

Fire Management in the Kimberley and other Rangeland Regions of Western Australia

**Advice of the Environmental Protection Authority to the Minister for the
Environment under Section 16(e) of the *Environmental Protection Act 1986***

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Strategic Advice Timelines

Date	Progress stages
12 July 2005	Request for advice from Minister for the Environment
21 October 2005	Release of Issues Paper prepared by Dr Jeremy Russell-Smith for the EPA Fire Review Committee for 8 weeks
7-10 and 28-30 November 2005	EPA Fire Review Committee conducts initial round of consultations in the Pilbara and Kimberley regions
19 December 2005	Close of public comment period on Issues Paper
20 March 2006	Initial consultation in Kalgoorlie
22 May 2006	Release of Synopsis and accompanying Appendix for public consultation for 3 months
21 July 2006	EPA Fire Review Committee conducts second round of consultations in Kalgoorlie
27 July 2006	Teleconference with EPA Fire Review Committee and pastoralists
7-11 August 2006	EPA Fire Review Committee conducts second round of consultation in the Kimberley region and Darwin
11 August 2006	Close of public comment period on Synopsis Paper
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The Environmental Protection Authority acknowledges the significant contribution of the following people in preparing this Review.

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Executive Summary

Fire is occurring with alarming frequency in most of the Rangeland regions of Western Australia and particularly in the northern Kimberley regions. Late dry season fires, frequently deliberately lit, are burning many areas almost every year. Massive fires, usually caused by lightning, sweep over large areas of the Inland Arid Region, creating fire scars which persist for many years making the long-term survival of plants and animals difficult.

At the request of the previous Minister for the Environment, the Environmental Protection Authority (EPA) has examined the impacts of fire management in the Rangeland regions on biodiversity and has found the frequency, extent and intensity of fires to be of considerable concern. While the complexities of the interactions between fire and ecosystems are not completely understood; there is no doubt that the implications of frequent, large and intense late dry season fires are serious. The Kimberley studies undertaken to date indicate that native plants and animals are being adversely affected, with some communities (eg rainforest) and species (eg grain feeding birds) facing local and possibly regional extinction. There is sufficient evidence that altered fire regimes are resulting in habitat simplification and degradation, and together with increased predators and herbivores, are implicated in the decline and extinction of medium size mammals in the semi-arid and arid zones.

The EPA considers biodiversity conservation to be a priority for fire management, and second only to protecting human life, to prevent major environmental degradation. Taking into account the available data, the EPA has come to the conclusion there is enough evidence to justify urgent action being taken to prevent further loss of the biodiversity values of the Rangeland regions.

The EPA found there is a considerable body of research, mostly undertaken in the Northern Territory, into the links between biodiversity and fire which indicates a precautionary, adaptive approach should be applied to fire management. If long-term biodiversity decline is to be arrested, fire prevention and planning measures must be instituted immediately, and before more definitive information is available.

The EPA has also examined the impact of fires on human health and found there is growing evidence that bushfires have an impact on human health and in particular can exacerbate existing illnesses such as asthma. Savanna fires were also found to contribute to appreciable levels of greenhouse gases.

A common view from the widespread consultation undertaken by the EPA was that the paucity of fire prevention and fire suppression resources in the north of the State would not be tolerated in the south-west. Unallocated Crown Land, a State Government responsibility, is largely unmanaged, due to a lack of resources.

The EPA considers there are inadequate resources in the Rangeland regions to tackle the problem on the scale required and believes a considerable increase is required to address the situation; recommendations are made on the areas where the EPA believes additional support is required.

In accordance with its terms of reference to recommend ways in which the situation can be improved, the EPA is of the view that unless all stakeholders and parties that have a stake in fire management are involved in, and committed to the process, any attempts at improving fire management are likely to fail. The EPA has recommended measures it considers are required to achieve an improved biodiversity focused fire management regime for the Rangelands and urges on-going financial support to achieve the desired outcomes.

Summary of recommendations

Key Strategic Recommendations

The EPA recommends that:

1. Communication and Planning

A regional Fire Management Committee be established for each of the regions identified in this review:

- **NW Kimberley;**
- **Central Kimberley;**
- **Ord/Fitzroy Valley;**
- **Dampierland**
- **Pilbara/Murchison;**
- **Goldfields/Nullarbor; and**
- **Interior Arid Zone.**

The regional committees should be chaired by an appropriate local representative and have a membership comprising suitable local representatives of:

- **Pastoral industry;**
- **Aboriginal community;**
- **Traditional owners;**
- **Conservation interests; and**
- **Relevant local government.**

Each regional committee to be supported by the relevant agency to provide administrative and technical support. In addition the committee members should be recompensed for their time and expenses.

The regional committees should:

- **Coordinate fire management planning advice, with a key focus on biodiversity, to land managers and responsible agencies throughout the Rangeland region;**
- **Develop a bushfire biodiversity management strategy for the Region that accommodates the interests of all the stakeholders;**

- Assist landowners in the preparation of fire management plans, in which biodiversity and conservation are a key element;
- Provide advice on the availability and provision of fire fighting resources in the region; and facilitate deployment of those resources on a needs basis, particularly when a rapid response is necessary;
- Disseminate the best current knowledge about appropriate fire management practices, with a focus on biodiversity conservation, to fire managers and all relevant stakeholders;
- Provide advice on monitoring requirements; and
- Advise on the development of appropriate communication and education strategies to ensure the community is fully informed about the use of fire in conservation management.

The chairpersons of the regional committees and senior representatives of:

- Department of Environment and Conservation;
 - Fire and Emergency Services Authority;
 - Department of Agriculture and Food;
 - Aboriginal Lands Trust
 - Pastoral Lands Board; and
 - Western Australian Local Government Association
- meet annually to discuss issues arising from the fire management program and policies, and provide advice on future directions and allocation of resources.

2. *Capacity to manage*

- a) Fire management in Western Australia be urgently provided with significantly increased resources.
- b) Increased resources be provided for fire management in Unallocated Crown Land.

3. *Monitoring and Research*

- a) Appropriate ecological monitoring programmes be developed for all WA rangeland regions, the results of which should be used to adapt an appropriate fire management regime for any region if necessary.
- b) Further research be undertaken into more fully understanding the complex relationships between fire and different ecosystems in Western Australia in the different Rangeland regions.

- c) To achieve the above two recommendations, a substantial increase in funding be made available for research and monitoring into how fires impact on biodiversity in the Rangeland regions of WA.

Supporting Recommendations

4. Fire Prevention

- a) There be more flexibility in the prescribed burning programme; and urgent consideration be given to the availability of helicopters, more aircraft and improved on-ground equipment and personnel.
- b) Fire Teams be established in the four Kimberley regions, to facilitate with on-ground burning and suppression as well as undertake other land management measures such as weed control and provide assistance to pastoralists in their land management.
- c) Funding be provided for the Fire Teams, including remuneration, for an initial period of five years; and that a review of the role and performance of the Fire Teams be undertaken in the fifth year, to determine their value and to consider whether operational adjustments might enhance their value.

5. Fire Suppression

Fire suppression measures to protect biodiversity be carried out where possible and when they are likely to be effective.

6. Fire Management Planning

Fire management plans, at property and regional scales, be developed, implemented and audited with advice and support from the regional committees.

7. Fire Management and Biodiversity Conservation

The adoption of an adaptive management approach to ensure that a fixed prescription approach is not used.

8. Human Health

Air quality monitoring is undertaken in Derby and Kununurra by the Department of Environment and Conservation to measure particles of less than 10 microns and less than 2.5 microns concentrations and to assess their potential significance.

9. Other Threats

- a) The Pastoral Lands Board ensures no further introductions of gamba grass in Western Australia.

- b) The Department of Agriculture and Food declares gamba grass as a noxious weed and undertakes the removal of existing plants as a matter of urgency.**
- c) The Department of Planning and Infrastructure and Tourism WA carefully consider the implications of any proposals to upgrade the Gibb River Road particularly as it relates to fire control; and local governments and Main Roads WA consider better roadside facilities, particularly in the Kimberley and Pilbara regions.**
- d) Trials be undertaken on clearing strips each side of major roads in the Kimberley region, to determine whether this is effective in reducing the number of fires started accidentally or deliberately.**

10. *Community Engagement, Communication and Information*

- a) A Bushfire Management Information Strategy to explain current fire management practices to the community, be developed based on a needs analysis identifying key messages and target audiences. Information relevant to WA Rangeland regions should be developed and delivered to the relevant communities.**
- b) Electronic information such as Fire Fax and Fire Watch be made freely available to land owners and land managers; and training in the use of such information be conducted through the regional committees in conjunction with fire management planning.**

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1. Overview

Process and history of review

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on its review of fire management in the Kimberley and other Rangeland regions of Western Australia.

This advice and recommendations are provided to the Minister for the Environment, Mark McGowan MLA, under section 16(e) of the *Environmental Protection Act 1986*, as requested by the previous Minister for the Environment, Dr Judy Edwards. The Minister specifically requested the EPA to provide advice in relation to:

1. *Advise on the environmental impacts of the frequency of fire in the Interior and Northern Regions of WA, with an emphasis on the Kimberley Region, in particular with respect to:*

- *Biodiversity conservation and protection; and*
 - *Protection of environmental health,*
- in the context of the importance of protection of human health, property, assets and infrastructure.*

2. *Consult with key organisations, government agencies, knowledgeable persons and the community as appropriate.*

3. *Make recommendations on ways and means to improve the situation.*

The EPA formed a Fire Review Committee comprised of a previous Deputy Chairman of the EPA and two current EPA members to steer the review. The Committee commissioned and released a paper, *Fire in the Kimberley and Inland Regions of WA – Issues Paper*, prepared by Dr Jeremy Russell-Smith of the Tropical Savannas Management Cooperative Research Centre in Darwin, from October to mid December 2005.

The EPA also formed a Reference Group comprising members across a broad range of interests to provide advice to the EPA Committee as required.

The EPA Fire Review Committee consulted and met with a variety of people and organisations in the Kimberley and Pilbara Regions in early and later in November 2005 and undertook some consultation in the Goldfields Region in March 2006. In addition, twenty-three submissions on the Issues Paper were received from members of the public and government agencies.

The EPA then prepared a document, *Fire Management in the Kimberley and other Rangeland Regions of Western Australia: a Synopsis and Invitation for further public comment*, based on the submissions, consultation and information provided at the public meetings. That paper, and an accompanying Appendix, was released for public comment from 22 May to 11 August 2006. Thirty-one submissions were received, a summary of which is in Appendix 5.

The EPA Fire Review Committee conducted further consultation in the Goldfields region in July and in the Kimberley region and Darwin in August 2006. A teleconference was held with a number of pastoralists in July 2006. All submissions and consultation, together with research into current fire management matters, have been used to assist the EPA in the preparation of this paper.

Key Principles

In preparing this paper, the EPA adopted key principles for the review:

Biodiversity conservation should be the prime objective, after considering the protection of life, for fire management.

In line with the EPA Position Statement No 7 (EPA 2004b), the conservation of biological diversity and ecological integrity is a basic principle of environmental protection, natural resource management and sustainability and needs to be considered in terms of genetic, species and ecosystem diversity.

Biodiversity conservation needs to be applied across all land tenures.

The National Inquiry on Bushfire Mitigation and Management (2004) stressed the need for applying conservation objectives over a large part of the landscape recognising that a system of national parks is insufficient to deliver adequate biodiversity conservation and should be addressed across all land tenures. The Inquiry (2004) cited the National Strategy for the Conservation of Australia's Biological Diversity (1996) that "the conservation of biological diversity is best achieved in situ and requires integrated and consistent approaches across freehold and leasehold and other Crown lands."

Keith *et al.* (2002) stress the importance of developing a framework for conserving biodiversity across a range of land tenures. This is particularly important when a comprehensive, adequate and representative reserve system is not in place (Keith *et al.* 2002) which is the case for much of the Rangeland regions. Only approximately 45% of the EPA's Conservation through Reserves Committee Red Book recommendations for the System 7 (Kimberley region) have been implemented (EPA 1981). The other rangeland regions have fared better with 81% of the Pilbara, 67% of the Murchison, 88% of the Goldfields and 70% of the Deserts/Nullarbor recommendations implemented (EPA 1993). While the Discussion Paper on Biodiversity Conservation in WA (CALM 2004) seeks to achieve a target of at least 15% of ecosystems in legislative protection, only eleven out of fifty-four IBRA regions have achieved that goal (EPA 2006).

Given that a complete system of reserves is unlikely, Hale and Lamb (1997) consider that conservation management outside reserves is essential as the traditional approach has failed because all ecosystems are not represented, many areas are too small for successful management and threatening processes from outside reserves could destroy them. According to the Department of Conservation and Land Management (2004), in its document *Towards a Biodiversity Conservation Strategy* Discussion Paper, landscape scale conservation has to be promoted. This is essential to address major threats such as inappropriate fire regimes and cane toads. The Discussion Paper notes

that a Biodiversity Conservation Bill is being prepared to replace the *Wildlife Conservation Act 1950*. This Bill will include provisions for the protection, restoration and sustainable use of biodiversity.

The Precautionary Principle.

In line with its Position Statement No. 7 (EPA 2004b) the EPA considers the precautionary principle must be applied to any consideration of fire management. This means that lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the case of fire management, the EPA considers the best current available fire management for biodiversity protection should be applied to all rangeland regions and it should be done in an adaptive management framework to advance knowledge.

Importance of engaging the community in fire management.

There are a number of challenges in engaging communities in fire management. The EPA is of the view that unless all stakeholders and parties that have a stake in fire management are involved in and committed to the process, then any attempts at improving fire management are likely to fail.

Key Considerations

Fire can both benefit and disadvantage biodiversity. An ecologically inappropriate fire regime can be a significantly threatening process.

There is growing evidence that extreme fire regimes including frequent fires, very large and intense fires, and in some instances, very long intervals between fires are detrimental to biodiversity. Biodiversity in the tropical savanna region of the north Kimberley is being threatened by frequent, large and intense late dry season fires. Large and intense fires are also threatening biodiversity in other parts of the rangelands, especially those dominated by spinifex (*Triodia* sp.). Indications are that these altered fire regimes are resulting in habitat simplification and degradation, and together with introduced predators and herbivores, are implicated in the decline and extinction of medium size mammals in the semi-arid and arid zones (CALM 2004).

Apart from fire, the EPA notes pressures on the rangelands include grazing, feral animals, weeds and climate change (EPA 2004).

Protection and maintenance of areas of high conservation value should be pursued as a priority.

The EPA recognises that priority should be given to protection of areas of high conservation value that are still in relatively pristine condition. However, every opportunity should be taken to improve degraded areas by appropriate fire regimes and by other measures, such as controlling introduced predators, herbivores and weeds.

Fuel management is the key to reducing the intensity and extent of wildfires; however fire suppression is also important in this context.

The EPA recognises that managing fuel accumulation by the prescribed use of fire is the key to reducing the frequency, extent and intensity of wildfires in all rangeland regions but this has to be applied according to the best available scientific knowledge, including local ecological characteristics, to reduce the risk of adverse environmental consequences. The EPA also recognises fire suppression is important, perhaps paramount, in some parts of the rangelands and needs to be applied in accordance with understanding and knowledge of the fire ecology of that region. Similarly, community education about the wise use of fire has a role in reducing the incidence of large wildfires.

Social change, land use change and changes in population distribution have had, and continue to have, impacts on fire management.

The EPA recognises that in all Rangeland regions considerable social and land use changes have taken place over time, which have had significant impacts on the environment and fire management practices. Aboriginal fire management practices, where still used for hunting purposes near communities, have been considerably modified and may not be appropriate in all situations, but there are valuable insights to be gained and beneficial practices that should be utilised, together with scientific knowledge, in current fire management.

Considerable population and land use changes have occurred in the Rangeland regions since the advent of the pastoral industry which have impacted on fire management. Aboriginal people burnt less of their traditional land when they were employed as stockmen; and their subsequent movement in the 1960s from pastoral stations into towns reduced the labour force to manage fire. In the Kimberley region, more recent moves back to outstations have taken place alongside increased corporatisation of pastoral landholdings; further reducing the number of people working on stations. These various changes have imposed different fire regimes, and necessitated different fire management practices, some of which do not assist biodiversity conservation.

2. *Rangeland Regions*

There are considerable regional differences in the fire environment, due to geographical variation in climate, topography, geology and vegetation. The role of fire and the ways in which ecosystems and organisms respond to fire (fire ecology) will be variable across the Rangelands. No one fire management regime or approach will meet the social and environmental requirements of all regions.

The Rangeland regions of WA constitute 87% of Western Australia's land mass (EPA 2004a). They are areas of considerable physical and biological diversity and are very important to Western Australia for social, economic and environmental reasons. Rangelands are generally areas where climate and rainfall is variable ranging from hot dry deserts to tropical areas in the north with distinct monsoonal wet and dry seasons. The Rangelands coincide with the State's extensive land use zone (EPA 2004a) where the predominant agricultural use, if any, is grazing of sheep and cattle on native vegetation. Large tracts of the Rangelands which are part of the protected area network, are Aboriginal lands or are Unallocated Crown Land.

The Rangeland regions are associated with pastoral activities, mining, horticulture, natural products, conservation, heritage, Aboriginal land management, conservation and tourism (EPA 2004b).

The major economic goods produced in the Rangeland regions include mineral, pastoral and horticultural products, natural products and water supply (EPA 2004a). Mining provides the most significant economic product ranging from gold and base metals in the Goldfields and Pilbara regions, iron ore in the Pilbara and Yilgarn and diamonds in the Kimberley. Pastoral activities are most widespread for the production of cattle, goats and various sheep breeds for meat and wool. Horticultural products are mostly concentrated on the alluvial plains of the Gascoyne and Ord Rivers. There are a range of natural products derived from the plants and animals including sandalwood, honey, native seeds and bush foods (EPA 2004a). Tourism is a major industry and the regions contain considerable heritage sites of both Aboriginal and European significance.

Pastoralism is the dominant land use, covering approximately 42% of the rangeland regions or about 36% of the State's land mass. (See Figure 1). Land tenure is predominantly Crown leasehold or Unallocated Crown Land, with Crown reserves and Native Title determined areas for Indigenous use. (EPA 2004a). At present there are 478 pastoral stations made up of 523 pastoral leases. Ownership is 48% by individuals or families, 29% corporations, 12% Aboriginal corporations, 10% mining companies and 1% private conservation organisations. The Department of Environment and Conservation (DEC), (previously the Department of Conservation and Land Management) has purchased and converted 29 leases and parts of 23 pastoral leases to conservation areas. (Vreeswyk, pers comm.).

Because of the extremely long period of geological stability and the variation in climates, plants and animals have been able to evolve and diversify in relatively small areas. There is an extraordinary richness and complexity and high degree of endemism in the rangeland's biota (EPA 2004a).

Although the Rangeland regions have 80-100% of native vegetation remaining, and a high proportion has the lowest continental stress rating of 6, there are a number of declared rare flora, threatened and priority fauna, and threatened ecological communities (EPA 2006).

Changed fire regimes represent a significant threat to the Rangeland regions. Introduced animals including domestic and feral animals such as camels, goats, donkeys, pigs and horses; weeds; overgrazing and climate change present additional threatening challenges to the biodiversity of most Rangeland regions (EPA 2006).

Fire is an important land management tool in the Rangeland regions. It is used to increase pastoral productivity, protect fire sensitive habitats and culturally significant sites as well as manage woody weeds (Myers *et al.* 2004). Used unwisely, however, fire can impact biodiversity detrimentally. It can lead to declines in flora and fauna, cause soil erosion, increase salinity, reduce water quality and increase weeds and feral populations (Myers *et al.* 2006).

As discussed above, fire regimes are determined by a range of factors and are largely, but not exclusively, driven by climate. Consequently, the Review has divided the Rangelands into 8 major regions based principally on climate and geology. (See Figure 2.) The Kimberley has been divided into 4 regions recognising inherent differences in biophysical characteristics and fire regimes. The following information about the regions is taken from the EPA's *Position Paper No. 5* (2004) and the *Bioregional Summary of the 2002 Biodiversity Audit* (CALM 2003b) and includes a brief description of biophysical characteristics, fire regime, fire management and the impact on biodiversity, where known. Much of the information on the latter is from Radford (in prep.) and most relates to the Kimberley regions.

2.1 North-West Kimberley Region

The NW Kimberley region is composed of the IBRA North Kimberley 1, termed the Mitchell subregion. It has a diverse array of exposed basement strata dissected by rivers and thin sandy soils over sandstone country with significant areas of volcanic and dolerite, laterite uplands and alluvial floors along major river valleys.

Vegetation is composed of tropical eucalypt woodland and grasslands with mangroves, grasslands and rainforest on the coast. Rainforest patches are scattered through the region.

The climate is hot, dry, tropical and sub-humid with high summer rainfall of between 1000 mm and 1400 mm/year (Craig, 1997). Rainfall occurs mostly from November to the end of March with a 'dry season' from May/June to October/November. Towards the end of the dry season, temperatures and humidity increase which is conducive to rapid development of grassy fuels (Fisher *et al.* 2003). Fires often occur on an annual to biennial basis, sometimes started by lightning, but more often by people (Fisher *et al.* 2003). There is only a very small window of opportunity to burn safely on a large scale because of the fuel build-up (Craig 1997).

Geology can influence burning patterns as sandstone and sand substrates support fewer fires than basalt hills which experience the highest fire frequency with relatively few fire-free intervals (Fisher *et al.* 2003, Vigilante *et al.* 2004). Areas such as basalts, black soils and swamps retain moisture until relatively late in the dry season (Radford, in prep.) Land use also plays an important role. The research by Fisher *et al.* (2003), which also covers part of the area of sub-region Central Kimberley, found that the highest fire frequency was associated with pastoral lands and that fire frequency is strongly related to land use. The area is remote and is also subject to extensive, late dry season wildfires.

The main land use uses are pastoral, Aboriginal reserves, Unallocated Crown Land and conservation.

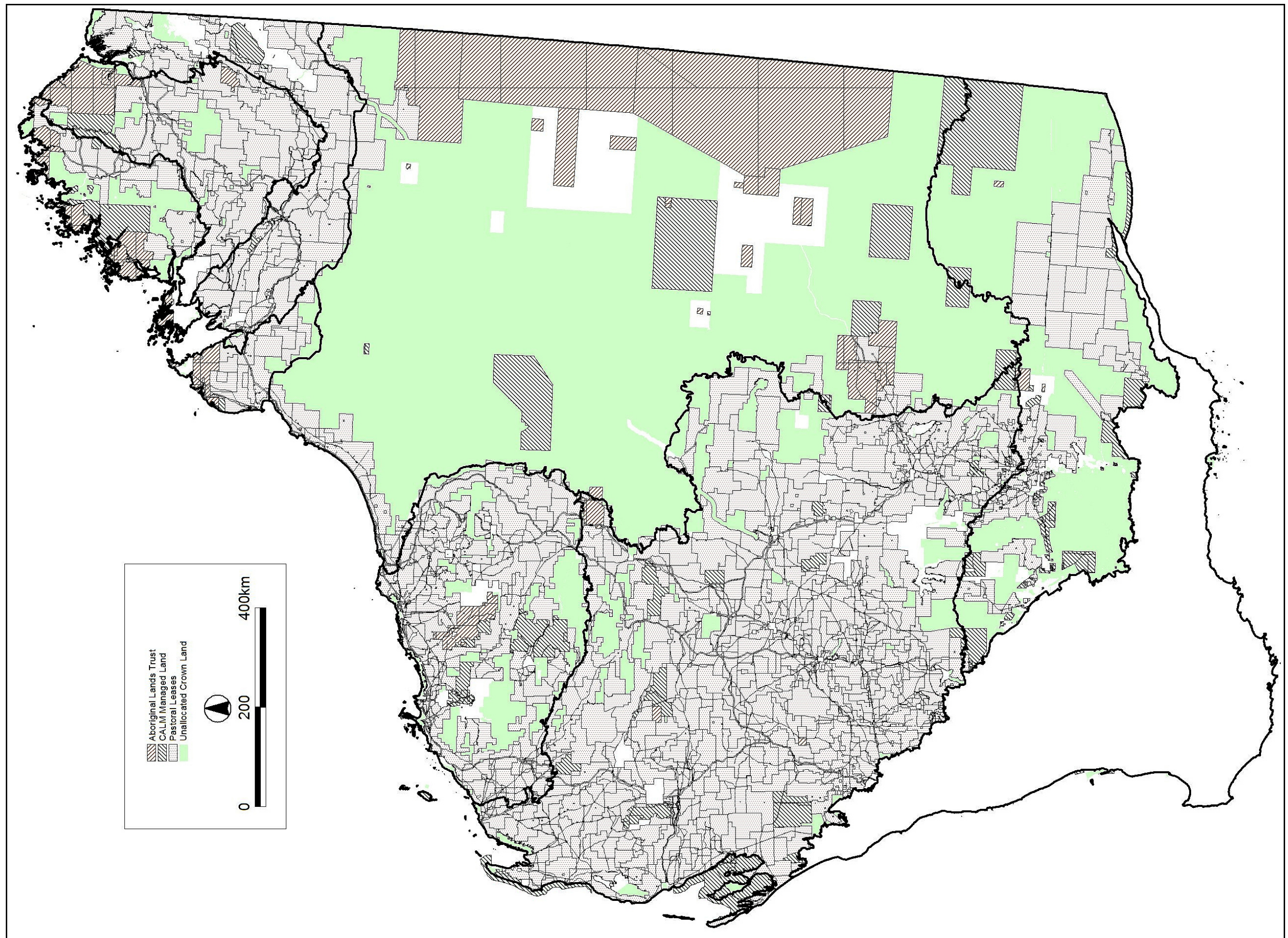


Figure 1: Land tenure in the Rangeland regions.



Figure 2: Regions based on the Interim Biogeographic Regionalisation for Australia (IBRA) regions

Radford (in prep.) has carried out a comprehensive review of research on the biodiversity response to fire in tropical Australian savanna ecosystems and found that the research to date indicates that fire regimes have little floristic effects on most dominant savanna trees but can have significant influence on savanna vegetation structure. Also herbaceous vegetation has been found to be floristically resilient, but increases in *Sorghum* spp. (*Sarga* spp.) are associated with high frequency or intensity of fire regimes. Rainforests are fire sensitive (Radford in prep.) while fires can have a high impact on riparian vegetation (Douglas *et al.* 2003).

Fauna appears to be more resilient to a range of different fire regimes (Andersen *et al.* 2005) but with different responses in some species. As reported previously (EPA 2006), Russell-Smith (2005) considers the simplification of the vegetation would have severe consequences for small fauna with limited home ranges and Graham (2004) identifies several fauna which are now either extinct or restricted to islands or isolated coastal areas. Woinarksi (2005) warns that, while some bird species will increase because of current fire regimes, others will suffer at least regional extinctions.

Research in the NW Kimberley region around Kalumburu by Vigilante and Bowman (2004a&b) found evidence of changes in the vegetation structure and floristics associated with fire frequency. However, the region overall is regarded as still retaining much of its biological integrity despite the pressures of frequent fires (EPA 2006, CALM 2003b, Graham, pers.comm.) and has been identified as a separate region in this Review for that reason.

2.2 Central Kimberley

The region comprises the IBRA Central Kimberley subregions Pentecost, Hart and Mount Eliza and the IBRA North Kimberley subregion Berkeley. The IBRA subregion Berkeley is less dissected than the IBRA subregion Mitchell (in the NW Kimberley region of this review) and is dominated by upland of mainly sandstones supporting open savanna woodland with a few vine thickets (CALM 2003b). Rainfall is high (800-1000mm per year).

The Central Kimberley is hilly to mountainous with parallel ranges of Proterozoic sedimentary rocks. It is dominated by tropical eucalypt woodland/grasslands, tussock and hummock grasslands. The climate is dry hot tropical, sub-humid to semi-arid with summer rainfall between 600 and 1000 mm becoming drier in the south-east and wetter nearer the coast.

Land uses are extensive cattle grazing, traditional Indigenous uses, defence and conservation.

Parts of the region are difficult to access. There is a lack of detailed information about the impact of fires but the region is almost certainly being affected by changed fire regimes (Graham pers.comm.). However, what is known about the region indicates the sandplains, tussock grasslands and rocky uplands are in fair to good condition (EPA 2004) with effects from fires, feral animals and stock.

Evidence from the research and monitoring program at Mornington Station, located in the Pentecost IBRA sub-region, suggests that appropriate managed fire regimes have resulted in a “greater abundance of biodiversity” (Submission to EPA Fire Review).

The results of regular trapping at permanent monitoring sites show that the abundance and species diversity of small mammals have increased since 2004, following both the destocking program and a change in fire management. The submission recognises, however, that it is difficult to determine the separate effects of cattle and fire.

Extensive trapping surveys throughout Mornington Station are also showing that areas experiencing less frequent fires have the highest mammal species densities. These areas are usually protected by the topography, or in habitats that have a large number of micro-refugia. *Callitris intratropica*, a fire sensitive species, is only found in micro-refugia habitats. Some mammals, like ningbing false antechinus and quolls, are only trapped in areas with some sort of fire protection. The abundance of seed-eating birds, including the Gouldian finch, is greatest in the parts of Mornington with a pre-2004 fire history characterised by less frequent, smaller fires.

2.3 Ord/Fitzroy Valley

This region comprises the Ord and Fitzroy River valleys where there has been more development, and fire in conjunction with other threatening processes has brought about significant change at the landscape level. (CALM 2003a)

It is comprised of the Victoria Bonaparte, Ord Victoria Plain and part of Dampierland IBRA regions. The Victoria Bonaparte region extends into the Northern Territory and consists of a number of basins with the highly dissected Victoria River Plateau inland. The Ord Victoria Plain also extends into the Northern Territory and is a relatively level plain with scattered hills. The region near Derby is dominated by the Fitzroy River alluvial plain with isolated ranges.

The climate is more arid apart from the northern part around Wyndham and Kununurra which experiences annual rainfall of around 800 mm/year (Craig, 1997). Rainfall occurs in summer and can be variable.

Land uses are irrigated agriculture, grazing, conservation and Unallocated Crown Land.

Natural vegetation in the Victoria Bonaparte region and Ord Victoria Plain is tropical eucalypt woodland/grasslands and tussock and hummock grasslands with other grasslands and acacia shrublands in the far west. Many natural grasses in the Victoria Bonaparte region have been replaced with agriculture or annual grasslands and bare slopes.

For most of the region, there has been no specific biological survey work apart from those undertaken and published for areas such as Lake Gregory, Mirima National Park; Purnululu National Park and its associated Conservation Park (CALM 2003a).

2.4 Dampierland

Dampierland is the coastal, semi-arid, north-western margin of the Canning Basin. Sandplains cover sandstones and support pindan vegetation on the plains and hummock grasslands on hills.

The climate is hot and semi-arid with summer rainfall. The northern part of the Dampier Peninsula experiences an annual rainfall of up to 800 mm per year.

The major land uses are grazing, traditional Indigenous use and nature conservation. There have been considerable impacts from fire and other development, particularly in areas associated with water (CALM 2003).

2.5 Pilbara

The Pilbara region consists of mountainous ranges and plateaus, dissected by basalt, shale and dolerite gorges, alluvial plains and granite and basalt plains.

The climate is hot and arid with summer rainfall. Vegetation varies from shrub steppes on the plains, hummock grasslands, and tree steppes on the ranges. It also contains acacia forests and woodlands.

The land uses are mining, grazing, traditional Indigenous uses and conservation. The region has many special values - species rich ecosystems, many Aboriginal culturally significant sites and is important as it supports habitat for threatened and endangered species.

Weeds, intense, frequent bushfires, feral animals and grazing have had a detrimental impact on the environment of the region. Extensive fires can occur if cyclones extend into the region in the summer period.

2.6 Gascoyne/Murchison

The Gascoyne region consists of low rugged sedimentary and granite ranges and broad flat valleys. The eastern Murchison region is characterised by internal drainage and extensive areas of elevated red desert sandplains with minimal dune development. The Western Murchison contains the headwaters of the Murchison and Wooramel Rivers.

The Murchison region is dominated by mulga woodlands, hummock grasslands and saltbush shrublands. The Gascoyne region is characterised by acacia shrublands and acacia forests and woodlands. A large percentage of the area consists of rocky uplands and spinifex pastures.

The region has very hot summers and warm winters. Rainfall is erratic and unreliable and is associated with the passage of summer depressions and cyclones which sometimes reach this region.

Parts of the region that are dominated by acacia shrublands and rocky uplands rarely, if ever, experience fire because the vegetation is sparse. These ecosystems are largely independent of fire and can be damaged by even infrequent fire. On the other hand, there are large tracts of grasslands, including spinifex and soft grasses that are flammable. In these ecosystems, appropriate fire regimes are beneficial but inappropriate regimes can cause significant environmental degradation.

The major land uses are sheep and cattle grazing, traditional Indigenous uses and conservation.

The region has a high level of environmental degradation from impacts other than fire, mainly over-grazing by domestic and feral animals.

2.7 Goldfields/Nullarbor

The Goldfields region consists of granite rocky outcrops, low greenstone hills, laterite uplands and broad plains. There are numerous salt lakes associated with ancient river systems. The Nullarbor region is composed of sedimentary rocks on granite rocks. The Nullarbor Plain is a tertiary limestone plain and is the world's largest arid land karst system.

The region has hot summers and low rainfall, usually associated with the remnants of summer cyclones.

The Goldfields region is dominated by eucalypt woodlands, eucalypt open woodlands in the east, other shrublands, acacia shrublands and mallee woodlands. The northern part of the Nullarbor is dominated by mallee woodlands and shrublands and chenopod and samphire shrublands. The Nullarbor Plain is a vast and flat treeless plain supporting a bluebush-saltbush steppe with a fringing acacia (mulga and myall) woodland.

The main land uses are grazing and conservation with a large portion of the area being Unallocated Crown Land.

A high proportion of the Nullarbor's original mammal fauna is extinct and in pastoral areas much of the vegetation cover has been modified partly by grazing and partly through fire, and replaced by grasses and weeds. Land degradation in the Goldfields region has not been as great, however, impacts on vegetation from fire have been substantial. Eucalypt woodlands are fire sensitive and have suffered extensive damage from wildfires, particularly in the summer of 2004/05 (Kealley pers. comm.)

Fires in the region can be extremely detrimental to the natural environment, as vegetation takes many years to recover and extensive fires are difficult to extinguish once started. Hence the emphasis for pastoral purposes is on fire suppression to the fullest extent possible, with a rapid response to any outbreaks. For conservation land and Unallocated Crown Land, this desirable response has not been possible because of insufficient resources, however DEC has recently undertaken fuel load reduction measures and mosaic burns in Unallocated Crown Land to try to create a vegetation mosaic to prevent extensive fires.

2.8 Interior Arid Zone

The interior deserts have been grouped together for this review and include the Great Sandy Desert, Tanami, Little Sandy Desert, Gibson Desert, Great Victoria Desert and the Central Ranges.

There is considerable variation in the subregions from hills and ranges in the Tanami, dominated by hummock grasslands and salt lakes; dune fields and lakes in the Great Sandy Desert with hummock grasslands and samphire shrublands; dunefields in the Little Sandy Desert with associated hummock grasslands and acacia forests; vast undulating sand plains, dune fields, low rocky ridges and uplands in the Gibson Desert with similar vegetation; ranges and sand plains associated with acacia forests and woodlands in the Central Ranges; and dunes and swales with playas in the Great Victoria Desert dominated by hummock grasslands and acacia forests, mallee and eucalypt woodlands.

Many areas have not been surveyed extensively for biological values and knowledge is limited. Areas where surveys have been carried out, for example at Lorna Glen Station which was acquired by DEC in 2000, reveal considerable fauna diversity (Kealley pers.comm.)

Land uses in the interior arid zone are grazing, traditional Indigenous uses and land management and conservation.

Fires in the desert regions have been massive in the past ten years (Kealley pers.comm.) and are largely started by lightning. DEC has commenced aerial controlled burning programmes at the Queen Victoria Springs and Plumridge Lakes Nature Reserves in the Great Victoria Desert in an attempt to provide mosaic burn patterns which should assist in arresting wildfires.

Burrows *et al.* (2006) considers there is overwhelming evidence that the fire regime has changed significantly in the last 50-60 years with the departure of traditional Aboriginal burning. Their data showed that traditional Aboriginal burning resulted in a mosaic of small patches of vegetation at different post-fire (seral) stages. The cessation of traditional burning across much of the landscape has resulted in very large and intense, mostly lightning-caused wildfires. They suggest that, in the absence of definitive scientific knowledge, and consistent with the precautionary principle, there is sufficient evidence of the impacts of the current wildfire regime in the desert regions to warrant applying managed fire regimes that are similar to those in place during the Aboriginal occupation of the land. It is envisaged that working with Indigenous people towards that goal could provide meaningful employment and ensure that traditional knowledge and skills are retained.

3. Fire Management

According to the *National Inquiry on Bushfire Mitigation and Management* (Ellis *et al.* 2004), there is “no way we can ‘fire proof’ Australia, nor should this be our objective.” The EPA agrees, but considers that the impact of fires on biodiversity in the Rangeland regions can and should be reduced with improved fire management.

More fires occur each year in Australia’s rangelands and northern savannas than southern Australia (Ellis *et al.* 2004). Fires in southern Australia can be extremely destructive to lives and property while those in the north are of low to moderate intensity, generally restricted to the grass layer (Andersen, 2005) and do not often threaten lives or infrastructure. However, fires occur more frequently in the rangeland regions and the northern savannas with over 50% of some regions being burnt each year (Russell-Smith 2005) with associated concerns about the impact on biodiversity.

The EPA considers the key to mitigating the extent and frequency of fire in the rangeland regions is to reduce the fuel load by actions such as controlled burning and clearing by hand or grading. Although it would be impossible to prevent all wildfires, the EPA considers their extent and impacts can and should be reduced through the use of appropriate mosaics and/or firebreaks. This approach, along with community education, can assist in controlling fires which have been lit deliberately or accidentally.

Fire suppression, however, should also be considered in all rangeland regions, if adequate resources and access are available. In the Goldfields/Nullarbor region fire suppression plays a more important role and fire preventative measures may be different.

The EPA believes there is considerable information available on how to manage fire for biodiversity; and that it is not being used adequately by current fire managers and land owners. If further biodiversity losses are to be prevented, best fire management practices must be implemented as a priority. This is particularly urgent in the Kimberley region.

The EPA believes fire management planning is crucial and is required at all levels and needs to be developed and implemented as soon as possible. This, and other matters, are explored more fully in the sections below.

3.1 Fire Prevention

The EPA recognises that fuel accumulation and climate in the rangeland regions determines the frequency, extent and intensity of wildfires which have the potential to cause adverse environmental consequences.

Fire prevention, for the purposes of this review, is taken to be measures undertaken to reduce the fuel load in order to reduce the intensity, extent and frequency of wildfires. This can be done in a number of ways; however, given the inaccessibility of much of the rangeland regions of WA, fuel management is generally undertaken through the use of fire, commonly described as prescribed burning. As mentioned in section 3.6, FESA undertakes community programmes which assist in reducing fires. These include targeted bush fire reduction and targeted fire awareness for remote and indigenous communities.

The aim is to achieve a fine scale mosaic pattern of land burnt at different times which will prevent large, hot dry season fires from spreading too far. This is usually done using aerial controlled burning in the Kimberley regions and is also increasingly being used by DEC in the Goldfields region to break up the country and establish burnt fire mosaics. On-ground activities are also undertaken to establish fire breaks. It is essential that fire management planning be undertaken prior to using either aerial or on-ground prescribed burning so that appropriate areas are burnt and at appropriate seasonal times.

The EPA considers there are inadequate resources to undertake an environmentally acceptable prescribed burning programme, particularly in the provision of aircraft. The EPA believes that increased flexibility in this programme is necessary to maximise biodiversity protection and this will be improved through more aircraft being made available at critical time periods. Helicopters could also be useful as the burning could be more precise and hence more effective.

Mornington Station managers advised they use a helicopter for this purpose and are extremely happy with the results. In their experience, the timing of the prescribed burning must remain flexible and can not be subject to a timetable booked months or even weeks ahead. Using a helicopter is, in their opinion, the only option to cover so much country in a very short time window. It was suggested that, while expensive,

the costs could be lowered if neighbouring properties combined their aerial burning work.

On-ground prescribed burning can often be far more precise and is the only way in which wildfires at specific places, such as cultural or rock art sites, can be protected.

One way in which the Aboriginal community could be involved is through the use of Fire Teams. Fire Teams could achieve greater burning precision, provide meaningful employment, address the significant problem of irresponsible lighting of fires and draw on the knowledge of Aboriginal people

The EPA was impressed with the achievements of the teams established under the Kimberley Regional Fire Management Project, as it had prospects of providing meaningful employment for Aboriginal people while drawing on their knowledge and assisting in biodiversity protection. This project, funded through the Natural Heritage Trust, established two Fire Control Teams to undertake on-ground burning and suppression. Reintroduction of such teams would also help to address the significant problem of the irresponsible lighting of fires, a matter drawn to the attention of the EPA committee, including elders of Aboriginal communities.

The EPA does not envisage that such teams would be exclusively comprised of Aboriginal people. Rather, Fire Teams should be constituted to include all sections of the community, and Aboriginal knowledge should be used where appropriate. Aboriginal elders and holders of fire burning knowledge should be encouraged to pass the knowledge on to their younger generation. As well as fire protection and suppression, these teams could be involved in other land management areas such as weed control and provide specific assistance to pastoralists in their land management. The EPA also notes the concerns about the Interior Arid Zone and the need to improve the understanding of traditional fire management practices and it supports the concept of Fire Teams assisting DEC in its work in applying managed fire regimes as described in Section 2.8.

There may be an opportunity for work for Fire Teams associated with offsets for proposals involving greenhouse gas emissions as discussed in Section 6.

Training for Fire Teams in traditional burning methods as well as modern fire and safety techniques will be essential. Ongoing funding is critical and must be maintained once established successfully.

The EPA is aware that not all Aboriginal people can “speak for country” and organisers of Fire Teams, most likely through the relevant regional committee, would need to be cognisant of that and ensure that respective customs are respected.

Similar respect should be given to traditional owners of land and they should be consulted and included, as should all land owners, in total fire management planning and implementation.

The EPA is aware that FESA has developed a number of community engagement programs such as the Remote Indigenous Communities Program. The Fire Teams would not supplant such programs, but would enhance and complement them.

The EPA recommends on-ground preventative burning is used more, in accordance with fire management plans. Considerably increased resources are recommended to enable this to be undertaken. The fire teams recommended above would be a part of that increased resource.

Recommendation

- 1. The EPA recommends that there be more flexibility in the prescribed burning programme; and urgent consideration be given to the availability of helicopters, more aircraft and improved on-ground equipment and personnel.**
- 2. Fire Teams be established in the four Kimberley regions, to facilitate with on-ground burning and suppression as well as undertake other land management measures such as weed control and provide assistance to pastoralists in their land management.**
- 3. Funding be provided for the Fire Teams, including remuneration for an initial period of five years; and that a review of the role and performance of the Fire Teams be undertaken in the fifth year, to determine their value and to consider whether operational adjustments might enhance their value.**

3.2 Fire Suppression

There are completely different ecosystems in the various Rangeland regions requiring quite different fire management responses. In the Kimberley, fires occur on an annual basis given the rapid fuel build-up to very high levels caused by high temperatures and rainfall. They are generally not extinguished unless they threaten life or property given the distances involved and sparse resources. Vegetation growth rates in the Pilbara and Goldfields regions are not so high therefore intense wildfires occur less frequently with gaps of several years between fires. In the Nullarbor region, fires can cause long-term damage to pastures and the environment, leading to a fast-response policy to extinguish any fires as soon as possible.

Suppressing fires can be extremely costly as pointed out in a submission to the Review by a pastoralist regarding a fire in July 2006 on a station south of Halls Creek. The cost of fighting the fire at that stage was estimated to be around \$56,000 with pasture losses of almost \$40,000. Wide firebreaks and overgrazing were suggested as ways which pastoral managers might use to mitigate for such events, although it was recognised this would not be environmentally acceptable.

The EPA was provided with a submission from a Kununurra based helicopter company pointing out the availability of its aircraft and pilots for fire suppression work. This is the type of equipment the EPA considers is needed – flexible, available locally and with the relevant expertise to assist ground crews in fire suppression. Clearly, fire suppression by helicopter can only be used in circumstances where water supplies are readily accessible.

Extensive fires in the Eastern Kimberley in September this year could potentially have been extinguished, according to a letter to the EPA, if helicopters had been used. A

fire near Kachana Station was successfully put out by 4 people using a helicopter and backpack sprays and the question was posed as to why such equipment had not been used to fight the fires which burnt the Carr Boyd Range near Kununurra. The EPA was also advised there are experienced helicopter pilots available in the East Kimberley who could also perform such work.

While acknowledging that fire prevention through reduction of fuel loads and establishment of firebreaks must be the primary management approach, the EPA considers that, when wildfires occur, the opportunity for fire suppression should be carefully evaluated on a case by case basis, taking into account biodiversity protection as well as life and property when weighing up the costs and benefits of such actions.

Recommendation

The EPA recommends that fire suppression measures to protect biodiversity be carried out where possible and when they are likely to be effective.

3.3 Fire Management Planning

The EPA considers that, after the protection of life, the protection of biodiversity is paramount. The EPA believes this can be achieved despite what appears to be conflicting land uses, because broad land management objectives can co-exist. For example, burning by pastoralists in mosaic patterns can benefit biodiversity as well as promote productivity.

Given the complex interactions between ecosystems and fire, the EPA believes fire management planning is critically important even if a complete understanding of the impact of fire on ecosystems is not available. The EPA is concerned that it found scant evidence of fire management plans in any of the Rangeland regions, apart from a few such as those developed for Bow River Station, and the Mornington Station which is managed by the Australian Wildlife Conservancy.

The EPA accepts that pastoralists, as a matter of course, incorporate fire management into their planning process, based on a knowledge of the land and past burning practices. Nevertheless, the EPA is concerned there is no record of management plans to guide and inform future actions and directions, and provide an historical record. Furthermore, it is difficult to produce a regional plan without having the property plans as building blocks.

The EPA considers fire management planning is essential at all levels, at regional, sub-regional level and also at the property level. A regional plan would provide strategic aims and the obligations of land managers while local management plans would be more detailed and specific. The EPA considers Regional Fire Management Committees (section 3.6) could undertake regional fire management plans and that all land owners and managers should prepare property plans, with the assistance of the relevant regional committee.

Some agencies have prepared useful guidelines which can assist in the use of fire for biodiversity-focused planning. Examples are fire management guidelines for the Kimberley, Southern Shrubland and Pilbara Pastoral Rangelands (DPI, 2005a & 2005b) and draft principles and strategies for fire management in savanna landscapes

of the Kimberley and also landscapes dominated by spinifex grasslands in the arid interior of WA (CALM, 2005 & 2006).

The EPA was provided with an excellent synopsis by the Macquarie University researchers of what management plans might include. The Macquarie University's submission's management planning section is included in full in Appendix 5, Summary of Submissions, and the EPA recommends this be considered for use by the proposed regional committees. A synopsis is provided here.

The researchers assessed a number of fire management plans written for other parts of Australia (Wilson 1999; James and Bulley 2004), and planning guidelines written for the development of fire management and management for biodiversity conservation (Saunders and Hobbs 1995; Rose *et al.* 1999; Keith *et al.* 2002).

The researchers stress that fire management plans need to have measurable goals, the flexibility to deal with random events and accommodate new knowledge, a means of resolving management conflicts, and a means of assessing performance and incorporating this into future management (Keith *et al.* 2002).

Fire management plans should contain: the definition and setting of clear objectives and the likelihood of achieving those objectives; fire regimes, works schedule, and monitoring and review processes.

The EPA considers the potential for wildfires has to be factored into fire management planning using the most up-to-date scientific information as discussed in Section 3.4. The *Emergency Management Act 2005* provides a legislative means to ensure preparations are made to prevent wildfire incidents as well as the recovery and restoration of the environment following such an event.

Recommendation

The EPA recommends that fire management plans, at property and regional scales, be developed, implemented and audited with advice and support from the regional committees.

3.4 Fire Management and Biodiversity Conservation (This section is reported more fully in Appendix 3.)

The *National Inquiry on Bushfire Mitigation and Management* (Ellis *et al.* 2004) reported that inappropriate fire regimes have been recognised as potentially threatening to the conservation of biodiversity and that popular perceptions have focused on high intensity fires because there is considerable visible damage caused by such fires. There is growing evidence, however, that fire frequency is more important than fire intensity, particularly in northern Australia. There is increasing support for substantially increasing the extent of relatively long unburnt habitat (Andersen, 2003, 2005) and for a diversity of fire regimes.

The *National Inquiry on Bushfire Mitigation and Management* concluded that biodiversity is best protected by a mosaic of fire regimes in the landscape. This was described as a mosaic of fire ages with some patches rarely burnt, others more frequently, some in each season, some small, some large, some high intensity and some cooler.

The most frequently used fire management regime in WA is one of low intensity prescribed fires in the early dry season. This does not appear to be effective, however, in preventing the incidence of extensive, late dry season fires, particularly in the Kimberley region. Such fires, which also occur in the Interior Arid Region, burn many areas every 1-2 years.

The Northern Territory Kapalga fire experiment undertaken by the CSIRO (Andersen *et al.*, 2003) examined how biodiversity responded to different fire regimes over a period of 5 years between 1990 and 1994. Overall, the experiment concluded that different plants and animals are affected in different ways by different ways of burning but that it would be better if less country was burnt each year. Andersen (1999) argues that the Kapalga experiment generated surprising results which challenge some accepted beliefs about ecological responses to fire management in northern Australia.

The Kapalga experiment also revealed fire management regimes, particularly catchments burnt in the late dry season, can result in significant changes to riparian vegetation and increased stream biodiversity (Douglas *et al.* 2003).

One of the conclusions from the Kapalga experiment is the importance of avoiding habitat homogeneity and of management at the landscape level so that losses in one area can be traded off against gains in another. However, working out an appropriate fire regime for an area or a region is not easy. Research supports the idea that Aboriginal burning created a fine-scale mosaic of burnt and unburnt areas and indicates it created rich and abundant plant and animal populations (Bowman *et al.* 2004; Bowman and Prior 2004) but do not support the widely held view that Aboriginal burning was focused primarily in the first half of the dry season.

Recent research (Prior *et al.* in press) cautions that frequent, early dry season fires that have become a management goal in much of northern Australia should not be emphasised too much because it does not mimic Aboriginal burning as is claimed.

The importance of setting clear targets for the maintenance of biodiversity at the landscape scale is stressed by Andersen (2005) although he recognises this will be hard to achieve given the differing value systems of different stakeholders.

Andersen *et al.* (2003) believe that the results of the Kapalga experiment in the Northern Territory demonstrate that key components of the biota prefer habitat which has been unburnt for a number of years. The findings pose a challenge for the tropical savanna areas because it is unlikely to be met using the current fire management techniques. Cook (pers.comm.) recommends that a management action for the savanna areas should be to increase the area remaining unburnt for 5 or more years to at least 10% at any given time.

Andersen (2005) believes further research should focus on the ecological significance of different fire-free periods to determine the ideal length of time that different areas should be free from fire. The 'Burning for Biodiversity' project, established in 2004, in the Territory Wildlife Park near Darwin will examine this issue through subjecting 18 hectare size plots to different fire regimes.

The comprehensive review by Radford (in prep.) outlines the complex interactions within ecosystems and how difficult it is to tease out the mechanisms behind fire responses. Radford’s work highlights the complexities of burning for biodiversity protection and emphasises that much is not yet fully understood. In the absence of perfect knowledge, Radford suggests prescribed burning to reduce overall fuel loads should aim to produce small areas of incomplete burns of different vegetation types, topography or geology.

Andersen (1999) urges the adoption of an adaptive management approach rather than a ‘command and control’ system where the focus is on producing arbitrary yields or on applying fixed prescriptions. He believes that fire managers in northern Australia have become preoccupied with the implementation of particular burning patterns rather than developing a strategic vision which would benefit biodiversity. He argues that effective ecosystem management aims to maintain the diverse and dynamic ecosystems that underpin sustainable landuse. Andersen also concluded (1999) that no particular fire regime was beneficial to the entire region’s biota but should instead be considered on a strategic basis with land management objectives clearly articulated before any particular fire management was adopted.

Figure 3 shows an adaptive management approach in which clear objectives determine performance indicators which can be used to assess management. Management prescriptions can be refined according to the feedback from monitoring.

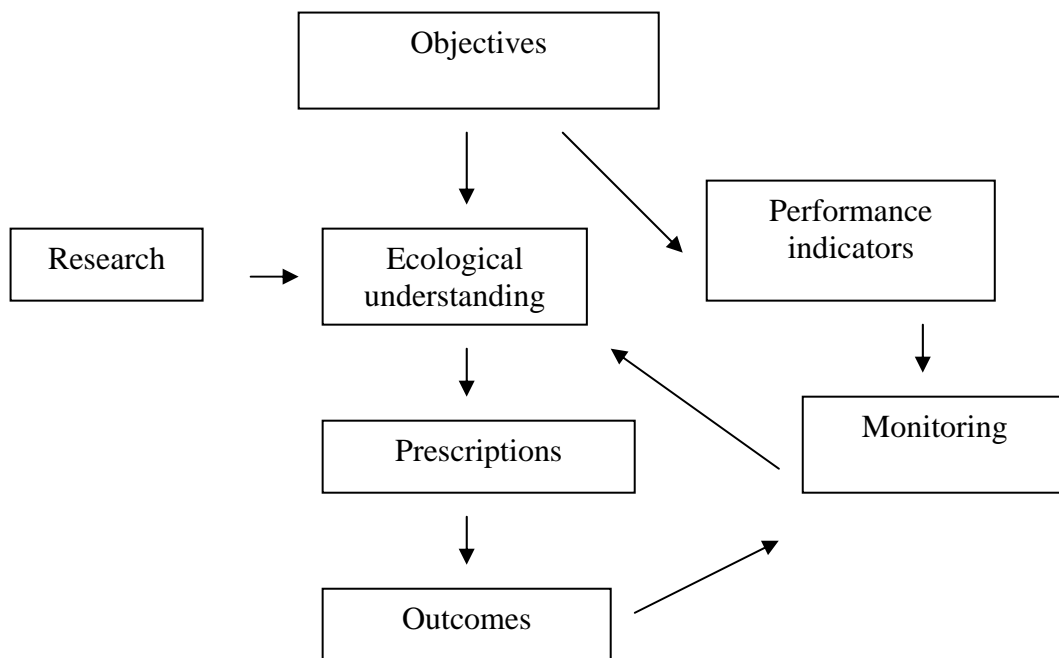


Figure 3. Schematic of adaptive management. (Andersen 2003)

The EPA believes the current fire management approach in much of Western Australia’s Rangeland regions more resembles the “command and control” approach than the development of a strategic vision beneficial to biodiversity. The EPA considers such a vision is vital in Western Australia.

The EPA is of the view that, while there are still considerable gaps in understanding how fire impacts on biodiversity and much work yet to be done, there is enough information available to inform an adaptive fire management approach, and that this approach is essential in WA.

Recommendation

The EPA recommends the adoption of an adaptive management approach to ensure that a fixed prescription approach is not adopted.

3.5 Community Engagement

It became clear to the EPA committee during its consultations that fire management would not improve without the full involvement of all the relevant stakeholders. This is particularly the case in the Kimberley, but applies to all the Rangeland regions.

The EPA committee was impressed by the fire management arrangements in the Nullarbor region. The Shire convenes a pre-fire season meeting involving pastoralists every year around July and early August to discuss strategies and deployment of fire fighting resources, based on fuel loads and fire risk. This may currently operate well because of good relationships amongst the participants and because the fire suppression regime is less complex. However, this type of community-focused arrangement could be formalised and further developed in other regions.

With clear direction, clear leadership and full community participation, fire management is likely to improve. The EPA considers that dialogue between the various stakeholders is vital and is achievable through the coordinating committees recommended in the section 3.6.

The importance of such engagement is a central concern of a report to the Australian Government (Myers *et al.* 2004) about fire management in the Rangelands generally. The report stresses the importance of all interested parties in building capacity within the community. For successful capacity building, the report suggested there needs to be:

- Genuine collaboration between the external organisations and communities;
- A high degree of support from and participation by the community;
- Close coordination of the process; and
- An ability to work with the community's culture and processes.

The EPA committee found a willingness within most communities in the Rangeland regions to build capacity and cooperation between all parties.

Sections of the community the EPA particularly believes must be fully engaged in fire management are Aboriginal people and traditional owners. This was supported overwhelmingly by submissions to the Review and is particularly applicable to the Kimberley region. The reasons for this are that Aboriginal people form a high proportion of Rangeland populations, in the case of the Kimberley region over 50%, and are a valuable source of information and expertise. Burgess *et al.* (2005) examined the health benefit of Indigenous involvement in natural resource management in the NT and found that Aboriginal people believe that continued

association with and care for their traditional country is a key determinant of health. Social benefits can be obtained by including Aboriginal people in natural resource management and the study concluded that it would also provide a vehicle for biodiversity conservation.

The Healthy Country: Healthy People programme introduced in the Northern Territory and discussed more fully in Section 4, Human health, found that the project has implications for natural resource land management including traditional fire practices and involves the Aboriginal perspective on what constitutes healthy country. Additional benefits were opportunities for increased physical activity, better diets and improvements in self-esteem (Burgess *et al.* 2005).

One way in which the Aboriginal community could be involved is through the use of Fire Teams. This is discussed more fully in section 3.2.

3.6 Governance

The EPA addressed governance at length in its Synopsis paper (EPA 2006) because it believes it is a critical and central issue for the review. Biodiversity will not be adequately protected unless fire management is approached in a coordinated way across all land tenures, all land managers and all land systems. As there are multiple landowners with differing land management objectives, and different agencies involved in land management, there is a need for improved coordination and collaboration.

The EPA found that fire management arrangements are fragmented and confusing for people in most Rangeland regions, but particularly so in the Kimberley region. This was discussed in the Synopsis paper (EPA, 2006). There is a lack of fire planning, a general lack of coordinated fuel reduction measures as well as confusion about responsibility for fire suppression. Many in the community expressed concern about the reduced numbers of birds and animals which they felt was linked to poor fire management and there was considerable distrust about how some government agencies conduct fire management. There are perceptions in the community that all fires are bad and should be stopped, as well as a misunderstanding about fire management measures, particularly the purpose of fuel load reduction measures.

The EPA notes that, under existing fire legislation, local government is legally responsible for fire management for most of Western Australia outside the fire gazetted districts of cities and towns. The EPA also notes that local government does not adequately undertake its legislative role, largely due to a lack of resources in terms of human resources, capacity and equipment. This is particularly relevant for the obligations and powers which authorise the taking of measures to prevent the outbreak of bush fires. These preventative measures include making a firebreak or abating a fire risk and include the use of fire by burning areas to prevent the outbreak of uncontrolled fires. The EPA also notes that FESA has taken over some of those responsibilities, particularly with regard to aerial controlled burning on pastoral lease properties.

FESA performs those functions under s35 of the *Bush Fires Act 1954* and s11 of the *Fire and Emergency Services Authority of Western Australia Act 1998*. The *Emergency Management Act 2005* allows for the prevention of and preparation for

incidents on a large or catastrophic scale. The EPA notes that FESA's primary role, for which its professionalism and competence is recognised, is in fire suppression and in protecting life and property. Extension of this role into fire preventative measures could be argued as legitimate in the interests of protecting life and property.

DEC (previously CALM) takes responsibility for fire management on land under its control, including Unallocated Crown Land, as part of its land management and biodiversity conservation functions; an arrangement which the EPA believes should continue. Responsibility for the protection of biodiversity outside land managed by DEC is less clear and requires different competencies, not resident in FESA.

The Community Development and Justice Standing Committee presented its report on the review into fire and emergency legislation to Parliament on 19 October 2006. The committee examined and made a number of recommendations about improvements it considers are required in fire and emergency arrangements in Western Australia, including one that fire management planning should be compulsory to ensure consistency and application Statewide (Western Australia Parliament 2006). The EPA also considers fire management planning to be necessary to protect biodiversity; this issue is discussed in Section 3.3.

The EPA found overwhelming support in all its consultations with the community and stakeholders for changes to governance to clarify the existing confusing situation, particularly in the Kimberley region (see Appendix 5 for report on submissions.) The EPA considers there is adequate knowledge, expertise and willingness within the community and with stakeholders to undertake proper fire management in the Rangeland regions but that it needs coordination and cooperation because no one agency has all the competencies; expertise and local knowledge to carry out fire management adequately on its own.

FESA has considerable expertise in fire matters generally, supported by a State-wide network. The Authority has devoted considerable effort, and is increasing its effort, to reduce fires through its various programmes such as strategic pastoral station bush fire management in the Kimberley, visual fuel load guides, targeted bush fire reduction, targeted fire awareness for remote and Indigenous communities and the Bush Fire Mitigation Programme. However, its emphasis is appropriately on protection of fire and property and in the case of the pastoral industry, on productivity. Protection of biodiversity is not included in its legislative requirements, nor is it well equipped to undertake this role.

DEC is responsible for fire management in land under the control of the Conservation Commission as well as the critically under-resourced Unallocated Crown Land which covers a very large percentage of the State. The EPA considers DEC must have a formal role in any governance arrangement, as it has the specialist biodiversity knowledge as well as the prime responsibility for conservation in Western Australia.

It seems unlikely that local governments will be able to undertake fire management to protect biodiversity unless their resources were massively increased, although it remains an important stakeholder and there are some dedicated officers working in that area.

The EPA is also concerned about FESA's advice that in 2004, local governments in the Kimberley refused to issue FESA with 'permits to burn' and s11 of the *Fire and Emergency Services Authority of Western Australia Act 1998* was used (Submission to the EPA Fire Review). At that time Crown Solicitors Office advised that FESA did not legally require local governments' 'permits to burn'.

While FESA received considerable support for its operation in some of the regions, particularly the Pilbara and Goldfields/Nullarbor, there was less enthusiasm among the Kimberley community. It is also of concern that FESA has advised that it had unsuccessfully sought the cooperation of the local authorities in creating Bush Fire Advisory Committees in the Kimberley.

It is interesting to examine the Northern Territory governance model. The NT Bushfire Council was established as a statutory body to advise the Minister for Natural Resources, Environment and Heritage about measures to be taken to prevent and control bushfires throughout the NT. Council members include pastoralists, Aboriginal communities, primary industries, CSIRO and the Bureau of Meteorology. There are also government representatives, including the Chief Fire Control Officer who is an employee of the NT Government. There are 10 Bushfire regions with the chairperson of the region committee being a member of the Council.

The Bushfires Council is responsible for fire management within approximately 99% of the Territory, with the exception of the Emergency Response Areas around major urban centres which are the responsibility of the Northern Territory Fire and Rescue Service.

The Minister appoints the Chairman and Members of the Bushfires Council for a three year term of office. Under the *Bushfires Act* the minimum membership is nine, with the maximum being at the discretion of the Minister. The current Council has a membership of 17. The full Council meets twice a year at various locations in the Northern Territory. For each Regional Committee, there is a government officer who works out how the programme will be delivered and assists pastoralists in the preparation of management plans (Duff pers.comm.)

Bushfires NT is within the Department of Natural Resources, Environment and the Arts and is responsible for implementing the *Bushfires Act* and supporting landholders with fire mitigation. The 24 staff of Bushfires NT and the 23 staff of the NT Bushfires Council, are part of the Department of Natural Resources, Environment and the Arts; and are located throughout the Northern Territory.

A number of roles are carried out by the Bushfires NT staff including policy, research, equipment subsidy and maintenance programs, education and training, administrative support and volunteer brigade support. Much of the research carried out is a collaborative effort between Bushfires NT (BFNT), Tropical Savannas CRC, National Heritage Trust (NHT) and other Commonwealth bodies.

The figure below shows the relationship between the Bushfires Council and landholders in the Northern Territory (Anderson 1994).

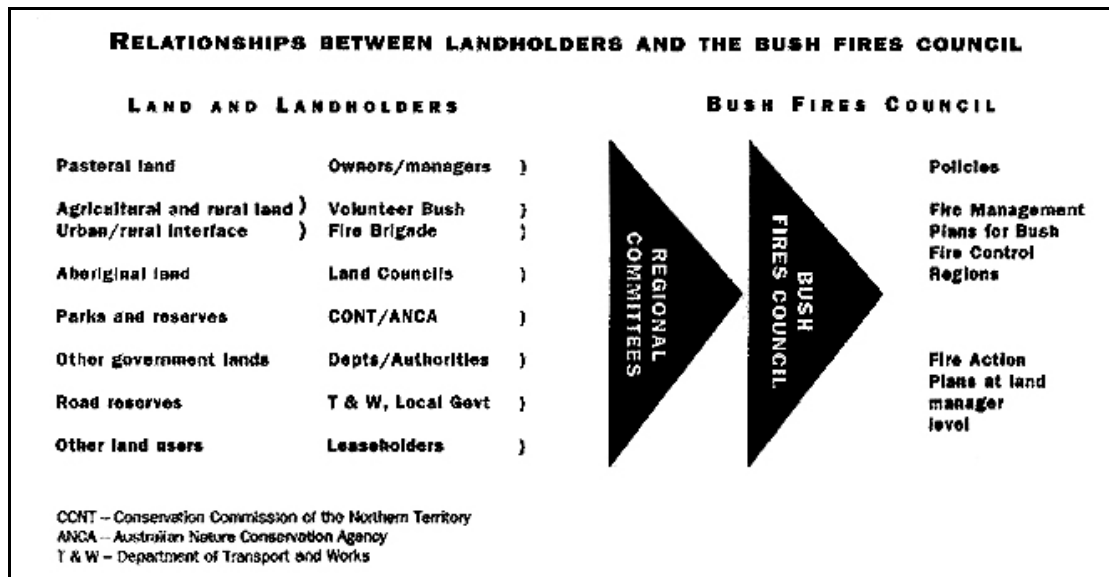


Figure 4: *The Northern Territory Bushfire Council's role in fire protection and management, emphasising the importance of landowners and managers in the overall scheme.*

The WA Government is a signatory to the *National Strategy for the Conservation of Australia's Biological Diversity* (DEH 1996) which recognises fire as one of the threatening processes that can have a negative impact on biological diversity. Fire is also a land management issue.

The EPA again notes that its key principles included the need for biodiversity conservation to be applied across all tenures, and the need to have all stakeholders involved in and committed to the process. It therefore believes that the governance arrangements must comprehend both of those requirements.

Earlier in this section it was commented that FESA has considerable expertise in fire matters, but that it needs to be assisted in regard to biodiversity and other environmental aspects. The EPA considers that the Department of Environment and Conservation must be specifically included in the governmental arrangements for fire management. It is worth noting that, while this advice is for the Rangelands, any such arrangement should apply to the whole of Western Australia.

There remains the need to consider ways in which stakeholders in the Rangelands regions can be explicitly involved in fire management planning, practice, and communication in their region. The arrangements in the Northern Territory have considerable attraction, particularly in regard to resources, independence and accountability. Setting up a statutory body would initially cause delays and it could well be argued that such an arrangement is unnecessary to achieve the desired outcomes.

The EPA has concluded that its objectives will be achieved by establishing regional committees in each of the eight regions with a primary responsibility of developing regional fire management plans. Further, the EPA considers it would be vital to bring the chairs of each committee and the various government agencies together on an

annual basis. This could be likened to a Bushfire Council. The committees would, however, have to be independent and adequately resourced for this approach to work. In addition, there would need to be an agency given the responsibility of administering these committees and providing the appropriate resources, including expertise. The consultative provisions of the *Fire and Emergency Services Authority of Western Australia Act 1998* and the *Bush Fires Act 1954* can provide the legislative means to form the regional committees.

Appropriate resources would have to be provided to support the committees including the provision of secretariat facilities so that they can undertake the duties outlined below. The committees must be independent and not be controlled by any one agency. An example of how this might work administratively is the EPA itself whose services are provided by the EPA Service Unit, housed administratively in the DEC, but not directed by the DEC.

To provide the broader context, to consider generic issues relating to fire management and conservation of biodiversity, and to provide advice on level and allocation of resources, it is suggested that the chairs of the regional committees and senior representatives of the relevant departments and agencies meet on an annual basis.

Recommendations

The EPA recommends that:

1. A regional Fire Management Committee be established for each of the regions identified in this review:

- **NW Kimberley;**
- **Central Kimberley;**
- **Ord/Fitzroy Valley;**
- **Dampierland**
- **Pilbara/Murchison;**
- **Goldfields/Nullarbor; and**
- **Interior Arid Zone.**

The regional committees should be chaired by an appropriate local representative and have a membership comprising suitable local representatives of:

- **Pastoral industry;**
- **Aboriginal community;**
- **Traditional owners;**
- **Conservation interests; and**
- **Relevant local government.**

Each regional committee to be supported by the relevant agency to provide administrative and technical support. In addition the committee members should be recompensed for their time and expenses.

The regional committees should:

- **Coordinate fire management planning advice, with a key focus on biodiversity, to land managers and responsible agencies throughout the Rangeland region;**
- **Develop a bushfire biodiversity management strategy for the Region that accommodates the interests of all the stakeholders;**
- **Assist landowners in the preparation of fire management plans, in which biodiversity and conservation is a key element;**
- **Provide advice on the availability and provision of fire fighting resources in the region and facilitate deployment of those resources on a needs basis, particularly when a rapid response is necessary;**
- **Disseminate the best current knowledge about appropriate fire management practices, with a focus on biodiversity conservation to fire managers and all relevant stakeholders;**
- **Provide advice on monitoring requirements; and**
- **Advise on the development of appropriate communication and education strategies to ensure the community is fully informed about the use of fire in conservation management.**

The chairpersons of the regional committees and senior representatives of:

- **Department of Environment and Conservation;**
- **Fire and Emergency Services Authority;**
- **Department of Agriculture and Food;**
- **Aboriginal Lands Trust**
- **Pastoral Lands Board; and**
- **Western Australian Local Government Association**

meet annually to discuss issues arising from the fire management program and policies, and provide advice on future directions and allocation of resources.

4. *Human Health*

As discussed in the Synopsis document (EPA 2006) people in the Rangeland regions do not consider bushfire smoke to be a health issue. Interestingly, after the first visit to the Pilbara and Kimberley regions, one person had questioned people in the Derby area and subsequently advised that asthma and hay fever sufferers in that area reported being affected by smoke from bushfires. Perhaps it was the increased awareness associated with the review, but more people said in the second consultative round that smoke could be a health issue in the Kimberley region.

The EPA reported on research carried out in Darwin (Johnston *et al.* 2002) in its Synopsis document (2006) where it was found that there is a strong relationship between respirable particles and hospital attendance. The EPA Committee discussed

this and further research being conducted in Darwin on the associations between bushfire smoke, fire management and human health with the researcher.

Darwin is affected more by bushfire smoke than most Rangeland regions in Western Australia because of prevailing winds from the south-east. The population is also larger. Because pollution in Darwin is caused primarily by bushfire smoke (95%) as opposed to traffic and industry (5%) (Johnston, pers comm.) research on the impacts of bushfire smoke is comparatively simpler than in most southern Australian cities.

Results of the most recent research in Darwin will be published later this year. What is interesting about the findings (Asthma Update, 2006) is that there is a clear association between exposure to bushfire smoke and the onset of asthma symptoms and the increased use of medication, and this occurs well below current air quality standards. The research, conducted for seven months during the dry season of 2004, found statistically significant associations between smoke pollution levels and certain health aspects. It was found that approximately 5% of participants experienced worsening of their asthma symptoms when there were higher levels of particulate pollen even though air quality guidelines were not breached.

In the case of the Kimberley regions, it is possible this is also occurring as there is constant smoke haze present in much of the dry season; however, the air quality has never been tested in those towns. Although one submission pointed out that smoke had not been identified as an issue by a qualified authority, the EPA considers that air quality monitoring equipment should be installed in selected locations to determine if particulates similar to those reported in Darwin are present. The most suitable locations for such monitoring are Derby and Kununurra which have reasonable size populations and experience smoke. Broome's sea breeze usually blows any smoke from bushfires inland so monitoring would not be necessary in that town.

People in the Darwin area appear to be more aware of smoke as an issue (Parr 2006) than people in the northern rangeland regions of Western Australia, which is probably related to the fact that the Darwin region is strongly affected by smoke and haze during the dry season.

It was also pointed out that Aboriginal people are more vulnerable to bushfire smoke because of their low general health (Johnston, pers comm.) A current project run by Charles Darwin University, *Healthy Country: Healthy People*, is examining the link between landscape health and Aboriginal health. The project has implications for land management including fire ecology and involves the Aboriginal perspective on what constitutes healthy country. Preliminary findings (Charles Darwin University Healthy Country: Healthy People Electronic Newsletter 3, February 2006) are that the country and the people need each other. Further research will determine if improved ecological health is reflected in the health of Aboriginal people who return to their country.

Recommendation

The EPA recommends that air quality monitoring is undertaken in Derby and Kununurra by the Department of Environment and Conservation to measure

particles of less than 10 microns and less than 2.5 microns concentrations and to assess their potential significance.

5. Monitoring and Research (This section is more fully reported in Appendix 4)

As reported in the Synopsis document (EPA 2006) the majority of research relating to rangeland systems has been conducted in the Northern Territory. Neither site-specific nor temporal landscape-scale research has been undertaken into the impact of fire on flora and fauna in Western Australia to the same extent as in the Northern Territory. Results from landscape-scale research such as the Kapalga experiment (Andersen *et al.* 2003), are applicable to the Kimberley region but regionally specific research which would inform localised management decisions is fairly sparse.

There is a view that further research is not required, with enough information already available about the effects of fire. The EPA agrees there is a substantial body of information available from research and that this should be used to enhance fire management, but considers that further studies of the complexities and interactions in ecosystems specifically for WA would be beneficial. This must not delay action to improve fire management and adoption of an adaptive management approach

There is some research proposed for WA announced recently by the Government (McGowan 2006). The project will investigate fire regime history and some of the ecological effects in the Kimberley region, the results of which will assist in determining the ecosystem responses to the DEC planned burns.

Other research projects include determining curing rates of grassland specific to different landscapes; species response to fire; the role of fire mosaics in biodiversity processes in Kimberley mammal ecology and a study into critical weight range mammals, fire and feral animals.

There were a variety of suggestions about the types of research which could assist good fire management in WA, including more baseline flora and fauna data; determination of the effectiveness and optimum size for mosaic burns; the importance of land that is 'long unburnt' and the relative effectiveness and impacts of early dry season burning. Other research which could be undertaken include the ecology of fire sensitive species, interactions between fire and weeds and the traditional knowledge of plants and animals vulnerable to fire.

Priority should be given to the Kimberley region because of the critical situation which has been identified in this Review. However, the requirement for more research applies to all Rangeland regions as this would better inform land managers and owners about the impacts of their fire management and how it can be improved to protect biodiversity.

The EPA considers that FESA's suggestion for a process to get research, published and unpublished, into the appropriate non-biodiversity organisations and forums for integration into agency policy and practices has merit and should be undertaken.

As discussed in the Synopsis document (EPA 2006), monitoring is an essential part of any research programme and should be applied to fire management regimes. Allan *et*

al. (2001) stresses the importance of monitoring and recording the effects of fire management, and then making those records accessible to have lasting benefit. Monitoring can be achieved in a variety of ways including on-ground, using aerial photographs and satellites.

Monitoring on a landscape scale will enable adaptive processes to be put in place (Myers *et al.* 2004), however, the cost of monitoring can be high and it is suggested has not been undertaken effectively at a landscape scale in Australia's Rangelands.

Andersen (2003) considers that, although NT fire-mapping services are excellent, ecological monitoring programmes are less well developed. WA is some way behind the Northern Territory in all of these areas and the EPA considers appropriate monitoring programmes need to be commenced as soon as possible so that adaptive fire management can be used to properly protect biodiversity, among other uses.

The EPA believes there should be a realistic budget for this work as substantial funds will be necessary to carry out relevant research and undertake monitoring in all regions and ecotypes.

Recommendations

The EPA recommends that:

- 1. Appropriate ecological monitoring programmes be developed for all WA rangeland regions, the results of which should be used to adapt an appropriate fire management regime for any region if necessary.**
- 2. Further research be undertaken into more fully understanding the complex relationships between fire and different ecosystems in Western Australia in the different Rangeland regions.**
- 3. To achieve the above recommendations, a substantial increase in funding be made available for research and monitoring into how fires impact on biodiversity in the Rangeland regions of WA.**

6. Other Threats

The EPA is concerned about other threats, including threatening processes, which complicate the issue of fire management, particularly in the Kimberley region. Those include weeds such as buffel grass and the greater threat gamba grass, incursion of cattle and feral animals, climate change, industrial development and increased tourism.

Radford (in prep.) considers fire regimes in the NW Kimberley Region have more impact on biodiversity than the threatening processes of weed, cattle and feral animals in the north-west of Australia because that region has not yet been invaded to a large degree. In other parts of WA Rangelands, however, such factors are important (CALM 2003).

Weeds

The Northern Territory fire managers have to contend with the introduced grass *Andropogon gayanus* (gamba grass) and there is the potential for it to be a significant threat to biodiversity in Western Australia.

Introduced to the Northern Territory in 1931 by the CSIRO Division of Land Research (Csurhes 2005), the grass has become a major threat to the native savanna communities of northern Australia because it has the potential to alter nutrient and water availability and fire regimes (Rossiter 2003). It is a very productive grass for fattening livestock at high rates (NT Primary Industry 2004), however, it is now a serious environmental weed in the Darwin region (Howard 2001). As the plant grows relatively tall, up to 4 metres, and maintains that height during the dry season, it produces biomass up to 10 times greater than native grasses (Csurhes 2005) and subsequently increases fire intensities of up to 8 times that of native grasses. Gamba grass flames are much higher than native grass fires and can reach higher than the tree canopy (Rossiter *et al.* 2003).

These characteristics have the potential to produce intense, late dry season fires (Rossiter *et al.* 2003) and can dramatically alter the native vegetation structure (Csurhes 2005) by destroying the tree layer. At this stage, gamba grass is only detectable in isolated areas of the Kimberley near Kununurra and Port Hedland (WA Herbarium 2006).

Pastoralists have to seek permission from the Pastoral Lands Board (PLB) before planting anything other than native grasses. Other weeds considered to increase the intensity and frequency of fires are *Pennisetum polystachyon* (Mission Grass) and *Cenchrus ciliaris* (Buffel Grass) (Radford in press). Buffel grass has become a widespread weed from Shark Bay to the Pilbara and adjacent desert (EPA, 2006). It, and other grasses, are found to replace native perennial grasses with annual grasses and cause increased fire intensity particularly in the Kimberley (Graham and Mackenzie 2004). The EPA considers the threat to the Kimberley's ecological system from gamba grass in particular is critical and all efforts should be made by the relevant agencies to prevent the further use of this plant in WA and the removal of existing plants.

Climate change

The Intergovernmental Panel on Climate Change (IPCC) is currently preparing its Fourth Assessment Report (AR4) which is expected to be completed in 2007. According to the IPCC website, the report will provide comprehensive and up-to-date information about climate change, its causes, impacts and possible response measures. There is understandably little certainty in predictions for much of the Rangeland regions of WA.

In terms of biodiversity, the 2001 Summary for Policymakers (IPCC 2001) considers there is high to medium confidence that ecosystems at risk may sustain substantial damage or complete loss of the systems and extinction of some endangered species.

Projections of changes in annual water runoff by the year 2050, relative to average runoff for the years 1961 to 1990, are related to projected changes in precipitation and show a decline of (150 - 250) mm/yr in the Kimberley region and declines of (0 - 25)

mm/year in most of the Rangeland regions. The desert areas are predicted to experience an increase in annual runoff (IPCC 2001).

The report to the Australian Greenhouse Office (2005) by the Allen Consulting Group points out that further information is required about regional climate in Australia which is largely determined by the ENSO and Southern Annular Mode. All climate modelling undertaken for Australia projects future average temperature increases (Australian Government 2006). Inland regions are expected to experience slightly higher temperature increases, particularly in spring and summer. Rainfall may increase in north-western Australia but with increased evaporation rates. This could have severe implications for the Rangeland regions as increased rainfall could lead to increased fuel loads which might dry out more quickly than at present because of increased temperatures. Severe fire events may be the consequence.

The uncertainty about climate change in WA leads the EPA to the conclusion that the precautionary principle is highly relevant and that current actions should take into consideration future prospective situations.

Greenhouse Gas Emissions

As reported in the Synopsis document (EPA 2006), almost half of the WA agricultural sources of greenhouse gas emissions come from savanna burning (Western Australian Greenhouse Task Force 2004).

Emissions from savanna fires contribute around 3% of accountable national greenhouse gas emissions which are methane and nitrous oxide (Russell-Smith 2005). Carbon dioxide is not an accountable gas as it is assumed that new growth will take up emissions from burning in the previous season.

If land is burned less frequently, and that burning is not as hot, less greenhouse gases will be emitted. The Northern Australian Fire Abatement project proposes a reduction of 2.07 Mt CO₂ -e over the period 2008-2012 in the Arnhem Land project area (Western Australian Greenhouse Task Force 2004). This project has been approved and is now operating.

Tourism

There is an increasing interest in self drive tourism in all Rangeland regions, particularly in the Kimberley region. This type of tourism in caravans, camping and motor homes within Australia has increased in recent years (Tourism Green Paper 2001) with many people, largely retirees, heading for the bush and natural experiences. Key trends noted are a dramatic growth in the 4WD vehicle market, off-road caravans and trailers with more people having outback-style holidays (Desert Knowledge Australia 2005). There has not been an associated increase in roadside management to ensure facilities are properly managed by local governments (Tourism Green Paper 2001) which poses an increased risk of wildfires.

Demand for a bitumen surface on the Gibb River Road is likely to increase which would open up the area to more people. There is evidence from satellite imagery to suggest that many fires originate from campsites along this, and other roads. Roadside camping facilities are often very minimal and could be greatly improved, particularly

from a fire risk viewpoint. Campsite fire facilities are said to be better in Central Australia; the EPA encourages local government to follow that example.

Any future moves to open up the NW Kimberley to increased tourism should require careful planning of facilities and land management to minimise fire risk and environmental impact.

As stated above, the EPA notes many fires start from roadsides, either through carelessness or are deliberately started. As well as improved facilities, if fuel loads were reduced along strips bordering the roads, it is likely that the number of fires would be reduced. The EPA considers it is worthwhile to undertake trials to determine if this is the case.

Recommendations

The EPA recommends that:

- 1. The Pastoral Lands Board ensures no further introductions of gamba grass in Western Australia.**
- 2. The Department of Agriculture and Food declares the plant as a noxious weed and undertakes the removal of existing plants as a matter of urgency.**
- 3. The Department of Planning and Infrastructure and Tourism WA carefully consider the implications of any proposals to upgrade the Gibb River Road particularly as it relates to fire control and for local governments and Main Roads WA consider better roadside facilities, particularly in the Kimberley and Pilbara regions.**
- 4. Trials be undertaken on clearing strips each side of major roads in the Kimberley region, to determine whether this is effective in reducing the number of fires started accidentally or deliberately.**

7. Communication and Information

Public perceptions about fires are important. A study conducted in the Darwin region (Parr and McKaige, 2006) found some positive perceptions while at the same time revealing important knowledge gaps and highlighting differing responses depending on where the respondent lived. The study found overseas visitors were more likely to view fire as dangerous and threatening while Australians were less concerned. Local residents were found to understand prescribed burning more than those from other areas.

Perceptions in WA are unknown as no similar study has been carried out, however, the EPA committee found considerable communication and information gaps in all areas resulting in confusion in the community about proper fire management. This is partly because the public believes that current fire management is not working, particularly in the Kimberley region, but partly because nobody is attempting to ensure the community is kept well informed. The public is also often confused about

who is responsible for fire management, even in well managed areas such as the Goldfields.

Again, the Northern Territory appears to be more advanced than WA in communicating relevant factual information to the public. Good coordination is essential along with good communication with the general community about what is happening and why.

Information in a number of forms was suggested in submissions including the use of the internet, television, radio, video, posters, information booklets, community materials and messages, with school curricula used to promote the message. Daily radio reports on local stations about prescribed burning taking place could ensure communities were well informed and could take appropriate action, including decisions as to whether it was safe to go bush-walking. Meetings and workshops were also suggested for land owners and managers. Information technology such as Fire Fax and Fire Watch are considered extremely useful. Some services are by subscription only and should be more widely available. Land managers require training in the use of such technology and this could be done at the same time as fire management planning.

Fires can be reported by calling the 000 National emergency number if the situation is critical. FESA is examining ways of ensuring reporting can be done locally through after-hours numbers.

Parr and McKaige (2006) recommended information be disseminated to local people through school education programmes and information on the internet and websites while visitors could be targeted most effectively through displays and information available at places likely to be used by them such as tourism offices, hotels and national park visitor centres.

Some tour operators in the Kimberley region were identified as providing inappropriate information and it is suggested they, and other key stakeholders should be better informed about the purpose and benefits of prescribed burning.

Information on fire occurrences and vegetation mapping are extremely important for fire management, particularly planning. The DEC *Fire Mapping for Conservation Planning programme* has mapped all the fires since 1972 from satellite data for most of WA. It is anticipated the Pilbara area will be completed by February 2007 but the Kimberley region has not yet commenced.

WA could adopt communication priority areas similar to that identified by Parr and McKaige (2006) as being:

- Enhanced understanding of the effects of fire on biodiversity;
- Smoke behaviour and impact on human health and ecosystems;
- Aboriginal engagement in fire management; and
- Public awareness and education.

The DEC submission suggested the dissemination of information about why areas are burnt and current fire management practices should be considered in a proper needs

analysis to determine the audience, what was already known and what needed to be delivered. This could be coordinated by the relevant body for statutory responsibility for fire management and coordinated to ensure the same message was getting out to the various audiences.

Recommendations

The EPA recommends that:

- 1. A Bushfire Management Information Strategy to explain current fire management practices to the community be developed based on a needs analysis identifying key messages and target audiences. Information relevant to WA Rangeland regions should be developed and delivered to the relevant communities.**
- 2. Electronic information such as Fire Fax and Fire Watch be made freely available to land owners and land managers and training in the use of such information be conducted through the regional committees in conjunction with fire management planning.**

8. Resources

The EPA was informed that the current expenditure by DEC on biodiversity fire management for the conservation estate and Unallocated Crown Land for the Pilbara, Kimberley and Goldfields regions is only \$1.5 M, equivalent to a few cents per hectare. The EPA considers this figure, along with funds used by other agencies, is extremely small to ensure proper fire management over such extensive areas and that a significant injection of funds is required in the areas discussed in this review. In particular, the EPA considers there is an urgent need for greatly improved resources in the following areas:

- Equipment for prescribed burning such as more fixed wing aircraft, helicopters and fully equipped ground crews including Fire Teams;
- Equipment for fire suppression such as water bombing helicopters (where water is readily available); road water tankers with pumps, fire safety equipment, fire drip torches, bulldozers, graders, loaders and fire units;
- Support for Fire Teams in the Kimberley;
- Support for fire management , including planning, prevention and suppression, in Unallocated Crown Land;
- Freely available GIS technology and fire mapping capability and information;
- Training in the use of GIS fire information technology for fire fighting and for integration into fire management planning; and training for Fire Teams in fire management;

- Qualified people to assist in fire planning advice and assistance to landowners, support to visit communities and educate them;
- Research into fire ecology, behaviour and ecosystems;
- Development of a Fire Management Information Strategy and dissemination of appropriate information about fire management to the community;
- Support for regional committees to be established to improve the coordination of all stakeholders; and
- Appropriate compensation be provided people appointed to the regional committees for time and expenses spent in committee duties.

Recommendation

1. **The EPA recommends fire management in Western Australia be urgently provided with significantly increased resources.**
2. **The EPA recommends increased resources be provided for fire management in Unallocated Crown Land.**

Appendix 1

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Appendix 2.

Consultation.

People who were consulted during the Review, made submissions, participated in the Teleconferences or attended meetings with the EPA Fire Review Committee.

NAME	ORGANISATION OR INTEREST	PLACE
Simon Abbott		Broome
Tim Anders	Heliwork WA	Kununurra
Phil Avery	Shire Derby West Kimberley	Derby
Dr John Bailey	Conservation Commission	Perth
Lauren Barrow	Macquarie University	
Jane Blackwood	KRFMP	Broome
Michelle Birch	Mining	Kalgoorlie
Gina Broun	DEC	Kalgoorlie
Mel Brown	Mining	Kalgoorlie
Peter Brown	Pastoral	Auribiddy Station
Susy and Robert Bugle	Pastoral	Nanutarra/Uaroo Station
Jack Burton	Pastoral	Broome
Ryan Butler	DEC	Kalgoorlie
Greg Campbell	Pastoral Company	
Peter Cann	FESA	Roebourne
Sylvia Clark	DEC	Kalgoorlie
Gary Cook	A/ CEO CSIRO	Darwin
Isabelle Cosides	Environment	Broome
Andrew Craig	DAG	Kununurra
Andrew Craig	Local Government	Kununurra
Dan Craig	Pastoral	Go-Go Station
Jim Craig	Pastoral	Halls Creek
Doug Dixon	Pastoral	Margaret River Station
Marion and Louie Dolby	Pastoral/Aboriginal	Mt Pierre Station
Chris Done	Consultant	Kununurra
Phil Drayson	Goldfields Land Council	Kalgoorlie
Gordon Duff	CEO, Tropical Savanna CRC	Darwin
Rita Elliott	Aboriginal	Kalgoorlie
Danielle Eyre	NRM	Derby
Marcia Finger	Pastoral	Derby
Graham Forsyth	Pastoral Company	
Dennis Forrest	Aboriginal	Kalgoorlie
Mark Forrester	Pastoral	Kanandah Station
Gordon Graham	DEC	Kununurra
Dave Grosse	DEC	Kununurra
Tricia Handasyde	N Australia Fire Project	Kununurra
Dave Harrington	Macquarie University	
Brian Harris	FESA	Halls Creek
Jo Harrison-Ward	CEO, FESA	Perth
Jeff Harvey	Tourism	Kununurra
Ed Hatherley	DEC	Broome
Chris Hennigler	Kachana Pastoral Company	Kununurra
John Henwood	Pastoral	Fossil Downs Station
Des Hill	Kimberley Land Council	Kununurra
Gill Holmes	NRM	Kununurra

Barry Hooper	DEC	Kalgoorlie
Kelly Howlett	Conservation	Port Hedland
Andrew Jaques	Community	Derby
Peter Jeggisberg	Pastoral	Kununurra
Fay Johnston	Charles Darwin University	Darwin
Gary T King	Local Government	Kununurra
Ian Kealley	DEC	Kalgoorlie
Jim Kohen	Macquarie University	
Peter Kneebone	Local Government	Derby
Alan Lawford	Pastoral/Aboriginal	Bohemia Downs Station
Adam Liedloff	CSIRO	Darwin
Sarah Legge	AWC	Mornington Station
Richard Lethbridge	Conservation	Broome
Jiri and Marie Lochman	Photographers	Perth
G Lodge	Community	Kununurra
Pat Lowe	Environs Kimberley	Broome
Butch and Robin Maher	Pastoral	Yeeda Station
Gae Mackay	DEC	Kununurra
Cam Mackie	Tourism	Kununurra
Maria Mann	Conservation	Broome
Anna Mardling	KLC	Broome
Steven Martin	Local Government	Derby
Peter McConnell	Local Government	Halls Creek
Claire McGuire	Aboriginal	Kalgoorlie
Eddie McKenzie	Aboriginal	Kalgoorlie
Keiran McNamara	CEO, DEC	Perth
Murray McQuie	Pastoral	Bulga Downs Station
Maxine Middap	Local Government	Kununurra
Peter Mitchell	Environs Kimberley	Broome
Tony Morley	Local Government	Halls Creek
Wes Morris	KALAAC	
Jim and Joy Motter	Pastoral	Bulka Station
Steve Murphy	AWC	Mornington Station
Philipp Nauer	Community	Kununurra
Wayne Neate	Local Government	Derby
Rachel Nelson	DOW	Kununurra
Anna Nowicki	Wildflower Society	Perth
Phil Palmer	DIA	Derby
Thalie Partridge	Macquarie University	
Dick Pasfield	Ord Land and Water	Kununurra
Murray Percasky	Local Government	Kalgoorlie
Lynda Prior	Charles Darwin University	Darwin
Bev Quartermaine	Conservation	Kalgoorlie
Ross Quartermaine	Conservation	Kalgoorlie
Natalie Raisbeck	KRFMP	Broome
Ian Radford	DEC	Kununurra

Tony and Robyn Richardson	Pastoral	Mt Florance Station
Graham Rogers	Pastoral	Pardoo Station
Liz Rosenberg	Conservation	Broome
Ian Rudd		Roleystone Perth
Steven Rusbridge	Mining	Kalgoorlie
Bruce Russell	Media	Kununurra
Jeremy Russell-Smith	Tropical Savanna CRC	Darwin
Nadene Schiller	DAG	Kununurra
Dr Beth Schulz	Conservation Council	Perth
Jim Sharp	DEC	Perth
Trevor Shelson	Conservation	Kalgoorlie
John Silver	KDC	Derby
Troy Sinclair	DEC	Broome
John Storey	Community	Kununurra
Peter Stubbs	CEO, Local Government	Halls Creek
Chris Tallentire	Conservation Council	Perth
Leo Thomas	Aboriginal	Kalgoorlie
Rob Thomas	DIA	Perth
Jacinta Thompson	DOW	Kununurra
Allan Thomson	DEC	Kununurra
Bindi Thomson	PGA	Perth
Katya Tripp	Local Government	Kununurra
Mark Turner	Local Government	Broome
Roger Underwood	Bushfire Front	Subiaco Perth
Lee Vallance	FESA	Derby
Rob Versluis	WA Forest Alliance	Perth
Tom Vigilante	KLC	Derby
Hugh Wallace-Smith	KALAAC	Fitzroy Crossing
Geoff Warriner	Pastoral	Carlton Station
Danny Waser	Community	Kununurra
Ruth Webb-Smith	PGA	
Peter Wilden	Local Government	Derby
Jennifer Wilksch	Conservation	Kununurra
Susie Williams	DOW	Kununurra
Noel Wilson	DAG	
George Wiseman	Community	Newman
John Woinarksi	Department NREA	Darwin
Lesley Woolf		Kununurra
Ross Wood	Pastoral	Rawlinna Station

Abbreviations

DAG	Department of Agriculture and Food
DEC	Department of Environment and Conservation
DIA	Department of Indigenous Affairs
DOW	Department of Water
FESA	Fire and Emergency Services Authority of Western Australia
KALAAC	Kimberley Aboriginal Law and Culture Association
KDC	Kimberley Development Commission

KLC	Kimberley Land Council
KRFMP	Kimberley Regional Fire Management Project
NRM	Natural Resource Management
PGA	Pastoralists and Graziers Association
SEEKS	Save Endangered East Kimberley Species

Appendix 3.

Fire Management and Biodiversity Conservation

The *National Inquiry on Bushfire Mitigation and Management* (Ellis *et al.* 2004) reported that inappropriate fire regimes have been recognised as potentially threatening to the conservation of biodiversity and that popular perceptions have focused on high intensity fires because there is considerable visible damage caused by such fires. There is growing evidence, however, that fire frequency is more important than fire intensity, particularly in northern Australia. There is increasing support for substantially increasing the extent of relatively long unburnt habitat (Andersen, 2003, 2005) and for a diversity of fire regimes.

The *National Inquiry on Bushfire Mitigation and Management* concluded that biodiversity is best protected by a mosaic of fire regimes in the landscape. This was described as a mosaic of fire ages with some patches rarely burnt, others more frequently, some in each season, some small, some large, some high intensity and some cooler.

The most frequently used fire management regime in WA is one of low intensity prescribed fires in the early dry season. This does not appear to be effective, however, in preventing the incidence of extensive, late dry season fires, particularly in the Kimberley region. Such fires, which also occur in the Interior Arid Region, burn many areas every 1-2 years.

The Kapalga fire experiment undertaken by the CSIRO (Andersen *et al.*, 2003) examined how biodiversity responded to different fire regimes over a period of 5 years between 1990 and 1994. Areas between 15 to 20 km² were burnt according to one of four treatments - early dry season from May to June; late dry season from September to October; progressive throughout dry season to mimic an approximate traditional Aboriginal burning; and unburnt.

Overall, the experiment concluded that different plants and animals are affected in different ways by different ways of burning but that it would be better if less country was burnt each year.

It was clear from the Kapalga experiment that certain taxa, such as litter invertebrates and reptiles and small marsupials, favoured unburnt habitat but other taxa, such as ants, frilled lizards and diurnal predatory birds, preferred frequently burnt habitat and were most abundant in areas which were subjected to late dry season burning. Andersen (1999) argues that the Kapalga experiment generated surprising results which challenge some accepted beliefs about ecological responses to fire management in northern Australia.

Fire seasonality was found to be variable in the study by Williams *et al.* (2005) as part of the Kapalga trial. It was found that although early dry season fires were on average, one quarter as intense as late dry season fires, several fires of relatively high intensity occurred in June in one year. The study concluded that, in terms of fire characteristics and impacts on trees, the eucalypt savanna fires of northern Australia are more like grassfires than the eucalypt forest-litter fires of southern Australia. This emphasises the importance of fire management relative to the needs of the particular region.

The Kapalga experiment also revealed fire management regimes, particularly catchments burnt in the late dry season, can result in significant changes to riparian vegetation and increased stream biodiversity (Douglas *et al.* 2003).

One of the conclusions from the Kapalga experiment is the importance of avoiding habitat homogeneity and of management at the landscape level. Of course, one difficulty is working out what habitat is the best to emulate. Andersen *et al.* (2003) suggests it is possible to reproduce conditions before humans arrived as has been adopted for South Africa's Kruger National Park and proposed for Namibia's Etosha National Park. That scenario would imitate the conditions where lightning was the main determinant of fire regimes. Alternatively, an aim could be to reproduce the Aboriginal burning which took place throughout the year but was mostly done during the early and mid-dry season. It was argued that the most pragmatic course would be to adopt a fire regime which recognises the changes that have occurred and that what worked in the past may not work now.

Working out an appropriate fire regime for an area or a region is not easy. Research supports the idea that Aboriginal burning created a fine-scale mosaic of burnt and unburnt areas and indicates it created rich and abundant plant and animal populations (Bowman *et al.* 2004; Bowman and Prior 2004) but do not support the widely held view that Aboriginal burning was focused primarily in the first half of the dry season.

Recent research (Prior *et al.* in press) cautions that frequent, early dry season fires that have become a management goal in much of northern Australia should not be emphasised too much because it does not mimic Aboriginal burning as is claimed.

The importance of setting clear targets for the maintenance of biodiversity at the landscape scale is stressed by Andersen (2005) although he recognises this will be hard to achieve given the differing value systems of different stakeholders.

Andersen *et al.* (2003) believe that the results of the Kapalga experiment in the Northern Territory demonstrate that key components of the biota prefer habitat which has been unburnt for a number of years. This poses a challenge for the tropical savanna areas because it is unlikely to be met using the current fire management techniques. Cook (pers.comm.) recommends that a management action for the savanna areas should be to increase the area remaining unburnt for 5 or more years to at least 10% at any given time.

Andersen (2005) believes further research should focus on the ecological significance of different fire-free periods to determine the ideal length of time that different areas should be free from fire. The 'Burning for Biodiversity' project, established in 2004, in the Territory Wildlife Park near Darwin will examine this issue through subjecting 18 hectare size plots to different fire regimes.

The comprehensive review by Radford (in prep.) outlines the complex interactions within ecosystems and how difficult it is to tease out the mechanisms behind fire responses. He suggests that burning may fundamentally alter ecosystem control in savanna landscapes and may alter the system temporarily from a bottom-up system to a top-down controlled system which would have important implications for predators. He raises the possibility that traditional Aboriginal people might have altered the role

of predators by hunting the major vertebrate mammals. He suggests this could be important as simply re-establishing a pseudo-Aboriginal burning pattern is unlikely to bring about the return of threatened species.

Radford's work highlights the complexities of burning for biodiversity protection and emphasises that much is not yet fully understood. He suggests that fuel reduction buffers alone are not likely to be effective in reducing the extent of fires in the Kimberley region, nor is a compartmentalisation approach likely to have results. In the absence of perfect knowledge, Radford suggests prescribed burning to reduce overall fuel loads should aim to produce small areas of incomplete burns of different vegetation types, topography or geology.

An example of how biodiversity-based fire management can be approached without perfect knowledge was contained in a submission to the Review. The AWC at Mornington Station try to achieve the aim of increasing the area of relatively long unburnt habitat. The AWC sets targets in their fire management planning to reduce the total area of the property that burns in any year, and to reduce the average size of each fire event. They also try to prevent entire habitat patches from being burnt in a single fire event and to reduce the fire frequency in habitats that require a relatively long period without fire to complete their life cycles as well as increase the proportion of area that burns in the early wet season as opposed to the dry season.

Andersen (1999) urges the adoption of an adaptive management approach rather than a 'command and control' system where the focus is on producing arbitrary yields or on applying fixed prescriptions. He argues that effective ecosystem management aims to maintain the diverse and dynamic ecosystems that underpin sustainable landuse. Andersen also concluded (1999) that no particular fire regime was beneficial to the entire region's biota but should instead be considered on a strategic basis with land management objectives clearly articulated before any particular fire management was adopted.

Figure 3a shows an adaptive management approach in which clear objectives determine performance indicators which can be used to assess management. Management prescriptions can be refined according to the feedback from monitoring.

If the process is driven by management prescriptions rather than strategic objectives, it can become what Andersen termed a "command and control" approach. Andersen (1999) believes that fire managers in northern Australia have become preoccupied with the implementation of particular burning patterns rather than developing a strategic vision which would benefit biodiversity. (See Figure 3b)

The EPA believes the current fire management approach in much of Western Australia's Rangeland regions more resembles the "command and control" approach than the development of a strategic vision. The EPA considers such a vision is vital in Western Australia.

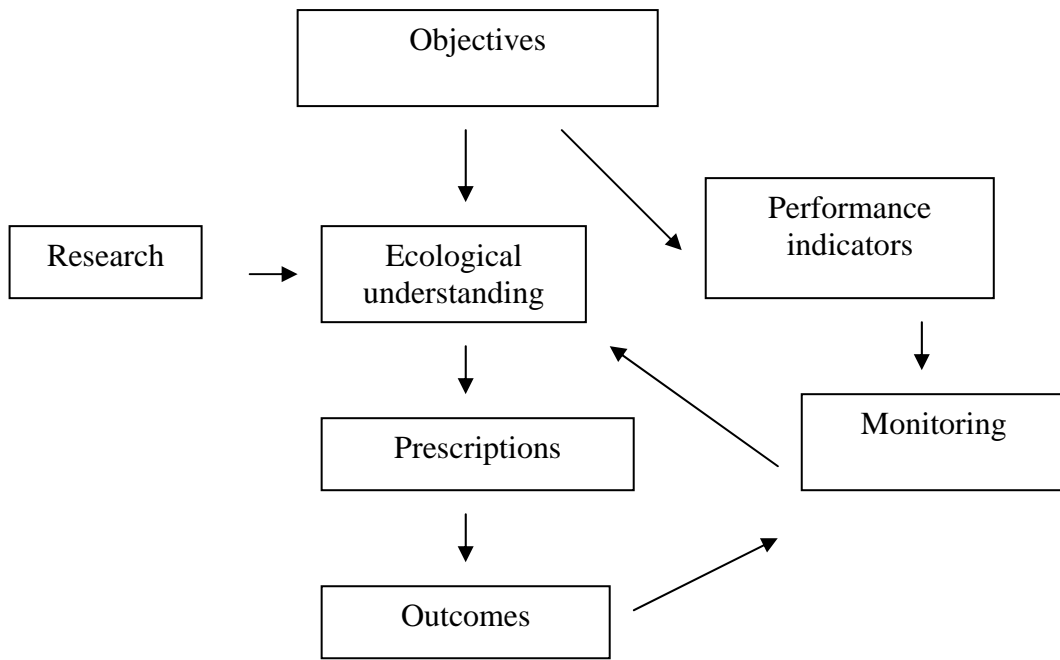


Figure 3a Schematic of adaptive management. (Andersen 2003)

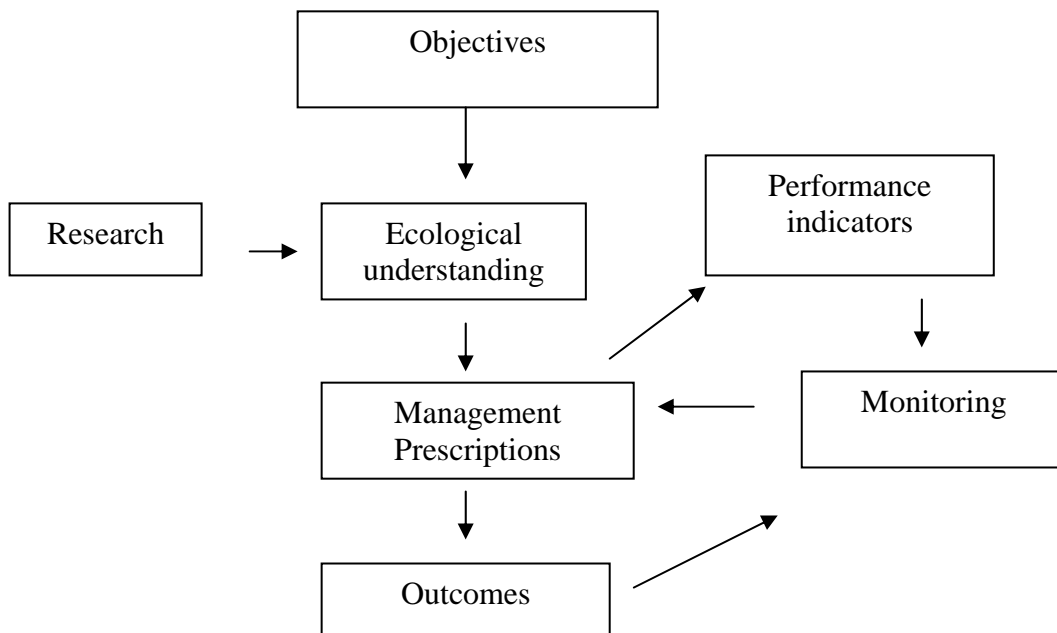


Figure 3b. Schematic of adaptive management. (Andersen 2003)

The EPA is of the view that, while there are still considerable gaps in understanding how fire impacts on biodiversity and much work yet to be done, there is enough information available for fire managers, land managers and owners which can be applied to fire management. The EPA supports the use of adaptive fire management but also considers further research is essential in WA at an ecosystem scale.

Appendix 4.

Research

As reported in the Synopsis document (EPA 2006) the majority of research relating to rangeland systems has been conducted in the Northern Territory. Neither site-specific nor temporal landscape-scale research has been undertaken into the impact of fire on flora and fauna in Western Australia to the same extent as in the Northern Territory. Results from landscape-scale research such as the Kapalga experiment (Andersen *et al.* 2003), the theories about fire management and the research carried out by the Tropical Savannas CRC is applicable to the Kimberley region but regionally specific research which would inform localised management decisions is fairly sparse.

There is a view that further research is not required, with enough information already available about the effects of fire. The EPA notes there is a substantial body of information available from research and that this should be used to enhance fire management, but considers that further studies of the complexities and interactions in ecosystems for specific WA situations in response to fire will be beneficial. This must not delay action to improve fire management; adaptive management can be applied.

There is some research proposed for WA announced recently by the Government (McGowan 2006). A joint project will be undertaken between the DEC and CSIRO Division of Sustainable Ecosystems to investigate fire regime history and some of the ecological effects in the Kimberley region. The project will focus on the Mitchell Plateau and Purnululu regions, because of their high biodiversity values and will use satellite images to map the fire history to determine classification of areas according to the seasons they were burnt, the frequency of burning and the time since the last fire. Assessments will then be made of the biological impacts of the fire regimes through examining the plant and insect life. The results will assist in determining the ecosystem responses to the DEC planned burns.

Other research projects include one to determine the curing rates of grassland specific to different landscapes to enable predictive systems for forecasting relative fire danger; one to investigate species response to fire; another into the role of fire mosaics in biodiversity processes in Kimberley mammal ecology and a study into critical weight range mammals, fire and feral animals.

There was a variety of suggestions about the types of research which could assist good fire management in WA. The type of research suggested include a need for more baseline data on plant and animal distributions so that changes can be assessed as well as information on responses of flora and fauna to fire regimes. Also suggested was research into mosaic burning to determine its effectiveness and the optimum size. Research into the effectiveness of fire management activities and how improvements can be made is another area of research which should be undertaken as well as examination of the importance of land that is 'long unburnt'.

As discussed in Section 3.4, the latter is emerging as a very important fire management matter (Andersen *et al.* 2003, 2005) and further information is needed about what constitutes the length of time not burnt and what area should be left unburnt. The effectiveness and impacts of early dry season and wet season burning should be researched as some researchers are advising caution about this timing (Prior *et al.* in press).

Other specific research should be undertaken into the ecology of fire regime sensitive species and ecosystems in hummock grassland landscapes and interactions between fire and weeds, especially buffel grass and how to improve fire behaviour prediction in hummock grassland fuel complexes. Ethnoecological research was also suggested which is the traditional knowledge which can help to identify plants and animals vulnerable to fire and indicators of habitat regeneration.

Research priority should be given to the Kimberley region because of the identified critical situation; however, the requirement for more research applies to all Rangeland regions as this will better inform land managers and owners about the impacts of their fire management and how it can be improved to protect biodiversity.

The EPA considers that FESA's suggestion for a process to get research, published and unpublished, into the appropriate non-biodiversity organisations and forums for integration into agency policy and practices has merit and should be undertaken.

As discussed in the Synopsis document (EPA 2006), monitoring is an essential part of any research programme and should also be applicable to fire management regimes. Allan *et al.* (2001) stresses the importance of monitoring and recording the effects of fire regimes making that available to be effective. Monitoring can be done in a variety of ways including on-ground, using aerial photographs and satellites. Monitoring on a landscape scale will enable adaptive processes to be put in place (Myers *et al.* 2004), however, the cost of monitoring can be high and it is suggested has not been undertaken effectively at a landscape scale in Australia's rangelands. Myers *et al.* (2004) report that fire monitoring of Kakadu National Park comprised about 1% of the park's annual budget but suggested there may be other cost-effective solutions. These include ongoing daily fire monitoring and monthly fire mapping from satellite sources and reporting mechanisms about the extent of fire and wildfire with respect to mapped assets, including fire-sensitive communities to the Bushfire Regional Councils and the NT Landcare Council.

Andersen (Andersen *et al.* 2003) considers that, although NT fire-mapping services are excellent, ecological monitoring programmes are less well developed. WA is some way behind the Northern Territory and the EPA considers appropriate monitoring programmes need to be commenced so that adaptive fire management can be used to properly protect biodiversity, among other uses.

Appendix 5.

Summary of Submissions

SUMMARY OF SUBMISSIONS

A total of 26 written submissions on the Synopsis paper were received. See Appendix 1 for a list of the people who provided submissions.

Of those, 7 were received from people with pastoralist interests, 3 from State Government agencies, 3 from Local Government agencies, 5 from community organisations, 3 with Aboriginal interests, 4 from community members and 1 from a University research team.

Most people responded to the questions listed in the Synopsis paper sometimes with additional comments. There was a range of response styles, some brief and a few very comprehensive well researched replies.

Twelve people involved in the pastoral industry participated in a teleconference with the EPA Review committee in July 2006. Thirty-nine people were consulted either separately or at meetings during July and August 2006 at Kalgoorlie, Broome, Derby, Fitzroy Crossing, Halls Creek, Kununurra and Darwin. The names of those people are in Appendix 1.

This section discusses responses raised in submissions in the same format as the Synopsis document and has some general comments at the end. Where the submission has been directly quoted, the section is shaded light grey.

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IMPACT ON BIODIVERSITY

a) *In your experience, have you observed any impacts of fire on flora and fauna in your area?*

Thirteen submitters agreed that they had observed impacts on the flora and fauna in their region and, although many could not quantify this impact, they were said to range from considerable and severe to minimal. Not everyone thought that the impacts had been detrimental; one submission said there were positive changes to the vegetation and fauna due to fire because burnt areas attracted birds and other fauna because of fresh vegetation.

Evidence of negative impacts had been observed across the Southern Rangelands and a distinct change to an increasing population of both perennial and annual grass pastures and a decrease in the Kimberley region of upper storey trees, increased Acacia thickets, loss of soft seed grasses replaced by native Sorghum and spear grass and a noticeable decline in most reptiles and some bird species, especially small birds, finches, and fairy wrens.

In the East Kimberley, increased weeds were observed along with a reduction in native vegetation along Mooloolaba Dam (King River Rd) near Wyndham over about a seven year period. Cane grass and kerosene grass along the Kununurra – Wyndham road has largely replaced perennial grasses and other vegetation with associated reduction of stands of small trees and lack of new tree/bush establishment. In the same areas, and at Keep River NP (NT) and Parry Lagoons Nature Reserve, there are fewer sightings of Gouldian finches, pictorella manikins, tawny grassbird and cisticolas. Another submission noted a reduction of seedlings reaching maturity and increased grass species in the East Kimberley.

One submission stated there was cumulative fire damage at the base of mature eucalypts, particularly because of late dry season fires, which caused them to topple. This submission stated an eagle nest had been lost on a pastoral lease near the Great Sandy Desert in this way.

Another submission told of a decline in large mature eucalypts in pindan woodlands in Broome/Dampierland region with an associated increase in weed invasion of overburnt areas surrounding townsites.

In the Nullarbor, wildfires were blamed for a significant impact on the Western myall trees with associated evidence of change causing reduction of grass and increase of bluebush.

One submission suggested that increases in some species and decline in others might be a natural cycle rather than due to fire impacts and another was of the opinion that seasonal fluctuations have more impact on fauna than fire.

b) *Do you have any actual evidence of a decline or increase in plant species, vegetation communities or birds and animals which could assist the EPA in this review?*

One submission suggested that visitors to Purnululu had observed a reduction of the mammal population by 90% in response to fire management regimes; however, research evidence from Macquarie University researchers demonstrated that many species are resilient to the effects of fire. Other conclusions were that particular environments such as Spinifex grasslands and rainforest pockets or species are impacted upon more than others.

Few people, apart from those conducting research, had actual evidence of changes. Most felt they had personally seen gradual changes over up to 26 years, or had information passed on from community elders over a 50 year period of habitat and wildlife destruction and disappearance. It was felt that major declines and ecological changes had occurred gradually in the last 15-20 years but it was obvious that natural systems have been steadily degrading.

HUMAN HEALTH IMPACTS

a) *Do you think smoke from bushfires is a health issue in your region?*

Interestingly, since the first visit by the EPA Fire Review Committee to the Kimberley region in November 2005, more people have realised that bushfire smoke could be a health issue in that region. Six people agreed that this was the case while only two submissions considered it was not an issue.

One person had questioned people and discovered that asthma and hay fever sufferers are particularly affected by smoke while another person considered that it was similar to passive smoking but it was harder for people affected to avoid its effects. Cane fires were raised again as an issue for the Kununurra area while people in places like Broome felt they were unlikely to be impacted because of the location and the prevailing winds. One submission stated that it had not been identified as an issue by a qualified authority.

b) *If so, what measures do you think are needed to reduce exposure to bushfire smoke?*

Reduction of bushfire smoke by extinguishing more fires, education and no cane burning were suggested as measures to reduce exposure to bushfire smoke.

GOVERNANCE

a) *What is the best way for environmental protection to be incorporated into the fire management system?*

Most submissions felt that the best way environmental protection could be incorporated into the fire management system was through better governance arrangements with environmental protection as the highest priority. A much more effective and formally structured collaboration between all stakeholders was considered essential to ensure that ecologically sustainable fire management is well planned, implemented cooperatively and reviewed regularly.

Other measures suggested included using cool burns early in the dry and late wet seasons in a mosaic pattern, applying a monetary value to environmental land, education, resourcing people who live in the area and qualified people making decisions taking into account local knowledge and knowledge from older people.

b) *Which agency or level of government do you think should be primarily responsible for the overall responsibility of fire management (from planning to prevention and suppression) in your region?*

The majority of submissions for the Kimberley region considered that the State Government should be primarily responsible for overall fire management, with a number suggesting FESA, and one CALM (DEC), as the appropriate agency to undertake this role. Most people considered it was very important to include all stakeholders and the local community with an emphasis on local knowledge.

Pastoralists in the Kimberley region would prefer local fire brigades to play a greater role in fire management, however, it is claimed the brigades cannot function properly

as their funding has been reduced. Pastoralists consider this has caused delays to reaction times to emergencies and they may result in uncontrollable wildfires.

From a pastoralist point of view, governance arrangements in the Nullarbor appear to work well. Strategic planning for fire management occurs prior to the fire season with CALM and FESA. Those pastoralists are heavily involved in the region's fire brigades with the pastoralists taking primary responsibility for the fire and the brigade providing assistance if the fire cannot be controlled.

Pastoralists in the Pilbara believe they do not require assistance from government agencies as they have acquired on ground expertise on how to manage fires. One pastoralist with experience of both the Goldfields and Nullarbor regions favours a regional approach to management because of the vast differences in the land, vegetation and climate.

A submission from a pastoralist in the Gascyone/Murchison was of the opinion that the only equipped organisation to hold overall responsibility for fire issues state-wide is FESA and they are best suited to carry out this role in the Rangelands. It was also considered that the best able to advise FESA are the Shires who are quite capable of using either a specific sub committee or LVDC. FESA officers are trained and equipped to take control if required, to coordinate resources and to facilitate implementation of plans. In addition, FESA officers could maintain updated inventories of plant, equipment and other resources. It was also considered that all ratepayers contribute to the ESL, therefore it is reasonable that some return on contribution be available back to the contributors in the Rangelands.

c) *What do you think of the suggestions that an overarching body be established to coordinate fire management?*

Most submissions suggested better governance structures were necessary with various suggestions as to how this might be achieved. Nine submissions agreed with the suggestion that an overarching body be established to coordinate fire management. Only one submission did not feel this was necessary while another questioned the need for another body and suggested that resourcing current bodies with a representative committee might work better.

The concept of an overarching body was supported by pastoralists in the Goldfields/Nullarbor region, particularly with regard to potential quick reaction if needed. The difference from other regions was also stressed and the point made that it could not be a 'one size fits all'.

One other submission partly agreed provided the mind set was not on burning but rather burning where absolutely necessary. One submission considered it was too much for one body as fire suppression is a huge task on its own and prevention and planning is the landowner's responsibility. Another said it was inappropriate to give all responsibility to any particular government agency because effective fire management requires expertise in both environmental and property protection.

d) *If a coordinating or overarching body was to be established, do you see it being done through legislation or through an advisory committee?*

There were various combinations suggested for the coordinating body. These included a community-based approach, a single independent responsible body with regional branches, a single authority with legislative powers and a single fire authority (for the Kimberley region) with a specific Board of Management under FESA control to administer and develop practical solutions. Some saw the body having regional

branches while others suggested support by a community advisory group which would include environmental technicians from CALM and FESA. A similar way suggested is to have a specialist State body broken up into regional areas specialising in the needs of an area using local expertise. Zoning of the Kimberley region according to the priorities given to conservation in various areas was also suggested in conjunction with an independent responsible body.

Most submissions considered that the makeup of the group should reflect the community as well as various expertise such as Indigenous, CALM, FESA, pastoralists and so on. One submission warned, however, that a collaborative or group approach might not work in the Kimberley region because of the different ideologies and aspirations of the partner organisations involved in the demise of the Kimberley Regional Fire Management Project.

The Conservation Commission considers that the risk management and fire suppression for areas outside Conservation Commission lands should be formally delegated to FESA working in conjunction with local government, pastoralists, Aboriginal communities and other landowners. A FESA 'Fire Management Officer' stationed in each local authority or region could provide a link with communities, providing an educational and liaison role. Risk management and fire suppression inside the extensive Conservation Commission lands should remain with DEC. It was considered clear lines of communication and responsibilities would need to be maintained to deal with fire risk management and suppression that crossed reserve boundaries.

Some submissions urged changes to legislation to include biodiversity protection as a priority in fire management practices and to give powers to a single authority to undertake all aspects of fire management in the region. Some level of legislative power would be required, according to one submission, to make sure that the roles of stakeholders were clear. NSW was given as an example where District Fire Management Committees were given power to integrate fire management across landscapes comprising multiple managers with varying roles. The submission quoted Keith et al (2002) who suggests it is critical that legislation recognises the complexity of fire regimes and that they play an important ecological role rather than focussing on property protection and the destructiveness of fire.

e) *What do you think about the other suggestions, eg to have dedicated Fire Officers located in regions?*

There was overall support for dedicated Fire Officers located in each region, largely because of the large distances involved.

f) *What other fire prevention, management and suppression arrangements do you favour?*

Responses to this question varied from suggestions about mechanical methods of fire control such as graders and aerial water-bombing in association with ground crews; to fire plans and prevention through early season management. One submission suggested the EPA must challenge the mentality that the 'fire is good for the bush' which was considered to be prevalent in CALM and the wider community. This submission recommended independent systematic scientific research should be carried out before burning all vegetation types to establish the impacts of burning on biodiversity. The submission also questioned the regulation of burning on pastoral leases by the Pastoral Lands Board.

Another submission recommended further research is needed to understand the effect of fire on ecology and biodiversity values. The submission recommended a

comprehensive database of fire events should be set up for WA and pointed out that the effects of fire on an ecological community are complex and interrelated. It was also considered a much higher emphasis has to be put on protection of biodiversity values and incorporated into the fire management system. It also suggested there should be a legal requirement for local government to consider biodiversity loss when considering applications.

g) Do you think Aboriginal customary burning should be recognised and permitted legally?

The response to the question of Aboriginal customary burning was varied with most people (8) supporting the concept while 5 did not, with some very strongly opposed to the proposition. This opposition was strongest from the Pastoralists and Graziers Association, and from individual pastoralists. It was felt customary burning should definitely not be legislated for nor seen to be a native title right. The reason given for this view is that there is no need for this to occur in this day and age as Aboriginal people no longer have to burn land to catch food to survive. Retention of the knowledge of traditional burning practices by Aboriginal people was questioned.

A number of submitters considered Aboriginal customary burning should be recognised but that it should not have a unique legal status. It was suggested that Aboriginal customary law and the endorsement by traditional custodians who speak for country should be accommodated as part of cooperative fire management arrangements.

Some of the comments in favour of customary burning were that there was no reason why compromises could not be made to allow such burning on pastoral leases and conservation estates. It was considered customary burning may support the goals of biodiversity conservation and wildfire restriction as well as the protection and promotion of pastures, recognising it would require appropriate consultation and management planning. The Department of Indigenous Affairs considers that native title and customary burning needs to be accounted for in FESA legislation and extended through representation and practical application measures such as training and employment.

Other comments were that the vegetation has adapted to those fire regimes because Aboriginal people have been burning the country for thousands of years. Aboriginal knowledge and practices should be therefore by incorporated into fire management to mimic traditional fine mosaic fire burning patterns. It was also suggested that Aboriginal fire use is a good way to keep fuel loads down and to break the country into different aged fire patches and prevent large fires.

h) If so, should there be an advisory or supervisory body to monitor such burning?

Only one submission commented on monitoring of Aboriginal customary burning suggesting overall control should remain in the hands of a responsible agency, which was recommended to be either DEC or an independent Fire Protection Authority. It was considered that if consent was given for customary burning, it should be to particular communities and not for general use.

FIRE MANAGEMENT PLANNING

a) Do you think fire management planning is important?

Twelve written submissions agreed that fire management planning was important, one considering it to be very important, and one critical. Responses varied and included comments that planning needed to be flexible to cater for intervening

unplanned fire changes in weather patterns, there should not be targets set for total areas to be burnt; and planning at smaller scales such as property or local scales should be in the context of regional plans with general priorities and goals. Some opinions were that fire management burning should be recorded; and fire planning was useless if not given funding and resources or if not regularly assessed and updated.

Pastoralists in the Pilbara thought those people who manage their land well should not have to prepare management plans and should be given accreditation and not have to perpetually seek permits to burn. It was suggested an accreditation process could be supervised by FESA and the Local Government and would apply to those pastoralists who were doing proper strategic burning.

b) If so, who should prepare such plans?

Most submitters favoured an overarching body to be responsible for preparing fire management plans. One submission said that the body would need to be well educated in fire law and environmental issues. Another said the overarching body should be responsible for the coordination and preparation of management plans for the region. Advice and assistance in the development of management plans at a smaller scale could also be provided, particularly for landowners without resources.

Other suggestions were that the preparation of the plans should be done by FESA; various combinations of State government agencies assisting landowners; or the community assisted by NRM bodies with cultural advisors. It was suggested that effective fire management could only be achieved when individual land managers are fully involved in the process and are responsible for ensuring that the fire management on their properties is carried out as set out in the plan.

c) Should they be developed at a regional or local level, or a combination of both?

The majority of submissions favoured a combined approach to management planning, ie at both regional and local scales. A few favoured preparation at local level specific to land use, or at a property or district level. A coordinated tiered approach was suggested as well as annual regional plans which were progressively updated based on outcomes and research input.

One submission suggested local management plans would need to consider the aims of a regional plan. A regional plan would give an outline to managers on their obligations and how to achieve them while considering the needs of their neighbours. Management at a local level would likely be more detailed and specific in terms of fire management zones and management strategies within them. The submission also quoted Rose *et al.* (1999) who examined mosaic burning strategies for the protection of life and property and the conservation of biodiversity. Rose *et al.* (1999) suggested that fire management is best planned across land tenure boundaries and a regional management plan helps to identify how objectives and outcomes of land management types differ. A regional plan is also important for conservation reserves which may play a role in protecting habitat particularly when a certain fire regime may not be supported in other land management types. Regional planning would also be better at addressing education and training programs. Rose *et al.* (1999) also suggested that all management levels need to be considered; regional, management zone, vegetation community and burn patch level.

d) Who would coordinate and monitor implementation of the plans?

Most people thought the overarching or regional body should coordinate and monitor the implementation of fire management plans, perhaps also calling on other

organisations such as FESA, DAG and DEC to assist. There was one submission each suggesting different agencies, such as DEC, FESA, DAG for pastoralists and CALM for parks. There were also calls for this to be done by a fire consultative panel, regional fire officers and community representative bodies.

e) *Should they be compulsory?*

On the matter of compulsion, the submissions were largely in favour although the same number was partly in agreement. A few people considered that an incentive based approach to fire management planning (such as provision of training, on-going technical support and equipment subsidies) is preferred, although some recommended compulsion might be needed to deal with 'recalcitrant' landowners whose neglect threatened both their own land and that of their neighbours.

One submission felt that compulsion should be applied only if a specific safety or environmental issue could not be resolved in any other way.

One submission felt that separate management plans for each estate is probably unrealistic and it may be more appropriate for the governing/advisory body and/or FESA, the Dept of Agriculture and DEC, to develop a set of best practice guidelines and simple monitoring techniques for the development of fire management. This submission also suggested management plans for conservation estates could potentially act as a guide for biodiversity management in other similar areas; however biodiversity in non-conservation estates needs to be considered separately. The submission also recommended management plans should be developed through consultation with all land managers and land users and it should be compulsory for fire managers to notify a governing body and ALL neighbours and land users of burning plans. It was also thought that successful fire management strategies should be reported.

f) *What should such plans include?*

Suggestions on what should be included in fire management plans include an understanding of individual land systems and landscape in general, areas and times targeted for prescribed burning, deployment of suppression equipment, scope and form of desired conservation outcomes and the need to recognise that all areas have at least some environmental significance. Other suggestions were that they should include human and equipment resources available; they should use satellite imagery, local knowledge, recent fire history for the area and the ecological impacts to be addressed.

It was recommended that important areas of ecological and cultural significance should be recognised and given special attention. They should also have careful mapping with coding or overlays that identifies areas and intensity of previous burns with local plans complimenting the regional plan. Plans should include preventative action undertaken, location of firebreaks, water resources and other resources available (vis: slip-on fire units, machinery etc.). Plans also need to specify various levels of response action in the event of fire outbreaks. There should be annual reviews of plans.

Other submissions suggested the plans should identify chains of command, fire management resources, plans for preventative burning and wildfire suppression.

The Macquarie University researchers briefly assessed a number of fire management plans written for other parts of Australia (Wilson 1999; James and Bulley 2004), and planning guidelines written for the development of fire management and management for biodiversity conservation (Saunders and Hobbs 1995; Rose *et al.*

1999; Keith *et al.* 2002). The information in the submission is comprehensive and is repeated in the paragraphs below.

Keith *et al.* (2002) stresses these points – fire management plans need to have measurable goals, flexibility to deal with stochastic events and new knowledge, a means of resolving management conflicts, and a means of assessing performance and incorporating this into future management. The researchers suggested that the following needs to be included in a detailed management plan; however, various factors will need more or less emphasis depending on the plans scale and aims.

Define the problem and objectives – What is the reason for fire management? What is fire management hoping to achieve. Is it aimed at a single species, ecological community and at what scale? Can fire management for biodiversity be incorporated into other management objectives such as control of weeds and cattle (as opposed to the other way round)?

The ability to achieve management objectives needs to be given consideration. This is particularly important given that financial, political and other pressures can strongly influence the success of a management plan. The researchers suggest that while the Purnululu National Park Management Plan received international recognition (Anonymous 1995); it has not yet been successful in achieving the majority of its objectives. They believe this is because management strategies were not given a quantifiable level of success. In addition, management objectives and the strategies to achieve them were unrealistic given the time frame, lack of financial support and changing management priorities.

Background information is also needed and this will help identify what further information is required to develop future management activities and objectives.

Define the scale – Management plans need to consider both the short and long term, and their relevance to all management levels (*Regional, Management Zone, Vegetation, Burn Patch*). Following is a summary of suggestions made by Rose *et al.* (1999), on what management planning needs to consider at each level.

Regional planning allows for the consideration of different objectives and management across tenure boundaries. Ecological and cultural assets and appropriate fire regimes should be identified at the regional level. Consideration of whether protection of specific species/communities in conservation reserves is adequate is also possible. In some cases different manipulation of fire regimes in conservation reserves may be required if a species/community is at risk from the fire regimes being implemented for other management goals. The importance of remote fuel management for the protection of assets can also be examined, and potentially be developed more efficiently.

At a subregional level (eg conservation reserve), management zones can be identified within which more detailed planning is required. James and Bulley (2004) identified a number of management zones for Bribe Island (QLD) including: Asset protection, wildfire mitigation, conservation, sustainable production, rehabilitation, reference/research and exclusion. In the implementation of management within these zones Rose *et al.* (1999) make this point:

'It is desirable that most fire management zones contribute in some way to both mitigation of unplanned fire and biodiversity conservation, even though this often involves more complex planning than the simpler approach of zones with (primarily) a single purpose. When all zones are considered complementary, greater recognition

is given to the cumulative benefits of management of each zone (across a landscape) with less reliance on the traditional 'sacrificial areas' to mitigate fire effects on assets.'

Planning should also consider the development of mosaics at the vegetation and burn patch level. There may be a number of these within a management zone or they may make up a whole zone. Vegetation communities generally have different flammability and fire regime requirements, an important consideration for long term plans and fire implementation. Planning mosaics at the burn patch level are particularly important for protecting the habitat requirements of threatened species. Prescriptions may include conditions such as the percentage of a species habitat that can be burnt given its habitat requirements.

Define the fire management strategy – This needs to be developed for specific management objectives within the different management levels/zones. It should include further background information, including species/communities of significance and potential indicator species. The current fire mosaic and fire environment needs to be established. Information in this section would include the fire history of the management level/zone, fire characteristics of different vegetation types, and the conditions associated with bush fires and suitable for prescribed burns. It should include a risk assessment and guidelines on reducing the effects of fire. Other environmental problems or assets in the area that may influence fire behaviour and needs should be considered, eg cattle activity may have produced fire breaks or introduced flammable grasses into rainforest patches, and assets may include buildings and sites of cultural significance.

Monitor and record results – It is essential to record what is being planned, what has been carried out, and the results. Monitoring regeneration and faunal use of regenerating areas will develop our understanding of the fire regimes needed for biodiversity conservation. Monitoring is essential to allow the fire management programme to be adjusted where necessary, particularly given our currently poor understanding. However, monitoring itself needs to have a purpose. Monitoring for the sake of monitoring is limited in what it can tell us. Monitoring needs to be conducted in order to identify specific changes in a species or community and what has caused that change.

Works schedule - Wilson (1999) includes a work schedule which outlines a number of specific projects (eg. flora and fauna research projects, fire impacts monitoring projects, mapping and database management, timing and priority of burning activities) which will be undertaken over the life of the management plan. Some of these are ongoing, while others are given specific commencement and development dates depending on the results of earlier work. Including this is likely to help determine the ability to implement activities in the prescribed time, with the resources available. It will also enable prioritisation of activities should conditions and resources change.

Plan review and administration – This will outline how the performance of the plan is to be assessed, such as through regular reports to a governing/advisory body. A timeline for review of the plan needs to be provided. Included in this, particularly for a regional management plan, should be a strategy for communicating the results and success of the fire management. Communication of results should be undertaken for fire management that works and also fire management that does not work.

A submission from Australian Wildlife Conservancy at Mornington Station advises that a fire management program has been in place on Mornington since 2004 which aims to promote biodiversity. The program has been designed using:

- a satellite imagery-generated 7- year fire history for Mornington that describes how fires behave in the 'unmanaged' system; this helps define practical aspects of our management.
- The results of the growing body of research into the effects of fire on biodiversity; this helps define our conceptual approach to management.

AWC also has an active weed control, feral animal control, and destocking program in place at Mornington. In addition, a large research and monitoring program follows the effects of these management initiatives on wildlife

The PGA submission pointed out that pastoral regions are very distinctively unique and need management plans tailored to the region's characteristics. In the Pilbara region, the PGA said assistance from government agencies is generally not required by pastoralists as they have acquired on ground expertise on how to manage fires. Strategic burning is undertaken after the first rains as the vegetation is greener and therefore the fire is more manageable as it's not as intense. These strategic fires are designed to reduce fuel loads to halt larger more destructive wildfires from entering their station. Spinifex for example, is burnt rotationally to allow native fauna adequate time to migrate to other vegetation.

The PGA submission went on to say that fire management planning in the Kimberley must adopt a pragmatic approach as there are small windows of opportunity with favourable burning conditions. Burning is said to occur every 2 or 3 years to reduce the build up of fuel loads as, if left unmanaged, vegetation would build up and fuel large wildfires.

The PGA also said that the only time meetings take place to discuss fire management in the Gascoyne region is when a major wildfire occurs. Pastoralists stress the need for greater preparedness for fire outbreaks prior to the summer season in the form of liaison between pastoralists/FESA and local governments.

g) What additional information would be necessary to be able to undertake comprehensive fire management planning?

Submissions on what additional information would be required suggested a variety of matters including satellite imagery, information from other north Australian fire districts and agencies, customary Indigenous fire management practices; better vegetation maps and better understanding of faunal assemblages for many areas and habitats. While there is a growing body of research from related regions of the Northern Territory and Queensland that can be incorporated into management, one submission considered that an understanding of the specific conditions in the Kimberley is important. The submission pointed out that, even in a World Heritage area such as Purnululu, scientific research is urgently needed to learn about the plants and animals and how they are affected by fires.

Apart from local knowledge, especially listening to older and long term people, submissions suggested there needed to be information about fire behaviour models that allow confident prediction of fire behaviour within the defined vegetation structure types under a variety of weather and fuel moisture conditions. Other information suggested was fuel accumulation models that allow the prediction of fuel quantity with the ability to accommodate seasonal inputs such as localised rainfall and drought.

h) Should all land managers participate in fire management planning?

Most people thought all land managers should participate in fire management planning; reasons given were that they could then have influence over the plan and also so that all parties are familiar with what is required in the event of a fire.

The PGA was doubtful of the concept advising that 'while many accept the validity of preventative planning and preparing annual plans there is concern from pastoralists about FESA's proposals for implementing mandatory fire management plans.'

The PGA also thought responsible land managers who have implemented a voluntary fire management plan in the Pilbara and Nullarbor regions ought to be issued with an open-permit to burn as soon as the ideal conditions present. These permits would be issued to proven responsible pastoralists in collaboration with FESA and Local Government for the Pilbara and by FESA alone in the case of the Nullarbor as it was said they have a greater understanding of fire management than the shire which currently issue the permits.

FIRE CONTAINMENT

a) Do you think wildfires should be put out in the early stages if at all possible or left to burn, and why?

This question elicited responses demonstrating the completely different set of circumstances experienced in the regions and in particular the Nullarbor. It was said that a quick early response is the answer to limiting the environmental impact of wildfires in the Nullarbor region. It was said that the longer the delay in getting to Nullarbor fires, the larger they become and suppression can turn into a very costly exercise in terms of machinery and manpower costs and resultant environmental impact.

The submission said that wildfires occur on the Nullarbor under a specific set of conditions. The submission went on to say 'good winter and spring rains produce an enormous growth of spear grass, which in above average winter conditions, produces a huge bed of seed on the ground in late September. This is then like kerosene when dry October/November thunderstorms can ignite dozens of fires in one night. If fires persist to the following afternoon they are then fanned by the afternoon 'doctor' at the hottest part of the day and can travel 100 km or so in one night. Best firefighting conditions occur after midnight, when winds abate, and damp coastal air has been brought in by the 'doctor'. At this stage graders can turn the edge of the grassfire back on itself and patrols next morning can mop up but all smouldering timber must be extinguished or the fire will be away again next afternoon.'

The situation is quite different in the Kimberley region, where it was said that the 'fundamental cause of major environmental damage in the Kimberley is the spread of wildfire, many travelling for months before finally being extinguished by the first rains of the 'wet'.'

There were different opinions about extinguishing fires in the early stages in the Kimberley region, some saying that large fires should be left to burn and others suggesting fires should be put out in high priority accessible conservation areas, or where life or property is at risk. One submission questioned the difference between a wildfire and other fires and another suggested that not all wildfires are bad as some lit during the storm season travel short distances only. It was suggested the aim should be to put out any fires that have the potential to cover extensive areas and,

given the inaccessible nature of most of the Kimberley, the only option is to use aircraft.

The Macquarie University researchers thought that reducing the extent of wildfires is important given their size and effects on biodiversity and risk to life and property. Attempts should be made to improve detection and suppression of wildfires at an early stage. They did not think, however, that wildfire suppression should be relied on as the first approach to reducing fire extent and frequency in the Kimberley.

The researchers were of the opinion that wildfires are a natural occurrence and quoted evidence that, even with the fire mosaics created by traditional burning, wildfires occurred throughout the fire season (Braithwaite 1991; Braithwaite 1996). They stressed that the difference is that the impact of wildfires would have been patchier and over a smaller spatial scale than wildfires today. They also suggested that it has been found that the more country is burnt in the early dry season, the less that it is burnt during the late dry season (Press 1988; Braithwaite 1996). It was suggested that a better approach would be the incorporation of wildfire probability into control burning programs and the development of a mosaic burning strategy which will reduce their impact.

b) If an early response to extinguishing fires is adopted, what resources would be needed?

The regional differences were again highlighted by the responses to this question. In the Nullarbor region, it was said that 'insufficient manpower and machinery are the greatest handicap to suppression although all neighbours tend to help'. Back burning is one of the most valuable tools of firefighting, but the use of this is usually limited to specific conditions, as regular grading of firebreaks as a preventative measure is impossible because a grade exposes the limestone and limits regular or annual preparation of breaks from which to burn back.

The type of resources and equipment suggested for extinguishing fires early were responsible incident control; graders; aerial reconnaissance; ground crew with some light tanker presence for safety; back burning and mop up; one or two 4 x 4 water units arriving promptly; 3 fast attacks; 2 x (2x 4) fire units; 1 grader; 1 lowloader truck; 1 dozer; and aircraft.

The DEC submitted that the entire fire fighting resources currently available in the State would not be sufficient to deal with the seasonal fire load in the (Kimberley) regions and said that suppression is only one component of risk mitigation.

FESA said that the resources needed will depend on very many variables such as the rate of spread, access, fuel load, fire intensity, travel time (response time), vegetation types e.g. ease of access for wheeled loader or tracked machine; turn around time to the water supply, fire suppressant use and availability as well as considering environmental impacts.

The Macquarie University researchers had similar concerns about reliance on the ability to prevent or extinguish wildfires and suggested again the development of a mosaic burn strategy. If the fire was to be extinguished, they pointed out that 'a reasonably accurate early notification system of fires is already available through the North Australian Wildfire Information hotspot notification service; however improvements can be made to it. Two problems relate to its use, misidentification of hot spots (eg hot rocks) and a lack of use by fire managers. The latter is probably of greater concern but would require a simple education program in its set up and its relevance to fire detection. If an early response to extinguishing fires is adopted the

quickest and most successful method would be aerial water bombing (assuming water is within reach). Ground crews and a means to get them to the fire boundary would also be needed to clean up edges. In addition, it may be considered useful, following prediction of fire behaviour and likely extent, to 'drop' ground crews into areas to conduct back burning operations. This may be particularly important around remote cultural and ecological assets. Aircraft and ground crews would need to be available and resourced relative to the regions needs. For example one water bomber for the entire Kimberley in a period of high fire risk is unlikely to be able to respond to all fires.'

One submission was received from a manager of a helicopter charter company based in Kununurra who had carried out work for the DEC to extinguish grass fires. It was considered that the key factors influencing the success of the operations were knowledge of fire conditions by ground crew, including terrain, fire fuel and forecast weather; knowledge of the capabilities and limitations of aerial suppression by ground crew; constant communications between ground crew and air attack/observation aircraft and proximity of useable water source to fire location. The operations were to provide assistance to ground crews already engaged in fire suppression and that, used on its own, a helicopter and water bucket would not be effective as a tool.

c) *What fire regime do you support, with respect to frequency, intensity and size?*

There was a wide range of views about what fire regimes would be suitable for various regions. These varied from 'none' and 'what occurs by lightning' to simple 'pre season burning and controls to reduce fuel and lessen the extent of wildfires'. Others were more specific suggesting 'low frequency mosaic burning mainly of low intensity fires', small, slow moving fires at times of high humidity such as the start of the thunder storms in November', 'frequent early dry season burning, low to medium intensity and small to medium size' to 'burn in strips providing fire breaks with a different strip burnt each year to provide the regeneration of fresh growth on previous strips'.

One submission said that one pass of the plane will not be sufficient and suggested that ground burning and aerial burning must be used together. This submission also contended that 'until people get out and travel their land and know it well, no amount of computers, fire faxes or satellite imagery will do the job'.

One pastoralist considered that and where and when burning takes place is the result of subjective judgments made by managers regarding the state and condition of their land and it is clear that environmental diversity is not matched by a variety in management techniques. The same submission cautioned against the risk of using poorly understood Aboriginal fire practices to develop a fire ecology and suggested that using such unreliable data is not an appropriate base for strategic fire management.

The Macquarie University submission suggested there are substantial differences in the appropriate fire regimes between and within the different regions considered in the review. They say that the simplest way of describing the difference in fire regime required in the Kimberley and rangeland regions is a declining fire frequency and intensity with rainfall, and a variable intensity and size of fires with more in the lower range. However, it is suggested to be more complex than this, for instance more fertile soils are able to support more rapid vegetation growth and more frequent fires, while rock outcrops, rainforest pockets and creeklines are likely to need protection

from wildfires. Their research has shown that habitats in a relatively similar geographical region require different fire frequencies

The researchers suggest that planning for fire regimes needs to consider spatial mosaics, which can be created relatively quickly, and also the development of temporal mosaics which require long term strategies (James and Bulley 2004). The importance of temporal mosaics is highlighted by Keith and Bradstock (1994), and Keith *et al.* (2002). They show that maintenance of full species diversity requires a fire frequency that includes occasional short intervals to reduce competition of dominant species as well as longer intervals which allow for the establishment of a generous seedbank. Spatial mosaics are particularly important for maintenance of animal diversity (Keith *et al.* 2002). While some species such as the desert mouse (*P. desertor*) appear to utilise only one type of fire regime, many others draw on resource from habitat subjected to different fire regimes, for example the mala, *Lagorchestes hirsutus* (Lundie-Jenkins 1993).

The researchers caution against creating a 'block' burning pattern as discussed by Rose *et al.* (1999) and James and Bulley (2004) who stress 'that it is critical that fire management areas are NOT managed as blocks and burnt either in their entirety, or on a rotational basis, and the reliance on access tracks to contain fire should be avoided'. They suggest that this may result in undesirable spatial patterns that lack variability. Habitat features, structural and species characteristics of vegetation communities and moisture gradients can be utilised to create mosaics and variability within fire affected areas.

The approach at the Mornington Wildlife Sanctuary is 'based on the growing body of published research that suggests that the general aim of fire management in the tropics should be to increase the area of relatively long-unburnt habitat (Andersen *et al.* 2003; 2005).' Their targets are to:

- Reduce the total area of the property that burns in any year
- Reduce the average size of each fire event.
- Prevent entire habitat patches from being burnt in a single fire event (The vegetation boundaries of habitat patches on Mornington are currently being revised using aerial photography and ground-truthing, but in the interim, we delineate a habitat patch using the *Vegetation Associations* as currently defined by Hopkins *et al.* 2002).
- Reduce the fire frequency in habitats that require a relatively long period without fire to complete their life cycles (eg. spinifex-dominated systems on sandstone uplands and pavements require 6+ years without fire in order for obligate-seeding plants to flower and set seed).

Increase the proportion of area that burns in the early wet season as opposed to the dry season (due to Mornington's aridity, areas that are burnt from roughly May to September lie bare for many months, thus exposing soil fauna and fauna to UV sterilisation, encouraging crust formation of the soil, and allowing substantially longer periods for wind and water erosion to take effect).

d) *Do you think people who deliberately light fires should be prosecuted?*

On the question of prosecution for people who deliberately light fires, five people strongly agreed saying that a 'tough stance should be taken on all illegal fires and arsonists severely fined'. The reasons for this were that illegal fires not only endanger biodiversity values but also put human lives at risk as well as endanger property. It was also said that no fires should be initiated without prior knowledge of the ecology of the area and that fires should only be deliberately lit if sufficient

warning has been given to all persons who may potentially be found in the area. Pastoralists in the Kimberley region said they experienced a number of pressures about fire management and thought vandalism was the worst aspect and spoke about the difficulties of prosecuting those responsible even if caught.

FESA advised that the Police, particularly the Arson Investigation Unit, Crime Stoppers and many of the General Duties Officers have been strong partners in the targeted arson reduction program. The Department of Education and Training provided great support and access to schools for FESA to present a consistent message to the students and staff. Catholic education schools have also provided easy access to their schools, particularly in the Kimberley Region as well as shopping centres where static displays were set up.

FESA consulted widely with the potential partners, particularly during the development phase of the program, to ensure that the prevention objectives address the bush fire arson problem from a whole of community perspective. The program has been specifically focused on:

- Primary schools in and around the immediate target area. It has been shown that if the primary schools immediately adjacent to the target area are not covered, then the natural movement into and through the area can result in less effective bush fire reductions.
- Shopping centre displays (where possible) with poster displays and specific relevant local information.
- Door knocking of all houses within the target area promoting the program message of “help us help you”. Houses not attended during the door knock are left with a fridge magnet and information flyer with the relevant bush fire reduction message.

Specifically separate strategies were developed by FESA for children in primary school and adults who are the primary carers.

Other people suggested that prosecution issue was not quite that simple and that given the size of the Kimberley and the ability to find evidence and the perpetrator, a prosecution in relation to non management fires is likely to be difficult (particularly in the case of remote wildfires, rather than arson around specific assets). It was considered that prosecution would need to seriously consider the effort required in finding the perpetrator and proving that the lighting of a fire was deliberate. It was further suggested that funds would be more appropriately put towards developing fire mosaics that would prevent this type of fire from becoming a problem and in educating the community about fires.

Other submissions suggested penalties such as supervised work orders might be more appropriate than fines or goal. It was also suggested that community leaders might enter into a MoU with the Fire Management overarching body for indigenous fire practices.

It was also suggested that there should be a requirement for fire managers to report on the success or lack of success of fires. It is recognised that many fire managers could not provide a detailed assessment; however, even basic reporting of what went wrong and how to avoid it in the future would develop fire management.

- e) *Are there other programmes for reducing the number of fires, eg training and education?*

Training and education were suggested as the most appropriate ways to reduce the number of fires. The KRFMP was said to address this issue with visits to communities and discussions with elders and all ages of Aboriginal people.

FESA advised of its various programmes which are:

1. Statewide Bush Fire Threat Analysis (BFTA)

BFTA is this is being developed in partnership between FESA, CALM and Western Power (the latter is a minor partner) with supporting finance from the Natural Disasters Mitigation Committee.

The BFTA will apply across the whole of the state regardless of land tenure.

2. Kimberley Region – strategic pastoral station bush fire management

This project will enhance the capability of the pastoral community in the Kimberley to better manage the bush fire prevention and response capability through FESA undertaking strategic bush fire planning and implementation on the ground at pastoral stations. The on ground work will provide a basis for “best industry practice” to be identified and applied across the Kimberley. Pastoralists will be able to review and identify which of the components are applicable for their stations. This project will enhance the current bush fire management and planning activities undertaken by pastoralists in accordance with the Bush Fires Act.

The project will liaise with industry bodies e.g. PGA and ILC and individual pastoralists with a view to gathering data and information from experienced fire managers and pastoralists in the Kimberley. This information will be used to augment information gathered during the preparation for the 2006 dry season fire season and also the 2006 aerial burning program (ACB).

During the liaison with the bodies and pastoralists FESA will support the work with a financial contribution to the pastoralists and to the ACB program across all participants.

FESA will gather the data and anecdotal information, compile the report and distribute to the pastoralists.

FESA is seeking to undertake a similar project in the Pilbara next financial year.

3. Visual fuel load guides

FESA in partnership with pastoralists and other property owners have been developing visual fuel load guides for the non-southwest forest region of Western Australia. Many local governments have been extremely cooperative in allowing access to there land. Where there is a closed canopy forest environment leaf litter is a significant fire fuel and can be measured utilising the litter depth gauge and the comprehensive tables in the CALM Forest Fire Behaviour Tables.

Where there is not a closed canopy, such as occurs in around 25 IBRA regions, but rather scrub vegetation with scattered tree over storey, the fuel load is predominantly the scrub. This is difficult to non-destructively measure so FESA is developing visual fuel load guides for the IBRA regions outside of the south-west forest region.

To date the fuel measurement has occurred for the Geraldton Sand Plain and the Swan Coastal Plain. FESA is finalising the compilation of the first draft document. The Kimberley fuel load measurement has been undertaken but the samples have not yet been oven dried and weighed.

It is planned to undertake similar work in the Pilbara and Goldfields in the forthcoming months.

4. Guide and Tables for Fire Management in Western Australia

FESA has finalised the development of a guide utilizing the four CSIRO fire danger and fire spread meters and therefore covers all IBRA regions in Western Australia. FESA has received an updated IBRA boundary documentation from CALM for its inclusion. The draft document has been distributed to a SA Country Fire Service Officer and also a researcher at the Bushfire CRC for comment. This is in addition to around 100 FESA staff.

5. Targeted bush fire reduction

These activities are centred on the towns of the Kimberley. The targeted bush fire (arson) reduction program was initiated in December 2001. It was initiated after several months of comprehensive analysis and review of the bush fire attendance data. The bush fire attendance data provided an opportunity to ascertain whether arson bush fire ignition patterns could be determined. This monthly analysis provided some superficial trends. The data was plotted onto maps, providing an opportunity to determine major physical features that may attract fire lighters. By analysing physical locations, vegetation types and times of ignition it was possible to develop a hypothesis on how to reduce the high number of arson bush fires.

Matching the targeted arson reduction program with FESA's cooperative community centred joint agency approach also provided some significant benefits. As FESA undertakes joint training and practical application for bush fire investigations with both CALM and the Police, the process supports a partnership arrangement for the targeted arson reduction program.

6. Targeted fire awareness – remote and indigenous communities

Following the introduction of the town community centred targeted bush fire prevention activities it was recognised that a program needed to be developed that met the needs of remote and indigenous communities. FESA was invited to the Makajarrka Festival, which is an Aboriginal cultural and law festival. The participants at the festival come from across the Kimberley.

FESA sought approval to conduct two deliberately lit fire prevention activities based on “how to prepare a safe fire place” and also “the fire calendar year (good and bad fire)”. These themes were developed after consultation with the local Aboriginal elders, as was the change of name from arson to deliberately lit fires. From this activity FESA is developing community specific unplanned fire reduction messages for a number of communities. FESA will be utilising local artwork to support the message development.

FESA seeks funding support for the program under the Emergency Management Australia's Natural Disaster Mitigation Program, Local Grant Scheme and Bush Fire Mitigation Program.

7. Bush Fire Mitigation Program

FESA through its application under the Bush Fire Mitigation Program has been successful in obtaining funds (FESA \$71,000, Local government \$53,500 out of \$550,000 – the bulk of the finance goes to DEC (formerly CALM) \$425,500 for work in the south west of the State) to undertake mapping and remote sensing projects.

The mapping project will commence in the Perth area, then the south west of WA covering major towns, farm lands, private property and plantations. From there the project will radiate out east and north, depending on the work load and information.

The mapping project will include the following aspects:

1. Fuel loads
2. Community values including heritage, environmental and infrastructure
3. Vegetation types
4. Roads and tracks
5. Bush fire threat values
6. Rainfall zones
7. Hydrants and water points

The remote sensing project will commence in the Kimberley and also undertake some targeted work in the Pilbara. The Pilbara work will where possible link into the work of the Bushfire CRC.

These maps when developed will be able to support bush fire mitigation, prevention, suppression and recovery activities across Western Australia.

FESA also supported a number of local governments with finance and physical support for their funding requests.

FIRE PREVENTION

a) *What fire prevention practices would be appropriate for your region?*

Responses to the question about fire prevention practices varied from suggesting efforts should concentrate on the apprehension and prosecution of arsonists as well as on education. Other measures suggested including fire planning at a regional scale; more training on the use of the Fire Map web site; education (radio/TV) to the wider community to highlight the serious impacts of fire; and engagement of Aboriginal people to broadcast the fire preventative message highlighting the impact on wildlife and regeneration of traditional bush foods.

It was suggested in one submission that preventative management or preparedness on the Nullarbor would require large scale spraying of road verges or fencelines to create a mosaic from which back burning could be carried out in the event of a fire, thereby limiting it to one area, but the cost would probably be prohibitive.

One submission favoured prescribed burning forming a very small part of the overall suite of preventative measures as the arsonists are doing the job already. Other submissions suggested aerial controlled burning and ground based burning to develop fire mosaics.

Another submission suggested that the best fire prevention practice is to pre-emptively manage fire. This includes burning breaks through areas that shouldn't burn in one go, across areas that are regular conduits for wildfires, and around areas that need to be protected from fire, for example sensitive vegetation and cultural sites. It was considered that more emphasis should be put on early wet season burning, although this is a difficult time to burn as it requires very fast responses to unpredictable conditions.

b) *What changes could be made to the effectiveness of aerial controlled burning?*

There were varying answers to this question. One submission suggested there should be less, while another said the scale would need to be increased very significantly to mitigate the current inappropriate fire regimes. FESA believes that the ACB program is quite successful in its current format.

One submission was not supportive of widespread aerial incendiary burning because it is difficult to control and can lead to very intense fires. The submitter contended the Pastoral Lands Board needs to be held accountable for the contribution which grazing makes to creating out of control fires and contributes to the loss of biodiversity. A number of questions were posed about the regulation of dispensing aerial incendiaries; accountability for their distribution; feedback information required from those who use them; whether there is a State government budget allocation for burning and if it is this budget that drives the fire management rather than proper scientific justification.

A number of people suggested more ground burning should be integrated with aerial operations while one suggested smaller aircraft should be used to complement the service provided by the larger plane currently in use. FESA believes that the effectiveness of the ACB program could be enhanced if there was an opportunity to run two aircraft in the Kimberley for the duration of the program. It was considered, however, that the unit costs of having two aircraft would increase the operational costs to the pastoralists which might make the operation cost prohibitive.

The submission from AWC advised that helicopter use was very successful and reported that 'there is no other way to cover as much country in such a short time window. It is expensive, but the costs would be lowered if neighbouring properties combined their aerial burning work (and thus reduced ferry times)'.

Kimberley region pastoralists discussed the frustrations they encounter with the aerial controlled burning they need smaller aircraft at their disposal which can be used at the appropriate opportunities. They thought helicopters, as used in the NT, was a more accurate way of burning from the air. More financial support for ACB was also suggested although one pastoralist disagreed saying that the landowner should have to be responsible.

The pastoralists in the Pilbara said they do not undertake aerial controlled burning. All burning is on the ground and is carried out to encourage better production. Burning takes place after good opening rains when winds are favourable. Grass country is protected and not burnt as it is the most valuable and takes a long time to recover if burnt. The pastoralists said they did not burn when birds are nesting. Wildfires are thought to fluctuate according to the climate, occurring after good wet seasons.

FESA considered the fire management value of the regionally strategic buffers could be enhanced if the State was to part fund or fund these buffers, although it was felt there needs to be significantly more work undertaken on this hypothesis before it could be considered on an operational basis. FESA also considered that improved vegetation mapping and cultural asset mapping would greatly assist in the planning for the ACB program.

The AWC submission implementation of smaller control burns around sensitive areas prior to aerial burning. These would not necessarily have to be conducted in the same year and would depend on curing and regeneration of vegetation. This would

need long term fire planning and flexibility should conditions change. The submission also advocated greater flexibility in flights to allow burns to be conducted with a few days notice and suggested there should be ground-based assessment of ground conditions (eg vegetation curing) prior to aerial burns being conducted.

AWC considers that, to be effective, 'ACB work needs to be carried out in a very short time window, after the grass is too wet to carry fire, but before it is so cured that fires do not reliably extinguish overnight (for example, on Mornington, this window is typically 10-14 days long). The timing of the window also varies across the property, depending on habitat type, aspect, etc. This means the timing of the ACB work *must* remain flexible, almost until the last minute - it can not be booked months or even weeks ahead.'

AWC is of the opinion that ACB *must* be based on sound on-ground knowledge of the moisture content of grass, prevailing wind conditions, variation in the curing rates across habitats and landforms. The submission contends that the land managers need to carry out preparatory work to make the ACB effective as part of an overall fire management program.

c) *Should aerial controlled burning be used in other Rangeland regions, apart from the Kimberley?*

One submission, which preferred aerial controlled burning did not occur in the Kimberley, was not in favour of extending it into any other regions. Two submissions supported using the programme in other regions, while four submissions were cautious suggesting ground based burning in conjunction or using helicopters.

d) *What fire regime do you consider is appropriate for the different regions which are being considered in this review?*

One submission relating to the Kimberley region, suggested that more frequent control burns may be more beneficial than infrequent wildfires. The submission also stressed the importance of understanding that seasonal variation is valuable. The submission also pointed out that the high frequency of wildfires associated with volcanic soils in the North Kimberley is environmentally determined and they are highly fire-prone, fire-tolerant landscapes.

A pastoralist with experience in the Goldfields region said that wildfires are confined to the Spinifex areas and generally die out naturally when they reach Mulga watercourses, stony country and breakaways. Control is therefore on a 'land type' basis. A strategy of early patch burning of Spinifex is done over a period of years to break up the area into staged growth.

One submission from a pastoralist in the Pilbara rangelands, said that fire breaks were created only in the year after an extremely good wet season when the Spinifex growth has been prolific. The breaks are done in strips with a different strip burnt each year providing new growth on previous strips.

Another suggestion was that a fire consultative group is needed for each region to identify that region's needs.

The Macquarie University researchers consider that planning for fire regimes needs to consider spatial and temporal mosaics. They cited papers which demonstrate the importance these play in maintaining full species diversity to reduce competition of dominant species and to build a generous seedbank. They consider that spatial mosaics are particularly important for maintenance of animal diversity and give

examples of some mammals which have benefited from habitat subjected to one type of and also different fire regimes.

The AWC considers that, in general, 'a fire regime that maximises heterogeneity (in terms of frequency, intensity and timing) is a bet hedging strategy, but the specifics of each of those three factors will vary enormously depending on vegetation type (which depends on geology, rainfall, etc). It is impossible to prescribe a regionally-based fire regime; fire needs to be managed on a much finer scale.'

Other submissions suggested simply preventative measures while another named back burning, fire breaks and resources. DEC was of the opinion that 'a combination of preparedness measures and extensive prescribed burning to achieve a fine-grained mosaic is the only viable option in the majority of those remote regions.'

FESA considered there is not a simple answer to this very complex question. The absence of the flora, fauna and ecological community research data and varying biogeographic regions and sub-regions in the Kimberley and inland areas were said to compound the complexity of the fire regime determination.

FESA also considers the needs for pastoral leases have to be factored into as the Kimberley is a significant pastoral industry zone. FESA thinks it is difficult to determine the appropriate fire regime because of the overarching criteria of the protection of human life and property assets, coupled with very little scientific data for natural environmental values, while accommodating cultural and heritage values and pastoral management issues.

e) *Should there be more preventative burning in the early dry season?*

Most of the submissions supported more preventative burning. There were, however, many provisos including a statement that burning in the early 'wet' season may be found to be beneficial in some areas and would need to be undertaken with sensitivity to environmental impacts and the area's fire history and include monitoring of biodiversity impacts. The effects of early dry season burning was also said to be poorly understood with negative impacts of both late and early dry season fires for some species of plants and animals.

A fine scale mosaic pattern of land burn at different times, with more early dry season burning and burning in the wet season was also proposed with attempts at suppressing late dry season fires. Another submission cautioned that early dry season burning should not become an end in itself, as 'whereas there is little evidence to suggest that this would benefit biodiversity, there is evidence available to suggest that increasing the fire-free interval and reducing the size of fires may promote biodiversity.'

The Department of Environment and Conservation contends that burning early in the dry season in the Kimberley has proven to be very effective in terms of providing a mosaic of vegetation composition and structure and reducing the rate of recruitment of introduced grasses in following years. More extensive use of fire early in the dry season would significantly contribute to stabilisation of the inappropriate fire regimes currently in place. DEC supports early dry season burning, however it does not support an approach that favours early dry season burning and the exclusion of burning at other times of the seasons.

FESA probably supports increased early dry season burning in the Kimberley region and suggests the burning that could be undertaken needs to be strategic and meet

the needs of the land owner/manager. The method of ignition should be a mixture of aerial and hand burning.

FESA probably does not support increased early dry season burning in the inland areas, depending on the rainfall season and the available fuel load.

f) *If you agree, how should that be done?*

One submission did not agree with increased early dry season burning but, for those who did, it was suggested it would depend on the area and circumstances and controlled mosaic burns and fire breaks by both aerial and ground ignition operations. It was suggested that this should occur over all land tenures.

g) *Do you think on-ground Fire Teams similar to that organised through the Kimberley Regional Fire Management Project should be established?*

All the submissions supported the concept of on-ground Fire Teams, some more enthusiastically than others. Supporting submissions described the teams as successful and said they needed to be taken further so they could offer secure employment on fire and other land management issues. It was suggested these teams could be coordinated by the Shires with financial funds from the State. Another supporting submission suggested Federal funding, but not through CDEP which was seen as a demeaning process. One submission suggested the teams should be educated in the reasons for burning and how ecological research into fire management is important.

Other submissions supported the concept in principle but felt it must be adapted to local arrangements. It was considered that the teams must be community-based to help support the integrated fire plans. The difficulties associated with Aboriginal fire management teams moving across cultural boundaries were also pointed out.

One submission pointed out that the fire teams are a great idea in principle, but they have three drawbacks:

- Their effectiveness is potentially handicapped by the same constraints that currently limit the ACB approach in the Kimberley – ie a lack of flexibility in timing and response.
- They are potentially expensive because the same job can be carried out by a smaller number of land managers/owners who know the lie of their country, prevailing wind, usual fire behaviour, etc, much better.
- Ideally, the Aboriginal people associated with the country in question should be involved with the fire management, rather than a team of people who may come from elsewhere.

h) *If you agree, what role should they play and how should the teams be funded?*

Most responses about the fire teams concentrated on the funding issues suggesting ongoing funding is a critical issue. Both State and Federal funding was suggested with one suggestion that it be a mix of user pays and general government funding to support the regional management body. Another submission suggested that, 'if cooperative and extensive integrated fire management planning can be achieved and funded as part of land management agencies' core business, then funding can be made available under contractual arrangements for fire service provision by fire teams on a commercial basis.'

It was also suggested that the use of fire teams and funding should be assessed in terms of the value of fire management outcomes for each dollar invested and the concept should not be viewed primarily in terms of social benefits.

In terms of the role the teams would play, FESA suggested it would be to support DEC on the DEC estate and where required by the pastoralist on their station.

i) *What do you think about the suggestion that the Emergency Services Levy be used to finance Fire Teams, if they were established?*

There was a mixed response to using ESL to finance fire teams, and FESA pointed out that this was not the purpose of the levy. Others thought it was not appropriate while some considered it might be a legitimate source of revenue. It was also suggested others using the rangelands such as the pastoral, tourism and mining industries should contribute as they would benefit from improved fire management.

One submission suggested support from the levy in providing equipment; training, community safety programs and emergency response capacity could be justified. It was also pointed out that 'establishment of fire teams across the Kimberley and rangeland regions will need substantial initial investment in specialised training, which may not be able to be covered by the levy. Aboriginal people involved in fire teams are also unlikely to be able to work purely as volunteers, therefore, development of fire teams as a CDEP project or similar is suggested.'

RESOURCES

a) *Do you think there are adequate resources in your region for fire management?*

Most submitters were of the view that there were inadequate resources for fire management, although one pastoralist in the Gascoyne/Murchison region thought most resources were available locally but that coordination and inventories of resources and operators is lacking.

Most comments related only to the Kimberley region and one submitter restricted comments to fire suppression and related inadequate resources to that. However, most regarded resources are inadequate across the board with one saying that one of the 'greatest impediments to better fire management is a lack of funding.'

The PGA thinks there has been and continues to be enough good scientific research into fire impacts, prevention and management and that on the ground implementation needs funding for essential equipment and support for aerial controlled burning.

There were different opinions among Kimberley pastoralists at the teleconference about resources, some suggesting a centralised place to store equipment would be useful while others thought most stations had adequate equipment to fight fires.

FESA considered there are adequate resources in the regions for fire management, particularly when pastoralists' resources are taken into account.

b) *If not, can you outline what resources you consider should be supplied?*

There was a wide range of responses regarding what resources should be supplied. This ranged from physical equipment such as more fixed wing aircraft, water bombing helicopters and helicopters to carry out aerial controlled burning and fire suppression; ground equipment such as road water tankers with pumps, fire safety equipment, fire drip torches, bulldozers, graders, loaders and fire units to suppress fires; to human resources such as fully equipped ground crews and people trained for

fire management on the ground, particularly prevention. It was suggested that equipment for fire suppression could be controlled by a regional body and could include equipment loaned by organisations such as DEC and mining companies.

It was also suggested that equipment such as GIS technology and fire mapping capability should be freely available and subsidies should be available for fire fighting equipment aerial controlled burning. Qualified people to assist in fire planning was seen as another requirement as well as advice and assistance to landowners, visiting communities and educating them and overall communication and coordination of all stakeholders.

Concern was expressed about the availability of resources for smaller communities such as Kalumburu and Warmun.

FESA considered further resource allocation should be deferred pending the outcomes of the biodiversity research. FESA considered that once that research has been undertaken and the results shared with FESA and other stakeholders then a separate budget allocation should be made to assist with the creation of strategic ACB buffers.

c) How should these resources be allocated?

Two submissions thought the resources should be allocated to the major towns, and another suggested it was essential that manpower and equipment could be transferred quickly and easily around the State on an as needs basis. It was also suggested that, once a strategic fire management plan with fire management outcomes was determined for each region, the tasks and priorities could be allocated to achieve those outcomes. One submission suggested a reasonable amount should be allocated to apprehension and enforcement as arson is at the heart of the problem.

d) What do you think about the suggestion that CALM's equipment be used to suppress fire in the Kimberley region during the late dry season months?

While most submitters saw use of DEC's equipment from the south-west of the State in the northern areas as being sensible, DEC advised this was not a feasible solution. DEC advised the resources are required in the south-west for a large part of the year (nine months in many locations) and would not be available in the northern areas when burning or fire suppression operations are being undertaken in the south-west.

e) Should mining companies and other industry provide more resources to help suppress fires?

Some people considered mining companies should provide more resources to help suppress fires, however, others said some mining companies were already assisting when emergencies occur and they can only be expected to continually invest resources into activities that will provide a benefit to their business. It was said that most resource companies would argue that their investment in fire suppression is to protect mining infrastructure and is already adequate for their needs. Basing landscape scale fire management on funding offered by the resources sector was not seen as sustainable or wise.

It was also suggested that 'resources sector operations that have an impact on the environment could be required by Government to invest in environmental offsets such as underwriting more sustainable fire management as part of the approval to implement a project.' It was considered this would ensure clarity and transparency for both the resources sector and the community as to why, where, how much and

how long funding was to be provided by the resources sector and where and how those resources would be applied.

ROLE OF INDIGENOUS PEOPLE IN FIRE MANAGEMENT

a) What role do you think Aboriginal people should play in fire management?

There was a wide range of responses to the role Aboriginal people should play in fire management, from none to a large on the ground role. The reasons against were that the current generation does not need to hunt for survival, access is by road and vehicle and Aboriginal people do not know the old practices. One submission said Aboriginal people should play the same role as everyone else while another said they should be educated and controlled not to burn, with elders only being permitted the right to burn.

Most people saw the role as being significant and vital given that Aboriginal people constitute approximately 50% of the total Kimberley population. They were seen as a valuable source of information and expertise and should be well represented in the overarching body regulating fire management. It was suggested they should be involved at all levels, from determining management aims to implementation. They were also seen as having native title rights over large areas of the Kimberley and as such should be responsible for fire management in those areas. Others suggested Aboriginal people should be given roles in all areas of fire management effort including investigation of causes, enforcement and fire suppression if they were willing.

FESA considered the role Aboriginal people needs to be identified by Aboriginal people themselves and engagement should be through a community-centred approach. FESA considers the role Aboriginal people play in fire and fire management will be different to the role of non-Aboriginal people due to the cultural significance of fire to Aboriginal people.

The Department of Indigenous Affairs sees a place for increased investment in partnered research that involves Indigenous people in biodiversity and ecosystem assets and threatening processes in relation to fire. It is considered these aspects are relevant in relation to regional sustainability in the *State Sustainability Strategy Hope for the Future*.

The Kimberley Aboriginal Law and Culture Centre pointed out that fire management was one of the key issues identified in a 2 day intensive community consultation process held in the community of Jarldmadanga. The communities are looking to ways in which they develop economic opportunities from the fire work they undertake. The value of the Yiriman project was pointed out, which is an Aboriginal youth project set up to help people to develop life skills, promote leadership and build capacity.

b) Do special measures need to be put in place to protect cultural and heritage sites, such as rock art?

Most people supported special measures be put in place to protect cultural and heritage sites and suggested this could be done through the KALAAC and KLC for the Kimberley region or through the Department of Indigenous Affairs to ensure an appropriate strategy for protecting sites of ethnographic and mythological significance in accordance with the Aboriginal Heritage Act 1972. Protection of these sites was not thought to successful using large scale aerial burning unless more accurate protection burns or mosaics are in place.

c) *If so, what measures do you suggest would be most effective?*

It was considered a comprehensive planning process is required for protection to be effective. Ideally, the strategic planning process would identify relevant heritage values, however, many heritage sites are not listed on public databases, making their identification, location and judgements about their vulnerability difficult or impossible. Protection would require the identification and location of cultural heritage in a GIS format and scale useful for fire management.

RESEARCH

a) *What areas of research are needed?*

Most submitters saw a need for continuing research while some thought there was no need for any more because there is ample evidence of what fire does, NT research is applicable to the Kimberley and sufficient examples of how pastoralism can produce significant improvements in biodiversity.

Other people suggested that action should not be delayed pending more research and that it is pointless doing research on animal numbers as so much has already been lost.

The type of research suggested covered many aspects, including a desktop study of all research to date and identification of the gaps. It was also suggested research papers need to be collated and integrated as part of an overall Kimberley Fire Management Plan under a regional authority. Arson research was suggested by one person with investigation into the opportunities for more penalties.

Two specific areas of research suggested were ecology of fire regime sensitive species and ecosystems in hummock grassland landscapes and to examine interactions between fire and weeds, especially buffel grass. This submission also suggested further research is needed to improve fire behaviour prediction in hummock grassland fuel complexes. Another area suggested requiring significantly more research is the flora, fauna and ecotypes of the various Interim Biogeographic Regionalisation for Australia (IBRA) regions and sub-regions.

One submission suggested that, as there has been as there has been very little research conducted in the Kimberley in any area, it is a difficult question to answer. A number of priorities suggested are:

- Ethnoecological research – traditional knowledge can help to identify plants and animals that are vulnerable to fires and indicators of habitat regeneration, and will help to focus fire management.
- Research into the effectiveness of fire management activities will help improve burning programs.
- Responses of fauna/flora to fire and species which may act as useful indicators.
- What size, shape and within burn patchiness is necessary for the conservation of fauna and flora?

The AWC suggested that:

research requirements include inventory work as there are very few baseline data on plant and animal distributions and abundances which can be used to examine whether and why changes are taking place, and where the remnant populations of declining species (such as northern quolls and Gouldian finches) are persisting as well as the effects of fire because, although progress has been made (especially in the NT) we still have a limited understanding of how and why wildlife responds to different fire regimes.

Key areas suggested for further research include:

1) the importance, role and desired scale of patchiness.

Although there is a perception that 'patchiness' (from mosaic burning) is important, we have little idea of a) whether this is true, b) whether there is a critical size of patches that we should be aiming for, or c) why this is important (ie mechanistically).

2) The importance and critical parameters of land that is 'long-unburnt'.

The area of land that is 'long-unburnt' across northern Australia is vanishingly small, yet evidence is emerging that this may be important for biodiversity (Andersen et al. 2003; 2005). We need to determine some of the important parameters, such as how many years without fire constitutes long-unburnt, how big an area of long-unburnt is necessary (overall and at the patch scale), and why is this important for biodiversity?

3) The biodiversity effects of wet season burning.

The current dominant fire management paradigm is to carry out prescribed burns in the early dry, in order to avoid extensive fires in the late dry. The effectiveness of this approach, and its effects on biodiversity, are not adequately documented nor understood. Burning in the build-up season or early wet season is another way to reduce fuel in a relatively 'safe' way that may have quite different effects on biodiversity compared with dry season burn. However, there is almost no data on how species and communities respond to wet season burning.

b) *Which geographical regions do you consider require most research and why?*
Opinions varied on which geographical areas require most research with some advocating those with unique flora and fauna to those with high biodiversity value and high fire frequency. In terms of geographical distribution, one person said there is still a need for overall knowledge, and others said the Kimberley region requires most research, followed by the Pilbara and West Gascoyne, East Gascoyne/Murchison and Goldfields.

AUDITING AND MONITORING

a) *Should auditing and monitoring of the effectiveness of an agreed fire regime be carried out?*

All submitters, apart from one, thought auditing and monitoring are important; one saying that it is probably one of the most important things for developing fire management. The one dissenting submission thought there needs to be a shift from environmentally-based thinking to one that recognises that the pastoral industry does have many positive outcomes for the environment, and appreciates the experience and knowledge that exists in the industry,

A range of matters to be audited was suggested including significant changes in vegetation and fauna populations. It was also suggested that the "goal" should not be how much prescribed burning has been achieved but how well targets aimed at reducing unauthorized burns and late season devastating wildfires have been achieved. It was suggested auditing should ideally be aiming towards monoculture type landscapes and declines in fauna and flora.

The Macquarie University researchers suggested, considering our limited understanding of what an appropriate fire regime should be, monitoring should be conducted at a regional, management zone, vegetation and burn patch level. The example of Bradstock et al. (1995) was provided which states that the key to flexible

management is an ongoing assessment of how fire management actions influence fire regimes. In addition, it was felt it is important to conduct an assessment of the responses of flora and fauna to the imposed fire regime and whether these responses are in agreement with predictions based on the existing knowledge at the planning stage.

One opinion was that the auditing should be done using 'on the ground' checks and not just by satellite photos. Another opinion is that it is part of the full cycle for effective fire management and should be part of an assessment for unplanned fires as well as prescribed fires.

b) What indicators might provide useful measurements to determine if the correct fire regime is being achieved?

A number of suggestions were made including very general ones such as biodiversity change and biodiversity maintenance or enhancement of the critical indicator species; vegetation monitoring, soil monitoring for stability and biological activity, relevant native species of insects and mammals and the effect of appropriate grazing strategies as well as erosion, top soil cover, and the rate seedlings grow into mature trees. More specific suggestions were that regeneration of fire sensitive species such as *Callitris* spp could be used.

One submission suggested this depends on the management aims and the area being managed. It was suggested that, if the aim of a particular fire regime is to protect an endangered species, then monitoring that species and determining its habitat requirements would be required. If the aim of a fire regime is to develop a fine scale mosaic of fire affected habitat then assessment of fire scars and the ability to reduce the extent of wildfires would be useful, as well as analysis of biodiversity within habitat patches.

Monitoring of the change in diversity of species or particular species groups would enable assessment of the effects of fire regimes. It was felt that, considering that frequent fires are a concern, monitoring of the status of fire sensitive species can indicate whether a better fire regime is being achieved.

At Mornington, changes are being monitored in vegetation (both floristics and structural) following changes in fire management, as well as changes in the diversity and abundance of terrestrial vertebrates. AWC is also trialling techniques for measuring the population health of seed-eating birds (a group that has undergone substantial range and density reductions in recent years) that live in areas with different fire management. It was said this is proving very successful, and preliminary results suggest that the health of populations is compromised at key times of the year in areas with frequent extensive fires. AWC is also beginning a research project designed to test the utility of key bird species as indicators of good fire management.

At a landscape scale, it was considered the effectiveness of prescribed burning might be measured over time in terms of the persistence, range and abundance of species across the landscape. Knowledge of the current status of the biodiversity of an area would be required to appreciate and make meaning of any changes. This would require a sustained and extensive monitoring and survey program to identify changes.

COMMUNICATION, CONSULTATION AND EDUCATION

a) Do you think current communications for reporting and suppressing fires are adequate?

Most submitters thought current communications for reporting and suppressing fire were inadequate although a few said it was just they were not being used and that a transient population required a continual flow of messages. A number of people mentioned the confusion about who to contact in the event of reporting fires and who was supposed to take responsibility.

One submission reported that there is 'a perception which may be fostered by some tour operators such as scenic flight pilots and safari operators, that many, if not all of the fires in the Kimberley are CALM burns. This incorrect information is given out no matter what time of the year it is, whether the fire in question is a prescribed burn or a wildfire, and no matter what land tenure it occurs on. There needs to be specific information/ education available to operators on a yearly basis (because they have new staff every year) because this incorrect information may not only be unfair to CALM, but also may give some credibility to what may in fact be a wildfire, in the eyes of some tourists.'

Pastoralists in the Goldfields/Nullarbor region felt the technology for spotting fires could be improved as well as informing people about fires. Communication was said to be poor in this region.

b) *Should there be more consultation and information exchange with the community and between agencies and, if so, who should be consulted?*

On the issue of consultation and information exchange, all submitters agreed more was needed. Those who should be consulted included traditional owners, pastoralists, conservation managers, researchers, current fire management staff, and Aboriginal communities, Shires, CALM, DAG and FESA. It was also considered communication is needed to most groups, including tour operators, as fire can impact heavily on where they take groups. It was pointed out that 'Willis Walkabouts' has been aerial-bombed twice in the last 5 years.

It was also felt that people needed education on what they are seeing. It was thought the Internet and media has caused fear among many people about fires and suggested the word 'wildfire' should be replaced with 'unplanned fire'.

FESA in particular, believes that there needs to be a process whereby both published and unpublished research gets into the appropriate non-biodiversity organisations and forums for integration into agency policy and practices.

FESA suggested a group headed by an independent person and containing representatives from FESA, DEC, Museum, local governments, DIA, PGA, WAFF and other significant groups with a vested interest be established to ensure that as research into biodiversity is undertaken within WA it is circulated to those that can have an influence on protecting that biodiversity.

c) *What form should communication about fire management take, is written material adequate or should there be more use of meetings, video, radio, TV and the Internet?*

It was suggested more use should be made of all available technology, including the Internet, TV, radio, video, posters, information booklets, community materials and messages, education through schools, meetings, and workshops for land managers and phone to communicate about fire management.

- d) *Do you think information sources such as Fire Fax and Fire Watch are useful?*

People who had direct experience of using Fire Fax and Fire Watch were very enthusiastic about their use, however, it was pointed out that many people in remote regions do not have access to this type of information technology and that the public hardly knows of them.

In the teleconference, some pastoralists said they used Fire Fax and Fire Watch while others knew little about them and did not know how to use them. For those people, it was felt the money could be used for other purposes while those who did use them, considered it saved them time and money.

- e) *Should there be more information similar to those?*

A range of suggestions for further information was received including informing the public of imminent prescribed burning via local press and radio, more education flows and on the ground observations as well as improving and extending existing information.

- f) *If so, what information do you think should be prepared and distributed?*

The value of education was highlighted in one submission which suggested that working with the whole community on a continuing basis is essential to control the incidence of inappropriate or risky fire ignitions. It was also felt that it is important that educational curricula deal adequately with the topic of fires in the landscape and how it can be responsibly managed. NHT funded fire projects were cited as demonstrating some successful approaches at the primary school level within Aboriginal communities which could be incorporated at a broader scale.

Other suggestions for the type of information were Internet Fire Watch, with weather conditions and effects noticed on environment, which could be presented on TV and radio daily. Other ways of presenting information suggested were through quarterly newsletters showing community involvement.

DEC suggested the question needs to be the focus of a proper needs analysis. It was suggested it was necessary to know who the audiences are, what they already understand, what the messages are for transmission and how would they be most effectively delivered to target audiences. It was considered that the provision of information should be coordinated so that conflicting messages and duplication of effort are avoided between all the information providers.

GENERAL COMMENTS

A general comment was made in one submission that arson is the major reason for the fire problems in the Kimberley and the second significant cause is the frequency, timing and extent of FESA/DALM/other authority sanctioned fires.

Another submission made the point that 'CALM has been at the forefront of trying to achieve better fire management in the Kimberley since at least the late 1970s. This was actually before CALM was formed but its precursors, the National Parks Authority and Wildlife section of Fisheries and Wildlife but more specifically the Forests Department, were pivotal in bringing the perceived inappropriateness of the fire regimes to the notice of the then Bush Fires Board and government as early as the early 1980s. They also played a role in raising the public awareness of the issue(s). Subsequently CALM and its officers were involved in early prescribed

burning work and also the fostering and management of Fire Control Working Groups etc. CALM also bought a great deal of technology and expertise to the area and was probably the first agency to use satellite imagery (for example), in planning and monitoring burning/fires in the Kimberley.'

Both the Conservation Council and the WA Forest Alliance commented that fire is not a natural environmental factor in Western Australian ecosystems, other than by lightning ignition. Those organisations put forward the argument that this may be one of the reasons too many Australians light fires frequently and carelessly, with disastrous consequences for biodiversity. It was considered that the review should challenge the view that "fire is good for the bush" mentality that is asserted is still very prevalent within the DEC and the wider community.

One submission pointed out that it is important to acknowledge 'traditional owners' as opposed to Aboriginal communities. It was said that their interests extend far beyond 'cultural' to include 'native title rights, natural and cultural resource management.' Another submission said that Native Title should not negate the need for any person to obtain the necessary fire permit.

One submission from the Kimberley region said there should be more emphasis placed on fire suppression measures.

A few submissions complained about fires on neighbouring land which impact on their pastoral land or are not burnt at regular intervals so that a large fire could subsequently develop.

One submission believed the Pastoral Lands Board needs to be more diligent in its inspection process to ensure land managers adhere to their responsibilities towards managing the environmental integrity of the land in their care. This submission also suggested the advisory team being assembled to coordinate a new NHT funded Kimberley fire project is being chosen to be representative of land management interests in the Kimberley and could undertake the fire management advisory role.

It was noted in one submission that Main Roads WA owned vegetation on road verges that is not subject to any fire management regime. It was considered this poses a massive fire threat as pastoralists are prohibited from burning this bush therefore fuel loads build up to dangerous levels.

APPENDIX 1

PEOPLE WHO MADE WRITTEN SUBMISSIONS ON SYNOPSIS DOCUMENT

NAME

Tim Anders	Heliwork WA
Dr John Bailey	Chairman, Conservation Commission of Western Australia
Susy and Robert Bugle	Nanutarra/Uaroo Station
Greg Campbell	Chief Executive Officer, S Kidman & Co Ltd
Chris Done	Kununurra
Graham Forsyth	Beefwood Pastoral Company
Managing Director	
Tricia Handasyde	Kununurra
Chris Hennigler	Kachana Pastoral Company
Jo Harrison-Ward	CEO, FESA
Peter Kneebone	Derby
Richard Lethbridge	SEEKS Conservation Group
William (Butch) Maher	Yeeda Station
Peter Mitchell	Chairperson, Environs Kimberley
Keiran McNamara	Director General, Department of Environment and Conservation
Murray McQuie	Pastoralist
Jim Kohen, Thalie Partridge,	Department of Biological Sciences
Dave Harrington, Lauren Barrow	Macquarie University
Sarah Legge, Steve Murphy	Australian Wildlife Conservancy
Ecologists	Mornington Wildlife Sanctuary
Wes Morris	Centre Coordinator, Kimberley Aboriginal Law and Culture Centre (KALAAC)
Wayne Neate, Phil Avery, Steve Martin	Shire Derby-West Kimberley
Anna Nowicki	Wildflower Society of WA
Tony and Robert Richardson	Mount Florance Station
Ian Rudd	Roleystone, Perth
John Storey	Kununurra
Peter Stubbs	CEO, Shire Wyndham East Kimberley
Chris Tallentire	Director, Conservation Council
Rob Thomas	Manager Land Use and Planning, Department of Indigenous Affairs
Katya Tripp	Shire Wyndham-East Kimberley
Tom Vigilante	Kimberley Land Council
Rob Versluis	A/Convenor, Western Australian Forest Alliance
Hugh Wallace-Smith	KALAAC
Ruth Webb-Smith	Chairman, Pastoral Committee, Pastoralists and Grazier's Association

PEOPLE WHO PARTICIPATED IN THE TELECONFERENCES

Pilbara/Gascoyne

Robyn Richardson – Mt Florance Station
Graham Rogers – Pardoo Station

Kimberley

John Henwood	Fossil Downs Station
Doug Dixon	Margaret River Station
Ruth Webb-Smith	Carnarvon
Jim and Joy Motter	Bulka Station
Geoff Warriner	Carlton Hill
Chris Hennigler	Kachana

Nullarbor

Ross Wood	Rawlinna Station
Peter Brown	Aurubiddy Station
Mark Forrester	Kanandah Station

Goldfields

Murray McQuie	Bulga Downs Station
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PEOPLE WHO WERE CONSULTED IN JULY AND AUGUST 2006 IN MEETINGS OR SEPARATELY

Simon Abbott	Broome
Phil Avery	Shire Derby West Kimberley
Gina Broun	DEC, Goldfields Region
Ryan Butler	Fire Ecologist, DEC, Goldfields Region
Sylvia Clark	DEC, Goldfields Region
Gary Cook	A/ CEO CSIRO Darwin
Andrew Craig	Department of Agriculture and Food
Andrew Craig	Shire Halls Creek
Gordon Duff	CEO, Tropical Savanna CRC, Darwin
Danielle Eyre	Rangelands Coordinating Group
Gordon Graham	DEC Kununurra
Tricia Handasyde	Kununurra
Des Hill	Kimberley Land Council
Ed Hatherley	DEC Broome
Barry Hooper	DEC, Goldfields Region
Fay Johnston	Charlies Darwin University
Ian Kealley	Manager, Goldfields Region DEC
Adam Liedloff	CSIRO Tropical Ecosystems Research Centre, Darwin
Richard Lethbridge	SEEKS, Kununurra
Gae Mackay	Manager, DEC Kununurra
Maria Mann	Kimberley Environs
Jim Motter	Bulka Station
Joy Motter	Bulka Station
Dick Pasfield	Ord Land and Water
Rachel Nelson	DOW Kununurra
Wayne Neate	Shire Derby West Kimberley
Lynda Prior	Charles Darwin University

Ian Radford	Fire Ecologist, DEC Kununurra
Ken Robinson	Kimberley Aboriginal Law and Culture Centre, Fitzroy Crossing
Jeremy Russell-Smith	Tropical Savanna CRC
Trevor Shelson	Native and Agricultural Rehabilitation Association Inc.
Troy Sinclair	DEC Broome
John Storey	Kununurra
Jacinta Thompson	DOW Kununurra
Katya Tripp	Shire Wyndham East Kimberley
Hugh Wallace-Smith	Kimberley Aboriginal Law and Culture Centre, Fitzroy Crossing
Noel Wilson	Department of Agriculture and Food
John Woinarski	NT Department of Natural Resources, Environment and the Arts
Lesley Woolf	Kununurra