued plantations has been an effective mechanism to reduce fire spread and damage. Aerial intervention needs to be timely, strategic, and carried out by trained operators.

AFG recommends that greater deployment of resources be made to on-ground attack, and that well controlled aerial water bombing capability be restricted to early intervention at source and to protection of built assets such as houses.

AFG recommends that further expenditure on aerial water bombing are only made based on the results of a careful review of the costs and effectiveness of that tactic when used in established bushfires remote from built up areas.

NATIONAL COORDINATION

Pre fire season coordination of fire suppression authorities needs to occur in all regions of Australia. Coordination should include cross agency training, intra- and inter- agency communications, and development of an appropriate mix of skills and practical experience.

Independent auditing against fire preparedness benchmarks to check the fire season readiness of public land agencies may be beneficial. Audits would take into account the extent of pre-season fuel reduction, fire training, fire detection systems, fire fighting equipment and communication systems. Rather than supplying limited funding, a long term reporting system is required to ensure that prior to each fire season fire suppression authorities are aware of fire risk and preparedness throughout Australia.

It was noted that during the bushfires last summer, in some instances fire authorities did not consult sufficiently with local people that had the detailed knowledge of the conditions, access and fuel types.

It is a matter of the physics of fire and long standing common sense that the more rapid and vigorous the initial attack the better the chances of extinguishing a fire.

AFG recommends that a much higher level of coordination and standardisation at all levels be developed, along with management plans based upon contiguous fuel type. It may be necessary to review current processes and make them more appropriate. Such historic concerns as interagency coordination, communication system compatibility, and skills capacity should be targeted.

AFG recommends that a National Fire Audit Office (NFAO) be established to provide confidence to the community. The NFAO would report annually to the Federal Parliament against the following terms of reference:

- ***Assessment and standardisation of essential equipment, communication and coordination between agencies (intra- and inter-state);***
- ***Report on the fire readiness of the country prior to each fire season;***
- ***Oversight of the deployment (by the States) of regional rapid response units to support fire suppression and filling of human resource gaps caused by such things as employee rostering and lack of available volunteers.***
- ***Establishment and implementation of guidelines to compel fire management authorities to recognise and act on important and credible local advice. (This should apply to all fire suppression operations especially initial attack on outbreaks).***
- ***Creation and management of a national education program designed to provide a range of options that residents should consider when confronted by impending fire. (The major focus is to provide advice on "stay or go" options when confronted by impending fire and fire preparedness).***

BUSHFIRE POLICY

Australia has no national bushfire policy, nor do any of the State or Territory jurisdictions have over-arching policies which will guide land management, planning and Local Government authorities. As a result there is a mish-mash of policies developed independently by different agencies or Councils, with no coordination and no whole of Government ownership.

AFG calls for the development of a national bushfire policy for Australia, to ensure consistency in land management and planning strategies across all State agencies.

FIRE MANAGEMENT AND DAMAGE TO PRIVATE PLANTATIONS

Whilst AFG advocates that every effort should be made to manage bushfires, there has been some unnecessary damage to private plantations. An AFG member had his costly high pruned plantations heavily damaged for a fire break. AFG recognises the importance of a fire break in preventing the spread of fire; however it was the location of the fire break which caused the most grievance in this case. The fire break could have been positioned in a different, however still close proximity creating the same effective result with a lot less damage to this valuable resource.

Plantations are valuable assets and in addition to the commercial gain from harvesting a stand, trees in the landscape provide a myriad of environmentally beneficial outcomes. As such, unnecessary damage to plantation crops should not occur. AFG is aware of other examples where plantations have been set alight in order to protect other agricultural crops.

There is a misconception held by community that plantations are a greater fire risk than native forests when often the opposite is the case. In the Grampians fire in 2006 local farmers put their sheep into blue gum plantations to prevent losing them to fires across their pastures. As David Geddes states in his paper *Fire Behaviour in Hardwood Plantations* 'as the area of [hardwood] plantations has increased, there has been regional community concern about the level of fire risk these plantations present. Communities have experienced the impacts of fires in native forests and there have been perceptions that hardwood plantations have similar fuel types and therefore similar potential fire behaviour'. In his study, David Geddes found that 'when hardwoods have been established on formerly cleared agricultural land, plantation fires will be less intense than in pine and native vegetation types and slower spreading than in fully cured grasslands'. Hence, a well managed blue gum plantation has a lesser fire risk that a native forest.

Another example occurred in November 2002 where a large fire burnt 20,000ha of native forest near Albany in Western Australia. The fires were slowed down by two 4 year old blue gum plantations managed by a private forestry company. Despite many burning embers landing within the plantations, the fire did not spread to any significant extent. One of the plantations aged 3.5 years had 0.1ha defoliated adjacent to crowning native vegetation and around 3ha of scorch as a result of radiant heat from intensely burning native vegetation, with no fire entering the plantation itself. The other, aged 4.5 years suffered scorch of around 0.5ha, again adjacent to native vegetation, with around 3ha carrying fire within the plantation, with minimal associated scorch.

Figure 1: Blue gum plantations stop a bushfire from spreading near Albany, Western Australia.

Figure 2: An aerial view of the November 2002 fires in Albany, where a large fire burning under extreme weather conditions, slowed down when it hit two blue gum plantations.

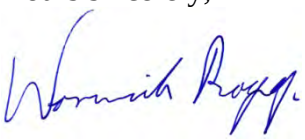
CONCLUSION

Bushfires occur every year in Australia, but the occurrence of large high intensity fires that cause significant social, economic and environmental damage appears to be increasing. In particular, the devastation of the recent Victorian bushfires makes it imperative that there must be a serious re-evaluation of fire management practices nationally. Vegetation type, weather conditions, slope and the type and amount of fuel available are all factors which contribute to fire intensity and determine fire damage. The only variable in human control is fuel load and this can be controlled through fuel reduction management techniques.

AFG seeks the development of a system whereby broad plans for active management of fire in Australia are subject to a rigorous approval and monitoring process, which facilitates public scrutiny and vigorous debate. However, the process must also allow practical implementation at a local level with a minimum of bureaucratic intervention. AFG advocates that fire-fighting equipment purchasing decisions should be based on careful cost-benefit analysis, including assessment of the effectiveness of associated tactics. We believe this will show that more resources should be allocated to on-ground and low-cost aerial options, which are designed for and capable of rapid response. AFG supports the implementation of a highly coordinated, independently audited national approach to fire management (such as through a National Fire Audit Office), with management plans based on contiguous fuel type. Implementation of fuel reduction strategies should be enforced through the system.

Thank you for the opportunity to make a submission. Please do not hesitate to contact the undersigned on 6162 9000 should you wish to discuss any of the issues raised.

Yours sincerely,



Warwick Ragg
Chief Executive

ATTACHMENT A – AFG POLICY STATEMENT No. 19
FIRE MANAGEMENT

ATTACHMENT B –AFG SPECIAL LIFTOUT No. 87
AUTUMN 2009 Vol. 32 No. 1
TAKING RESPONSIBILITY FOR FIRE SUPPRESSION AND FUEL MANAGEMENT
BY PHIL CHENEY

ATTACHMENT A – AFG POLICY STATEMENT No. 19

FIRE MANAGEMENT

Australian Forest Growers:

i. recognises that land managers have a duty of care to actively manage for fire mitigation;

ii. seeks recognition that active fuel reduction programs in appropriate vegetation types is a necessary means of reducing the risk of landscape scale mega-fires;

iii. seeks that fire management strategies be developed across vegetation type and that management for fuel reduction is promulgated across all jurisdictions;

iv. seeks that fire tracks across land tenure are maintained and accessible throughout summer months;

v. calls for a higher level of national coordination and standardisation of fire suppression authorities;

vi. calls for the development of a process for assessing and authorising management plans to minimise bureaucratic intervention in implementation;

vii. seeks that fire management teams be appropriately resourced and trained with more resources committed to research into fire behaviour in an Australian context; and

viii. seeks the creation of a National Fire Audit Office (NFAO) to report on preparedness for coordinated fire suppression; and which is empowered to enforce fuel-reduction targets.

Background

Fire management in Australia has been characterised in the past decade or more by disputes regarding the impacts of prescribed burning on ecosystems, including whether burning equates to vegetation clearance (as it does under South Australian native vegetation laws). This dispute has resulted in an increasingly cautious approach towards active fire management, particularly on the part of the government agencies responsible for management of the public protected area estate. This has resulted in a build-up of fuel loads to levels impossible to manage in fire hazard conditions. The devastating impact on ecosystems, human life and assets from recent wildfires that burnt into areas of high fuel loads has been illustrated in the ACT, Victoria and New South Wales. The extremity of these fires has resulted in a reappraisal of the active versus passive fire management debate in Australia.

AFG recognises that fire is a natural part of the Australian environment. It is an agent for regeneration and releases nutrients locked up in litter on the forest floor.

Discussion

Fire occurs each year in Australia. Regionally, fire frequency and fire intensity differs, depending on vegetation type, weather conditions, slope and the type and amount of fuel available. Only the fuel load can be managed.

In order to maintain and enhance biodiversity, and reduce risk to life and property, land managers have an obligation to ensure that fuel loads are actively managed,

access to vegetated areas is maintained and adequately trained personnel are continually available.

Permission for hazard reduction burning is extremely difficult to obtain in some States. Often those with the authority to approve prescribed burning plans have little understanding of fire behaviour and a philosophical objection towards using fire as a land management tool. Current processes impede management because they require bureaucratic intervention at every step.

To restrict the frequency of high intensity wildfires, fuel reduction using prescribed burns on private land should be encouraged and impediments to reasonable measures removed. Greater attention, through the use of publicly reported performance indicators, should be paid to actual fuel reduction rather than to planning.

A lack of understanding of the practical realities of fire behaviour poses a risk to environmental and productive values, as well as to human life. The level of expertise amongst land managers in fire management positions must be rebuilt with an emphasis on adequate experience of actual fire management.

Public funding must continue for research into fire behaviour and to resource activities that will transfer this knowledge into practical management technologies, practices and effective community wide information dissemination.

Fire suppression teams are more effective if adequately resourced with appropriate equipment. The initial response to fire often dictates the extent of the final impact. The more rapid and vigorous the initial response, the greater the chance fire will be extinguished quickly. It has been shown that rapid, combined ground and aerial intervention has been effective in reducing fire spread and damage in high value plantations.

Fires do not recognise cadastral boundaries. Management and suppression would be more effective if strategies operate across vegetation types rather than to State borders or other arbitrary boundaries.

Preparedness is vital. Pre-fire season coordination of preparations would reduce costs, maximise efficiencies and importantly ensure preparedness amongst agencies to work together to extinguish major fires. Cross-agency training, communications planning and the development of complementary skills and practical experience are essential to effective teamwork at a fire front. Adequate consultation with local people who have detailed knowledge of the conditions, access and fuel types can ultimately save lives and property.

Independent auditing against fire preparedness benchmarks may be beneficial to check the fire season readiness of public land agencies. Audits would assess the adequacy of pre-season fuel reduction, fire training and coordination between agencies and the preparedness of fire detection systems, fire fighting equipment and communication systems.

A National Fire Audit Office (NFAO) reporting annually to Federal Parliament could provide greater community confidence of adequate preparedness.

Preferred Outcomes

- Development of a system whereby plans for active management of fire in Australia are subject to a rigorous approval and monitoring process, facilitating public scrutiny and vigorous debate, allowing for practical implementation with a minimum of bureaucratic intervention.
- Fire-fighting equipment purchasing decisions based on careful cost-benefit analysis, including assessment of the effectiveness of associated tactics. We believe this will show that more resources should be allocated to on-ground and low-cost aerial options capable of rapid response.
- A highly coordinated, independently audited national approach to fire management (such as through a National Fire Audit Office), with management plans based on contiguous fuel type. Implementation of fuel reduction strategies should be enforced through this system.

ATTACHMENT B

SPECIAL LIFTOUT No.87

Autumn 2009 Vol. 32 No. 1

Taking responsibility for fire suppression and fuel management

By Phil Cheney

After every fire disaster, there are claims we need more prescribed burning for fuel reduction and counter-claims that fuel reduction does not work under extreme fire weather conditions. But as Aboriginal people across Australia know, the only way of avoiding the intensity of catastrophic fires is to reduce the volume of fuel available to burn in the landscape.

Why this is so and examples of the behaviour of fire under extreme conditions are discussed in the first part of this Special Liftout. Where there are dry, abundant fuels and high wind speeds, the rapid rates of spread, ease of ignition and intensity of heat transfer all increase to a degree that is difficult for people to appreciate. The only variable we can affect is through reducing the levels of fuel by prior burning. Fuel reduction is, therefore, essential to reducing the damage done by extensive wildfires and prescribed burning is the most ecologically sound way of doing it.

The need for prescribed burning is easier said than done. How we put it into practice forms the second part of the Liftout. The most serious concern, the author contends, is that by placing suppression in the hands of emergency services, land managers have been given no incentive to take an active role in fire preparedness. Land managers, such as plantation owners and farm foresters, have a responsibility to factor in the cost of good fire management. In particular, for effective prescribed burning to take place, governments will have to make their land management agencies totally responsible for fires on their land, carry out effective fire management and set an example for other land managers to follow.

N P (Phil) Cheney BSc For (Melb.), Dip For (Can), FIFA (Fellow Institute of Foresters of Australia), PSM.

Phil Cheney is an Honorary Research Fellow with CSIRO. He led the CSIRO Bushfire Research group from 1975 to 2001, and has 40 years of experience in research into bushfires including bushfire behaviour, prescribed burning, mass fires, fire ecology, aerial and ground suppression, firefighter physiology, firefighter safety, heat transfer, home protection and water catchment hydrology. He has written more than 100 papers, articles and reports and contributed to seven books.

Awards he has received include the N W Jolley Medal (outstanding service to forestry); CSIRO Medal (outstanding research achievement in the application of fire science for safer fire fighting and safer communities); and a Public Service Medal.

He is currently preparing papers on forest fire behaviour. However, the prospect of getting his golf handicap into single figures, although remote, is increasing in priority.

This article is based upon the author's personal views and is not necessarily representative of the views of any other group or individual.

Fire and the Australian landscape

In the traditional Aboriginal landscape, burning occurred on a regular patchwork basis for hunting game and to keep the country clear as they moved through it.
SOURCE: Constitution Hill, Tasmania, by Joseph Lycett 1832 (Australian National Library).

Fire is an ecological process. Ecologically, it is part and parcel of the flora and fauna of Australia. Physically, it is a chaotic chemical reaction that produces heat, light and a variety of chemicals in the combustion products. It produces responses in the environment that cannot be exactly reproduced by any other means.

In the absence of humans, the extent, frequency and intensity of fire is determined by the climate. The assemblages of plants and animals that have evolved over the millennia have changed with the climate and the associated changes in fire regime. Fire is one of the variables influencing species composition along with rainfall and temperature.

If we accept that fire is an ecological process that is part of the Australian environment, then we are in a better position to understand its role both in maintaining biodiversity and in managing the effects that society deems undesirable for its lifestyle choices. For example, some of the chemicals produced by fire (mostly in trace amounts) are indeed harmful to people. This should not, however, be used as an excuse to try to stop the application of a natural process for fuel reduction because of concern about smoke. Rather those most affected need to take individual actions to protect themselves. The rays of the sun are also harmful to some people, and the consequences are far better medically documented than any harmful effect of bushfire smoke, yet society is accustomed to susceptible individuals taking individual protection. On the other hand, the effects of heat from wildfire are well known and devastating as recently witnessed in the Victorian disaster.

Most scholars of Aboriginal culture believe that they had a sophisticated knowledge of fire and used fire extensively for a great variety of reasons. Repeated observations by early European explorers revealed the open forests and woodlands with a grassy understorey covered much of the land and they gained an impression of an annual conflagration during the fire season caused by Aboriginal people.

The contentious issue for many non-indigenous Australians is the extent that fire spread across the landscape and changed the composition of our flora and fauna. Aerial photographs of the Western Desert in 1953, when the indigenous inhabitants still carried out traditional practices, show that Aborigines regularly burnt the spinifex grasslands. They often lit lines of fire along what appear to be treks across the countryside and they burnt under weather conditions when fires would just spread and self extinguish after travelling a relatively short distance. The average patch size was around 5ha and fires rarely travelled more than 2km, which is roughly 20 minutes duration.

In the Northern Territory, fire was applied in different ways. At times it was applied to specific areas under mild conditions to ensure that only small patches were burnt. At other times, it was applied under more severe weather conditions and burning would continue for several days. In the south-west jarrah forests of Western Australia, the fire scars on grasstrees indicate that most areas were burnt every two to three years, and very few areas survived without fire for more than five years.

The physics of fire spread cannot be ignored and I believe that Aboriginal people across Australia understood very well what would be the consequences of widespread fire in continuous fuel during the dry season. Because they had little, if any, capacity for suppression, they burnt regularly to protect themselves and the continuity of their food supply

The behaviour of fire under extreme burning conditions and its impact on the biota

The drivers of fire are well understood. They are the moisture content of the fuel, the amount and structure of fuel, and the wind speed. However, the speed and distance that fire can travel under the extreme conditions of dry and abundant fuels and high wind speeds are difficult for most people to appreciate. Rates of spread of single fires in both conifer and eucalypt forests of 10km/hr have been documented under extreme conditions. Rates of spread of grassfires in abundant standing fuel have exceeded 20km/hr. This means that under extreme weather conditions a single fire can burn out between 60,000 and 100,000ha in eight hours. Multiple fires burning in close proximity may induce even higher rates of spread.

Likewise, the ease of ignition by very small embers in low humidity and the duration of combustion of large material sustained by high wind are also difficult to appreciate. The duration of flaming combustion depends on the thickness of the fuel pieces. Tall flames are generated from fine well-aerated material generally less than 2.5mm in diameter and persist at any one point for around 10 seconds. Fuel beds, depending on their compaction, and the diameter of the larger fuel components, including branch and log material, burn for much longer. Smouldering combustion may persist for more than an hour after the flame front has passed.

The relative danger from different fuels depends on the both the rate of energy release and the duration of the flames. The heat release of a fire is the product of the fuel consumed, the

Table 1: Relative hazard of different fuel types under conditions of very high fire danger

Fuel Type	Rate of spread (km/hr)	Fuel load (t/ha)	Flame time (s)	Normalised Fire Hazard	Smoulder (survival) time (minute)
Eaten-out grass	4.7	1	3	**1**	0.1
Grazed pasture	9.3	3	5	**10**	0.5
Tall grass	11	6	10	**47**	1
Grassy woodland	5.5	7	20	**62**	5
Grassy forest	3.5	12	40	**135**	10
Short heath	3	15	80	**290**	15
Tall heath	4	25	100	**806**	20
Dry forest	3	25	200	**1210**	50
Tall forest	3	50	300	**3629**	100

heat of combustion, and the fuel load. If we multiply energy release by the duration of flaming combustion under the same weather conditions we get an expression of the relative hazard in different fuel types (see Table 1).

Even a fire burning in eaten-out pasture travelling at 5km/hr is unstoppable, and emits sufficient heat to kill an unprotected person. The relative hazard from a fire burning in tall forests with heavy fuel loads is 3,000 times greater.

Humans can withstand only a small increase in heat above the ambient environment. For example, the radiation flux on an object immersed in the flames of an intense forest fire is 100kW/m^2. The radiation from the sun at peak summer is 1kW/m^2 and the pain threshold for prolonged radiation is 1.25kW/m^2, which is generally considered appropriate as the radiation limit for survival in mass fires. Thus, even if you can survive the radiation and combustion gasses from the tall flames of the fire front, you have to seek protection from the radiation from slowly burning material behind the flame front, which may persist above the pain threshold for up to an hour after the front has passed.

Heat transfer processes largely determine the effects of fire on the biota. The two most important are convection and conduction. Understanding these processes is important in understanding the impact of fire and in determining how fire is to be used to achieve particular objectives. Convection transfers heat to the above-ground biota. The strength of this flux is determined by the intensity of the fire or the rate of heat output. If the intensity is high enough, it will kill above-ground flora and fauna. Removal of the canopy changes the insolation reaching the forest floor and there will be different responses depending on the various responses of the regenerating biota.

Plant tissue is killed on exposure to 60ºC for one minute. While some plants can protect vital tissue behind thick bark, in woody cones or under ground, the impact of high-intensity fire is devastating and some species will become locally extinct if there is not an available seed source at the time of the fire.

Conduction transfers heat below ground and through the bark. The strength of this flux depends on the total fuel consumed and the conductivity of the substrate, which in turn is primarily determined by its moisture content. It is not determined by fire intensity; a low-intensity fire will transfer the same conducted heat flux as a high-intensity fire if the fuel consumed is the same. Thus, the depth of the heat penetration sufficient to kill soil biota or germinate soil-stored seed will depend on the total fuel load, its moisture content and the moisture content of the soil. Under heavy fuel there will be different responses depending on the depth that different seeds are deposited.

A characteristic of the recent mega-fires that burn for weeks and months and cover millions of hectares is that while there may be variation in intensity associated with variation in weather, practically every square metre is burnt. This means that there are very few unburned refuges and ensures that any animals that survive the passage of the fire front will die later from starvation.

Given plant tissue is killed on exposure to 60ºC for one minute, the impact of high-intensity fire is devastating.

Reducing fire hazard by reducing fuel

The key to managing bushfires is to reduce the volume and duration of both the flaming and smouldering combustion. If the fuel load and the average diameter of fuel particles are reduced the fire hazard can be dramatically reduced (see Table 1). Compacting the fuel will reduce flame height, but will increase both the flaming time and smoulder time. In some fuel types, compacting the fuel has little effect on rate of spread.

Managing the fuel with fire is the only way to reduce hazards like the flammable bark on standing trees and, because fire is a natural process, it is the most ecologically sound method of fuel reduction. Changes in fire behaviour when fuels are reduced by burning will be:

- Reduced height flames and radiation flux;
- Reduced rate of spread;
- Increased time for a fire starting at a point to build up to its potential rate of spread;
- Reduced number of firebrands and the distance they are carried down wind, which dramatically reduces the spotting potential and ease of suppression;
- Reduced total heat output and reduced heating of the soil.

The persistence of changed fire behaviour will, of course, depend on the type of fuel and the rate that it returns to equilibrium fuel load and structure. Some examples of the fire behaviour under extreme conditions immediately after treatment and as fuels accumulate are:

Grasslands

Annual grassland will not burn until the grass grows the following year. Some perennial grasslands and pastures that have a compact layer of clover or organic matter may re-burn.

The ash deposited by a heading fire can insulate compact fuel near the ground which burns later by smouldering combustion. This is usually unimportant if some time has elapsed between the prescribed burn and the wild fire, because ash accelerates the decomposition of residual material.

Grassy woodland and forest

These are similar to grassland in that the effect of the prescribed fire only persists for the year of burning. Fuels do accumulate with time in grassy forests, even in tropical grassy forests where decay rates are high. The additional fuel in the bark and shrub layer will increase the intensity of the fire.

Also, larger branches and logs that decay only slowly will accumulate and increase the duration of smouldering combustion and the heat flux after the flames have passed. This flux caused serious burn injury to people who were caught in grassy woodlands in an equestrian reserve during the Canberra fires in 2003. While they survived the passage of the flames in vehicles and horse stables they were burnt walking over burnt ground back to the equestrian centre building.

Dense pine plantations

Pine plantations usually carry sufficient dead fuel in the crowns and are close enough to carry a crown fire regardless of the surface fuel. Plantations that are thinned and pruned to 8m and surface fuels are reduced to thin cover of pine litter will not crown. This protected the town of Mt Burr SA during the 1983 Ash Wednesday fires.

Dry eucalypt forest with a litter and shrub understorey

Where a prescribed burn has been carried to a satisfactory standard (70-80% clean burnt ground), the forest will not re-burn under extreme conditions for at least one year after burning. Two to three years after burning, the forest will carry a surface fire, but this will have a reduced rate of spread, flame heights and firebrands. Fire behaviour and rate of spread will not reach the full potential for 15 years after prescribed burning, which extends the range of weather conditions that firefighters can successfully suppress fires.

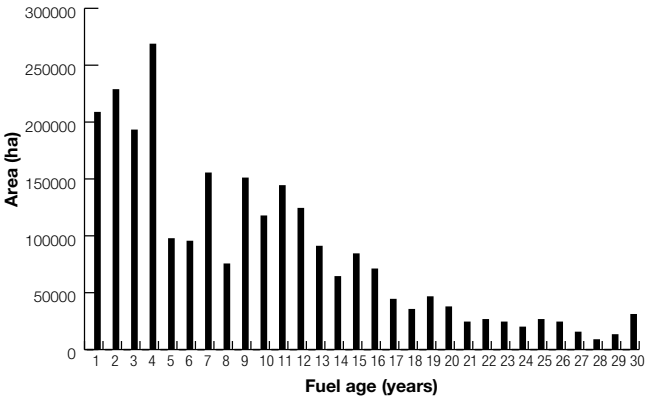
Because very little fuel is needed to carry a fire in extreme weather, fuel reduction is required at a level that provides a checkerboard of recently burnt blocks across the forest. Initially, this may need to be 10-12 % of the forest estate per year on an eight year rotation. Once the long-unburned fuels have been reduced, the fraction of forest burnt might be reduced a little, but should not fall below 8% per year.

This will mean that the fire will sooner or later burn up to recently burnt areas and stop, even under extreme conditions. Although the fire will continue to burn elsewhere, it will spread slower and be controlled more easily in light fuels when the weather conditions abate.

While management prescriptions may designated that some areas are not to be deliberately burnt, the practical application of a fuel reduction of 8% of the forest estate per year will produce a wide range of fuel ages and a diverse environment. The distribution of fuel ages in the south-west forests of Western Australia is shown in Figure 1.

A forest estate with a wide range of fuel ages is far more diverse than a single fuel age resulting from widespread summer wildfire. Not only does each fuel age have a specific biota associated with it, but also those areas treated by low-intensity prescribed fire will contain a range of fuel ages on the 20-30 % of the area that remained unburned when treated.

Figure 1: Area of forest with fuel in annual age classes in forest managed by the Western Australian Department of Environment and Conservation in the south-west land division at July 2006.



Taking responsibility for fire management

It is relatively easy to demonstrate that prescribed burning can reduce the intensity of fire and make suppression easier and more efficient. It is not so easy to put it into practice. The first step is for all land managers, be they owners of a suburban block or managers of public land, to take responsibility for fire suppression on their land. If they take this responsibility, they will soon recognise the part that reducing fuel volumes plays in allowing efficient suppression. Where the responsibility for suppression is left to the emergency service authority and is separate from the land management, there is little incentive for the land managers to increase their level of fire preparedness.

There is a growing awareness in the community that management of fuel to a low level of flammability will makes fire suppression safer and more efficient and may well be deemed a ‘reasonable step’ to prevent fire burning across the property and doing damage to others. As yet, the law does not demand that all citizens take reasonable care to avoid causing

foreseeable harm on the grounds it would create an intolerable burden of legal responsibility. That does not preclude, however, accepting that differing levels of responsibility exist between different types of land managers, as discussed in the examples that follow.

Unprotected country

There are vast areas of the country, particularly in northern Australia, where the population is too sparse to undertake effective suppression, let alone undertake effective fuel management. These areas come under a variety of tenures: government reserve, indigenous land ownership, leasehold land and absentee landholdings.

A practical solution may be to declare these areas legally unprotected. This would recognise that the landowner is incapable of fire suppression and is, therefore, not responsible for damage from fire burning out from their property. Such legislation would also need to recognise that neighbours, in order to protect their assets, have the right to undertake burning on the perimeter of these lands and are also not responsible for any damage that escaped fire may be deemed to do on unprotected land.

Plantation owners

Most forestry companies and large plantation owners have given only lip service to their bushfire responsibilities. In fact, they have a moral responsibility to factor the full cost of fire management into their investment planning. As there will be periods when their crop is vulnerable to even mild fire, they should be prepared to provide an effectively trained and equipped firefighting organisation that can carry out the majority of suppression in the fuel loads they choose to manage. This requires a skill level that should not be expected from emergency services.

The fire hazard in plantations can be substantially reduced by good management. This is most effective when hazard reduction measures are commenced at establishment, and silvicultural techniques are adopted, which reduce excessive fuel accumulation during the life of the plantation. Some factors to take into consideration are:

- Completely remove the debris from the previous vegetation at establishment and replanting. Windrows of large logs are very difficult to mop-up in the event of a fire and should be removed by stoking and burning;
- Undertake prescribed burning of all remnant bushland in and around the plantation at the time of site preparation. This ensures the plantation starts life with minimal fuels;
- Control unpalatable grass (e.g. *Poa* sp. tussocks) and herbaceous weeds by spraying with weedicide prior to planting. In subtropical areas where there is prolific growth of annual grasses, clean tending operations may be required early in the life of the plantation;
- Obtain rapid early growth and early crown closure by fertilising and competition control at establishment. This will rapidly suppress grasses and weeds and a newly established plantation in this way will have very low fuel loads for some years until litter beneath the plantation starts to accumulate;
- Retain a high stocking by replanting failed areas if necessary;
- Remove double, deformed or other unwanted stems in the first two to three years after planting before they contribute to substantial fuel loads in later thinning operations;
- Reduce grass fuels within the plantation by grazing as soon as the trees are large enough to avoid damage by stock. Grazing within the plantation not only reduces grass loads, but also breaks up debris from pruning slash;
- High pruning of conifer plantations up to 8m is needed to prevent crown fires under extreme conditions. This should be done by repeated pruning operations at short intervals to prevent excessive accumulations of pruning debris.

Good fuel management early in the life of plantations of smooth-barked eucalypts, such as blue gum, can make them virtually fire proof for up to eight years after establishment until litter starts to accumulate beneath the trees.

23 year old radiata pine plantation pruned to 8m. Surface fuel is easy to reduce by burning.

Farm forestry

Farm foresters and rural communities rely on the volunteer fire brigade for fire suppression. Generally, fuel reduction is only undertaken around specific assets. Farm foresters are obliged to maintain their fuels in much the same condition as the general countryside because they cannot expect volunteers to suppress fires in heavy fuels when they may not have the necessary experience or equipment. This objective can be achieved by good establishment, as discussed above, and supplemented by grazing and burning.

Prescribed burning can be carried out beneath fire resistant species from age 10 to 15 or when the trees are greater than 15cm diameter. However, prescribed burning in young plantations is a difficult and exacting task with a small window of opportunity. In most cases, it is impractical for effective prescribed burning to be carried out by individual holders of small plantation lots, although some notable exceptions exist.

Public land

The managers of forest and public lands, including national parks, are charged with the responsibility to manage their lands for multi-purposes. These include some or all of the following: conservation of indigenous flora and fauna, timber production, water production, and other commercial activities such as apiary, wildflower harvesting, and the oft-quoted, but poorly defined, management for biodiversity.

Management for biodiversity will need to limit the area burnt by high-intensity wildfire. This will require:

- A good knowledge of both biological and built assets at risk;
- The ability to rapidly determine priorities and apply different suppression strategies as required;

- A good knowledge of fire behaviour and the suppression difficulty in different vegetation types;
- Specific training in both fire management and fire suppression; and
- A thorough knowledge of the competencies and experience of all staff and the situations they are qualified to manage.

Management for biodiversity in the future will need to use fire and will require more sophisticated burning prescriptions to achieve specific objectives than those currently in use in most areas. These prescriptions will need to be developed from operational research by the land manager and will require multi-disciplinary expertise.

The knowledge and ability to undertake sophisticated fire management programs will only be achieved if the public land managers take responsibility for fire suppression on land under their control and this responsibility is supported and legislated by government.

Management of multiple objectives can lead to confusion of priorities. Without the legislated responsibility for fire suppression, it becomes too easy to compromise on fire management in favour of other objectives. There are few repercussions on the organisation that fails to assemble sufficient capacity to carry out effective suppression on the majority of fires when any escaped fire can be classified as an emergency.

Firefighting by emergency services has a far simpler objective of doing the best they can to put the fire out. If they fail, they can claim that conditions of fuel and weather were simply beyond human capacity to do anything about it.

Where government and other forest management authorities were to take responsibility for fire suppression and demonstrate this responsibility by effective fuel management, people on the peri-urban fringe would be more likely to understand and undertake fuel management on their properties. Less incentive would exist for local government to set tree preservation orders that result in the build up of unmanageable and dangerous fuel.

Applying prescribed fire

The proper application of prescribed fire is poorly understood. To many people, including volunteer firefighters, plantation owners and land managers, prescribed burning is 'burning off.' It is something they feel anyone can do and all is required is to pick the right day and light the match. 'Light it and see' is used too often. It may be OK for the owner of a small rural property and a farm plantation when the basic principles of prescribed burning are applied: ensuring that the block to be burnt is surrounded by a clear earth firebreak; lighting up under minimal burning conditions when fire is close to self-extinguishing and easy to control; and, mopping-up and patrolling the area until it is completely out.

However, the 'light it and see' approach is fraught with danger when applied to heavy fuels on larger blocks with inadequate knowledge. This was demonstrated in the Kuring-Gai national park disaster on 8 June, 2000. The burn was poorly planned with inadequate maps and a dangerous lighting strategy. Although burning conditions were mild and southerly aspects were too wet to burn, the crew did not use a burning guide or fire behaviour model to predict fire behaviour and failed to appreciate:

- The change in fuel moisture on different aspects and its effect on fire behaviour, resulting in not changing their lighting pattern as they moved from a moist aspect to a drier aspect;

Prescribed burn in the Grampians.
PHOTO: Athol Hodgson

- The rapid increase in fire spread when spot ignitions coalesce to form a line of fire;
- The dramatic increase in spread when the wind direction is aligned with the maximum slope;
- The increase in fire behaviour with increasing slope; and
- The increase in fuel consumption at low fuel moistures.

As a result, four of the crew were killed and three were seriously burnt.

If 500,000ha is prescribed to be burnt each year, the land management agencies have to develop a highly professional fire management section. This section has to develop a rolling planning process that will start up to seven years before each block is burnt. They need to develop prescriptions that, first, predict fire behaviour in different fuel types, then tailor the fire in terms of intensity, fuel consumption and fraction of area burnt. These prescriptions need to be designed to not only reduce hazardous fuels, but also to ensure forest species regenerate, to manage food and habitat for fauna, protect rare species, optimise water yield and quality, as well as cater for the needs of conservation, production forestry, other forest users and recreationists.

A program of prescribed burning is not cheap, but will be offset by cost savings in suppression, which is becoming increasingly costly and is clearly not working. Furthermore, the continuing practical training and assessment to ensure that a stream of people expert in burning will be available in the future will also provide staff who are expert in fire suppression. Today, only the Department of Environment and Conservation in Western Australia has made the investment in scientific prescribed burning that meets multiple objectives and substantially reduces the extent of high-intensity wildfire.

Conclusion

Fuel reduction is essential to reduce the damage done by extensive wildfires and prescribed burning is the most ecologically sound way of doing it. This will not be done, however, unless governments make their land management agencies totally responsible for fires on their land, carry out effective fire management and set an example for other land managers to follow.