HOTSPOTS FIRE PROJECT

MANAGING FIRE ON YOUR PROPERTY

A booklet for landholders in the Murray region

NSW RURAL FIRE SERVICE

Nature Conservation Council The voice for nature in NSW

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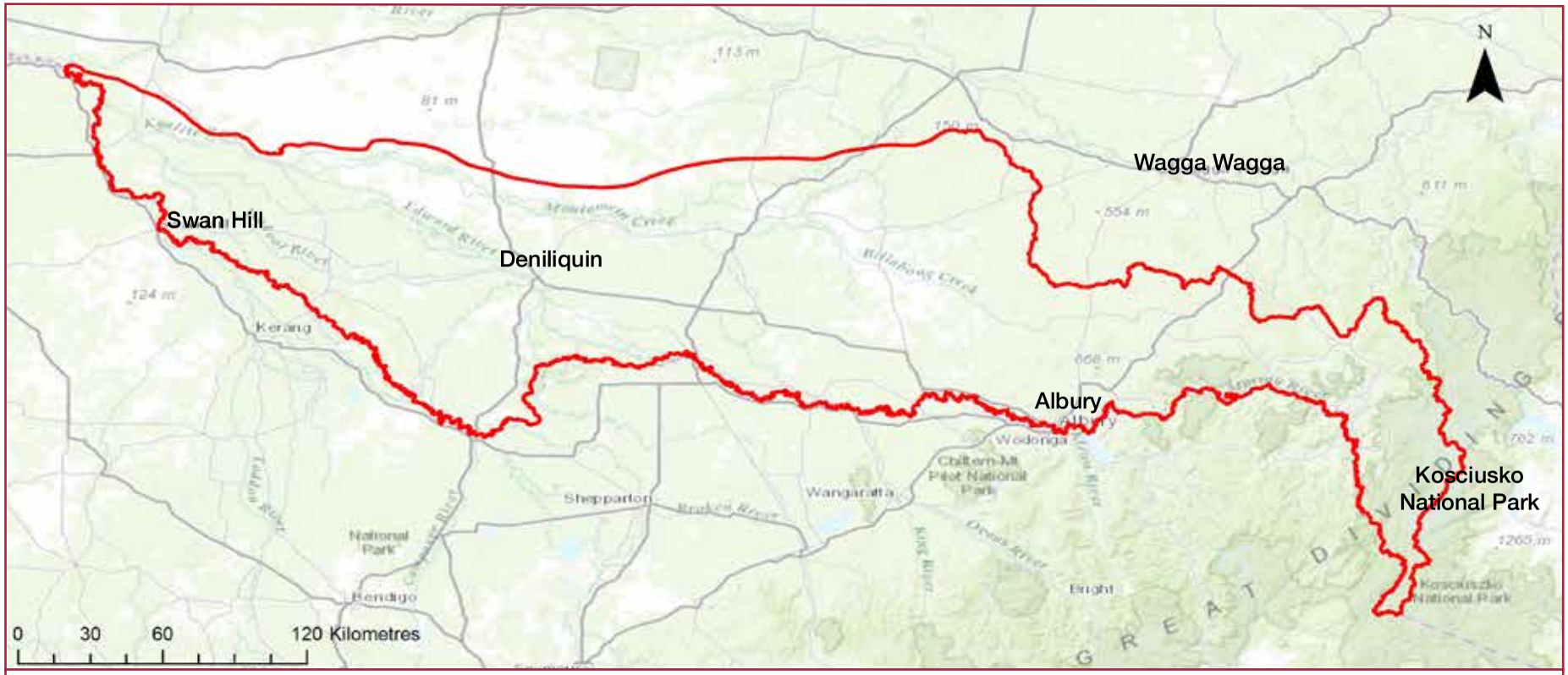
The Hotspots Fire Project is jointly managed by the Nature Conservation Council of NSW and the NSW Rural Fire Service.

WHAT DOES THIS BOOKLET COVER?



Murray River Catchment Area

1 INTRODUCTION TO THE MURRAY REGION

The NSW Murray catchment in southern NSW covers an area of around 42,000 square kilometres across a range of landscapes, from the steep alpine slopes in the east to the riverine floodplains and grasslands in the west[1]. Nationally significant areas include Kosciuszko National Park, the Murray River, and the Central Murray red gum forests. The Murray River forms the NSW-Victorian border for 1,880 km and forms a major arm of the 300,000 square kilometre Murray-Darling Basin. It is bordered by the Murrumbidgee catchment to the north and the Benanee and Lower Darling catchments in the west. The catchment supports wetlands of international, national and regional significance.

The catchment's population is around 107,000 people and is concentrated along the Murray and Edward–Kolety River systems in towns such as Corowa, Deniliquin, Holbrook and Moama and the regional city of Albury. Land and water resources within the Murray catchment support a range of agricultural enterprises, including dryland cropping, irrigation, grazing and horticulture. There is also an increasing interest in mineral and coal deposits.

The climate is cool temperate in the east of the catchment while the west is semi-arid with high temperatures and evaporation exceeding rainfall. Annual rainfall varies from 240–320 mm in the Rangelands to 700–1020 mm in the Upper Murray. The diversity of soils in the catchment reflects variations in parent materials as well variations in climate. Low rainfall areas are supplemented by the Snowy Mountain Hydro-Electric Scheme and an extensive irrigation network.

The NSW Murray catchment is highly modified for irrigation and broad scale agriculture, and contains very few intact blocks or corridors of vegetation. More than 125 aquatic and terrestrial species, populations and ecological communities are threatened, and other species are in decline. Endangered Ecological Communities in the catchment include a large number of the woodland communities as well as shrublands and grasslands. While vegetation community and species loss in the region is severe, the Murray does contain patches of remnant vegetation, particularly in areas associated with rivers and mallee woodlands and shrublands of the west[2].

The Murray area is rich in Aboriginal cultural heritage, with many Aboriginal nations living in the area for thousands of years and still living in the area today. Aboriginal nations of the region include the Wiradjuri, Yorta Yorta, Mutthi Mutthi, Wamba Wamba, Barapa Barapa, Pangerang and Monaro peoples. There are many important cultural locations throughout the catchment that are of state, national and international significance[2].

1. Murray Catchment Management Authority (2013) *Catchment Action Plan 2013 – 2023,* Murray Local Land Services, Albury.

2. Murray Catchment Management Authority & Office of Environment and Heritage (2012) *New South Wales Murray Biodiversity Management Plan: A guide to terrestrial biodiversity investment priorities in the central and eastern NSW Murray catchment*, Murray Catchment Management Authority, Albury.

2 LIVING WITH FIRE

Fire in the Murray

Fire is part of life on the land in the Murray region of New South Wales. Some landholders use fire as a land management tool. Others are concerned about the impact of wildfire on their properties, particularly during drought conditions.

Developed specifically for the Murray, this booklet provides an introduction on how fire can be managed for healthy, productive landscapes and also presents a framework for incorporating fire into property management planning activities.

Knowledge about the nature of fire and its effects on the landscape will help provide greater confidence in managing fire, both for the protection of life and property, and as a land management tool.

For some landholders, this information will stimulate a new understanding of the role of fire in shaping and sustaining local landscapes and the plant and animal species they contain. For those already in the know, this information will add to existing knowledge and hopefully prompt some important new insights into fire management.

Fire and the Australian continent

Triggered by lightning strikes and traditionally used by Aboriginal Australians, fire has shaped the character of Australian landscapes for millions of years. Many plant and animal species have evolved strategies to deal with fire, and some species have developed ways to take advantage of the opportunities it creates.

Aboriginal Australians actively used fire as a management tool. In some parts of the landscape, we know Aboriginal fire management practices involved smaller and more frequent fires than would have occurred naturally by lightning strike.

There is much debate though, about the nature and extent of Aboriginal burning across the Australian continent.

Even if we knew the whole story about Aboriginal fire management, this knowledge may not give us all the answers we need for the future conservation of native plant and animal communities.

The changes to our landscapes since European colonisation have been profound. In particular we are faced with fragmented vegetation, the spread of introduced species, and changes in the abundance of native plants and animals.

We need to draw on both old and new knowledge about fire in order to protect our bush and so manage for healthy productive landscapes. Much of our new knowledge and our current understanding of how fire might best be managed comes from looking at the way plant and animal species in different communities respond to fire. This topic is the focus of the next section.

> “For me fire is part of a bigger narrative about learning to live like an Australian, as if we intend to stay on this continent forever, for good.” [1]

1 Andrew Campbell - farmer, first national landcare facilitator, and Executive Director of Land and Water Australia speaking at the Australia Burning forum held just after the 2003 fires in Canberra. Quote taken from: Campbell, A. (2003) “Learning to live with fire” pp 243-247 in Cary, G., Lindenmayer, D., and Dovers, S. Australia Burning: Fire Ecology, Policy and Management Issues, CSIRO Publishing, Collingwood, Victoria.

3 MANAGING FIRE FOR BIODIVERSITY CONSERVATION

Science based management

Scientists and land managers have long recognised the relationship between biodiversity (the variety of different plant and animal species) and healthy land systems.

It wasn't until the late 70's that scientists gained a much better understanding of the significant role that fire plays in shaping these land systems and the biodiversity within them. Fire ecology is now an important area of scientific study.

For landholders, the most useful information to come out of this research relates to how different aspects of fire affect vegetation and wildlife, and how different plant and animal species respond to fire.

Plant responses to fire

Many Australian plant species have developed reproductive strategies in close association with fire. Since fire is such a powerful disturbance force, changes in fire patterns can quickly influence which species (and reproductive strategies) will persist in an area and which won't.

Different plant species respond differently to fire: some do not tolerate fire, some do tolerate fire and others rely on it for reproduction. For many Australian plants one or more of their reproduction processes (flowering, seed release or germination) occur exclusively, or most abundantly, in the months or years after a fire.

Scientists describe two broad post-fire regeneration strategies that occur in areas with a long history of fire which are of particular relevance to fire managers: *obligate seeding and resprouting.*

Obligate Seeders

When *obligate seeder* species are exposed to a fire, all, or almost all, plants are killed. These species can persist, however, by regenerating from seed (they're *obliged* to regenerate from seed if they are to survive in an area). This seed may be stored in the soil, on the plant (e.g. in cones), or brought in from nearby unburnt patches of vegetation by wind, water, birds or other animals.

Land managers implementing fire management strategies need to consider the frequency of burning if they wish to ensure the survival of these obligate seeder species.

Obligate seeders reliant on seed dispersal from other areas may also be threatened by extensive fires. This is because no or few seed supply areas escape being burnt and the likelihood of animals (or other dispersers) bringing in new seed is reduced.

Fire *intensity* can also affect obligate seeders because specific temperatures may be necessary to trigger seed release and/or germination.

Fire frequency needs to take account of the life span of obligate seeders; including the amount of time it takes for these plants to experience their first flowering and to produce seeds. If the interval between two fires is too short, the second fire may wipe out an entire generation of young obligate seeders before they have reached reproductive maturity (i.e. before they have started producing seed).

On the other hand, if fire is excluded from an area for too long, a whole generation of obligate seeders may move beyond reproductive age and die off before a fire has had a chance to trigger germination. While some seeds can survive in the soil for very long periods, seeds of some species are relatively short lived.

Obligate seeder ***Eucalyptus delegatensis subsp. delegatensis*** © David Francis

Resprouters

Resprouters are able to resprout after fire from woody underground *lignotubers* or from buds protected underneath their bark. Many landholders may be familiar with the behaviour of these plants.

Some resprouters can tolerate frequent fire, and some can live for a long time without fire. However, it is important to note that even resprouter populations may be affected by very frequent fire or by fire exclusion, and may rely on seed to ensure healthy, diverse gene pools.

Not surprisingly, in the absence of fire, those plants which come to dominate the landscape include long lived species and those which are able to regenerate without fire. These plants may competitively exclude other species from available light and space. A fire can help to open up the bush so light can reach ground level triggering resprouting, germination, and plant growth.

Fire regimes

Fire regime is the term used to describe aspects of fire that are important for managing vegetation and wildlife.

A fire regime includes the following factors:

- **Fire Frequency:** the number of fires in a given time
- **Fire Season:** what time of year the fire occurs
- **Fire Extent:** the area covered by the fire
- **Fire Intensity:** how hot the fire is

More on fire frequency:

It is important to consider the sequence of fire events. Long term effects on landscape and biodiversity are generally the result of a pattern of fires over time, rather than of just a single fire. (Although this is not to say that a single fire doesn't have the potential to significantly impact on a given area, like in a rainforest for example).

The amount of time between fires (fire interval) and the frequency with which fires occur in a given area are important in the conservation of our plant and animal species.

Frequent burning tends to reduce shrub cover and increase grassiness in some vegetation types resulting in more open landscapes. Infrequently burnt areas may naturally be shrubbier. These differences in vegetation structure affect the animals and birds that live in the bush. Some animals need shrub cover to shelter and breed, while others need open, grassy areas to find their food.

More on fire season:

Climate and weather will influence fire season more than any other factor. In the Murray, the bush fire danger period begins in November and extends through to March. The fire danger period may extend outside these times, especially during drought conditions. Western areas have been known to experience bush fires as early as September through until April. Weather conditions associated with bush fire season include moderate to high daytime temperatures and low relative humidity with winds from the north-west. Dry lightning storms are also common during this period. In some areas, frosts in winter create low fuel moisture contents.

Planned burns are, of course, constrained by the bush fire danger period and total fire bans, as well as by weather. The window of opportunity for planned burns is usually limited to autumn or spring. Burns may also occur during winter, but conditions are often marginal. The implementation of any planned burn is dependent on the exact weather conditions on the days leading up to and on the day of the burn.

From an ecological point of view, some variability in the season in which a fire occurs is likely to be the best way to go. While the season appears to affect some individual species,

scientific findings do not point to a particular season being 'better' for a whole community of plant and animal species. Where possible, it is probably better to avoid always burning at the same time of year.

More on fire extent:

The area covered by any particular fire can vary. Grass fires are common in the Murray and are fast moving and often driven by strong winds. For example, in 2009 a grass fire started in the Walla Walla area near Gerogery on 17 December. Strong winds, high temperatures and low humidity meant the fire spread quickly covering 5,238 hectares and damaging or destroying a number of homes, sheds and other agricultural assets. Other significant fires in the Ournie area also covered over 17,750 hectares and caused major damage and loss to residential and agricultural assets.

Within a fire perimeter, patches will often remain unburnt. Extensive fires that leave few unburnt patches may limit the ability of animals to find refuge during the fire, and food and shelter after it has passed. Unburnt patches provide a base from which animals can slowly move back into burnt areas as these recover. Those undertaking planned burns aim to leave unburnt patches.

However, small burns may also have a down side. Animals can easily move into small burnt patches from surrounding unburnt country and may place too much grazing pressure on the recovering vegetation in these small patches. This problem may be particularly prevalent where animals such as kangaroos are abundant. If a greater area is burnt, grazing pressure is more likely to be spread, reducing impacts on regenerating vegetation.

Landholders wanting to burn with biodiversity in mind may therefore want to aim for burns of varying size, while still ensuring unburnt bushland patches remain for fauna. Burning a number of different patches at around the same time is another way to spread grazing pressure over a larger area. Previously burnt patches can provide boundaries for later patch burns.

More on fire intensity:

A fire varies in intensity depending on factors such as wind speed, temperature, humidity, slope, fuel load and the structure of the vegetation. The most intense fires tend to occur during times of high temperatures, low humidity and strong winds.

Different vegetation types are adapted to different fire frequencies.

Variability in the interval between fires is important for maintaining species diversity. Repeated fire intervals of similar length are not always good news for plants or animals.

Eucalypt resprouting from base
© M.Graham, Hotspots Fire Project

Generally:

- Fires tend to be more intense when there is more available dry fine fuel. ‘Fine fuel’ is material less than a pencil width.
- High intensity fires are more destructive and will kill more plant and animal species, but they are also naturally occurring and important in some plant communities.
- After a high intensity fire, lots of seed germination may occur. Areas opened up by a high intensity fire will provide increased areas of sunlight and space for young plants to develop.
- Variation in fire intensity plays a role in keeping a greater number of species in the community (i.e. maintaining biodiversity).

Extensively burnt areas can affect the ability of plants and animals to recover after fire. © M.Graham

Low intensity fire. © W. Parker

Unburnt patches will provide animals with a refuge during and after the fire. © W. Drake

Fire regimes: implications for management

At best, fire management planning is a blunt tool and in some parts of the landscape, unplanned fire is inevitable. Prevailing weather conditions and natural landscape patterns will often influence fire season, intensity and extent. Management planning needs to be flexible enough to accommodate unplanned fire, variability in landscape and weather patterns.

Over thousands of years, much of the Australian bush has evolved ways to live successfully with fire and use it to reproductive advantage. Many vegetation types have also developed an ability to 'bounce back' from different fire regimes. This bouncing back is often termed 'resilience'.

The best approach is to vary your fire management actions over time. Talk to people with knowledge in your region, and try different things based on your own observations of vegetation responses to fire on your property.

> Biodiversity is more likely to be sustained when fire management extremes are avoided. Excluding all fire from your property, or burning as soon as vegetation has sufficient fuel to support a fire, will eventually see the loss of species adapted to a more moderate or variable regime.

High intensity fire. © G. Walker, NSW Rural Fire Service

4 FIRE IN THE LANDSCAPE: PUTTING THE SCIENCE INTO CONTEXT

Like many natural processes, the relationship between vegetation and fire regime is complex. However, there are some simple principles that emerge in the following stories about fire in particular plant and animal communities.


© A. Miehs

FIRE FREQUENCY IN GRASSY WOODLANDS

Grassy Woodlands in the Murray, like other regions, have been extensively cleared for agriculture. Patches of good quality Grassy Woodland where native species still dominate are therefore very valuable for conservation.

A great diversity of Grassy Woodland communities occupy the Murray catchment driven by varying annual rainfall and the complex interactions of elevation, fire, topography, geology and soil formation processes. The climatic variation across the east-west gradient in the Murray allows for the existence of four distinct Grassy Woodland classes; Subalpine, Southern Tablelands (eastern parts of the Murray), Western Slopes (south western slopes of NSW) and the Floodplain Transition Woodlands on the western alluvial plains.

Remnants with white box (*Eucalyptus albens)*, yellow box (*E. melliodora*) and/or Blakely's red gum (*E. blakelyi*) with a grassy understorey are part of the Critically Endangered Ecological Community Box-Gum Grassy Woodland. Other Grassy Woodlands that are recognised as Endangered Ecological Communities include Fuzzy Box (*E. conica)* Woodland, Grey Box (*E. microcarpa*), Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia. Conservation of these remnants is essential for retaining habitat for many declining native plants and animals.

Within Grassy Woodland communities, fire frequency can affect the balance between woody species and grasses. Frequent burning tends to produce open, grassy landscapes, whereas in places where fire has been excluded or is rare, shrubs and young trees may increase in number.

In Grassy Woodlands, tussock grasses such as kangaroo grass (*Themeda australis*); snowgrass (*Poa sieberiana*) and wallaby grasses (*Austrodanthonia sp)* dominate the ground layer. Smaller grasses and herbs grow in the spaces between these tussocks. Fire increases diversity by burning the dense tussocks, making space for the smaller species. Many of these grasses and herbs flower rapidly after fire, producing seeds which germinate while gaps between resprouting grass tussocks are still available. Some of the native tussock grasses, particularly kangaroo grass, are also encouraged by fire. Thus fire provides a way for large native grasses, small grasses and herbs to co-exist.

Where fire has been excluded from Grassy Woodlands, shrubs may increase or decrease depending on whether or not they rely on fire for regeneration. Shrubs and trees that are not reliant on fire and can regenerate between fires will likely increase in density in the absence of fire. If environmental conditions are favourable, these species may then progressively come to dominate the landscape shading out the grasses and herbs. Heavy litter which accumulates over time may also leave little room for small ground layer species. However, there are also shrubs that depend on fire to regenerate. These shrubs may appear in large numbers after a fire as seed stored in the soil is stimulated to germinate. These types of shrubs will tend to die off after a long time without fire, producing a more open understorey.

Both ground layer plants and shrubs form part of the rich diversity of Grassy Woodlands in the Murray region and fire plays an important role in regulating these woodlands. The extent of loss, fragmentation and change to Grassy Woodlands, means fire needs to be carefully managed and varying fire over time and space is likely to be important for maintaining diversity.

Grassy Woodland © M. Graham

FIRE AND ANIMAL HABITAT

Variability in fire frequency over time and across the landscape plays an important role in providing the habitat that bushland animals need. Fire alters the structure and density of vegetation layers and can change the species composition of bushland areas. Some birds, mammals and invertebrates may even disappear if fires occur too often or are excluded completely. Landscapes in the Murray provide a significant refuge for several nationally vulnerable fauna species.

Hollows as Habitat

There are significant areas of mature and old growth eucalypt forest across the Great Dividing Range and surrounding ranges of the Murray region. These magnificent forests have numerous hollows and provide habitat for an abundance of fauna. Many fauna species are dependent upon hollows for key parts of their life-cycle. Specifically, hollows provide places for animals to feed, shelter and breed. Hollows can take many centuries to develop or be replaced when lost from a landscape. Fires can burn through significant hollow-bearing trees and cause them to fall. This leads to a loss of valuable habitat and causes increased competition for remaining hollows. Maintenance of hollow-bearing trees and enhancement of these valuable habitats wherever possible, is needed to ensure the survival of many native species.

Hollow-bearing tree © M. Graham

Mammals and Birds

A number of iconic threatened fauna species are known to use hollows in the Murray catchment. The Vulnerable yellow-bellied glider (*Petaurus australis*), inhabits fertile and productive forests in the eastern and upper parts of the catchment. The Vulnerable squirrel glider (*Petaurus norfolcensis*), inhabits drier forests and woodlands in the eastern and central parts of the Murray. The feathertail glider (*Acrobates pygmaeus*) the smallest gliding marsupial in the world, while not a threatened species, also uses hollows in the catchment. Possums and gliders are favoured prey of the Vulnerable powerful owl (*Ninox strenua*), Australia's largest owl at 60 cm in height and the Vulnerable barking owl (*N. connivens*). Another threatened species that uses hollows is the gang-gang cockatoo (*Callocephalon fimbriatum*). To ensure the survival of these sensitive species large hollows must be maintained in the landscape. This will ensure that breeding pairs can successfully maintain their large home ranges and reproduce.

Regent Parrot
© David Cook Wildlife Photography
https://www.flickr.com/photos/kookr/

Extensive clearing of woodland vegetation for cropping and grazing across the Western Slopes and Plains of Victoria, NSW and Queensland has caused the ongoing decline of a group of

birds collectively termed "declining woodland birds". This group includes threatened species such as the superb parrot (*Polytelis swainsonii*), the regent parrot - eastern subspecies (*Polytelis anthopeplus monarchoides*) bush stone-curlew (*Burhinus grallarius*) regent honeyeater (*Anthochaera phrygia*), swift parrot (*Lathamus discolor*), grey-crowned babbler (*Pomatostomus temporalis*), diamond firetail (*Stagonopleura guttata*) and speckled warbler (*Chthonicola sagittata*).

Besides broad-scale clearing, woodland birds have declined for a variety of reasons that include: inappropriate fire regimes, particularly too frequent or intense fires; displacement by aggressive native birds; ongoing loss of understorey habitat structure caused by firewood gathering, mechanical clearing and fire; degradation by weeds; and predation by vertebrate pests. Retention of understorey habitat is critical for the survival of many woodland birds.

Protection of trees with hollows is also critical. For example the southern most population of the regent parrot which nests in the hollows in the river red gums of Barmah – Millewa area has continued to decline. During nesting the superb parrots travel up to 10 kilometres to feed in box woodlands. One of the main threats to superb parrots is the loss of connection from their nesting habit to their feeding habit. Land clearing and wildfires have significantly depleted the corridors from the red gum forests to the box woodland. While efforts are underway to replant these corridors it will take many decades before the trees form hollows.

The endangered mountain pygmy-possum (*Burramys parvus*) is a tiny marsupial first caught in Kosciuszko National Park in 1970. Surveys found that the possum populations are largely confined to the patches of boulder dominated habitat and associated shrubby Heathland in the Australian Alps. Heathland shrubs, in particular the mountain plum-pine (*Podocarpus lawrencei*), provide a major source of food throughout the year. During the spring and summer months migratory bogong moths constitute a major part of the pygmy-possum diet.

In recent years possum numbers in the four known subpopulations in the southern Kosciuszko have continued to decline markedly. Loss of habitat, activities associated with skiing and ski resorts and damage to alpine heath vegetation pose major threats. Decline in the number of bogong moths is also a threat as without this rich source of fat and protein it is unlikely that most local populations of pygmy-possum at high elevations could survive.

The mountain plum-pine is particularly sensitive to fire and because of this fire is also a threat to mountain pygmy-possums.

Mountain Pygmy Possum
© Kate Aitken OEH

Invertebrates

Different fire regimes will also affect invertebrates like ants, beetles and spiders. Numbers of these invertebrates can be reduced immediately post-fire, but can quickly recover. Although overall diversity can be the same between areas, the frequency of fires will affect the features of the habitat and therefore which species live there. Excess nutrients from bush fire debris can reduce aquatic macro-invertebrate populations post fire (e.g. insect, crustacean and mollusc), however they can also be quick to recover. Some plant-eating beetles, flies and spiders can take advantage of recent fires, while ants which feed in the litter layer can be more common in longer unburnt areas.

Bogong Moth © Donald Hobern

Bogong moths hatch in early spring as cutworm caterpillars and feed on grasses and crops on the plains, then travel several hundred kilometres to the Alps, feeding on flowering gum trees along the way. Over summer they provide a vital food source for the mountain pygmy possum and also antechinus, birds and spiders and lizards. Little is known about the causes of declining moth populations which highlights the need for further research, including on the role of fire regimes.

Wildfire, Mosaics and Variability

In some places, fire needs to happen often enough to maintain open, grassy forest environments rich in grasses and herbs, where early-successional animal species can thrive. Other places need to support good-sized patches of thicker vegetation where broadleaf shrubs and late-successional fauna can flourish. It is also important to remember some animals need access to both open areas and denser cover and a mosaic of patches can fulfil that requirement.

Where native vegetation covers large areas it is likely that wildfire will fulfil this prescription. Where remnants have been isolated by clearing and urbanisation, or where fire suppression has been unusually effective, some planned burning may need to occur. Hot fires have their place, as well as cool winter burns. A further point is the importance of topography in providing refuge areas from which re-colonisation of the post-fire environment can occur. Not only do unburnt areas serve this function, places where fire is less severe also play this role. When thinking about the effects of fire and how best to manage it, it is instructive to consider landscape patterns: how does vegetation change with topography? How does topography affect fire behaviour and how does this enable plant and animal species to survive and thrive together in a fire-prone environment?

THE STORY OF WHITE CYPRESS PINE

White cypress pine (*Callitris glaucophylla*) is a prominent feature of the landscape across central western New South Wales and is a component of many vegetation classes in the Murray. Unlike most trees in Australia, *Callitris* species are not flowering plants; they are conifers and produce seed on the surface of cone scales.

The recruitment of white cypress pine isn't triggered by fire, but rather is an occasional event associated with particularly good rainfall. The density of young pines can be quite high. Unlike eucalypts, pine seedlings can take many decades to reduce in density and thick stands

of small spindly trees can remain for many years. Whilst these stands can provide good habitat for native species including terrestrial orchids and woodland birds, dense regrowth is not suitable habitat for other species. Because of this, changes in habitat structure from open woodlands to dense cypress regrowth can lead to changes in native animal populations.

The last two hundred years have seen many changes in the cypress pine woodlands. Some have been cleared for cropping, while elsewhere the density of pine has increased. The balance between eucalypts and pines, and between large and small trees, has also changed. Early 19th century leases often required landholders to remove eucalypts, shrubs and young pines. Mature pines provided excellent wood. As foresters know, pine regeneration happens readily in 'understocked' stands: where once mature eucalypts and pines left few resources for new plants, logging created gaps for young pines to come in.

The regeneration and thickening of woody native species, such as white cypress pine, in previously cleared or agricultural landscapes is regarded as a problem for agricultural productivity. On the other hand dense regeneration of white cypress pine can provide a more sheltered and cooler microclimate than surrounding open habitats. This is particularly the case during extremely hot summer days when native animals such as the koala take refuge within cooler cypress stands.

Fire regimes have also changed. Historians and scientists who have studied cypress pine forests generally agree that fires started by Aboriginal Australians and lightning probably once helped maintain a mosaic of woodland patches. In many places the understorey was open and grassy under a canopy of eucalypts and mature pines, while in other places shrubs and young cypress grew thickly or in clumps. Although challenging to know for sure, it appears with European settlement, fire became increasingly less common in the slopes and plains of NSW.

White cypress pine is much more sensitive to fire than the eucalypts that grow with it. Not all cypress plants are killed in every fire: even in hot wildfires a proportion are generally tall enough to escape most of the flames. Seedlings, however, are readily killed in a burn. Thus fire has the potential to kill very young regrowth, and to thin dense cypress stands.

White cypress pine © W. Parker

Landholders who may wish to limit the density of pine stands may find fire a useful tool for managing white cypress pine seedlings. Fire and other management techniques that encourage the growth of eucalypts, native shrubs and deep-rooted perennial native grasses will in turn produce more ground fuel for fires, may discourage pine regeneration and provide habitat for those native animals that require the nectar, seeds and insects that are available from these native plants.

While fire may open up cypress pine stands, getting fire into them without burning down the neighbourhood can be challenging. The trick will be to find fire regimes that balance all the different needs of plants, animals and us – a job for landholders, people familiar with fire and scientists to tackle together.

5 MANAGING FIRE FOR DIFFERENT VEGETATION TYPES

If different vegetation types are adapted to different fire frequencies, how do landholders know whether their fire management actions are good for biodiversity?

To help make these decisions, the Office of Environment and Heritage (OEH) has developed fire frequency guidelines for broad vegetation types around NSW[1]. These guidelines are periods of time (in years) bounded by 'thresholds'. Thresholds refer to the upper and lower limitations to survival for species that are particularly sensitive to very short or very long, intervals between fires. The fire frequency guidelines aim to ensure fire intervals are long enough to let vulnerable obligate seeders grow to maturity, while also ensuring fire happens often enough to keep short lived species around.

Hotspots is working with OEH and local ecologists to further support these guidelines to take into account the considerable differences between regions within NSW. The 42,000 kilometres covered by the Murray catchment includes a wide range of environments, from alpine slopes in the east to the riverine floodplains and grasslands in the west. The Murray River rises near Mt Kosciuszko in the Australian Alps from an elevation around 2,200 metres.

Annual rainfall varies from 240–320 mm in the Rangelands to 700–1020 mm in the Upper Murray. Average maximum January temperatures range across the catchment from 16 °C in the east to 32 °C in the west. Average maximum July temperatures range from 4 °C in the east to 14 °C in the west. Higher minimum as well as maximum temperatures due to climate change are projected for the region.

All these factors affect which plants grow where, and how fast they grow. They also affect the way fire behaves. Fire frequency guidelines aim to reflect these differences.

> The recommended fire frequency intervals are based on what scientists currently know about fire ecology, and will continue to be refined as more information comes to hand. Upper thresholds in particular are currently based on very limited data.

Fire frequency intervals for broad vegetation types found in the Murray are listed on the following pages. To find out any recent developments on fire frequency guidelines in the revised Bush Fire Environmental Assessment Code for NSW Code please refer to the NSW Rural Fire Service website at: www.rfs.nsw.gov.au.

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[1]The vegetation types are classified according to a statewide assessment made in 2004 by Dr David Keith. The groupings can be recognised by specific combinations of plant species, in some cases, these include plant species found nowhere else. The vegetation types are also based on factors such as the height and spacing of the dominant plants as well as geographic indicators of rainfall and soil type.

Vegetation types of the Murray

Wet Sclerophyll Forest (grassy subformation)

Upper Murray Wet Sclerophyll Forest © M. Graham

The term *sclerophyll* refers to the hard, leathery leaves of many distinctly Australian trees and shrubs. Grassy subformation Wet Sclerophyll Forests are dominated by straight trunked eucalypts such as alpine ash (*Eucalyptus delegatensis)*, mountain gum *(E. dalrympleana ssp. dalrympleana)* and ribbon gum *(E. viminalis)* with a grassy understorey and sparse shrubs. This tall forest type grows on relatively fertile soils in higher rainfall areas. It is similar to Wet Sclerophyll Forest (shrubby subformation) but has a more open canopy, less shrubs and a greater grassy or herbaceous groundcover. In the Murray this vegetation community occurs in the highlands in the east of the catchment. Several NSW studies have found that fire frequency has a profound effect on vegetation structure in wet grassy forests. Frequently burnt areas are open and grassy, with a diverse herbaceous ground layer, while infrequent burning is associated with an increased abundance of shrubs and small trees. Each environment provides habitat for a distinct suite of plants, insects and small mammals. To provide for the full range, it is important to keep some parts of the landscape open with relatively frequent fire, while other places are burnt less often to allow thicker habitat to develop. Appropriate fire frequencies for this forest type are still being debated. The present state-wide recommendation is for fires every 10 to 50 years although occasional low intensity fire on a more frequent basis may be necessary for the maintenance of understorey diversity.

Grassy Woodland

Grassy Woodland © M. Graham

This eucalypt dominated vegetation community is composed of trees that are widely spaced with crowns that rarely touch. White box *(E. albens),* yellow box *(E. melliodora)* and Blakely's red gum *(E. blakelyi)* are widespread examples of dominant trees in Grassy Woodlands of the Murray Valley. The understorey is usually quite grassy with a diversity of herbs and scattered shrubs. Grassy Woodlands occur on rolling terrain with fertile soils and moderate rainfall, because of this they have been extensively cleared and used for grazing and cropping. In the Murray catchment these are amongst the most productive ecosystems. The Murray supports a high diversity of Grassy Woodlands, covering a gradient from the Alps in the east to the floodplain of the Murray River. The diversity includes the following classes: Grassy Woodlands of the Western Slopes, Southern Tablelands, Subalpine and Floodplain Transition Woodlands. Across the state, a variable fire frequency of between 5 to 40 years has been recommended. In places where plants grow quickly because of higher rainfall and warmer temperatures, intervals are likely to lie towards the lower end of this range.

Grasslands

Riverine Plain Grasslands © M. Graham

Grasslands are notable for their lack of woody plants, although a few low shrubs can sometimes be found in these communities. A wide variety of herbs grow in the spaces between tussocks of perennial native grasses such as kangaroo grass *(Themeda australis)*, snowgrass *(Poa sieberiana)* and wallaby grasses *(Austrodanthonia spp.)*. Many plants in native Grasslands are often missed; some may not be visible through autumn or winter, but re-emerge to flower in spring.

Extensive natural Grasslands were a prominent feature of the pre-European vegetation of the Murray. Grazing and pasture improvement have extensively modified natural Grasslands, so remnants where native species continue to thrive are places to be cherished. The structural and floristic composition of these natural Grasslands varies widely as a result of the interplay between climate, fire, altitude and landscape productivity. Classes of Grassland in the Murray catchment include Temperate Montane and Riverine Plain Grasslands.

Across the state, fires at intervals between 2 and 10 years are recommended to keep dominant grasses from overwhelming smaller herbs and to open up gaps for seedlings to germinate and grow. A slightly longer interval might be more appropriate in sites with slower growth (high altitude Grasslands). As rainfall decreases the spaces between grass clumps may close up more slowly. Knowledge of the fire responses of Grasslands is still developing.

Dry Sclerophyll Forest (shrub/grass subformation)

Dry Sclerophyll Forest © M. Graham

Dry Sclerophyll Forests (shrub/grass subformation) consist of open eucalypt forest with a sparse hard leaved shrub layer with a grassy groundcover. These forests occur on moderately fertile soils in areas of moderate rainfall. In the Murray there are several different forms of shrub/grass Dry Sclerophyll, and many intergrade with shrubby forests and the distinction among them may be arbitrary. The structural differences however can affect fire behaviour. Forests include the red stringybark *(E. macrorhyncha)*, Norton's box *(E. nortoni)*, broad-leaved peppermint *(E. dives)*, Blakely's red gum *(E. blakelyi)*, Dwyer's red gum *(E. dwyeri)*, and tussock grass open forest of the NSW South Western Slopes Bioregion and the white cypress pine woodland on the plains of central NSW.

Across the state, intervals in the 5 to 25 year range, with occasional intervals up to 50 years in some areas, have been recommended for these forests. The grass component is likely to be best maintained by short intervals, while the shrub component is predicted to increase with longer intervals.

Dry Sclerophyll Forest (shrubby subformation)

Dry Sclerophyll Forest (shrubby) © M. Graham

This vegetation type includes forests and woodlands dominated by eucalypts which in the Murray include brittle gum *(E. mannifera),* broad-leaved peppermint (*E. dives*), and Norton's box *(E. nortonii)* It also supports black cypress pine *(C. endlicheri)* bulloak *(Allocasuarina leuhmannii)* and belah *(Casuarina cristata).* The shrubby understorey of these forests contains many obligate seeders and resprouting shrubs whose flowers colour the bush in spring.

The cover of grasses and sedges is sparse. Dry Sclerophyll Forests grow on poor soils in moderate rainfall areas.

Variable fire intervals between 7 to 30 years are recommended to maintain diversity in this vegetation type.

Heathlands

Southern Montane Heaths © M. Graham

Heathlands are distinguished by a lack of trees and dominated by short hard-leaved shrubs, many of which are obligate seeders. Heath grows in moderate to higher rainfall areas, shallow and infertile soils, often in exposed positions.

Southern Montane Heaths is the heathland class occurring in the Murray catchment. It is restricted to upper elevations in the far east of the catchment.

Fires at a range of intervals between 7 to 30 years are recommended for maintaining biodiversity in Heathlands. Within this range, variability is important as this creates the space and opportunity for large and small species with a range of responses to fire, to live together.

Alpine Complex

Upper Murray Alpine Complex © M. Graham

Australia's Alpine Complex encompasses heathlands, herbfields, freshwater bogs and alpine fjaeldmarks. The upper reaches of the Murray represent the largest expanses of Alpine Complex in the country. Small-leaved shrubs, herbs and tussock grasses dominate the vegetation, while altitudinal climatic conditions inhibit tree growth. Site conditions, such as exposure, duration of snow cover and degree of waterlogging, determine formation of vegetation communities.

Fire should be avoided in this vegetation community.

Forested Wetlands

Inland Riverine Forest © M. Graham

These forests typically feature hard leaved trees (casuarinas and eucalypts), scattered shrubs and patchy groundcover of water loving sedges and herbs. They occur on flood plains, swamps or along riparian zones. The class of Forested Wetland that occurs within the Murray catchment is Inland Riverine Forest. River red gum *(E. camaldulensis)* dominates this type of Forested Wetland in the Murray Valley.

The largest area of river red gum forest in the world is the Barmah-Millewa forest on the Murray River floodplain near Moama and Echuca.

Scientists have not yet studied the role of fire in this vegetation type in any detail however some studies suggest that fire can regulate the density of river red gum populations. Variable intervals between 7 and 35 years have been suggested for Forested Wetlands.

Freshwater Wetlands

Inland Floodplain swamp, Murray River © M. Graham

Freshwater wetlands are commonly found in the Murray catchment. Two classes of wetland occur, Inland Floodplain swamps and Inland Floodplain shrublands. In floodplain areas, forests of river red gums and black box form a mosaic with lignum shrublands and reed-beds. In their natural state these wetlands usually have a dense groundcover of water loving sedges, rushes and herbs, and provide wonderful habitat for water birds.

Drought, river regulation and grazing have all impacted inland wetlands. Wet-dry cycles play a vital role in maintaining their diversity, and ensuring these continue is the major issue for their survival. Fire intervals of between 6 to 35 years have been suggested for freshwater wetlands and variable fire regimes may play a role in the recruitment of some shrubs in drier healthy wetlands. However, for most other wetland types, fires rarely occur, if at all, and have little ecological function. The use of fire therefore is not considered to be a practical management tool and should be avoided if possible. In some cases, these wetlands can occur on peat and peat fires can have a devastating effect on these systems and should be avoided. Freshwater Wetlands are areas of great environmental sensitivity and need to be treated with care.

Saline Wetlands

Saline Wetlands near Nitchie Lake © Jaime Plaza[1].

Saline wetlands predominantly occur west of the Murray region. There are however a few small Inland Saline Lakes, less than six hectares. These lakes contain ephemeral aquatic vegetation and low shrubby groundcover. Many of these plant species are sensitive to fire. These include the slender glasswort *(Sclerostegia tenuis)* which grows on the saline flats near drainage lines on the Murray floodplains.

Saline Wetlands are not fire-prone communities and fire exclusion from this class of vegetation is recommended.

[1].Saline Wetlands Inland Saline Lakes: classification from Benson, J.S., Allen, C., Togher, C. & Lemmon, J. (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains. Cunninghamia 9(3): 383-451. Photo ID018 Sclerostegia tenuis - Atriplex vesicaria chenopod shrubland near Nitchie Lake, [AGD66 33°27'27.6"S 141°49'45.0"E], 14/4/02, Jaime Plaza. From Benson, J.S. (2006) New South Wales Vegetation Classification and Assessment: Introduction,the classification, database, assessment of protected areas and threat status of plant communities. Cunninghamia 9(3): 331-382.

Semi-arid Woodland (grassy subformation)

Inland Floodplain Woodlands © M. Graham

Semi-arid Woodlands cover most of the western plains and the drier half of the western slopes of NSW. The woodlands of the semi-arid zone are dominated by sclerophyll trees (eucalyptus, she-oaks, wattles, cypress pines), contain drought-resistant shrubs and are home to many ephemeral (short-term or transitory) grasses and herbs.

Grassy subformation Semi-arid Woodlands occur on the floodplains in areas subject to occasional flooding. These woodlands intergrade with Grasslands and Arid Shrublands. To the east these woodlands become Grassy Woodlands. The main vegetation classes found in the Murray are Inland Floodplain Woodlands dominated by black box *(E. largiflorens)*, and Riverine Plain Woodlands dominated by weeping myall *(Acacia pendula)*.

Drought plays a major role in shaping the vegetation and also influences fire regimes. In many places fires will only burn when the grasses which flourish after good rains dry off. Fire frequency guidelines for Semi-arid Woodlands are particularly tentative due to lack of data; however intervals between 6 and 40 years have been proposed.

Semi-arid Woodland (shrubby subformation)

Riverine Sandland Woodlands © M. Graham

Trees in the Semi-arid shrubby Woodland subformation are generally shorter in stature than those in the grassy subformation, there is less grass cover but frequently drought-resistant shrubs are dominant. Sclerophyll trees such as eucalypts, wattles, cypress pines and she-oaks dominate these areas with drought-resistant shrubs and grasses making up the understorey. Vegetation classes found in the Murray are Sandplain Mallee Woodland, Riverine Sandhill Woodlands, and Inland Rocky Hill Woodlands. Soils vary from sandy outwash soils to red-brown loams on adjacent floodplains. The sandy soils naturally favour shrubs while the heavier floodplain soils will more likely support higher grass cover.

As with other vegetation classes, disturbance affects the density of trees, shrubs and grasses within Semi-arid Woodlands. Drought plays a major role in shaping the vegetation and also influences fire regimes. In some places where the shrubby areas have thickened up considerably since European settlement, lack of fire is thought to be one of several factors involved in this change. Fire frequency guidelines for Semi-arid Woodlands are particularly tentative due to lack of data; however intervals between 10 and 40 years have been proposed. The difference between the lower limitations for the two woodland types reflects the difference in the under-storey plant composition.

Arid Shrublands (chenopod subformation)

Riverine Chenopod Shrubland, Moree Plains © M. Graham

Arid Shrublands dominated by chenopods such as saltbush (*Atriplex* spp.), roly-poly *(Sclerolaena muricata)* and bluebush *(Maireana spp.)* are common on the riverine plains in the west of the Murray. These vegetation communities are part of the chenopod subformation of Arid Shrublands. The chenopod group of plants have evolved to survive in the harsh conditions of drought and salinity.

Chenopod shrublands have low flammability, and are considered extremely fire-sensitive. Chenopod species are mostly obligate seeders with only local seed dispersal and no effective post-fire seedbank. Fire should be avoided in chenopod shrublands.

Murray River © M. Graham

6 FIRE MANAGEMENT PLANNING

Introduction

If you live in a fire prone landscape, eliminating fire from your property is not a practical solution. Managing fire is an important part of living with fire, both to protect life and property and to respond to the needs of the bush.

Traditionally many landholders see their assets as being their house and property as well as the productivity of their land. In addition to this, a growing number of landholders consider the different plant and animal species on their property to be assets of real value. Aboriginal symbols of cultural importance are also considered to be assets.

If you consider native vegetation and wildlife as assets, effective planning will be essential to meeting the challenges associated with fire in the Murray.

This planning needs to address two goals: (1) protection of life and property and (2) protection of environmental and cultural values.

Each goal requires its own particular management strategies which can be developed and implemented at the property level. However, in particular areas of your property, these two goals may come into conflict. In these instances, the relative advantages and disadvantages need to be weighed up and tradeoffs are often inevitable.

Protecting *all* your assets

The *Rural Fires Act* (1997) recognises ecologically sustainable development and endorses the Bush Fire Risk Management Planning Process which is designed to protect life, property and the environment.

> "Hotspots is a way of returning the community back to the land, with a new range of training programs and education that can provide the community with the skills and knowledge to be in the drivers seat for managing their own land. They can now set their own direction."
>
> – Claude McDermott, Aboriginal Heritage Officer, Office of Environment and Heritage.

A zoning approach to fire management planning

The Bush Fire Risk Management Planning Process applies a zoning approach to fire management planning. Zones are a way of identifying areas in the landscape for planning and risk management purposes. There are four types of zones which have different intents.

- **Asset Protection Zones** (APZs) are fuel reduced areas surrounding a built asset or structure which is managed progressively to minimise fuel loads in order to reduce the potential radiant heat levels, flame contact, ember and smoke attack. Vegetation within these zones should be managed to ensure it does not provide a path for the transfer of fire from unmanaged vegetation to the asset either from the ground level or through the tree canopy. Refer to the RFS Standards for Asset Protection Zones and seek RFS advice to determine the recommended width of your asset protection zone. Environmental approval to undertake vegetation clearance may be required.

- **Strategic Fire Advantage Zones** are large scale, strategically determined areas which are regularly burnt to reduce fuel loads. These fuel reduced areas are designed to slow a fire and reduce its intensity in the landscape and provide a valuable opportunity for active firefighting during a bush fire. They are located in areas of known fire paths or adjacent to APZs. These zones are determined by each Bush Fire Management Committee during the development of a Bush Fire Risk Management Plan.

- **Land Management Zones**, the main focus of the Hotspots Fire Project, are areas that are managed to maintain or enhance land management objectives, including biodiversity. Fire history, vegetation type and fire frequency are important considerations in these areas. The RFS recommends burning in these zones to maintain a mosaic of areas with varying fuel loads.

- **Fire Exclusion Zones** are areas where planned and unplanned fire is actively excluded. These areas may include rainforest and other fire sensitive vegetation and some cultural/historic heritage sites and production areas. Planning decisions with respect to these zones should be heavily guided by the RFS.

When planning for a prescribed burn it is important to define your objectives. The fire frequency intervals in a Strategic Fire Advantage Zone (i.e. where your objective is to protect life and property) may be shorter than those needed to protect biodiversity.

Burning native vegetation on your property requires environmental assessment and consent. Landholders need to apply to the NSW Rural Fire Service (RFS) for a *Bush Fire Hazard Reduction Certificate* before planning and implementing a burn. Applications for a *Bush Fire Hazard Reduction Certificate* are assessed under the Bush Fire Environmental Assessment Code for NSW. In processing an application to carry out a burn in a Strategic Fire Advantage or Land Management Zone, the RFS will consider the vegetation type in which the burn is to be carried out, the fire history and the recommended fire frequency intervals for that vegetation type.

A range of RFS brochures and standards are available that provide detailed information about how to undertake a low intensity burn safely and how to maintain Asset Protection Zones. Most of these are available on the NSW RFS website, or from local district offices. For details on how to safely conduct a low intensity prescribed burn, refer to *Standards for Low Intensity Bush Fire Hazard Reduction Burning*, and for details on how to maintain a suitable Asset Protection Zone, refer to *Standards for Asset Protection Zones*.

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Some key messages in planning for biodiversity conservation

The relationship between fire and biodiversity is complex, and there is still much for scientists and fire managers to learn.

However fire management planning for biodiversity conservation need not be a complex or difficult process. You can take the information in this book away with you, think about it and decide for yourself how you might be able to apply it on your own property.

Based on existing knowledge, and on the information contained in this book, the following key messages provide simple guidelines for fire planning to protect biodiversity on your property.

When making decisions on issues such as fire frequency it helps to be very clear about what your land management objectives are in different areas of your property.

You should anticipate the need for flexibility with regards to your management actions. For many landholders, this forms part of an overall adaptive management approach to biodiversity on their property.

When your objective is biodiversity protection:

1. Think about the key messages listed here; and

2. Use the recommended fire frequency intervals for the different vegetation types on your property as a guide.

THE KEY MESSAGES

Simple principles for management

- Both too frequent and too infrequent fire can trigger negative impacts that throw systems 'out of balance' e.g. loss of species, weed invasion.
- Even within a single vegetation type, different species have different needs in relation to fire. To address this, vary fire frequency over time and space to allow for the full range of species.
- The bush at each stage of growth after fire looks different. Each stage provides different habitat, each has value.
- Don't burn entire vegetation types at once. Patchiness provides refuges for animals and a seed source for plants to recolonise burnt areas.
- Fires occur in a landscape context. It's useful to think about how the different vegetation types in a landscape are related in terms of fire.
- Coordinate fire activities with neighbours to provide a mosaic of vegetation in different stages of post-fire development, as different animals use different stages. Remember that fire management is a shared responsibility.
- When planning how often to burn, think about unplanned as well as planned fire. Unplanned fires may happen often enough to fulfil the needs of the bush.
- Understanding how fire behaves in different vegetation types and the influence of weather and topography will help you to better prepare for fire.

"Before Hotspots we were an isolated community, we felt we had to fight fire by ourselves, we were alone. But since the training, we feel part of a larger community now that we manage for fire as a community."

– Hotspots workshop participant.

7 PREPARING A PROPERTY FIRE MANAGEMENT PLAN

The following steps can help you prepare a property fire management plan:

1. Identify your property and productivity assets and map them.

- Talk to the NSW Rural Fire Service about setting up and maintaining Asset Protection Zones and Strategic Fire Advantage Zones.

2. Identify and map the vegetation types in your Land Management Zones.

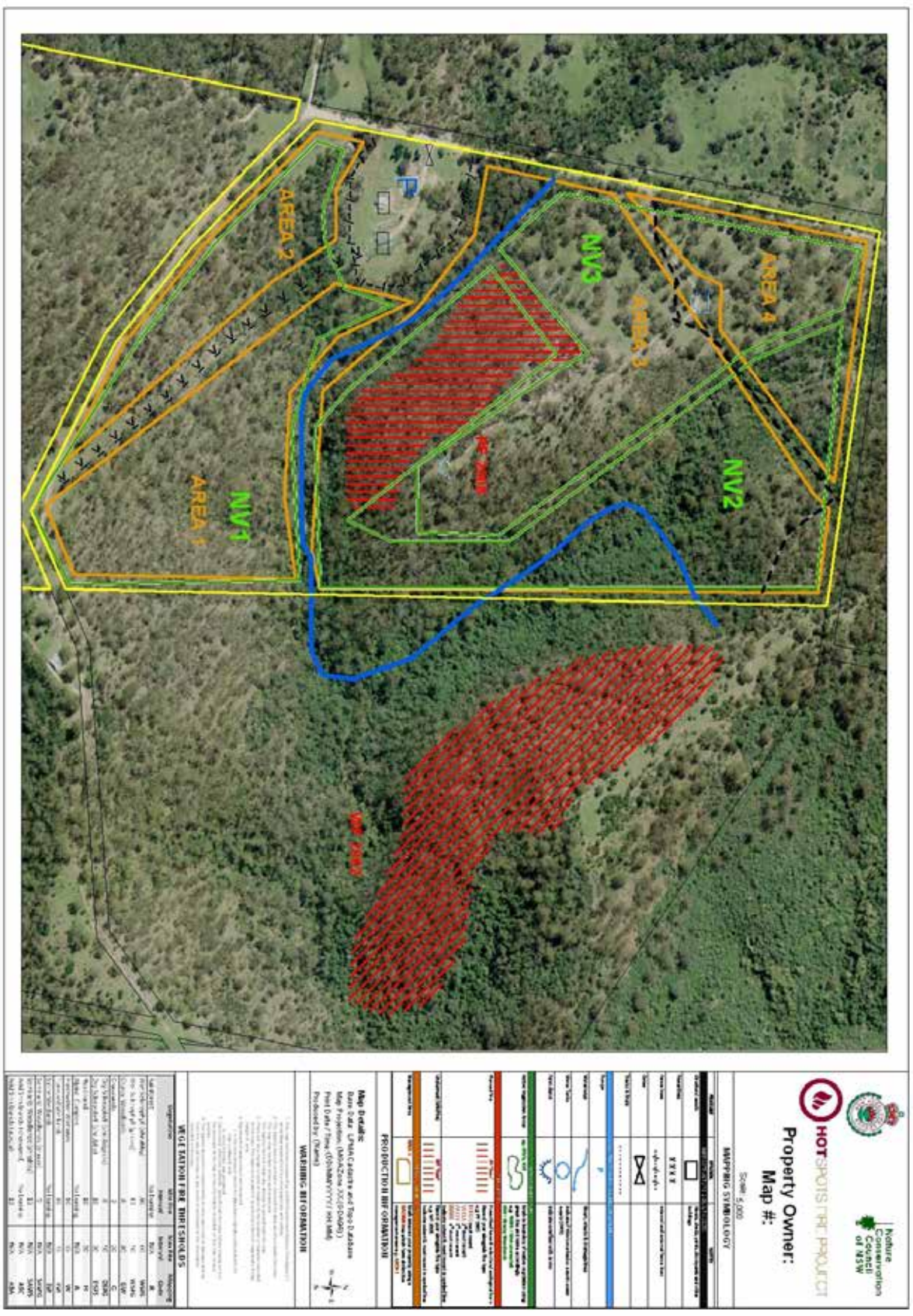
- Make a note of the fire frequency intervals recommended for the vegetation types on your property.
- How often have these vegetation types burned in the past? Note when and where fires have occurred.
- Are past fire regimes consistent with recommended regimes? Make a note of vegetation areas on your property that don't meet recommended fire regimes.
- Think about actions you could take to bring fire frequency into line with the recommendations.

3. Develop and maintain a mosaic of different stages of post-fire development.

- Do you have the resources to maintain parts of your property at different stages of development after fire?
- Could you work with your neighbours to make this happen?

4. Monitor and review.

- Keep a record of when fires occur and what areas they cover.
- Observe what happens to the vegetation, and to different species. Like all land management planning, fire planning is partly a matter of observation and responding to the needs of the land.
- Review your plan as you learn more.



Example Property Fire Management Plan

8 Fire and Climate Change

It is now generally accepted that the world is undergoing a significant change in climate.

The full impacts of climate change in Australia are not yet clear although an increase in extreme weather conditions including drought, storms, floods as well as changes in rainfall (increase or decrease in different places and in different seasons) are anticipated.

The frequency and intensity of bushfires is projected to increase as conditions for fire (such as hot, dry conditions) increase. By 2030 an increase in severe fire weather is projected for spring as well as summer for the Murray region. There is a high level of consensus that by 2050 the number of days of high or extreme bush fire risk is likely to increase by 15 – 70 per cent across all of south east Australia[1].

> “A warming of 1.5 °C and an 8 % decrease in rainfall (a moderate scenario for 2030) would make the climate of Wagga Wagga similar to the current climate of Forbes.”

Climate change in the Murray

Since 1950, the region has experienced warming of around 0.8 °C and an increase in the number of extremely hot days. This is likely to be due to human activities. While rainfall varies across the region on average it has declined by around 20–30 mm per decade. The contribution of human activities to this rainfall decline is hard to distinguish from natural variability. The future climate of the Murray catchment is likely to be warmer and drier both in the near future (2030) and the far future (2070). Such trends would also increase evaporation, heatwaves, extreme winds and fire risk. Despite this trend toward drier conditions particularly in spring, mainly along the Murray River, there is also potential for increases in summer and autumn rain and increased intensity of heavy rainfall events[2].

Climate change is likely to result in fewer cold nights across the catchment and affect the amount of snow in the east of the Murray catchment. Projections for the area experiencing 60 or more days of snow cover per year would decline by 18–60 per cent by 2020, and 38–96 per cent by 2050[3]. Such a scenario would have significant impacts on the native flora and fauna. If warming occurs at the higher end of the predicted change, some alpine plant and animal species are projected to completely disappear by 2070[4]. For example, a modest level of

warming may lead to the extinction of the mountain pygmy possum within 70 years. Current decline in numbers is linked to diminishing snow cover which reduces the insulating benefits for the pygmy possum of snow during their hibernation. It is also linked to early snow melt which if it occurs before the arrival of the bogong moths, may leave the possum with little food during the critical early spring period[5].

The 2003 fires in the Australian Alps resulted in a significant reduction in forest cover across the headwaters of the Murray River. In many of these areas forest cover has not re-established. Another hot fire before the alpine eucalypts have had time to fully regenerate could result in their complete loss. The long-term trend of declining rainfall, and area and depth of snow cover across the Alps have resulted in a reduction in inflows into the Murray River system and caused a general drying trend across the catchment. These trends are projected to continue with implications for wetlands and agriculture including the NSW Central Murray Forests.

However, it is not just climate change that will influence future fire regimes and subsequent fire management planning. Human development, settlement patterns, fragmentation and the landscape shifts will also play important roles.

> “The concept of a ‘normal’ bushfire season is rapidly changing, as bushfires are increasing in number and burn for longer.” [6]

1. CSIRO (2007a) *Bushfire Weather in South-East Australia: Recent Trends and Projected Climate Change Impacts*. Updated 2013.
2. NSW Office of Environment and Heritage (2014) *Murray Murrumbidgee Climate Change snapshot*. Produced by the NSW and ACT Regional Climate Modelling project (NARCLiM).
3. Hennessy, K. J., et al. “Climate change effects on snow conditions in mainland Australia and adaptation at ski resorts through snowmaking.” *Climate Research* 35.3 (2007): 255.
4..Pickering, C.M., Good, R., and Green, K. (2004) *Potential Effects of Global Warming on the Biota of the Australian Alps.* A report for the Australia Greenhouse Office.
5. Broome, L., et al. “Re-assessment of Mountain Pygmy-possum Burramys parvus population size and distribution of habitat in Kosciuszko National Park.”*Australian Zoologist* 36.4 (2013): 381-403.
6.Hughes, Lesley, (2014) *Be prepared: Climate Change and the NSW Bushfire Threat.* Climate Coucil of Australia.

9 WORKING TOGETHER TO MANAGE FIRE ACROSS THE LANDSCAPE

Cooperation in the Murray region

Fire management planning to protect life, property and the environment requires collaboration within communities, between agencies and across tenures.

In the Murray, this is already happening. Fire management planning, using a risk management approach, is being undertaken across the wider landscape in national parks, state forests and on public lands.

By working together, individual landholders can be part of a much broader process of fire management, whilst being able to make independent choices about fire management on their own land.

This process has a number of individual and potentially far reaching benefits. Among other things, it encourages landholders to:

- Plan and talk together about assets and how best to protect them;
- Listen to others with knowledge and ask them challenging questions; and
- Protect all of the aspects of the landscape most valued by landholders.

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About the Hotspots Fire Project

Based on best available science and operational knowledge, the Hotspots Fire Project delivers workshops and resources to landholders and land managers to provide them with the skills and knowledge they need to participate in fire management planning. Hotspots operates on a core belief that well-informed and well-prepared communities complement the roles of land managers and fire agencies and that a shared approach to fire management is critical to any form of planning.

Under the guidance of the nine project partners in the Advisory Committee, Hotspots is delivered through the coordinated efforts of the NSW Rural Fire Service and the Nature Conservation Council of NSW.

> “The workshop really brought the community together to implement not just individual property level planning but also a far reaching and coordinated approach to managing fire risk as well as biodiversity.”
>
> – Hotspots workshop participant

Partners and collaborators

This booklet has been compiled for the Hotspots Fire Project, with input from and in consultation with a wide range of stakeholders. The information contained herein reflects our understanding at the time of publication. We are learning more about fire and the environment every day and anticipate that some recommendations may change as new information comes to hand.

This booklet was prepared by Stefanie Pillora, Mark Graham and Kate McShea for the Hotspots Fire Project, based on existing landholder booklets written for other regions of NSW by Nicole Conroy and Penny Watson.

The Hotspots Fire Project is jointly managed by the Nature Conservation Council of NSW and the NSW Rural Fire Service.

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Thank you to Dr. John Benson (Royal Botanic Gardens), Kate Aitken (NSW Office of Environment and Heritage), David Francis, David Cook and Donald Hobern.

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The Nature Conservation Council of NSW
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Email: info@hotspotsfireproject.org.au

The following agencies have useful websites and may be of assistance:

Hotspots Fire Project
http://www.hotspotsfireproject.org.au

NSW Rural Fire Service
http/:www.rfs.nsw.gov.au

Nature Conservation Council of NSW Bushfire Program
http://www.nature.org.au/healthy-ecosystems/bushfire-program

Southeast Queensland Fire and Biodiversity Consortium
http://www.fireandbiodiversity.org.au/publications.html

Murray Local Land Services
http://murray.lls.nsw.gov.au/

NSW Office of Environment and Heritage
http://www.environment.nsw.gov.au/

NSW National Parks & Wildlife Service
http://nationalparks.nsw.gov.au

Forestry Corporation of NSW
http://www.forestrycorporation.com.au/

HOTSPOTS FIRE PROJECT

NSW Rural Fire Service

Nature Conservation Council
The voice for nature in NSW