FIRE AND BIODIVERSITY
LANDHOLDER INFORMATION KIT

Cape to Cape Catchments Group

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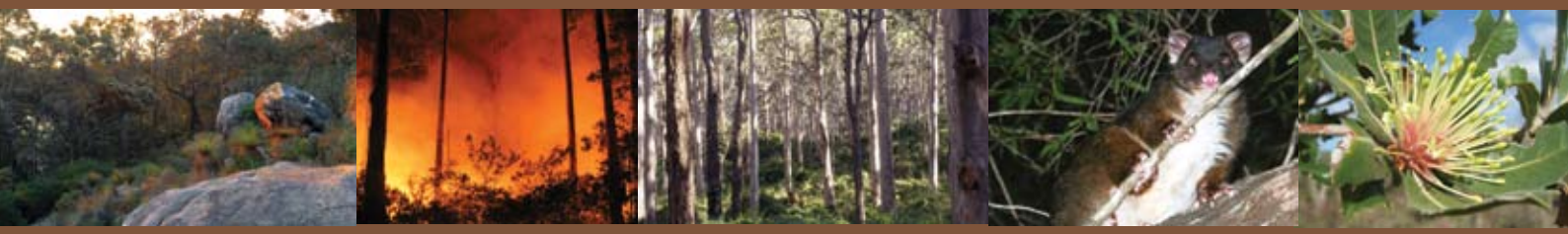

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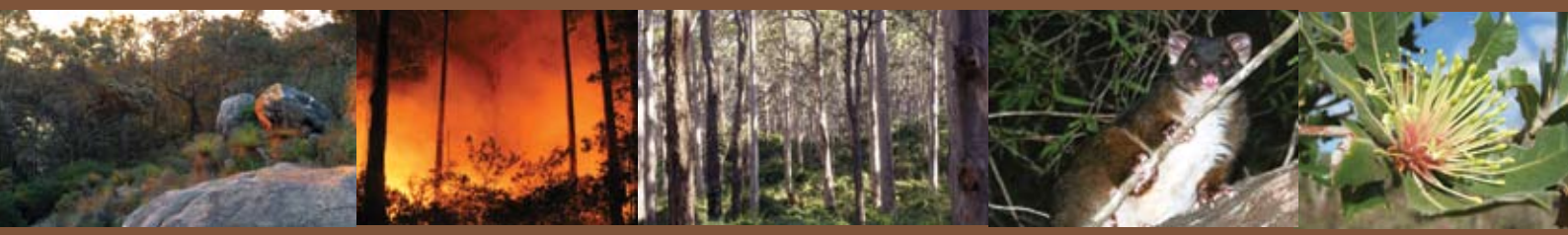

Introduction

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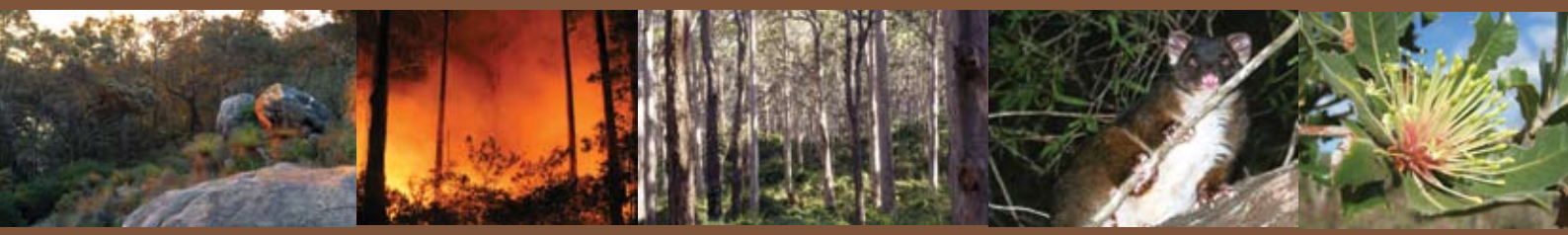

Introduction to the Kit

This Fire and Biodiversity Landholder Information Kit has been prepared to assist land managers, and particularly private landowners with large areas of retained native vegetation, to consider conservation of biodiversity values whilst planning for bushfire risk management on their properties.

The Cape to Cape Catchments Group thanks Lotterywest for funding the preparation of the landholder kit. We have used existing information from government agencies, organisations and experts in the field where available, and prepared specific information sheets to fill the gaps.

The kit focuses on the Margaret River region although much of the background material is based on research conducted over a wider area, and therefore has relevance to much of south-west WA.

Whilst risk management and the protection of people and property drive fire management decisions in large parts of our landscape, we believe that through a greater understanding of fire and biodiversity:

1. Risk reduction can often be implemented in conjunction with supporting a high level of biodiversity conservation; and

2. There is excellent opportunity for landholders to make major contributions to maintaining the highly diverse wildlife of our region through their fire management decision by providing for natural habitat that is retained outside Building Protection Zones and Hazard Separation Zones.

This kit is CCG's first attempt at addressing the challenge of promoting conservation awareness in fire planning at a time when the community is increasingly focused on the risks posed by fire in a drying climate. There is still much to learn and understand in this field and there are significant differences of opinion within the community and amongst experts on some of the information presented. Our aim is to translate this kit as an on-line resource that will be improved and expanded over time.

Acknowledgements:

The following people have contributed significantly and their expertise, time and support is greatly appreciated.

Cherie Kemp: Off Reserve Conservation Officer, Department of Parks and Wildlife.

Dr. Lachie McCaw: Principal Research Scientist and Program Leader Ecosystem Science, Department of Parks and Wildlife

Dr. Neil Burrows: Senior Principal Research Scientist, Department of Parks and Wildlife

Dr. Sean Molloy: Post Doctoral Researcher, ECU

Professor Don Bradshaw: Chair of Zoology, UWA

Dr. Boyd Wykes: Chair, Cape to Cape Catchments Group, Images as individually referenced

Michell Keppell

Department of Parks and Wildlife (DPaW) and the Parks and Wildlife Library Image Collection. Supply of some images are individually credited.

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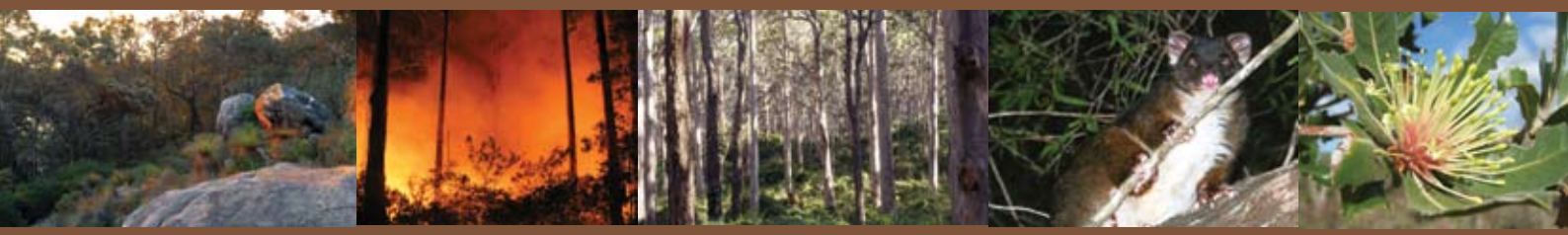
IMPORTANT:

The information supplied here is intended to be useful background to assist people who have portions of their property where biodiversity issues can be considered a high priority within fire risk planning. Protection of people and property will dictate fire management decisions within at least some zones on all properties and compliance with the appropriate legislation and local fire notices is critical. We encourage landholders to consult their local brigade and/or local government fire notices to ensure they are compliant at all times.

Every property has unique ecological values, topography, fire history, threats and risks. We strongly encourage land managers and landowners to seek professional guidance in the preparation of their Fire Management Plans.



Principles of Ecological Fire Management

Cape to Cape Catchments Group

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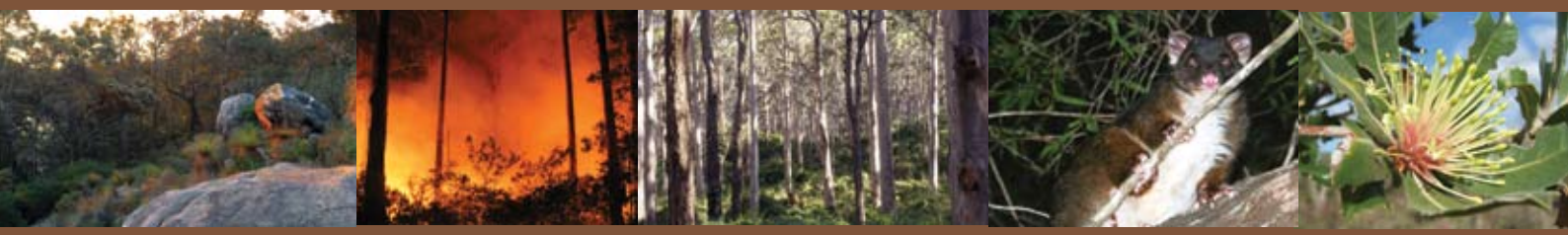

Principles of Ecological Fire Management

1. Fire regimes: a fire regime is defined by the frequency, intensity, seasonality and spatial pattern of burning.

Land managers, including private landholders, can influence fire regimes through decisions about when, how and under what conditions planned fires are lit. Excluding planned fire from an area of bushland also represents a particular fire regime, as the composition of plant and animal communities will continue to change in the absence of fire.

2. Fire response: the biota of the Margaret River region has evolved in a fire-prone environment and has developed a range of traits that enable it to persist with, and in many cases, depend upon a variety of fire regimes.

Reproduction and regeneration of many plant species are cued or enhanced by fire, for example flowering of grass trees. Particular fire regimes may be required to maintain floristic and structural diversity in different plant communities and to provide habitat diversity and opportunity for native mammals and birds.

3. Fire resilience vs sensitivity: species and communities vary in their response to fire.

Some assemblages are quite resilient to frequent fire and re-establish to their pre-fire state relatively quickly, while others may be sensitive to frequent or severe wildfire and take decades to return to a mature condition. Fire-sensitive species are most often associated with less flammable parts of the landscape including seasonal wetlands, watercourses and stream banks, exposed coastal dunes and granite outcrops. However, even these ecosystems may depend on occasional fire for their rejuvenation.

4. Diversity of ecological requirements: no single fire regime benefits all organisms or ecosystems.

Some elements of the biota benefit from frequent fire (e.g. native grasses, annual and biennial herbs, some re-sprouting shrubs, kangaroos, some fungi and invertebrates). Others elements require longer intervals between fire to provide opportunity for plants that take longer to produce seed, and to cater for animals, birds and invertebrates that prefer mature vegetation.

5. Patchiness and mosaics: a mosaic of patches of vegetation at different post-fire (seral) stages will benefit biodiversity because each stage contributes to structural and habitat diversity.

Planned fire can be used to create and maintain a mosaic of patches within a large area of bushland. An ideal fire plan creates patches of differing post-fire age and patches with differing fire regimes – for example, patches around the edge may be burnt more frequently to maintain a low fuel load while a central patch along a stream or granite outcrop may be designated a no-burn zone. However within small remnants, the direct disturbance of creating a safe boundary for containing a burn,

and indirect impacts of edge effects such as weed invasion, may be significant and out-weigh the benefits of creating a mosaic.

Provided their extent is limited, intense fires are not necessarily undesirable from an ecological point of view. However, large high-intensity fires can cause widespread damage to mature trees and mortality of birds, and other animals including invertebrate fauna. High-intensity fires typically leave few unburnt patches, leading to a more homogenous landscape where much of the vegetation consists of a single age class and seral stage. Soil erosion and sediment movement into streams may occur following high intensity fires.

6. Monitoring and adaptive management: while the need for planned burning to mitigate the impact of intense bushfires is generally accepted, there are many factors to consider and a variety of opinions about the most appropriate fire regimes to achieve this.

There will always be uncertainty and risks surrounding the outcomes of various planned fire regimes. These can be reduced by adopting an adaptive management approach that includes some simple actions:

- Prepare a long-term ecological fire management plan using all of your site knowledge and drawing on expert assistance available in our community.
- Prepare a plan for each burn based on a check-list including preparatory and follow-up actions.
- Keep records of when and how fire was used (e.g. weather conditions, pattern of lighting, flame height, ease of control).
- Monitor the outcome of burning (e.g. photographic points, notes about plant and animal response, any loss of large trees).
- Factor in the post-burn work that may be required including control of weed eruption and invasion, grazing impact of kangaroos and rabbits on fresh regrowth areas, fox and cat targeting of vulnerable wildlife.
- Review whether your objectives were achieved and modify as required.

These are some general considerations. More specific guidance is provided elsewhere in this kit e.g. see Fire and Seasonality for details on this aspect.

1. Identify your objectives: in many situations planned fire can be used to achieve multiple objectives.

For example, fire can reduce the amount and flammability of fuel, create ashbeds to encourage regeneration of tree and shrub seedlings, and heat the soil to encourage regeneration from soil-stored seed.

2. Fire season: seasonal conditions have a major influence on the way that fire behaves, and its effects on plants, animals and other features of the environment.

Patterns of rainfall, day length, temperature, atmospheric moisture and wind speed are important. Season of the year is the primary consideration but planning on the basis of actual seasonal conditions will be more reliable than relying on fixed calendar dates that are un-responsive to year to year variation. For example, rapid early drying in spring, or warm dry conditions extending into late autumn will have significant implications for planning a burn.

3. Autumn, winter or spring burn: when reducing fire risk to life and property is not an over-riding imperative, there is more opportunity to choose when to burn within the autumn to spring 'season', and if a planned time turns out to be unsuitable, reschedule for the next year.

Deciding when to burn will depend on the ecological objectives of the burn. This is a complex issue covered in detail in the 'Fire and Seasons' part of this kit.

4. Fire behaviour: understanding fire behaviour is vital for safely and effectively undertaking controlled burns even where ecological management is a primary objective.

Planned fire can be undertaken in conditions where a slow-moving trickle through the undergrowth can be managed with minimal risk. However often this will not be the case when burning is being done to achieve different ecological and fuel reduction objectives. The behaviour of a fire can be described in a number of ways including its rate of forward spread, duration of heating, size of flames and height to which live foliage on vegetation is affected by convective heating (crown scorch). More intense fires may be spread by burning firebrands, often bark fragments, that are blown downwind of the flame front in a process known as spotting.

Purple flag resprouting after a spring burn.

Grasstrees flowering after an autumn burn.

5. Fuel load: recommended fire frequencies for particular vegetation types are often stated in terms of a range of years such as five to fifteen years for Peppermint Woodlands. However, decisions about when and how to burn a specific patch of bush should be made based on the specifics of and objectives for that site and the time since last burn, including fuel characteristics.

Fuels in forest, woodland and shrubland accumulate with time since fire for at least a decade, sometimes longer, before reaching an equilibrium level.

The rate of spread and heating effect of a fire are determined by the amount and condition of fuel present, together with wind speed, fuel dryness and slope. In forest and woodland the fuel will include leaves and fine twigs on the ground (the litter layer), fine live and dead foliage on shrubs, and bark on the stems of trees. In heath vegetation, the fuel that burns will be predominantly live and dead foliage on standing shrubs. Cured, dry grass and annual weeds may be the most abundant fuel in roadside verges and remnants of bushland on agricultural properties.

6. Habitat trees and features: prior to burning, identify, map and protect habitat trees and features in your bushland.

These may include scrub patches that are known nesting sites for significant species, large hollow-bearing trees, granite outcrops, water-holes etc. Carefully clearing fuel from around the base and edge and specific attention to extinguishing these areas post-burn can help prevent damage.

7. Natural mulch: Consider the role of natural mulch and leaf litter in the ecology of your bushland. Natural 'mulch' within bushland is home to fungi, invertebrates and microorganisms critical to the recycling of nutrients, weed protection and native seed bank protection. It provides habitat and helps suppress fire. Repeated frequent burning can rapidly lead to a loss of this important feature/

8. Planning for post-fire flare-ups: Planned burning must be done in a way that ensures the burnt area remains secure in the event of hot, dry and windy weather. This involves burning out a secure perimeter around the area and extinguishing burning logs and trees close to the edge. In small patches of bushland this may necessitate burning out most, if not all of the area, to provide for security.

8. Unburnt patches: In larger areas of bushland it may be possible to leave unburnt patches away from the perimeter, thus providing:

- protection for fire-sensitive communities;
- unburnt or long-unburnt areas as a refuge from adjoining fires;
- a diversity of habitat features in comparison to the more frequently burnt perimeter and high-risk areas.

This can establish a mosaic that can be maintained by further patch burning in later years, which was how Aboriginal Australians sustained their environmental values for tens of thousands of years.

Acknowledgements

This document has been developed from information provided by Dr. Lachie McCaw, Department of Parks and Wildlife.

Note : Nothing said in this document changes a landholder's responsibility under the relevant fire legislation. Ensure you are compliant at all times and seek advice from a professional where necessary.

Further reading

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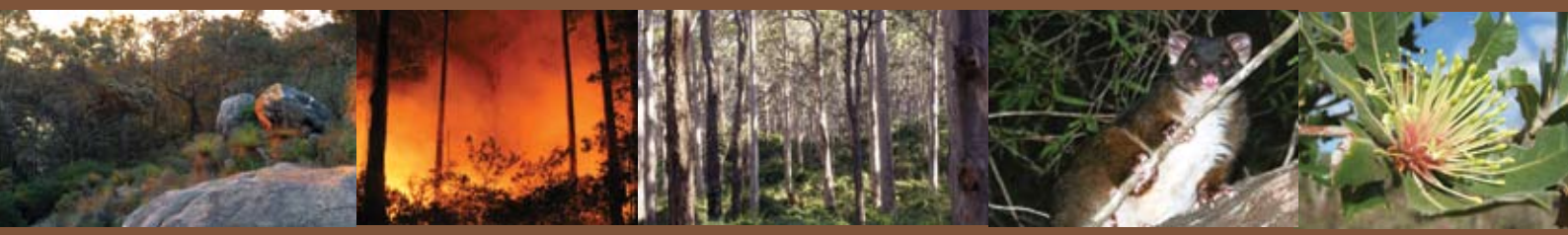

The Use of Fire in Small Remnants

Cape to Cape Catchments Group

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Wildlife Notes

No.17, January 2006

Information Notes for the *Land for Wildlife* Scheme in Western Australia

The Use of Fire in Small Remnants

Keywords:	fire, regeneration, remnant bushland
Location:	south-west Western Australia
Authors:	Penny Hussey and Avril Baxter

INTRODUCTION

Many landowners see a need to "clean up" their bushland by putting a fire through it to reduce the fire hazard and hopefully cause regeneration. However, in these altered landscapes the result may not be what we expect.

With flammable vegetation, dry summers and sources of ignition, it is not surprising that fires are an important component of ecosystems in south-west Australia. Over millions of years, native plants and animals have evolved various strategies to cope and persist in this fire-prone environment.

> If we wish to use fire for any reason at all, but especially for nature conservation, we need to be aware that the bush community's response to that fire may be very different to the response which would have occurred prior to European settlement.

Today, however, trying to manage fire in small isolated remnants of native vegetation, while at the same time trying to conserve that bushland and all its native flora and fauna, presents an enormous challenge.

In this Wildlife Note we explore some of the issues and consequences of using fire in small remnants and provide a checklist to help you in your decision-making.

WHY BURN BUSHLAND?

Planned fire may be prescribed to remove a perceived fire hazard or to promote regeneration ('ecological renewal').

Removing a perceived fire hazard

In areas where there is danger to life and property from wildfire, for example adjoining houses, fuel reduction for safety is a vital consideration. For example, burning sections during the cooler months of the year when the fire can be more easily contained and may go out overnight could be a suitable regime.

Nevertheless, conservation of the values of the natural community should be included in the fire management plans and compatible strategies considered, such as burning sections in rotation, and having permanent low fuel zones adjacent to the infrastructure being protected.

Promoting regeneration

Nothing lives for ever. All living things must reproduce a new generation; in vegetation communities we call this 'regeneration'. Without regenerative processes, a gradual decline of mature plants will eliminate them from an area, leaving no replacement seedlings. Work done in almost all south-west Australian vegetation communities shows that a 'disturbance factor' induces regeneration. One such disturbance factor could be fire.

There are two ways in which trees and shrubs respond to fire:

a) the whole plant is killed and a new generation grows from seed (reseeders) or

b) only parts of the plant are killed, and new growth arises from stem or rootstock (resprouters).

Fig. 1: Very soon after a fire, Kingias can be seen resprouting. No seedlings have yet germinated.
Photo: N. Burrows.

On extremely infertile and difficult soils, the most important role of fire may be in recycling nutrients. Without rapid decomposition by fungi or termites, or extensive leaf herbivory where the fauna recycle nutrients in their wastes, the nutrients remain held in living and dead plant material, so there is little left in the soil to fuel new growth. Both reseeder and resprouter plants take advantage of this release of nutrients to grow rapidly after fire.

EFFECTS OF FIRE ON NATURAL COMMUNITIES

The effect of fire on natural communities depends on many factors. Some of the most important are the frequency between fires, the season, its intensity, climatic events before and after the fire, the patchiness of the fire, the condition, size and connectivity of the bushland and the fauna present.

Fig. 2: Fire can change the composition of a plant community. The wandoo woodland in Wyalkatchem Nature Reserve had not burnt for over 60 years, and the ground layer consisted of perennials, grass-like plants and everlastings, as can be seen in the front of the photo. A very hot fire in the summer of 1999 through part of the reserve caused a massive germination of shrubs, which dominate the regeneration area. This change in community structure can clearly be seen in the centre of the photograph. Photo: P. Hussey

EFFECT OF FIRE ON NATIVE PLANT COMMUNITIES

Fire frequency

Fig. 3: Fire frequencies can affect vegetation communities. A fire in the 1960s led to the regeneration of sheoaks throughout this area. However, a fire four years later, which was stopped at the roadway, killed the regenerating sheoaks which had not been able to set seed, leaving room for powderbark wandoos, from a mature stand at the top of the ridge that had not been affected by the fire, to colonise the area. Photo: A. Baxter.

For many plants to persist after a fire, they must be able to reach maturity and set seed (the reseeders). Since plants vary in the length of time they take to do this, it follows that the frequency of the fires will have a distinct effect on the composition of the vegetation community. For example, in woodlands, the understorey follows a cyclical pattern of growth / decline / renewal, often on a shorter timescale than the tree species.

As a general rule of thumb fire intervals should be at least twice as long as it takes the slowest maturing plant to flower and produce seed, and before older plants are no longer able to reproduce.

Fire season

The time of the year in which the fire occurs will make a considerable difference. There are three possible fire seasons: midsummer/autumn, winter, spring/early summer.

Midsummer / early autumn fires

These fires are usually intense and difficult to control, they will consume most of the above ground material and most likely burn down mature trees. In doing so they remove herbivores (eg sap sucking insects) and parasites (eg mistletoe or dodder) from the population. Heat penetration of the dry soil is maximised, which will break the dormancy for some buried seeds such as wattles and peas. The chemicals produced by the fire will also encourage germination (see Fig. 2).

If the season is kind, then seeds which are stimulated to germinate by these fires will be supported by winter rain and plants that resprout from lignotubers will have water available to manufacture new food, using the released mineral nutrients to fuel the new growth. In adverse seasons the soil surface is exposed to potential wind and water erosion both from the bushland and into it from surrounding paddocks.

Winter fires

These low intensity fires will leave patches of unburnt vegetation. However, the new seed crop within the burnt patches may be destroyed before maturity, and plants such as everlastings and orchids, which have not evolved adaptations to survive fire during their growing season, will be damaged. Also, the fire may not trigger germination of the native seed stored in the soil, but could encourage the growth of grass weeds if they are present in the system.

Fig. 4: A winter burn in weedy bushland encouraged the growth of exotic grasses. Photo: A. Baxter

Spring/early summer

These fires are low to moderately intense, depending on the air temperature and humidity, the amount and moisture content of the fuel and soil, and the wind strength. Some of the tree crowns will be scorched and some patches may be left unburnt. They will destroy that year's seed crop for many plants. Seeds on the surface will be stimulated to germinate, but the fire may not be hot enough to crack the dormancy of buried seed. They also encourage the growth of already established perennial grass weeds such as veldt grass. Germinating plants may not survive until the autumn break of the season. However plants that resprout will grow well over summer and out-compete seeders.

We recommend autumn burning for most regeneration burns, especially where regrowth of wattle and pea thickets is important. If, however, the potential intensity of the fire is a management concern, then the fire can be timed for after the first winter rains, which will reduce the fire intensity, but be prior to the active plant growth.

Climatic events

The impact of unpredictable climatic events is enormous. Heavy rain after a fire can remove the ash, its mineral nutrients and germinating seed from the site. Weed seeds and artificial fertilisers can also be blown or washed in from surrounding paddocks. Regenerating plants can be affected by prolonged dry periods or frost, especially on granites and sandy soils.

Patchiness of fire

Burning small patches at a time creates an uneven aged bushland which has many advantages for both plants and animals. Seeds from unburnt patches can reinvade the burnt areas and recently burnt patches can be used as a break for the next planned fire. This more diverse environment generally makes it more resilient to fire – a case of not putting all your eggs in one basket!

> A 'safe' plan is to use only small patches of fire within a remnant, to create a mosaic of vegetation of different ages which maximises the resources for fauna and makes the remnant more resilient to fire.

EFFECT OF FIRE ON NATIVE FAUNA

Fire may kill some animals, whilst those that survive by sheltering in burrows may die of starvation or predation soon afterwards. If the remnant is connected to or near other bushland, then recolonisation can occur. If the whole block is burnt and migration is not possible, the animal may go locally extinct. Hence, burning small patches within a remnant to create a mosaic of different ages will allow animals to persist in an area.

The fire frequency that favours particular animals varies considerably from animal to animal. Some animals require long unburnt vegetation, for example, mallee fowl which require leaf litter for nest building are more common in mallee and broombush which has not been burnt for more than 40 years. A study in the Fitzgerald River National Park found that capture rates of honey possums were low for four to five years after a fire and peaked at 30 years - this pattern follows the amount of cover available.

Winter fires will disrupt the breeding cycle of some animals and spring fires may kill some young animals, for example nesting birds.

Hollows are also very important. Ironically, fire consumes hollows in trees and logs on the ground, and it creates them. Many animals including bats and 18% of Australian birds have been shown to use tree hollows for nesting or cover; numbats and some lizards need hollow logs on the ground. For these animals, the effects of fire can improve or destroy the habitat that they require. To save hollows, you may need to remove any debris that has accumulated against the trunks of favoured trees and around logs on the ground.

EFFECT OF FIRE ON SMALL REMNANTS

Disturbance is a key factor in opening up the bush to change, and fire is a major disturbance.

Small bush remnants are very often isolated and subject to far more disturbing factors than they would have suffered prior to European settlement, putting the natural communities under great stress. They are less resilient and often degrade to a simpler community.

Generally, the greater the 'edge-to-area ratio', the more effect the stress factors will have and the more quickly the bush is likely to degrade. Linear strips such as roadsides are the classic example.

Weeds

Having opened up the bushland it is very easy for weed invasion to occur at the edges and quickly cover the whole patch. Many introduced plants – especially pasture and crop weeds – enjoy disturbance and will displace native disturbance opportunists such as everlasting daisies. Similarly perennial/woody weeds, such as tagasaste, will displace shrub species.

This leads to a change in community structure, which will provide different resources for fauna and in turn respond differently to fire.

Many weeds will change the fire's characteristics including its readiness to burn, how easily it will spread, and the temperature at ground level. Bunch grasses which evolved in southern Africa under a regime of annual burning (eg African love grass, tambookie, veld grass), cause a massive change in the fire response when they come to dominate the ground layer of Western Australian communities. Veld grass in banksia woodland is a good example of this bad problem.

You can use the period immediately after a fire, (whether the fire was planned or unplanned) to undertake control of some difficult perennial weeds such as African love grass or bridal creeper. They will respond to the fire with rapid growth from underground reserves, often before native plants have started to resprout or seeds to germinate. Thus they can be hit immediately with a knock-down herbicide, without danger of damaging desirable native plant regeneration. In addition, because the fire opens up

an area, it is easier to reach dense infestations, and to locate all sites for control work.

WHEN NEVER TO USE FIRE FOR REGENERATION

When the soil is buried by wind-deposited material

Sometimes the natural soil surface (including rootstocks) is covered by a non-wetting layer of soil (usually sand), straw, weed seeds and sheep droppings blown in from an adjoining paddock. This prevents heat cracking the buried seeds and the chemicals leached from combustion products from reaching seeds and so stimulating germination. Buried rootstocks will often not regrow. Such a site, very common along sandplain roadsides, is gone for ever.

During or immediately after a severe drought

In this case, the plants are already under extreme stress and being forced to regenerate could totally exhaust those that resprout from lignotubers and so lead to death. Similarly there may not have been good seed set in previous years. Give the bush a couple of years of average conditions in which to recover.

When a locust plague is predicted for the following year!

SOME MANAGEMENT PRINCIPLES

The correct use of fire can stimulate regeneration and regrowth in bushland, thus creating habitats for fauna.

There is no need to "tidy up" the bush; some standing dead vegetation is beneficial in your bushland, providing habitat for many animals. As a general rule, if more than fifty percent of the understorey shrubs are dying or dead, the area is ready for a regeneration fire.

Successful regeneration of reseeder species is dependent on the availability of viable seed. Before burning an area of bushland, monitor the plants over the previous year to ensure that they have produced viable seed. Not all plants produce seed each year and this can affect the success of the regeneration. Other species may be able to regenerate from soil seed stores. Knowing your plants can help to plan a successful regeneration burn.

If all the shrubs are gone (eg after a long period of grazing or a long period without fire) some of the small seeds which could have been stored in the soil may be absent. You may need to introduce more seed into the system, preferably from a similar site nearby. The best way to test this out is to set up a small trial area and monitor regeneration.

Similarly, if there is not sufficient woody debris on the bushland floor, it may not carry a fire of sufficient intensity to promote regeneration of seeds such as wattles or peas, which are stored in the soil seed bank for many years.

A mosaic of small patch burns will create a greater variety of habitats for animals and allow them to recolonise an area as it regenerates. It will also prevent major losses to the bushland's resource if detrimental climatic events occur after the fire. If this is not possible, a combination of 'heap burns' (bonfires) and direct seeding is recommended, on-going in different locations every year (see Fig 5).

Aboriginal people used to burn bushland to *attract* grazing animals. Heavy grazing pressure can undo all the good the regeneration burn has done! Therefore after using fire, check immediately to ensure that fences are intact and stock excluded. Rabbits need to be controlled and in some instances (and under a specified management plan) kangaroos culled.

Follow the prohibited and restricted burning times for your area. Remember, nothing said here can override a landholder's responsibility under the Bushfires Act and the Fire and Emergency Services Act. You are obliged to keep the fire under control and on your property. If it escapes you could be answerable for the damage caused.

Essentially, to keep your bushland healthy, planned fire is a management tool you may need to consider. But before you get out the matches, work through the attached checklist.

Whatever strategy is chosen, there will inevitably be gains and losses. Though we may plan as well as we can, the result of fire in your small remnant is in the lap of the gods!

A cautionary tale - fires can be deceptive. A landholder reported:

"On a cool May morning I lit a small fire on a 2.5ha block of bush. It burnt slowly and gradually went out. Thinking this was a very good result, I went off to town for about three hours. On returning, I found a blaze that required neighbours and the volunteer fire brigade to attend."

'Hot' fires severely damage existing trees and can affect fauna. In relatively small remnants they are neither practical nor desirable. Piling dead material into low heaps and then burning them can create the same effect in a manageable way.

Fig 5: Brushing on ashbed trial, Muresk College of Agriculture. A 'tidy-up' bonfire was burnt on this site, then a week or so later, a seed-bearing branch from a nearby York gum was placed onto the ashbed. Three years later, this vigorous young tree is the result.
Photo: P. Hussey

Small Remnant Fire Management Checklist

1. *What do you hope to achieve by burning this bushland?*
   - ☐ protection of human property from wildfire?
   - ☐ promote regeneration of the vegetation community?
   - ☐ or both?

   The answer will dictate what type of fire you use.

2. *Does the whole remnant need to be burnt, or will a smaller burn satisfy the objective?*
   - ☐ whole remnant
   - ☐ smaller burn

   A smaller burn minimises the possibility of irreversible ecological failures (eg should a severe drought occur in the seasons following the fire).

3. *Can small areas be burnt over several years to create a mosaic of vegetation of differing ages?*
   - ☐ yes
   - ☐ no

   Vegetation at different stages of growth is ideal for the maintenance of resources for fauna.

4. *Is the remnant connected to other remnants by a suitable bush corridor?*
   - ☐ yes
   - ☐ no

   This will influence how fauna can get away from the fire, or return to regenerating areas.

5. *If it is not connected, can a bush corridor be planted prior to any burn being undertaken?*
   - ☐ yes
   - ☐ no

   Consider the needs of, for example, small birds, and design the corridor to facilitate their movement.

6. *Are the major plant species setting seed?*
   - ☐ yes
   - ☐ no

   If not, regeneration will be impeded. Allow twice the length of time to first seeding of the slowest growing plants for an appropriate interval between fires.

7. *Are there weeds in the bush?*
   - ☐ yes
   - ☐ no

   Control prior to the burn.

8. *Is there a nearby source of weed seed?*
   - ☐ yes
   - ☐ no

   Leave a buffer between the source of the seed and the area to be burnt.

9. *Is spread of Phytophthora or other plant diseases possible?*
   - ☐ yes
   - ☐ no

   Take appropriate precautions.

10. *Is Declared Rare Flora, Threatened Fauna or a Threatened Ecological Community present?*
    - ☐ yes
    - ☐ no

    Consult CALM.

11. *Are there special flora/fauna habitat features present, eg a wetland, or hollows in logs or trees?*
    - ☐ yes
    - ☐ no

    They may need to be specially protected.

FURTHER READING

Hussey, B.M.J and Wallace K. J 1993. *Managing Your Bushland.* Department of Conservation and Land Management, Perth.

Abbott I and Burrows N (Eds.) 2003. *Fire in ecosystems of south-west Western Australia: impacts and management.* Backhuys Publishers, Leiden.

Fire in ecosystems of south-west Western Australia: impacts and management. Volume 2. Community Perspectives about Fire. 2003. Department of Conservation and Land Management, Perth.

ACKNOWLEDGMENTS

Many thanks to Ken Atkins, John Carter, Brad Commins, Cherie Kemp and Lachie McCaw for helpful comments on earlier versions of the text.

Fire Management Plan
Name of bushland: .....

OBJECTIVES

ISSUES

Problem	Solutions

PLAN OF ACTION

What	Who	When

MONITORING AND EVALUATION

What	Date	Results

Published by the Department of Conservation and Land Management, Perth.
All correspondence should be addressed to: The Editor 'Wildlife Notes', CALM Species and Communities Branch, Locked Bag 104, Bentley Delivery Centre, WA 6983. Phone: (08) 9334 0530, Fax (08) 9334 0199

The Role of Fire as a Regeneration Tool

Cape to Cape Catchments Group

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The role of fire as a regeneration tool

In any discussion about Fire and Biodiversity management of the land, we need to firstly acknowledge this land and its original inhabitants, their knowledge and use of fire in the landscape.

Methods that landowners can use to trigger regeneration in their bushland:

- Rake and pile burns
- Ash bed creation – larger piles of vegetation
- Mosaic burning
- Individual remnants of vegetation burnt with the aim of obtaining "patchiness" within that remnant

Very good vegetation

Degraded/poor vegetation on the end of very good vegetation.
This area recommendations are rake and pile burns so that exsisiting vegetation is not disturbed by machinery.

Where the vegetation is degraded, a trigger mechanism may be required to encourage new regeneration.

Ash bed creation:

- Rake up leaves, gather larger twigs, branches
- Place in a cleared area or degraded area, preferrably no overhanging canopy/trees
- Pick a cool fine day in Winter to light these up
- Plenty of water on hand
- Natural regeneration should occur in these ash beds the following Spring/Summer

Heaps recommended to be used here.

This is the outcome years later with fencing, weed contol, feral control, ash bed creation, rake and pile burns and some additional tubestock planting.

(5 years later) Note – kangaroo proof fencing was used, ongoing weed control, rabbit control, brushing, direct seeding, rake and pile burns and tubestock plantings – with watering through the summer seasons. Some natural regeneration has also occurred within these areas.
Note – ongoing weed control is essential.

Mosaic burning:

- Section the bushland into a mosaic pattern
- Burn one section at a time
- Where possible, leave creeklines and wetland areas unburnt so wildlife have habitats to escape into
- Different bushland blocks have different issues and biodiversity values – specific fire management for each bush block

Examples : (note – differing soil types and vegetation types)

Landowner burnt sections every 8-10 years for 30 years – vegetation is in very good condition.

This property was burnt in sections every 5-6 years over 30-40 years and is described as being in excellent condition with high conservation values.

.

Mosaic burns leave sections unburnt for wildlife.
Mosaic burns leaves sections unburnt for different species of plants to flower and seed.

Whole remnant burning/patchiness:

When burning whole remnants – attempt to have some areas trickle slowly through the vegetation and other areas that will burn a little warmer – the aim of this is to create “patchiness” within the remnant.

- Patchiness leaves refuges for plants and animals
- Leave creeklines out of burning where possible
- Leave granite outcrops out of burning where possible
- Weed and feral animal control before and after

Some examples of patchiness: (Note these are different soil types and vegetation types)

Burnt every 5-6 years, very good condition.

Burnt at every 8-10 years maintaining very good condition.

When to Burn? The ultimate question for remnant bushland:

- Spring? burns are likely to affect juvenile wildlife.
- Winter? perhaps the safest?
- Not all native plants flower in Spring, not all juvenile wildlife are born in Spring.
- Autumn? Consider weeds.
- Each site or piece of remnant bushland is “site specific” and needs to be looked at on a case by case basis – these notes can be used as a guide, although each individual site has issues: weeds, ferals, disease, plants and animals to be considered prior to going ahead with any burning.
- Always use the precautionary principle and seek advice prior to undertaking any fire management.
- Contact your Local Government Fire Control Officer, or Department of Fire and Emergency Services for advice on protection of life and property, and check your Annual Firebreak Notice.

Ferals and weeds need to controlled before and after any fire/burn.

Acknowledgements

Photos taken by Kemp, C. © Cherie Kemp
Off Reserve Conservation Officer, Department Parks and Wildlife.

References

Abbott/Burrows (2003). Fire in ecosystems of South West Western Australia – Impacts and Management.

Acknowledgements

Thankyou to all the private landowners for the use of their properties and their knowledge and experience.

Other reading material – contact Off Reserve Conservation Officer on 97525533

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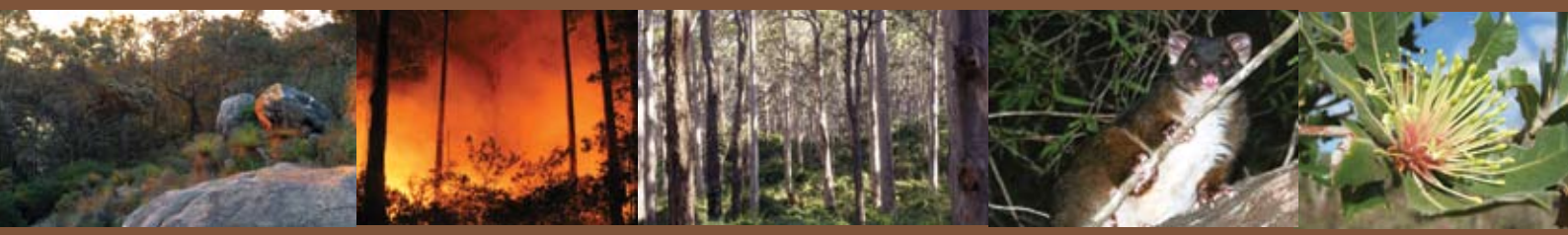

Ecological Fire Regimes

Cape to Cape Catchments Group

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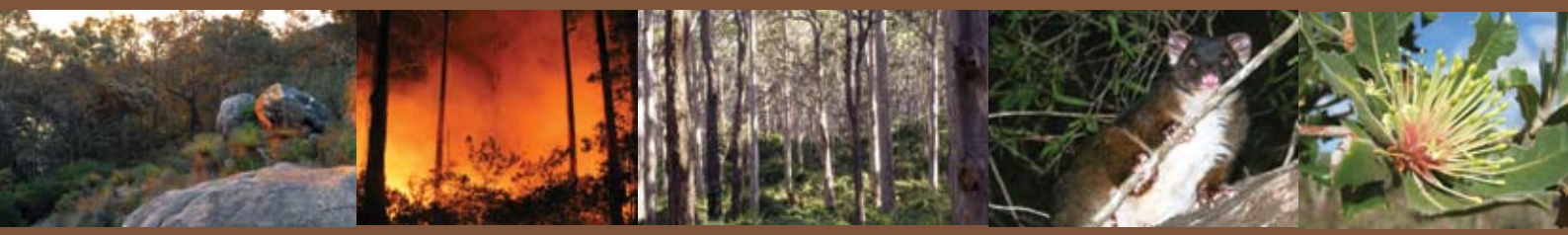


Ecological Fire Regimes

This document provides information about ecological burning considerations for different vegetation types in the Margaret River Region. This information is provided for use in those situations where biodiversity considerations can be the primary or major driver in fire management – obviously in many situations protection of property and people safety dictate a different management approach.

We have chosen to use the vegetation types as described in 'Wildflowers of Southwest Australia, Augusta-Margaret River Region' by Scott and Negus (2013). The fire regimes described for each vegetation type provide an indication of ecologically-desirable management practice as agreed by many but by no means all specialists in this field.

In general, the higher end of the indicated fire frequency intervals is required for some specialist plants and animals but longer intervals without burning may increase the risk of high intensity, extensive wildfire that is only manageable where appropriate mosaic and perimeter fuel management measures can be implemented.

Managing vegetation to reduce risk to life and property to an acceptable level introduces potentially conflicting considerations. The lowest end of the fire intervals provided here is what the vegetation will generally tolerate but would only be recommended where fuel load needs to be minimised due to other risk considerations.

Peppermint Woodland:
Dense or open woodland of *Agonis flexuosa* found on sandy coastal limestone soils and sheltered parts of the ridge.
Important habitat for the critically endangered Western Ringtail Possum which is sensitive to widespread hot fires.

Frequency: 5-15 year intervals

Season: Early spring and late autumn

Intensity: Low intensity, slow-spreading fires with flames less than 1 m

Comments: Mature Agonis woodlands with large, old trees can be maintained by mild fires that do not scorch the crowns of the trees. Intense fires will kill mature trees back to ground level and result in dense thickets of young trees that will be sensitive to fire for several decades

Banksia Woodland:
Woodlands dominated by *banksia attenuata* or *banksia ilicifolia* on sand. These communities are already being heavily impacted by Phytophthora dieback.

Nectar and seed from mature trees are important food sources for wildlife including black cockatoos and honey possums

Frequency: 5-15 year intervals*

Season: Early spring and late autumn

Intensity: Low intensity, slow-spreading fires with flames less than 1 m

Comments: Banksia woodlands typically occur on sandy soils that dry rapidly following rain, and often have an understorey of shrubs that may burn readily. Low-intensity fuel reduction burns help to protect mature trees from wildfire.
An occasional hot summer burn is needed to establish a new generation of trees from seed; with such fires hopefully limited in extent by maintaining low fuel.

*In situations where a Banksia Woodland or shrubland has been burnt by an intense fire that killed mature plants back to rootstock or seedlings then the interval may need to greater than 15 years to allow for recovery of flowering resources critical for several species including Honey Possum.

Karri forest :
Tall forest of *eucalyptus diversicolor* often with a dense shrub understorey. Confined to river valleys and sandy loam soils over deep limestone.
Karri Forests of the Leeuwin-Naturaliste Ridge are associated with a range of endemic flora and provide habitat for a range of significant mammal and bird species, some of which rely on old trees with hollow and long-unburnt understorey.

Frequency: Vary intervals between 7 – 20 years in in a patchwork that maintains some areas at the middle -to-higher end of the range

Season: Autumn

Intensity: Low to moderate intensity fires with flames less than 1.5 m

Comments Karri forest typically has a deep layer of and twigs that will not dry sufficiently to burn until early summer (December), and opportunities to burn safely in spring will be limited in most years.
Large old trees with hollow butts may fall if they catch fire. Removing the fuel around the base of large hollow butt trees by raking or using a small machine can minimise the risk of trees catching alight.

Jarrah-Marri Forest:
Our most common vegetation community with a very diverse range of understorey species depending on soil, fire history, hydrology and topography. Important habitat for black cockatoos and a range of important flora and fauna.

Frequency: 5-15 year intervals

Season: Spring and autumn

Intensity: Low intensity, slow-spreading fires with flames less than 1m.

Comments: The height and density of the understorey shrub in jarrah-marri forest will influence the amount of fuel present and the rate at which it dries after rain. Grazing by cattle and sheep has altered the understorey of some remnant jarrah-marri forest on agricultural land, with annual grasses replacing shrubs in heavily grazed remnants. The shortest fire interval can promote native 'fire weeds' of the pea family which grow rapidly, set seed then die off, re-establishing a high fuel load. A longer burning interval can break this vicious cyc le if the fire weeds are replaced by slower-growing, less fire-promoted understorey species. Some wildlife of the Jarrah-Marri Forest is confined to long-unburnt vegetation. Ideally, patches of forest and stream zones should be protected from burning for as long as possible, with surrounding patches maintained at lower fuel levels to prevent extensive fire when a wildfire eventuates. Large old trees with hollow butts may fall if they catch fire. Removing the fuel around the base of large hollow butt trees by raking or using a small machine can minimise the risk of trees catching alight.
Fallen branches and woody debris may be piled and burnt to create ash beds that will favour regeneration of eucalypt and some shrub seedlings. In late autumn it may be possible to burn individual piles

Sheoak Woodland:
Woodlands of common sheoak with or without Jarrah or Banksia on sandy soils over granite

Frequency: 5-15 year intervals

Season: Early spring and late autumn

Intensity: Low intensity, slow-spreading fires with flames less than 1 m

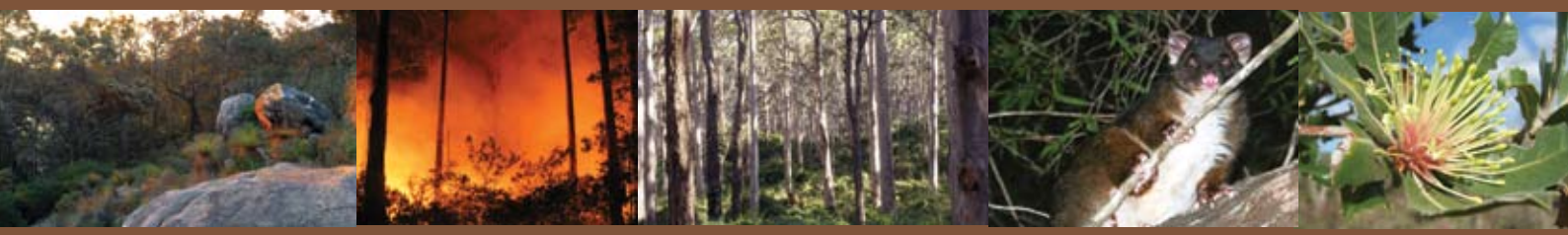
Comments:
Sheoak Woodlands typically occur on sandy soils that dry rapidly following rain, and often have an understorey of shrubs that may burn readily. Low intensity fires can maintain a low fuel load that helps maintain a habitat of mature trees and prevent intensive, extensive wildfire.

Granite outcrops: A unique suite of species suited to withstanding both inundation and extreme drying in summer. Important habitat for reptiles and a number of unique and threatened flora species 	Frequency: Only as required to meet specific conservation management objectives Season: Late autumn Intensity: Very low intensity, slow-spreading fires with flames than 0.5 m Comments: Granite outcrops often have a sparse vegetation cover and little or no leaf litter to carry fire. Patches of vegetation and wildlife inhabitants close to this fire barrier will often be spared from burning, thus providing a survival refuge from an intense, extensive bushfire. Periodic low-intensity burning of forest or woodland surrounding granite outcrops can reduce the potential for intense summer bushfires that can spread onto granites under very dry and windy conditions.
Sand Plains: These areas of sandy/ peaty soils over clay are often damp in winter and generally support heathland vegetation. 	Frequency: Only as required to meet specific conservation management objectives Intensity: Fires in heathland vegetation may not sustain and spread under mild conditions but can burn with a high rate of spread and intensity under dry windy conditions. Comments: If substantial areas of peat or organic soil are present then fire should be restricted to periods when the peat is moist and unlikely to ignite.
Coastal Heath: Dense shrubland ranging up to 3m or more in height. The dense nature of this community can provide excellent habitat for a range of bird and mammal species. 	Frequency: 5-15 year intervals Season: Dry periods during winter, early spring and late autumn Intensity: Fires in heathland vegetation may not sustain and spread under mild conditions, but may burn with a high rate of spread and intensity under dry windy conditions. Comments: To burn safely and effectively in coastal heath it may be necessary to establish a low-fuel buffer strip (e.g. 20-30 m wide) by slashing or other mechanical treatment. Burning against a paddock of green grass in spring, or an eaten-out paddock in autumn can also provide a secure boundary.

	If the heath contains dense thickets of grass trees and has not been burnt for some time, spells of fine weather during the winter months can provide an opportunity for selective burning of individual grass trees to reduce the amount of dense thatch suspended on the tree. This can reduce the intensity and flame height during subsequent planned burns. Note: Please note that this frequency is only tecommended for low intensity fires. Where high intensity fires in banksia woodland or shrubland have killed mature plants back to rootstock or seedlings, intervals greater than 15 years (some studies suggest 26-31 years) are required to allow for full recovery of flower and seed resources critical for sustaining Honey Possums and birds including cockatoos.
Winter-wet swamps and wetlands: These areas are typified by winter inundation but with minimal flow and 	These systems can tolerate only infrequent fire at greater than 20-year intervals. Generally avoid/ minimise control burns within these systems by burning out from from the edge to surrounding vegetation
Watercourses and stream banks: Wet areas at the bottom of the landscape with flowing water and 	These systems can tolerate only infrequent fire at greater than 20-year intervals. Generally avoid/ minimise control burns within these systems by burning out from the edge to surrounding vegetation.

Coastal Dunes: This dynamic and harsh coastal environment is dominated by low, often open communities critical in stabilising mobile soils and reducing wind and wave erosion 	Do not burn – fire-sensitive. Burn out from the edge to to surrounding vegetation where necessary to minimise fire incursion.

This document has been developed from information provided by Dr Lachie McCaw, Department of Parks and Wildlife.



Fire and Seasonality of Burning

Cape to Cape Catchments Group

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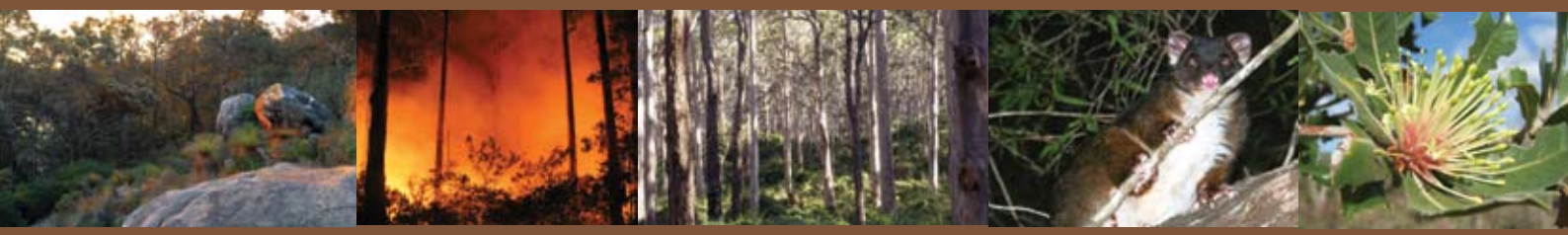


Fire and Seasonality of Burning

Snottygobble epicormic regrowth post fire.

The season in which a burn is conducted significantly influences the impact of the burn. The preferred season to burn will depend on the objective, the site vegetation and physical constraints, previous burning history of your bush and the context of the whole property and surrounding bushland.

The most important 'rule of thumb' for sustaining diversity of vegetation and wildlife in your bushland is to maintain a fine-scale mosaic of patches which, by differing in structure and species composition, reflect a variety of fire management approaches. This results in a fine-scale patch matrix important to biodiversity conservation because it provides flora and fauna species with ready access to a diverse range of resources and refuges. This helps species to persist through changes and threatening processes such as wildfire and climate change.

Wherever possible, the objective is to achieve different patches, to be burnt at different seasons, preferably with gaps of several years between the neighbouring burns, to provide heterogeneity between patches and groundcover in some areas at all times.

Summer

From the time that permanent structures of buildings, fences and crops were established by European settlers, Indigenous burning was discouraged and even outlawed. Summer fire became difficult to control once traditional practices of intensively managing Country using fire were disrupted.

When a summer wildfire burns through a patch of vegetation being retained for wildlife values, the regenerating vegetation needs to be managed to capitalise on potential benefits and address a number of negative impacts. Important points to consider are weed management, grazing pressure on regenerating vegetation, feral animal control and dieback management. These are discussed in more detail in other parts of this kit.

Note: Because summer fires can burn quickly given the dryness of bushland, high temperatures and strong, often unpredictable, winds associated with this season, even the best-managed fires can easily escalate into potentially devastating wildfires. Consequently, the use of summer fire as a management tool is highly regulated and only recommended under highly specialised applications, e.g. the management of specific species or ecological communities and, even then, only under highly skilled supervision and only where adequate safety and fire control measures are in place. Therefore, we do not recommend the use of fire in this season for normal conservation management purposes.

Autumn

Control burning can be conducted in April – May. During this period, the soil will be very dry and the leaf litter layer, logs and organic soil will ignite readily and burn completely, possibly over an extended period. For this reason, autumn burns are recommended for regeneration burns.

Autumn burns will generally result in more extensive areas of mineral ash bed from burnt logs and will heat the soil to a greater depth than spring burns. Winter rain after autumn-winter burns enables immediate regeneration of the vegetation.

Some generalisations about autumn burning are that:

- the dry conditions in this part of the year can result in hot, intense, fast-moving fires;
- this can consume most above-ground material and burn down mature trees;
- the dry soil conditions and heating of the soil to a greater depth can help trigger germination of buried seed;
- this can favour 'obligate seeders' especially legumes such as acacias and peas; and
- fire is often followed by winter rain and this encourages good regeneration.

Note: Autumn burns, particularly in the early part of the season, can be dangerous and difficult to control requiring very thorough planning and preparation. They are not recommended for most landholders to attempt without the support of local brigades or other professional backup. They will also remove much of the habitat value of a property for a number of years and do not always succeed in regenerating the desired vegetation or priority plant species.

Check to ensure that a good soil seed bank exists. Privately-owned vegetation remnants can be degraded and have often been subjected to frequent burning and grazing, resulting in a depleted soil seedbank.

Standing trees with hollow butts, scars and dead branches caused by previous fires are much more likely to ignite and burn during summer and autumn when conditions are dry. Once alight, trees may fall and continue to burn away on the ground.

If the follow-up rains do not eventuate in the particular year that an autumn burn is conducted, regeneration can be much less successful than intended.

Winter

With the increasingly dry winters experienced in the South West, there are now often extended windows in winter that provide an opportunity to undertake low-intensity fuel reduction burning.

Winter burns may be useful for safely reducing fuel loads in higher risk instances or reducing specific elements of the fuel load such as Grasstrees in order to facilitate subsequent Spring or Autumn burns. Winter burns are generally not preferred for regeneration.

Some generalisations about winter burning are that these:

- are generally low-intensity, low, slow burns;
- can be very hard to get started and can be patchy:
- often fail to achieve desired fuel reductions;
- are often not hot enough to break the dormancy of buried seeds;
- can promote introduced grasses where these are present;
- can disrupt the life cycle of flora and fauna - annual species reliant on setting seed each year can be particularly vulnerable; and
- often focus on some of the higher risk/fuel load elements of a piece of bushland such as Grasstrees.

Spring

Control burning is generally not achievable during early spring.

However, mid- to late spring is often favoured for fuel reduction burns due to reduced intensity and increased predictability. The soil and litter layer will normally be wet and will dry from the top downwards with the onset of warm, dry weather. Logs on the ground and areas of organic soil will also be damp following winter rains, and therefore less prone to catching alight during planned burns. Although spring is the breeding season and spring burns can impact breeding of many species, some birds will have already raised their first clutches by mid-October and spring burns generally burn patchily, leaving pockets of unburnt vegetation as wildlife refuges.

Some generalisations about spring burning are that these:

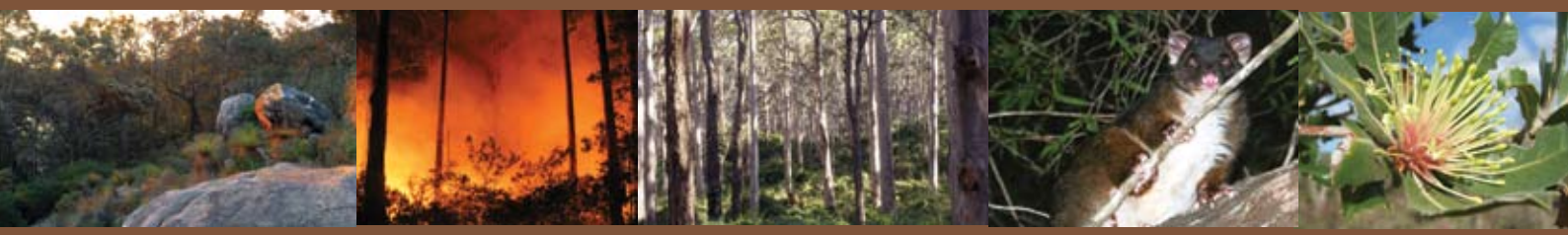
- are generally of moderate intensity depending on the vegetation type;
- are good for breaking dormancy of surface and shallow seed but not for buried seed;
- can promote native plant species which have evolved to respond to spring burns, and a sound practice is to plan to continue with spring burning for patches where this has been previously undertaken;
- can disrupt and harm animals and birds during breeding;
- can provide a competitive advantage to re-sprouting plants due to the extent of growth they can achieve prior to re-seeders that germinate with the first rains of the following autumn;
- can eliminate or seriously reduce that year's flowering (with subsequent impacts on nectar and pollen feeders) and subsequent seeding;
- can trigger spring germination that can then be lost to the following dry summer

Hibertia germination following a spring burn.

References

Hussey, B.M.J. & Wallace, K.J. (2003) Managing your Bushland. Department of Environment and Conservation, Kensington WA.

FESA, 2009 Winter Burning Guide: Controlled burns in winter may protect your home this summer.



Implications of Fire for Weeds, Dieback, Grazing and Feral Animals

Cape to Cape Catchments Group

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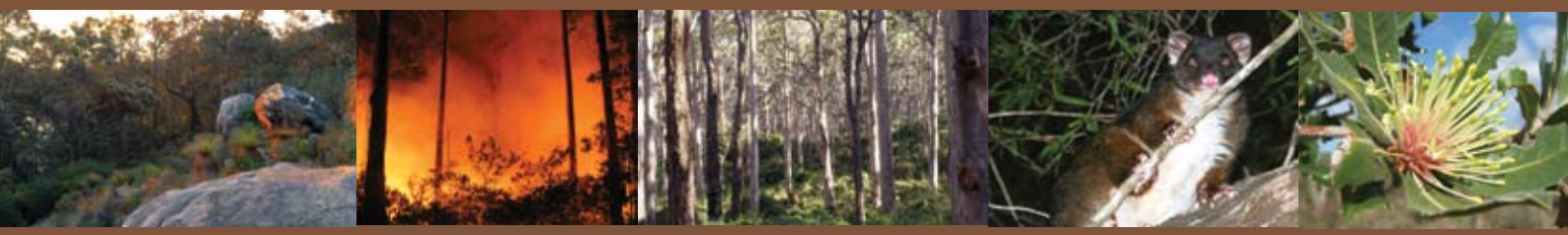


Implications of fire for weeds, dieback, grazing and feral animals

Environmental Weeds

Although fire represents a unique opportunity for reducing weeds, alone it will not solve your environmental weed problems. Without strategic and effective post fire management, a fire will likely result in environmental weeds increasing their extent, dominance and impact within our bushland.

Due to the fragmented nature of most privately retained bushland remnants and their proximity to roadsides, landscaped or productive areas, private- bushland remnants are generally far more vulnerable to environmental weeds than large remnants within National Parks and State Forests.

As with other aspects of biodiversity, fire is a potentially powerful management tool in environmental weed management. However it needs to be accompanied by carefully planned management and monitoring to ensure that it is effective rather than detrimental.

Whilst the impacts from any fire will depend heavily on the site, the season and the intensity of the fire in question, there are some common considerations relating to weeds when contemplating burning bushland.

Fire can kill some weeds

Whilst most priority weed species in the South West will regenerate strongly after fire (either through re-sprouting or reseeding), a limited number of species are fire sensitive and can be managed using fire. For example, seedlings and even larger plants of Sweet Pittosporum *(Pittosporum undulatum)*, which is native to rainforest areas of the eastern states, can be killed by warmer burns.

Pittosporum killed by controlled burn in A Class Reserve on the Margaret River.

Fire can facilitate removal of mature plants

Fire will generally thin out much of the understorey of native and introduced plants. This can:

- provide rare but short windows of opportunity to get at previously very difficult or impossible to access (e.g. Blackberry thickets);
- promote young fresh shoots and regrowth of weed species that are far more receptive to the uptake of herbicides than the old hardened foliage (e.g. Tambookie grass).

Fire-promoted mass germination can provide weed control opportunities

The heat, smoke and subsequent conditions within the ash bed often provide ideal conditions for the germination of weed and natives seeds. This can provide some unique opportunities for weed control, for example through:

- A window of opportunity for selective control if weed species respond (reshoot or reseed) quicker than the native plants;
- An opportunity to control almost the entire soil seedbank of some species (e.g. weedy wattles such as Sydney Golden Wattle) which otherwise might gradually germinate over a decade or more, requiring repeated annual follow-up to address reseeding;
- Young weed seedlings can be particularly susceptible to herbicide so early control can reduce the amount of herbicide required and assist selectivity when spraying.
- Keep an eye out for weed species emerging after a burn that weren't present before the fire as some seed will remain dormant for long periods after the removal of the original mother plant. Others can be brought in by birds.

Tips for managing weeds through fire:

1. Where possible, assess and map your bushland before the fire so you know what species and what areas need targeting,
2. Beware new species emerging from the soil seed bank.
3. Map your weeds well in advance so that you are ready to act after an unplanned fire as well as when you might choose to conduct a burn.
4. Make sure you can tell weeds from the native plant regrowth you want to keep. Weed and native seedlings and new growth can sometimes be difficult to identify with confidence. Your ID needs to be accurate to ensure that native species are not removed and that your control methods target the invaders. Help is available from Flora Base (http://florabase.dpaw.wa.gov.au) and the excellent book 'Western weeds: a guide to the weeds of Western Australia'.

Broombush mass regeneration after an Autumn burn

Case study: Barrett St Reserve, Margaret River

Post-fire environmental weed control within an urban bushland reserve.

An autumn fuel reduction burn was undertaken in this popular urban reserve located between the Margaret River and the centre of town. For several years prior to the controlled burn, the Friends of Barrett St Reserve had been tackling a range of weeds with a specific focus on Sweet Pittosporum *(Pittosporum undulatum)* and Asparagus Fern *(Asparagus scandens)*.

The burn helped to kill off almost all of the young seedlings of the fire-sensitive Sweet Pittosporum and provided a great follow-up to the work previously undertaken to tackle the large seed-bearing plants. The fire opened up the understorey almost completely and provided an excellent opportunity to survey, monitor and control Asparagus fern re-sprouting from mature individuals and seedling germination. Within 18 months, thick and rapid regrowth of Karri hazel *(Trymalium odoratissimum)* and other native species created a dense understorey making access (and weed control) within some areas incredibly difficult.

The fire also triggered germination of Eastern State weed wattles and introduced Dolichos Pea from the soil seed bank around the edges of the reserve.

Autumn control burn in Barrett St Reserve

Phytophthora Dieback

The root-rot plant disease "Phytophthora dieback" is widespread through the Margaret River region and impacts up to 40 per cent of south-west plant species. It spreads through the landscape by movement of contaminated soil or water. Dieback is commonly spread or introduced during firebreak creation and maintenance and fire control. Hygiene is critical. Remember that once introduced, dieback can't be eradicated from bushland, only managed. Refer to the excellent information available via the Dieback Working Group: www.dwg.org.au

Post-fire grazing

Privately-owned bushland can be particularly susceptible to grazing and browsing following a fire due to the generally large portion of private bushland that is exposed to edge effects where bordering cleared land. Grazing of newly-germinated seedlings by domestic stock, feral animals such as rabbits and native species especially Western Grey Kangaroos can pose severe and permanent threat to bushland by removing whole groups of plant species where fire has destroyed the adult plants and all seed has germinated only to be eaten.

Tips for reducing post-fire grazing:

1. Ensure that stock are not able to access regenerating areas.
2. Assess kangaroo and rabbit numbers and grazing pressure before planned burns and undertake management where necessary to keep pressure down for at least two years.
3. For small patches of valuable remnant bushland, fencing maybe an option.

Feral animals

Feral predator control is important for conservation of wildlife at all times but especially so following burns. Foxes and feral cats can sniff out a fire and travel large distances from their normal ranges to feed on animals fleeing a fire and on the vulnerable animals that remain following the loss of protection afforded by vegetation. Environmental agencies often advise post-fire baiting to help protect surviving wildlife. CCG's publication "A Guide to Fox and Feral Cat Control" addresses this topic in detail.

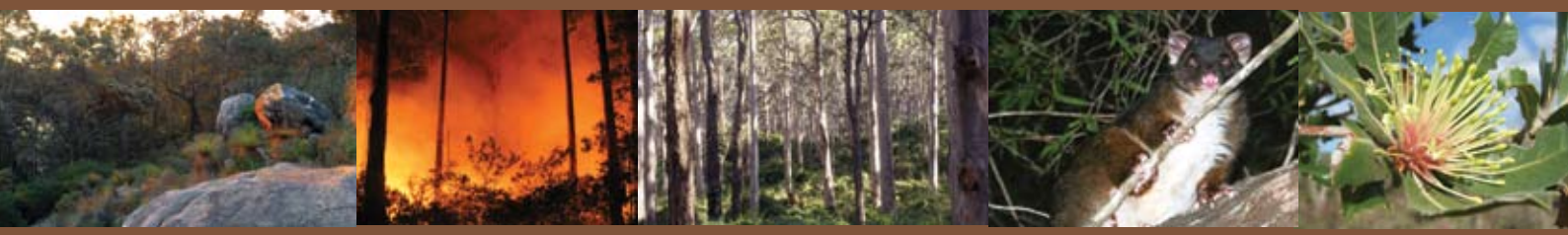
Further reading

Dieback Working Group: Range of information available on line via www.dwg.org.au

Cape to Cape Catchments Group: A range of information is available online including "A Guide to Fox and Feral Cat Control" and various weed identification and management publications.

Hussey, B.M.J. and Wallace, K.J. (2003) Managing your bushland. Department of Environment and Conservation, Kensington WA.

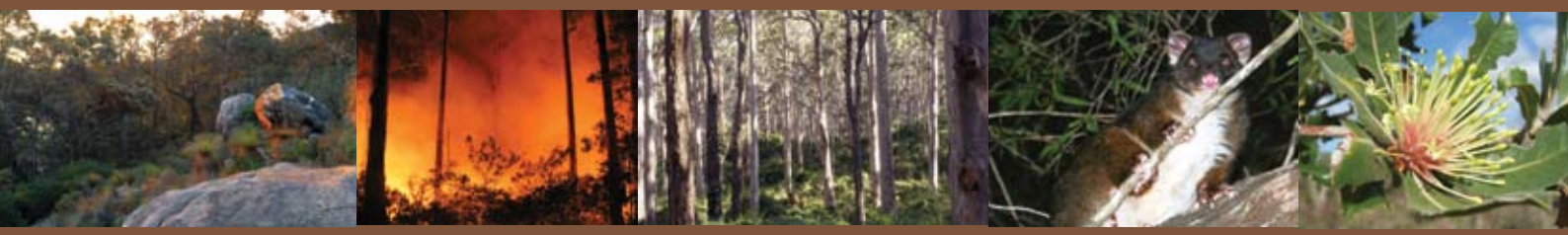
Florabase: www.florabase.dpaw.wa.gov.au



Special Ecological Features and Considerations

Cape to Cape Catchments Group

lotterywest supported



Ecological Features Requiring Special Consideration

Overview

Management of biodiversity values in the south-west is complex and often not entirely understood. These summaries provide a starting point for considering how to plan a fire regime that will best maintain particular biodiversity values in native vegetation of the south west. They are designed to be read in conjunction with the other information provided in this kit. Critical factors to consider in conjunction with planning to maintain biodiversity include ensuring appropriate risk mitigation and specifics of the vegetation/habitat types of the property and locality.

Further information

Many of the references cited are from publications that will not be readily available. However, some information on many of the species featured here plus others are available at the following sites:

https://www.dpaw.wa.gov.au/images/documents/plants-animals/animals/animal profiles

https://www.dpaw.wa.gov.au/plants-and-animals/animals/living-with-wildlife

The IUCN List of Threatened Species http://www.iucnredlist.org/

Acknowledgements

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CCG is grateful to the Department of Parks and Wildlife and Dr. Shaun Molloy of Edith Cowan University for reviewing the drafts, while CCG takes responsibility for all information presented.

New Holland Honeyeater
Phylidonyris melanops
Photo: Boyd Wykes

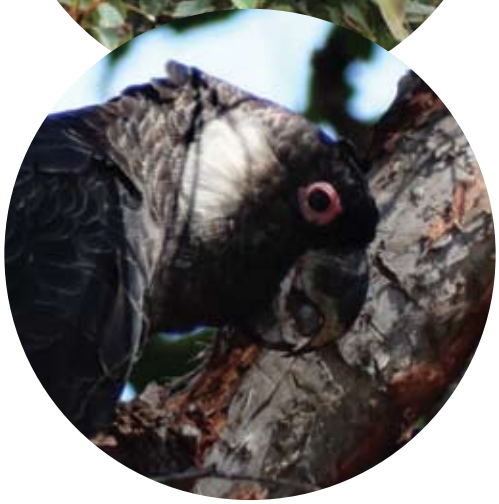
Scarlet Robin
Petroica Multicolour
Photo: Steve Castan

White-cheekd Honeyeater
Phylidonyris nigra
Photo: Steve Castan

White-fronted Chat
Epthianura albifrons
Photo: Boyd Wykes

Baudin's Cockatoo *Calyptorhynchus baudinii*

Status - Endangered at WA State level
- Vulnerable at Commonwealth level



Photos: Boyd Wykes

Baudin's Cockatoo is endemic to forests of south-west of Western Australia, where their distribution has significantly decreased in the past 50 years as a result of clearing and habitat fragmentation (over one quarter of its original habitat has been cleared), shooting by orchardists and competition for hollows especially by feral honey bees. Baudin's Cockatoo is especially vulnerable to shooting and disruption of breeding because of a very low rate of reproduction, with an average of 0.6 chicks raised per clutch, with each pair often only breeding in alternate years.

Extensive, intense summer wildfire can devastate and dislocate cockatoo populations throughout a region due to loss of seed sources for several years and long term loss of nesting hollows, as documented by the WA Museum after the 2016 Waroona-Yarloop wildfire.

Conservation of habitat trees with suitable hollows is especially important. These are formed in 100-200 year old trees of marri, jarrah, karri or wandoo through termite and fungal activity. Nest trees with hollows can be lost in wildfire, controlled burns and post-fire 'clean-up' of old trees that are considered a risk. In intensive wildfires, the trees burn from the top down (burning leaves falling into hollows etc.) and the best protection of an area is management to contain such fires.

For milder, controlled burns, dragging all deadfall and rake litter away from the base of all veteran and stag trees with hollows and potential hollows has been shown to work well in open woodland, such as wandoo. Saving nesting trees may be less achievable in dense forests of high rainfall areas of the south west. Here, protecting patches of old growth Marri and Karri from intense fire should be the priority.

Although a specialist of SW forests, especially equipped to extract marri seed, in the fragmented landscapes of our agricultural zones Baudin's Cockatoo is capitalising on the nectar and seed of some garden plants such as Callistemon and weeds such Pelargonium. Groves of non-native eucalypts can also be favoured as roosts. Land owners should use their own observations on how cockatoo are utilising their area to customise conservation measures at this time of changing dynamics.

References

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Carnaby's Cockatoo *Calyptorhynchus latirostris*

Photo: Steve Castan

Status - Endangered at WA State and Commonwealth levels

Carnaby's Cockatoo is an endemic species of SW WA that historically nested inland during July-Dec before moving to feeding grounds on the coast. Although driven to the brink of extinction by breeding habitat decimation in the wheatbelt, over the last half century Carnaby's Cockatoo has shown adaptability with some populations breeding on the coastal plain and Darling Scarp and utilisation of pine seed as an alternative to wholesale clearing of coastal vegetation for housing. There is also now a significant population in the forests around Busselton and Bunbury and east from Margaret River to Nannup where pine plantations are the primary food source.

Eucalyptus woodlands with jarrah, marri and tuart of 100-200 years age provide suitable tree hollows for nesting. Nest trees with hollows can be lost in wildfire, controlled burns and post-fire 'clean-up' of old trees that are considered a risk. In intensive wildfires, the trees burn from the top down (burning leaves falling into hollows etc.). The best conservation measure is management to contain the extent of wildfires and especially to protect patches of old growth.

For milder, controlled burns, dragging all deadfall and rake litter away from the base of all veteran and stag trees with hollows and potential hollows works well in the open woodland habitat of Carnaby's Cockatoo.

For a site to be suitable for breeding, foraging habitat and access to water need to be within usable distance from nest sites, with loss of feeding grounds within 12km posing a considerable threat to reproductive success. Small prescribed burns and patchy burns will leave unburnt areas providing seed food resources and help prevent extensive, intense wildfires. Carnaby's Cockatoo readily utilises artificial nest sites where suitable hollows are not available. Installing nesting boxes to increase availability of breeding sites may not be of benefit in areas of the south west where hollows are plentiful but they may be utilised where suitable trees are not present, for example as a result of a destructive fire history.

Banksia seed is a major food resource for Carnaby's Cockatoo, with the Candle Banksia, *B. attenuata* of sandy soils in our region being the main consideration. Candle Banksia resprouts after a fire but is not productive for seed until 10-30 years. Long unburnt stands are therefore needed but these are susceptible to wildfires which will kill adult trees and significantly increase recovery time. Low intensity (spring), patchy and buffer burns can reduce risk of extensive, intensive wildfire but need to be undertaken with great care to achieve the intended result.

References

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Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Conservation Status - Vulnerable at WA State and Commonwealth levels

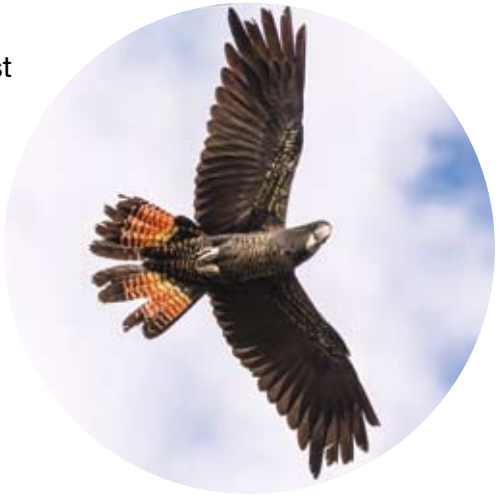

Photo: Steve Castan

One of three WA sub-species of Red-tailed Black Cockatoo, the forest sub-species is endemic to the wetter corner of the south-west where its range has been reduced by around 25-30 percent through clearing.

Forest Red-tailed Black Cockatoos nest in hollows formed as a result of termite and fungal activity in very old trees - 200 to 500 years age - particularly marri. Such trees are readily lost to wind, wildfire, controlled burns and post-fire 'clean-up' of old trees that are considered a risk. Monitoring of loss of nest trees indicates that availability of breeding sites in southern forests is under threat.

In intensive wildfires, the trees burn from the top down (burning leaves falling into hollows etc.) and the best protection of an area is management to contain such fires. For milder, controlled burns, dragging all deadfall and rake litter away from the base of all veteran and stag trees with hollows and potential hollows has been shown to work well in open woodland. Saving nesting trees may be less achievable in dense forests of high rainfall areas of the south west. Here, protecting patches of old growth marri, jarrah, bullich and karri from fire should be the priority.

Forest Red-tailed Black Cockatoo nests are typically clustered in the landscape, likely related to social interactions within groups. Protection of all veteran trees in areas known to support nesting is highly important. Forest Red-tailed Black Cockatoos are also particularly vulnerable to bushfires disrupting breeding, as breeding has been recorded in all months, with peaks in autumn (April-June) and spring (August-October). Peak months and years of breeding coincide with fruiting of either of the principal feed trees, jarrah or marri.

Ninety percent of forest Red-tailed Black Cockatoo diet consists of seeds of marri and jarrah, supplemented by seed of a range of other tree and understorey species including blackbutt, karri, sheoak and snotty-gobble. However, it is showing some of the adaptability of the other cockatoos of the region. Although not yet colonising to the extent of the recent expansion into Perth with the discovery of Cape Lilac as a food source, Red-tailed Black Cockatoos in the south west are utilising seed of cultivated Lemon-scented and Spotted Gum and Bushy Yate. Land owners should use their own observations on how cockatoo are utilising their area to customise conservation measures at this time of changing dynamics.

References

Department of Environment and Conservation (2008). Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-Tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia.

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Shrub foraging and nesting birds

In general, small bird species are resilient to single, patchy fires of small spatial scale and low to moderate intensity.

Most individual small birds are able to survive a low intensity burns by seeking refuge in trees or by flying ahead of the fire front to adjacent unburnt patches. Many return once the fire has past but survival can be low in the more open understorey post-fire. Landscape connectivity can provide routes for recolonization post fire from unburnt pockets once the burnt area has regained sufficient habitat resources.

In contrast, the response to extensive and intense fires is often a significant reduction in numbers, taking many years for populations of some species to recover. Recovery is successional, with species that prefer more open vegetation moving back earlier than those that need denser understorey. Repeat burning will prevent some species re-establishing.

Given that each species responds individually to fire and that the ecology of each site will be unique, there is no one fire regime that will achieve the requirements of all species. Rather than rely solely on fuel age for guiding management, it is important to identify key biodiversity values in areas to be managed, take into consideration the local fire history and local conditions, and maintain as much patchiness as the site allows. This table provides observations on fire response for some bird species of our region to demonstrate the variety of responses possible.

Examples of some bird responses to fire (after Burbidge 2003).

Common Name	Scientific Name	Vegetation type	Observation of species presence in response to fire event
White-fronted Chat	*Epthianura albifrons*	Low Open Scrub	Benefit post intense fires. Present for 2-3 years after fire, may still be present 6 years later.
Tawny-crowned Honeyeater	*Phylidonyris melanops*	Heath	Seem to benefit post fire, present 1-6 years after fire event, with abundance at its highest 2 years post burn.
White-cheecked Honeyeater	*Phylidonyris nigra*	Heath	Present between 3-6 years after a fire event.
New Holland Honeyeater	*Phylidonyris rnovaehollandiae*	Heath	Minimum of 6 years since fire event
Scarlet Robin	*Petroica multicolor*	Forest and Woodland	Colonize new areas or become more abundant in areas that are more open post fire. However, varying responses at different study sites have been observed.
Grey Shrike-Thrush	*Colluricincla harmonica*	Woodland	Remained in unburnt pockets adjacent to burnt areas for more than 2 years. Began to move back into burnt areas 3 years post fire.
Western Thornbill	*Acanthiza inornata*	Forest and Woodland	Varied response to fire at different sites with no strong trend identified.

References

Burbidge, A. H. 2003. “Birds and Fire in the Mediterranean Climate of South-west Western Australia.” In Fire in Ecosystems of South-west Western Australia: Impacts and Management, edited by Ian Abbott and Neil Burrows, 321-347 Leiden, The Netherlands, Backhuys Publishers.

Splendid and Red-winged Fairy-wrens *Malurus splendens* and *Malurus elegans*

Status - Not listed at WA State or Commonwealth levels

Splendid and Red-winged Fairy-wrens, two of the most characteristic and much loved birds of the south west, require dense understory for nesting and roosting, and an adequate supply of invertebrates as a source of food. Both establish family groups for maintaining territories and raising young. With limited capacity to move long distances across open ground between remnants, fairy-wren populations are at risk from frequent and extensive fire. Assuming recruits from survivors or other groups in the vicinity can recolonise a burnt area, a population will not re-establish in a burnt patch until the understorey recovers sufficiently to protect adults, eggs, nestlings and fledglings from predation. Numbers build up slowly as family groups establish and grow.

Photos: Steve Castan

The Splendid Fairy-wren prefers more open vegetation with patchier understorey than the Red-winged Fairy-wren. Splendid Fairy Wrens can have a high survival rate of adults during low to moderate intensity fires and although breeding success and survival of juveniles is very depressed over subsequent years, populations generally recover several years post fire. Some understorey species that support wrens such as bracken, grass-trees, and many acacias and peas respond rapidly and vigorously to fire. For example, a study in the Perth Hills found that a population of Splendid Fairy-wrens rapidly recovered after fire which promoted germination of prickly moses *(Acacia pulchella)*, with 50% of nests located in this species 3 years post fire.

The Red-winged Fairy-wren is associated with dense stream vegetation in jarrah-marri forest and the dense understorey of karri forest. The biology of Red-winged Fairy-wrens is focussed on quality rather than quantity, attuned to stable, predictable conditions. Compared with Splendid Fairy-wrens, adults have higher survival rates from year to year, are longer lived, have lower clutch size, a shorter breeding season and lower incidence of repeat breeding in a season. When their habitat does burn, adult survival is low and reestablishment of a population takes many years as vegetation recovers and recruits re-establish family groups. A population in karri forest at Manjimup took over 10 years to recover to pre-fire numbers after an intense fire event.

To maintain fairy-wren populations, particularly Red-winged Fairywren, the best burning strategy is not to burn. Patchy low intensity fuel reduction burns around the periphery may be a means of protecting 'no burn' core areas of stream lines and karri as habitat for Red-winged Fairy-wrens and a suite of other wildlife with similar requirements. Even low intensity burns in such habitat can be deleterious given that half the Red-winged Fairy-wren nest sites in the Manjimup study were in dead brush on the forest floor.

Maintaining connectivity between areas of habitat is particularly important for species such as fairy-wren with limited capacity to disperse over open ground. In isolated remnant bushland less than 120ha in area, fairy-wren populations may not be sustainable even with the exclusion of fire. Vegetation corridors are used with some success to enable dispersal through cleared farmland. Larger gardens such as those in outer Margaret River can support fairy-wren populations and provide connectivity between natural vegetation remnants.

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Ngwayir (Western Ringtail Possum) *Pseudocheirus occidentalis*

Status - Critically endangered at WA State level and Vulnerable at Commonwealth level

The Ngwayir (pronounced n–w-ear) is a nocturnal possum with a leaf diet restricted to a limited group of plants. Formerly distributed over a much greater range of SW WA, Ngwayir are still well represented in coastal and forest vegetation from Mandurah to Albany. Most research has focussed on the Mandurah to Busselton coastal plain population. Within the Margaret River region Ngwayir are largely restricted to streamlines, swamps and other wetter areas (including gardens) where the leaves of preferred plants such as Peppermints *Agonis flexuosa* are palatable. These areas also tend to have dense canopies of trees that provide shelter for 'dreys' – nests comprising a ball of woven twigs and leaves – and capacity to move from tree to tree with minimal descent to the ground. Skirts of grasstrees (Balga) are also favoured nest sites. There is probably some seasonal movement upland from their wetter core habitat in winter.

The main threats to Ngwayir are altered fire regimes, landscape fragmentation, roadkill and predation by ferals and dogs/ cats. When exposed to multiple disturbances, impact is compounded.

Ngwayir are most abundant in suitable habitat that has remained unburnt for more than 20 years or that have only experienced low intensity fire (flame height <2m up trees in jarrah and peppermint forest). Moderate-high intensity burns may be appropriate for bush regeneration and tree hollow development but only when the mid-story quality deteriorates at 20 to 50 years following an intense burn.

Long fire intervals will potentially result in high fuel loads that place the Ngwayir population at risk from wildfire. Where low-lying areas such as riparian zones support highest densities of Ngwayir, these can be protected by more frequent prescribed burns up slope.

For small remnants of high quality habitat, it may be necessary to create a mosaic with buffer and low-fuel patches to prevent total loss to wildfire. When burning small sections, as much of the remaining habitat should be left unburnt for at least 10 years. Movement between habitat remnants to repopulate and maintain gene flow, particularly following fire, is highly dependent on vegetation connectivity due to the limited capacity of Ngwayir to cross open ground.

Prescribed burns in Ngwayir habitat must take into consideration intensity and seasonality to reduce stress on a population from reduced food and shelter resources. Prescribed burns should therefore:

- be low intensity
- aim to retain the dead leaf skirts of balga and dense mid-story vegetation as nesting sites
- be conducted in mid-spring, particularly in jarrah forest, prior to the conclusion of the fresh spring leaf growth - the leaf quality over winter is often low in nutrient value and a mid-spring burn allows time for additional fresh leaf production before growth slows in summer.
- in wetlands Ngwayir can also nest on the ground in large sedges. These should not be burnt. Burning in these areas should only be in winter an no burning in partially inundated areas.

Summer and autumn are not a good time to burn. Summer fires are generally intense with greater loss of understory and mid-story cover, exposing possums to hot weather conditions and predation. In autumn, leaves lost won't be adequately replaced until the following spring, further reducing already low food resources over winter. If an autumn burn is unavoidable, keep the burn as small as possible whilst retaining large unburnt areas within the burn mosaic.

Predator control is critical, particularly where burning has been intense and in fragmented habitat - immediately prior to a burn and for about 3 years until the mid-story has properly recovered.

Legal Considerations

Due to high conservation status at State and Commonwealth levels, any action being considered that may have a significant impact on Ngwayir habitat and/or food resources needs to be undertaken in consultation with DPaW. See the recovery plan for details and what constitutes 'significant'.

References

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Koomal (Western Brushtail Possum) *Trichosurus vulpecula hypoleucus*

Status - Not listed at WA State or Commonwealth levels

PHOTO: Rodney Sales DEC

The Koomal, a small, attractively marked WA sub-species of Brushtail Possum, inhabits a wide variety of vegetation types, with the main requirement being adequate refuge and nesting sites. They use tree hollows for nesting, with preference for hollows deeper than 1m. Refuge sites on the ground include hollow logs, rock piles and burrows constructed by other animals. Koomal are herbivores, with a diet of leaves, flowers and fruits. Home range size varies between 1-15ha.

Numbers are reduced in the short-term after an intense summer-autumn fire but population recovery can be quite rapid. Fires of low intensity have very little impact. Koomal can cross long distances of open ground (up to 400m) between areas of suitable habitat and are therefore less susceptible to local extinction in vegetation remnants that have been burnt than might be supposed.

However, loss of tree hollows from intense fires is a significant threat. They generally prefer hollows that are at least 1m deep, which take an average of 300 years to form in jarrah and 200 years in marri trees. In one study, a minimum of 3 habitat trees was required per square hectare to support Koomal populations.

Flammable material should be raked away from the base of all old trees with hollows prior to a burn, especially for those known to be used by possums. Saving nesting trees may be less achievable in dense forests of high rainfall areas of the south west. Here, protecting patches of old growth Marri and Karri from fire should be the priority.

References

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Noolbenger (Honey Possum) *Tarsipes rostratus*

Status - Not listed at WA State or Commonwealth levels

Photo courtesy of Don Bradshaw

The Noolbenger is a small marsupial endemic to the south-west. It is reliant on pollen and nectar as a food source and as such, their recovery post fire is dependent on flower productivity. The main plant groups favoured for food are the *Proteaceae* (banksia family), *Myrtaceae* (eucalypt family) and *Epacridaceae* (heaths). Frequent and/or extensive fires can be significantly detrimental if flower production is reduced and landscape fragmentation limits their capacity to move into and return from suitable habitat adjacent to the burnt patch.

Noolbengers return to suitable habitat 2-4 years post fire, initially to feed each night and eventually to re-establish breeding populations (D. Bradshaw pers. com.). However, peak abundance is not reached for 20-30 years. Abundance has been observed to decline in areas unburnt for more than 36 years. An insight into why this is the case is provided by studies on the Candle Banksia, *B. attenuata*, a species of deep sandy soils in the Cowaramup area of our region.

Candle Banksia resprouts after a fire but is not productive for flowers and seed until 10-30 years later because post-fire energy is initially put into vegetative production.

Management of Noolbenger habitat in a mosaic of recently burnt and long unburnt patches with connective corridors is advisable for areas of vegetation sufficiently large to be managed in this way. Burn areas as small as 2ha are quite feasible although establishing tracks to help conduct burns around areas this small may not be desirable. For remnant vegetation too small to break up into a mosaic, the core habitat can be protected from fire by maintaining low fuel around the periphery through cool burns or other means, whilst maintenance of connectivity between habitat patches provides for recolonization when a bushfire eventuates.

Low intensity, frequent and patchy burns (intervals of 5-15 years) may help reduce wildfire risk without damaging or killing trees. However, such fires can easily go wrong and great care is needed to ensure the prevention is not as damaging as the cure.

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Bradshaw, D. (2014) The Honey Possum, *Tarsipes rostratus*, a keystone species in the Kwongan. In Lambers H ed(2014) Plant Life on the Sandplains in Southwest Australia, a Global Biodiversity Hotspot.

Chuditch (Western Quoll) *Dasyurus geoffroii*

PHOTO: S J Bennett

Status - Vulnerable at WA State and Commonwealth levels

The former range of the Chuditch, the largest remaining WA marsupial carnivore, was across semi-arid southern Australia from WA to western NSW and Queensland. This has been reduced by 95% since European settlement, with the species now only surviving in patches of southern WA. The densest populations are in jarrah forest along waterways which provide the necessary shelter from introduced predators, opportunity to establish dens underground and in logs, and adequate food.

Prescribed burns of less than 4000ha are considered to be ecologically beneficial to Chuditch as a means of building a mosaic of varying fuel ages in the landscape and with that a variety of food sources. Whereas hot summer bushfires are detrimental as they destroy log dens and promote uniformity of vegetation in the landscape.

Protection of log den resources requires consideration in planning a prescribed burn. This can be achieved by raking dead leaf and tree material away from hollow logs (and hollow dead standing trees) prior to burning and effort to extinguish any burning logs after the burn.

Chuditch prey on large invertebrates, reptiles and small mammals which may be in limited supply in the initial post burn stages. Connectivity with other patches to enable an enlarged foraging range will assist them during this time although they are capable of crossing open ground. Chudditch are vulnerable to fox predation, which increases with loss of habitat cover and need to shift or extend the foraging range post fire. Fox management is therefore worth considering immediately prior to the burn and during the recovery period.

Saving den logs and trees may be less achievable in dense forests of high rainfall areas of the south west. Excluding fire from the preferred habitat of stream vegetation within forest may be the best way to maintain Chudditch. In which case management may be needed for surrounding areas to reduce fuel levels and the risk of extensive, intense bushfire.

Legal Considerations

Due to high conservation status at State and Commonwealth levels, any action being considered that may have a significant impact on Chudditch habitat and/or food resources needs to be undertaken in consultation with DPaW. See the recovery plan for details and what constitutes 'significant'.

References

Department of Environment and Conservation (2012). Chuditch (Dasyurus geoffroii) Recovery Plan. Wildlife Management Program No. 54. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (2012). Chuditch Dasyurus geoffroii (Gould 1841). Department of Parks and Wildlife, Fauna Profiles.

Quokka *Setonix brachyurus*

Status - Vulnerable at WA State and Commonwealth levels

PHOTO: Sean McLean

The Quokka is a small, stocky, highly distinctive macropod that is now only well known for its Rottnest Island population, having been lost from 85-90% of its historic range across much of south-west WA since European settlement. The species has a very limited occurrence in the Augusta-Margaret River region, primarily in small forest pockets of the upper Margaret River catchment and lower Blackwood River catchment.

Habitat

The mainland Quokka has relatively high water requirements, which necessitates close proximity to fresh water throughout the year. Hence, the species is often present in riparian and swamp habitat.

Quokkas appear to require a landscape mosaic of vegetation structures including swamps with dense understory for refuge, interspersed between areas of more recent fire with an open structure and greater supply of food. Uniform old growth may limit Quokka feeding habitat and shelter through accumulation of dead material and mid-story vegetation senescence. Some concern has been expressed that prescribed burning generally only burns the periphery of wetlands, resulting in a limited fire mosaic within potential habitat.

However, there is also evidence that fire exclusion from wetlands is the best approach for maintaining quokka populations. This uncertainty reflects our limited understanding of mainland Quokka ecology and a landscape that has significantly changed since European settlement. Where quokka populations are identified, land-owners should confer with DPaW wildlife offiicers to develop a fire management plan.

Quokkas move in response to the seasons, shifting to the outer when winter rains inundate the centre of their swamp. They will be exposed to less predation if the outer areas of wetland habitat provide sufficient refuge.

Quokkas move between swamps in response to vegetation changing in the years following a fire event. Maintaining vegetation connectivity between suitable patches of habitat is therefore important to conserving quokkas in a fragmented landscape..

Legal Considerations

Due to high conservation status at State and Commonwealth levels, any action being considered that may have a significant impact on Quokka habitat and/or food resources needs to be undertaken in consultation with DPaW. See the recovery plan for details and what constitutes ‘significant’.

References

Department of Environment and Conservation (2012). Quokka Setonix brachyurus (Quay and Gaimard, 1830). Department of Parks and Wildlife, Fauna Profiles.

Department of Environment and Conservation (2013). Quokka *Setonix brachyurus* Recovery Plan. Wildlife Management Program No. 56. Department of Environment and Conservation, Perth, WA.

Bain, Wayne, Bencini (2016) Prescribed burning as a conservation for quokka.

Kwoora (Western Brush or Black-gloved Wallaby) *Macropus irma*

Status - Priority 4 (requires regular monitoring) at WA State level
- Not listed at Commonwealth level

The Kwoora is a large wallaby of southern and south-west coastal WA. A grazer rather than browser, the Kwoora favours open forest and woodland, particularly seasonally-wet flats with low grasses and open, scrubby thickets. It is uncommon in karri forests which have dense undergrowth. The Kwoora's range has been seriously reduced and fragmented by clearing for agriculture, and numbers further declined even in suitable habitat due to fox predation on juveniles.

Kwoora numbers are reported to have increased in abundance in areas where foxes have been controlled and prescribed burning programs conducted across much of its forest habitats are considered to favour this species.

Kwoora are frequently sighted and road-kills relatively abundant in the hinterland of the Margaret River region while sightings in the forest strip of the Leeuwin-Naturaliste Ridge are now rare.

The primary considerations for retaining Kwoora are therefore to retain areas of forest, particularly with seasonally-wet flats, with and connectivity where the vegetation is fragmented. The Kwoora's preference for dense understorey often associated with drainage lines and wetlands mean often do best in a moderate fire mosaic with a moderate burn regime of 4 -10 year rotation. This ensures a scrubby thicket to provide shelter and the capacity to avoid fox predation.

References

Department of Environment and Conservation (2012). Western Brush Wallaby Macropus Irma (Jourdan 1837). Department of Parks and Wildlife, Fauna Profiles.

Woinarski, J. & Burbidge A.A. (2016). *Macropus irma*. The IUCN Red List of Threatened Species.

Van Dyck, S. and Strahan, (2008) The Mammals of Australia. New Holland Pub Pty Ltd.

Western Grey Kangaroo *Macropus fuliginosus*

Status - Not listed at WA State or Commonwealth levels

PHOTO: Babs and Bert Wells

The Western Grey Kangaroo is a large kangaroo of southern Australia with a range from SW WA to western Victoria. The Western Grey has greatly benefited from an increase in suitable habitat and water supply associated with agriculture. The open, grassy understorey of frequently burnt forest can also carry high kangaroo numbers and native vegetation on the edge of farmland provides day-time shelter as well as roughage to supplement greener feed provided in pasture and crops.

Western Grey Kangaroos are generally a threatening factor when considering conservation aspects of fire management. Selective grazing by kangaroos on seedlings and resprouting shoots contributes towards shaping the vegetation composition post fire. Grazing can therefore not only reduce density of regrowth but cause decline and loss of targeted plant species and overall floristic diversity.

Post fire management of bushland may require the exclusion of kangaroos for several years if numbers in the area are high, particularly where sheltering vegetation has been retained adjacent to patch burns.

However large herbivores have a preference toward grass-like plants and may target some weed species and assist with post fire biomass control on the forest floor. Therefore, management decisions should be based on site specific ecological values and vegetation composition.

References

Burbidge A., Menkhorst P., Ellis, M. & Copley, P. 2016. Macropus fuliginosus. The IUCN Red List of Threatened Species.

Department of Environment and Conservation (2009). Western grey kangaroo. Fauna notes No. 29, 25 June 2009.

Howland B. W. A. & Driscoll D. A. (2016). At high densities kangaroo grazing can reduce biodiversity. Retrieved from: https://www.ecolsoc.org.au/hot-topics/high-densities-kangaroo-grazing-can-reduce-biodiversity.

Rafferty C., & Lamont B. B. (2005). Selective feeding by macropods on vegetation regenerating following fire. Journal of the Royal Society of Western Australia 88: 155-165.

Quenda (Southern brown Bandicoot) *Isoodon obesulus fusciventer*

Status - Priority 4 (requires regular monitoring) at WA State level
- Not listed at Commonwealth level

PHOTO: Peter Nicholas

Quendas are widespread in the south-west across karri, jarrah and coastal vegetation. They prefer swampy and creekline areas with very dense understory that provides protection and shelter from predators such as foxes and cats to which they are otherwise quite vulnerable.

Low intensity, high frequency fire regimes help support this.

Quenda benefit from a landscape mosaic of varying fuel ages, sheltering in dense vegetation and feeding in neighbouring patches that are more recently burnt.

The combination of fragmentation of suitable habitat across the landscape and extensive, frequent fire is a threat to quenda. Landscape connectivity is vital and can be promoted through the conservation and restoration of connective corridors between areas that provide suitable nesting habitat with dense understorey and patches burnt more frequently, ideally in a patchy burn mosaic.

References

Department of Conservation and Land Management (2005). Living with Quendas. Department of Parks and Wildlife, Fauna Notes (Living for Wildlife brochure).
Department of Environment and Conservation (2012). Quenda Isoodon obesulus (Shaw, 1797). Department of Parks and Wildlife, Fauna Profiles.
Van Dyck, S. and Strahan, (2008) The Mammals of Australia. New Holland Pub Pty Ltd.

Mardo (Yellow-footed Antechinus) *Antechinus flavipes leucogaster*

Status - Not listed at WA State or Commonwealth levels

PHOTO: Babs and Bert Wells DPaw

The Mardo is a distinct SW WA subspecies of the eastern States Yellow-footed Antechinus with differences including lack of yellow feet. This small, carnivorous marsupial is considered common with a stable but sparse distribution in forest and woodland habitats. They are omnivorous, eating invertebrates, small birds and mice as well as flowers and nectar. When young become too big for the mother to carry around, they rest in nests made of leaf litter.

Mardo prefer forested areas that have remained unburnt for more than 10 years where deep leaf litter provides nest sites and a high abundance of invertebrate food. Following fire in upland dry areas, Mardo populations may take 20 years to reach pre-fire population levels.

Retention of areas of live grass-trees with long skirts and fallen dead trunks can provide shelter for foraging and nesting within burnt areas to help maintain a Mardo population.

References

Christensen, P.E. and Kimber, P.C. (1975). Effect of prescribed burning on the flora and fauna of south-west Australian Forests. In Managing terrestrial ecosystems. Proc. Ecol. Soc. Aust. 9: 86-106.

Friend, G. and Wayne, A. (2003). Relationships Between Mammals and Fire in South-west Western Australian Ecosystems: What We Know and What We Need to Know. In Fire in Ecosystems of South-west Western Australia: Impacts and Management, edited by I. Abbott and N. Burrows, 363-380. Leiden, The Netherlands, Backhuys Publishers.

Menkhorst, P., Friend, T., Burnett, S. & McKenzie, N. (2016). *Antechinus flavipes*. The IUCN Red List of Threatened Species.

Strahan, R., Ed. (1995). The Mammals of Australia. Subfamily Phascogalinae: phascogales, antechinuses. Chatswood, Australia, Reed Books, p. 85-106.

Geocrinias *Geocrinia alba* and *Geocrinia vitellina*

Status *Geocrinia alba* - Critically Endangered at WA State level
- Endangered at Commonwealth level

Geocrinia vitellina - Vulnerable at WA State and Commonwealth levels

There are two species of Geocrinia frog found only in the Augusta-Margaret River Shire and of conservation significance, the Orange-bellied Frog *G. vitellina* and White-bellied Frog *G. alba.* Both have fragmented populations that are extremely restricted to specific wetland habitat types that have permanent waterlogging and seasonal inundation.

All known populations of Orange-bellied Frog occur on land managed by the Department of Parks and Wildlife. Some populations of G. alba are located on DPaW managed land and AMR Shire reserves, but the majority (77%) are on privately owned property. Therefore, it is management of the White-bellied Frog *G. alba* that is of interest here.

The species is particularly vulnerable to local extinction since there is little movement away from the waterlogged holes in which each small population occurs, as evidenced by significant genetic variation between populations. It also seems that ecologically this species does not require the processes of fire to maintain productivity or rejuvenate its habitat, and there is the potential for fire to promote weeds and reduce habitat quality if the area to be managed is small in size.

Therefore, exclusion of fire from swampy areas where known populations of White-bellied Frog occur may assist this species survival. This can be extended to areas of suitable habitat within the distribution range of the species. In such situations, management of surrounding vegetation through fuel reduction burning is recommended to protect the White-bellied Frog habitat from intense wildfire.

Both hot wildfires and cooler prescribed burns tend to cause an initial decline in numbers. Depending on localised conditions such as hydrology, surrounding habitat condition and landscape connectivity, populations may recover within 5-7 years following a burn.

Legal Considerations

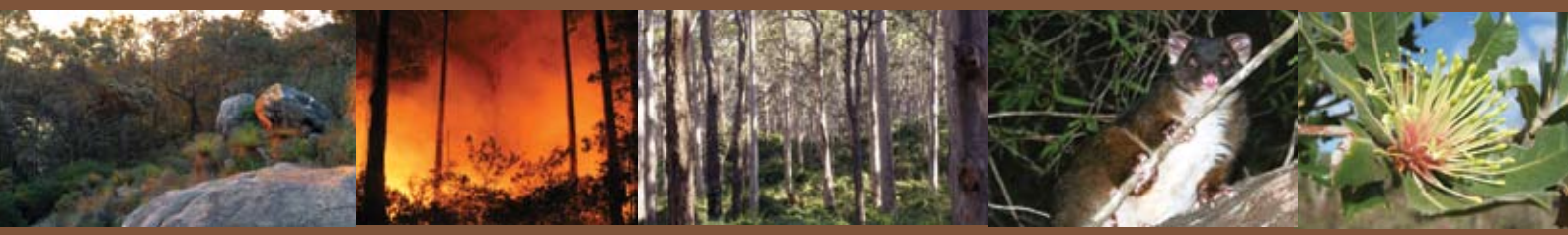
Due to the conservation status of White-bellied Frog, management of its habitat through prescribed burns should be guided by DPaW resources and advice. In 2005, DPaW contacted landowners with White-bellied Frog populations on their property to discuss the frog's habitat and recovery plan. DPaW have great resources, such as a 'Frog Recovery Kit' and a Fire Management Guidelines relating to G. alba.

References

Department of Parks and Wildlife (2014). White-bellied and Orange-bellied Frogs (*Geocrinia alba* and *Geocrinia vitellina*) Recovery Plan. Wildlife Management Program No. 59. Department of Parks and Wildlife, Perth, WA.

Driscoll, Don A. and Roberts, J. (1997) Impacts of fuel-reduction burning on the frog *Geocrinea lutea* in southwest Western Australia, Austral Ecology 22.3 Pp 334-339

Roberts, J., Conroy, S. and Williams, K. (1999) Conservation status of frogs in Western Australia. Declines and disappearances of Australian Frogs. Pp 177-184



Balancing Safety and Biodiversity: How to Achieve the Balance.

A Case Study of Private Properties in the South West

Cape to Cape Catchments Group

lotterywest supported

Private properties in the South West, Balancing Safety and Biodiversity

How do we achieve the balance?

Department of Parks and Wildlife

Balancing Safety and Biodiversity

This brochure has been put together for landowners so they can understand their requirements to reduce fuel loadings for fire safety purposes, whilst maintaining biodiversity values on their properties. Below are some dot points to consider:

- Building for bushfire safety – build to Australian Standards AS3959
- Building Protection Zones and Hazard Separation Zones
- Consider the use of rock walls/solid walls –barriers to bushfire around the house
- Consider sprinklers on roof, and in vegetation
- Consider the "stay or go" principle
- Obtain training – local Bushfire Brigade
- Ensure your own safety – have a bushfire ready kit in the house and DFES Bushfire Survival Manual
- Have a Bushfire Management Plan for your property
- Stay alert and keep in contact with your local DFES updates on bushfires in your locality

Building Protection Zones:

- Keep all trees 2-5m from edge of dwelling
- Keep landscaping plantings or native vegetation low
- Plant in clumps
- Landscaping design – pathways, rockeries, walls, sprinklers, rock mulch, ponds
- Regularly maintain by pruning, slashing, hedging the vegetation
- Carry out rake and pile burns in winter around the house
- Have plenty of water and fire fighting equipment on standby

Building Protection Zones

- Driveway
- Paths
- Ponds
- Bird baths
- Rock walls
- Low plants
- Rock mulch
- Sprinklers

Hazard Separation Zones

- Fuel reduction – 5-8 tonnes per hectare – How do we achieve this?
- Small rake and pile burns, only in the cooler/wetter Winter months
- Winter trickle burns
- Burn the base of balga skirts (check for wildlife first) in Winter
- Raking up leaves, removing dead/diseased wood (under 20cm diameter)
- Leave large old logs on ground – these are for wildlife habitat
- Prune, slash or hedge understorey plants

Hazard Separation Zones

Kangaroos reduce fuel loads by grazing and movement through vegetation

Sprinklers on roofs and in the vegetation can be turned on in any fire event to protect assets within the Asset/Building Protection Zone or Hazard Separation Zone
Metal fixtures, rain water tanks, generator or solar pumps and metal piping

Keep firewood away from the house

Leave large old hollow logs on ground where possible
Ferals return quickly after a fire and prey on small animals

Ensure after any vegetation modification that you carry out weed, feral and dieback control

FIRE MANAGEMENT PLANS – FOR BIODIVERSITY AND ADAPTIVE MANAGEMENT

Consider all aspects of bushland management

- Identify rare flora and fauna
- Identify other biodiversity values
- Identify weed, pests & diseases areas
- Identify other natural resource values e.g. creeklines
- What is worth protecting and how?

Consider all aspects of bushfire safety

- Protection of life and property
- Building to Australian Standards for bushfire protection
- Firefighting equipment
- Safety plan and equipment
- Stay or go principle
- Sprinklers, BPZ/HSZ design
- Bushfire Management Plan

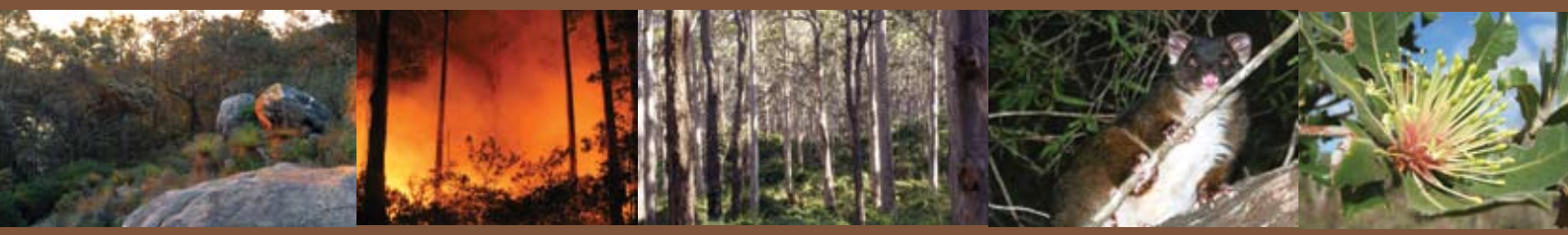
Additional Information

- AS3959-attached brochure from WA Commerce, www.as3959.com.au
- Planning for Bushfire Protection, Building and Hazard Separation Zones, www.planning.wa.gov.au
- Augusta Margaret River Firebreak Notice, Variation to firebreak notice
- DFES Winter Burn Guide
- DFES Fuel Load Guide
- DFES Bushfire Survival Manual, www.dfes.wa.gov.au
- Land for Wildlife Fire in Small Remnants
- Geographe Nursery and The Tube Nursery plant lists
- List of Firebreak contractors
- List of Bushfire Management Plan consultants
- Land for Wildlife Requirements for Native Animals
- Land for Wildlife Dead Wood and Wildlife
- Land for Wildlife Bushland Regeneration note
- Department Parks and Wildlife Case Study – Land for Wildlife and Covenant properties managing Fire and Biodiversity
- www.florabase.dpaw.wa.gov.au – Plant species of Western Australia
- www.naturemap.dpaw.wa.gov.au – Plants/Animals of Western Australia
- Department Agriculture – Feral animal control notes
- Cape to Cape Catchments – Fox control brochure
- Cape to Cape Catchments – list of invasive weed species in the South West
- Dieback Working Group brochure
- Marri decline note
- Peppermint decline note

Further Advice?

- Department Fire and Emergency Services – South West, www.dfes.wa.gov.au
- Shire of Augusta Margaret River Fire Control Officer, www.amrshire.wa.gov.au
- Department Parks and Wildlife - 97525555 (Biodiversity conservation advice), www.dpaw.wa.gov.au
- FAWNA – Wildlife rescue/care – 0438526660
- Wildcare Hotline - 94749055(24 hrs)

Written by C. Kemp, Off Reserve Conservation Officer, Department Parks and Wildlife



Fire Management and Planning Consultants

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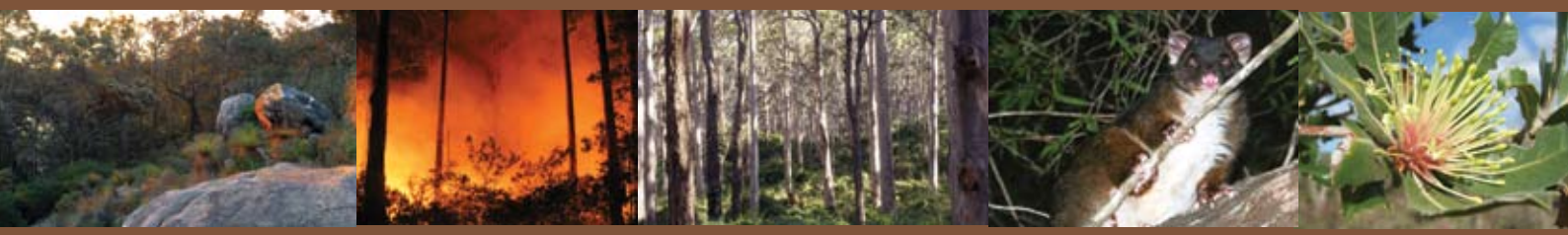

Fire Management and Planning Consultants

The following list of consultants is provided to help landholders who require assistance in the preparation of a fire management plan that considers biodiversity conservation.

CONSULTANTS NAME	SERVICES OFFERED	CONTACT DETAILS
Bushfire Prone Planning	Fire management planning	08 6477 1144 admin@bushfireprone.com.au
Bushfire Solutions	South WestFire management planning	0447 395 173 neill@bushfiresolutionssouthwest.com.au
Ecosystem Solutions	Fire management planning, Hazard assessment	08 9759 1960 or 0427 59 1960 info@ecosystemsolutions.com.au
FirePlan	Fire management plans	9493 1692 or 0418 941540 fireplan@bigpond.net.au
Ignem Fire Consulting	Fire management plans	0418909239 Aarron.grant@bigpond.com
RUIC Fire	Fire management planning, Risk management, Policy and Education	1300 797 607 admin@ruic.net.au
Strategen	Fire management plans	03 9380 3100 info@strategen.com.au
Tony Moran	Fire management plans	tonymoran@iinet.net.au
Working on Fire	Fire management planning, Training and Prescribed burning	0402 561 007

Please note that the presence of a consultant on this list does not represent a recommendation or endorsement of their services from the Cape to Cape Catchments Group. We strongly recommend that you choose your consultant wisely to ensure that they understand Fire and Biodiversity issues in our region and that you provide clear direction as to the services and outcomes you are seeking from them.

Some consultants will be more experienced in risk management and some more experienced in balancing risk management and biodiversity protection.

Check the Fire Protection Association Australia (www.fpaa.com.au) for a list of Bushfire Planning and Design accreditated consultants