SEASONED WITH FIRE

by Neil Burrows

Over the summer months in the southern half of Western Australia, bushfires rage through thousands of hectares of natural land. But fire cannot be allowed to run wild. Wildfires can destroy homes, buildings, fences, crops, stock and timber and endanger human life. The Department of Conservation and Land Management (CALM) has a prescribed burning program to reduce fuels in forests and prevent large, intense wildfires. However, the practice is controversial. There is concern that fuel reduction burning has adverse environmental effects. What is the real impact of such fires on the natural environment?

IN the wake of a bushfire the landscape is left blackened and seemingly lifeless. But before long, green shoots appear. The zamia palm is first to resprout, from rootstock buried in the soil and shielded from the heat. Seedlings emerge, plants sprout new leaves, life returns.

This is not the first time the bush has been burnt and it will not be the last. Over thousands of years, plants and animals evolved traits to help them survive in our fiery climate. Before European settlement, fires were started by lightning or by Nyungar hunters and gatherers. Today, lightning fires still regularly occur, but most fires are started by people, either deliberately or accidentally. Unlike the bush, towns and farms cannot adapt to survive the flames and they must be protected against large and intense wildfires. Even remnant bushland is threatened; introduced grasses and other weeds, quick to seize an opportunity, invade natural bush after fire. Outside the forest zone, large, intense wildfires could also threaten the future of rare or endangered animals, such as the Ground Parrot and Noisy Scrub-bird, which require long-unburnt vegetation.

Ironically, the most effective tool to minimise the effects of forest fires is fire itself. Not the type of fire which burns under hot, dry and windy conditions, when flames roar from the tree tops, and consume every leaf and twig. Not the kind of fire which spreads rapidly, preventing any chance of control. Rather, it is the type of fire which burns under cool, humid conditions, when flames trickle through the undergrowth at knee height, slowly consuming dead leaves and twigs that have accumulated on the forest floor. Such a fire can only be set after the opening rains in autumn or at the end of the rains in spring. Setting this type of fire every five to seven years, a practice known as fuel reduction burning, has successfully reduced destruction from bushfires. In the 30 or so years since fuel reduction burning was introduced to WA forests, no major bushfires have occurred.

However, fuel reduction burning is the subject of fierce debate. Some people believe that fuel reduction burning in spring adversely affects wildflowers and breeding animals, such as birds, and that late summer or early autumn is a better time to burn. Some argue that any form of burning is environmentally damaging. Others claim that the bush should be burnt more regularly.

The effects of fire on the ecology of WA forests have been studied for over 30 years. So far the results have shown that the effects of fire are very variable, and depend on the fire regime which applies. The 'fire regime' amounts to the cumulative effects of the interval between fires, their intensity (how hot the fires have been), the season during which they burn and their size. Forest ecosystems can persist and thrive under a wide range of fire regimes, although some plant and animal species are favoured by regimes which may not suit others. To compare the complex ecological effects of spring versus autumn fires concentrates on only one element of a fire regime (the season of burning), and ignores other factors such as fire intensity and frequency.

The most important difference between spring and autumn fires is the amount of live and dead vegetation (fuel) consumed by the fire. The amount of fuel burnt by a fire largely depends on fuel moisture content. In spring, following winter rains, logs, leaves, twigs, soil and living vegetation are damp. In summer and early autumn the entire forest is much drier, and fires burn more intensely and spread more rapidly.

Flames in a typical prescribed spring fire are usually about half to one metre high, whereas, in autumn, flames are often two or three times this height. Flame height is a useful estimate of fire

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Prescribed burning is done on a five to seven year cycle, depending on the fire hazard in each area.
Photo - Jiri Lochman

The nesting activities of some species of birds may be disturbed by spring burning, but within two years they begin to recolonise the regenerating vegetation.
Photo - Graeme Liddelow◄

Wildfires such as this are easier to fight, and also cause less damage, where fuels are reduced by prescribed burning.
Photo - Neil Burrows▼

intensity, which is a measure of the heat energy output of a fire. The taller the flames, the more intense the fire.

The most striking visual difference between a forest burnt in spring and a forest burnt in autumn is the colour of the vegetation. Soon after a low intensity spring burn, the understorey is a mottled green and brown colour. The brown leaves are those killed by the heat of the flames. After a summer or autumn fire, almost the entire forest is black and brown, indicating that all leaves have been killed, from the low shrubs to the tops of the jarrah trees. The vegetation soon regenerates, but fires which completely scorch the forest can physically damage the boles and canopies of trees, especially the smaller ones. Scorched eucalypt leaves are more rapidly replaced after spring than after autumn burns.

The dry forest fuels in autumn result in fires which burn almost the entire forest. It is rare to find unburnt patches. In spring, however, moister areas such as swamps, and along creeks and gullies, rarely burn. Surveys have shown that about 20 per cent of a forest ignited under spring conditions does not burn. These unburnt patches and gullies are important animal habitat and provide refuge areas from which animals can recolonise the burnt forest when vegetation regenerates. Autumn burns tend to burn more hollow logs, used by many native mammals for nests and burrows, than spring burns.

Wildflowers are at their peak during spring. About 70 per cent of plant species flower over the late winter and spring period. A spring fire inevitably destroys a high proportion of flowers and the foliage of low understorey plants, detracting from the beauty of the forest. It also reduces the food base for insects and other animals which feed on flowers and seeds. Autumn fires have a similar impact on species which flower at that time.

Scientific data about the effects of spring and autumn fire on insects and other invertebrates are inconclusive. Some researchers have reported that autumn burning may have less impact on the soil and on litter invertebrates than spring burning. Others have shown that there is no significant difference between litter fauna in forests which have been burnt regularly in spring and forests which have been long unburnt. Clearly, more research is needed.

Each year CALM firefighters battle some 400 wildfires throughout the jarrah forest.
Photo - Neil Burrows ▲

Cats paw is one of many wildflowers of the jarrah forest which regenerate quickly after fire.
Photo - Marie Lochman ▶

In forests which receive little effective summer rainfall (such as the northern jarrah forest), repeated frequent spring burning over many decades causes a gradual depletion of a group of woody plants, known as seeders. These depend on seed stored in the soil or in woody fruits on the plants for regeneration after fire. Plants such as prickly moses (*Acacia pulchella*) and heartleaf poison (*Gastrolobium bilobum*) form dense thickets after summer or early autumn wildfires, but regenerate poorly after low intensity spring fires. This is because the seeds buried in the soil germinate more successfully when heated, and fires which burn when the fuel and soil are dry (in summer or early autumn) heat the soil more than fires which burn in spring, when fuels and soils are damp. Seeds which germinate after the opening winter rains also have the moist winter months to become established, while many of the seedlings which germinate after a spring fire often die over the hot summer months. (This is not a problem in areas which receive summer rain and which have a longer growing period, such as the karri and southern jarrah forests.) Almost all seeders in the jarrah forest understorey reach flowering age by five years, so burning does not occur before they flower.

However, even repeated spring burning will not eliminate soil-stored seed. Seeds deep in the soil can last up to 100 years and these are germinated by occasional summer bushfires or an autumn burn.

Understorey plants in the forest zone which resprout from below ground appear to be unaffected either by spring or autumn fires at intervals of five to seven years. On some sites, in fact, species such as honey bush (*Hakea lissocarpha*) and tea-tree (*Agonis parviceps*) increase in numbers after spring fires, at the expense of the seeders.

Fire affects mammal species according to the amount of habitat disturbance and the rate at which vegetation regenerates. Autumn fires burn all of the forest litter, and kill or scorch the understorey, so have a greater short-term impact on mammals than spring fires, as they depend on the litter and understorey for food and shelter. At least one important forest

mammal, the chuditch, is clearly favoured more by spring than by autumn fires.

On the other hand, lack of fire can be disastrous for some mammals. For example, the endangered mainland tammar wallaby lives in dense *Melaleuca viminea* thickets which require infrequent (25 to 30 years) and intense fires in summer or early autumn to regenerate. Burning is being conducted during dry soil conditions in autumn to regenerate *Melaleuca* thickets which occur in broad valleys in the eastern forests. When these thickets have regenerated then the endangered tammar wallaby will be reintroduced from populations in the forest east of Manjimup.

Birds are also affected to the extent that a fire disturbs their habitat. This varies according to the requirements of each species; birds which use the forest floor and low understorey are most affected by spring fires. While spring fires may coincide with nesting, studies have shown that, in the jarrah forest, most birds have finished breeding by the time prescribed burning commences. There is some mortality among nestlings, especially in species which nest on or near the ground. Many birds are completely unaffected by spring burns, because they survive in unburnt patches. Elsewhere, bird numbers decline in the first two years after a spring fire, but they then increase. Birds are highly mobile and can recolonise burnt areas from surrounding unburnt forest, as soon as the habitat is suitable.

Autumn fires, which defoliate the understorey and scorch the overstorey, cause great initial disturbance to habitat and to birds and animals. However, the effects of both spring and autumn fires are relatively short-lived as the vegetation regenerates quickly. Fuel reduction burning is conducted in blocks of around 2 000 to 3 000 hectares scattered throughout the forest, so recently burnt areas are surrounded by forest that may not have been burnt for several years. This allows recolonisation from unburnt patches.

A large, uncontrolled bushfire causes much more disturbance to birds and other animals than does patch prescribed burning. Wildfires can spread rapidly and consume all live and dead vegetation over thousands of hectares. Many animals, including birds, kangaroos and possums, are unable to escape the flames and smoke. Animals that survive are exposed to predators and often die from famine.

The choice between a spring burn and an autumn burn is often determined by what is practical. Of the 200 000 hectares of State forest on which prescribed burning is carried out each year, up to 25 per cent is burnt in autumn. The proportion varies from year to year, depending on weather conditions. Most fuel reduction burning is carried out in spring and early summer, because there are more days when fuels are moist and the weather is mild and predictable. This results in fires of low intensity, which can be easily and cheaply controlled. There are few suitable days in autumn during which forest burning can be safely carried out. Dry fuels and the often unstable weather conditions in autumn increase the risk of fires escaping or causing undesirable damage. Autumn fires are more costly, as much more effort is required to prepare areas for burning and to mop up smouldering logs after burning.

There are both positive and negative ecological aspects of spring and autumn burning. In most forests, the ideal fire regime, one which results in minimal impact and damage caused by wildfires and one which caters for the natural environment, is a combination of spring and autumn burning.

For many years, CALM has been progressively increasing the area of forest burnt in autumn, and implementing a burning cycle that incorporates a mixture of spring and autumn burning. A more systematic approach is now being developed. For example, a forest would be given two spring burns, then an autumn burn, at five to seven year intervals. Then a 10 to 14 year period would elapse before the cycle was recommenced, with

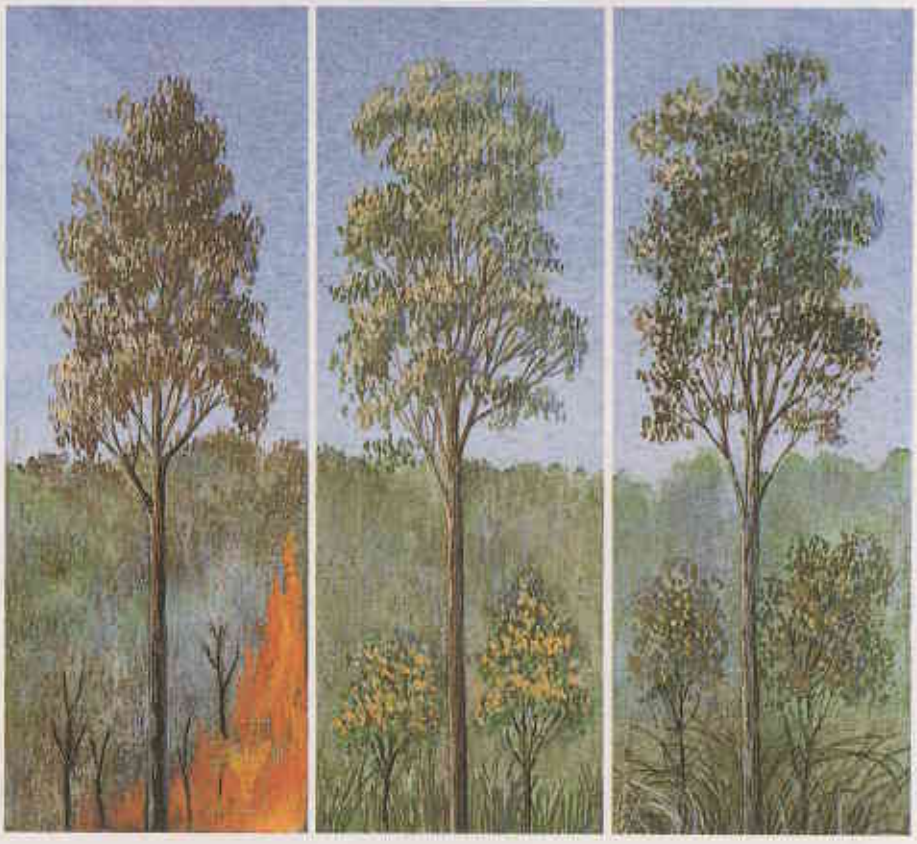
Top to bottom: long unburnt bush, where short-lived seeders have died out; five months after an autumn fire in the same location the vegetation is resprouting and the heat from the fire has cracked the hard-coated *Acacia* seeds buried deep in the soil; one year after the fire regeneration is well under way; two years after the fire the seeders are over a metre high and dominate the site; after three years the acacias are full-grown and flowering.
Photos - Neil Burrows

Western grey kangaroos prefer recently burnt bush, as they can graze on the new shoots which germinate after fire.
Photo - Jiri Lochman▲

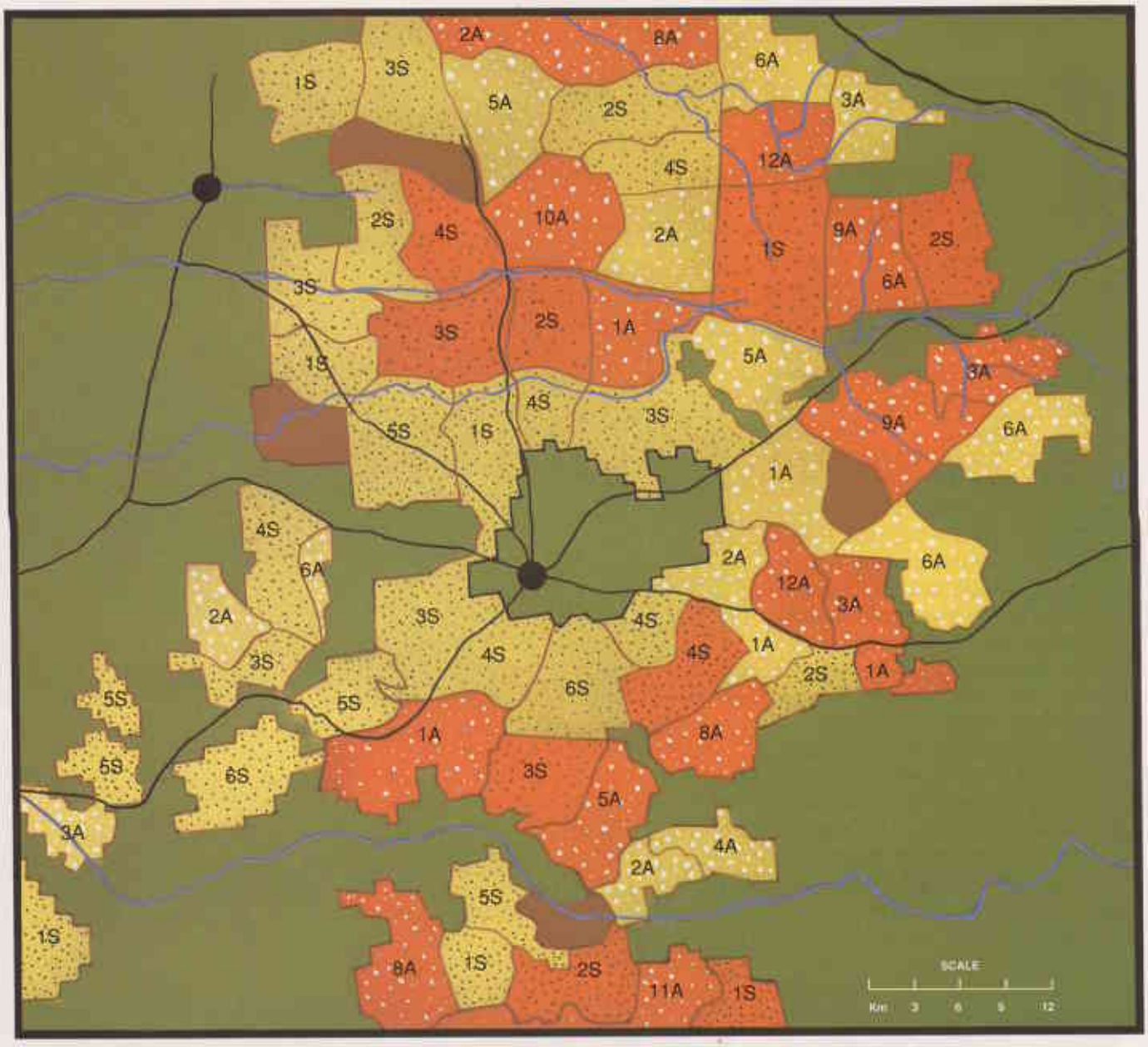
another fuel reduction burn in spring. The extended period between burns would allow seed stored in the soil to replenish, and provide a range of vegetation ages throughout the forest. This cycle will help to regenerate seeders, such as certain *Acacia* species (which help to fix nitrogen in the soil and may inhibit the spread of dieback) and species important for tammar habitat (such as *Melaleuca viminea*). This forest fire regime would help protect both human and conservation values.

Such a regime would focus on areas where regeneration of seed species and habitat is most necessary. Generally, this applies to the jarrah forest north of a line from Busselton to Albany. However, it would not be practical in all areas. Because of the threat to human life and property, extended burning rotations cannot be applied to forest areas around townships and areas considered essential to break up the run of potential wildfires through large, forested zones.

Fire management on natural lands is an evolutionary process, influenced by social attitudes, scientific knowledge and resources available to managers. Fire, whether it is in spring or autumn, frequent or infrequent, will affect the forest ecosystem in complex and subtle ways. CALM scientists are continually monitoring and studying the effects of fire in burnt and long-unburnt forests. They have found no evidence of any wildlife threatened with extinction as a result of the forest fire management methods currently being applied. Although thickets of seed species can gradually degenerate as a result of either long absence of fire or repeated and frequent spring fires, they can be easily regenerated by a fire



Flame height is about two and a half times higher in an autumn burn and scorching is much more extensive. However, seeders such as some *Acacia* species regenerate much more vigorously after an autumn burn, then begin to die off after about 10 years.



Areas which can be placed on a rotation burning cycle (two spring burns, then an autumn burn).

Strategic buffers to protect towns from wildfire and prevent major wildfires.

A — Last burnt in autumn

S — Last burnt in spring

No.= years since last burn

Unburnt

Farmland

Forest tracks or firebreaks

Towns

An example of a burning regime that incorporates a mixture of spring and autumn burning and buffers against wildfires. It includes areas of forest that have been recently burnt, areas that have not been burnt for 12 to 14 years and areas that will not be burnt at all.▲

set when soils are dry in autumn. It seems that a diverse fire regime, incorporating fires in different seasons and at varying time intervals, is most appropriate today. Continuing research and field experience will help to refine the methods used.

It is an axiom of land management that the first step to managing land is to protect it. Frequent wildfires can damage human and conservation values in the natural environment. The challenge is to control wildfires while maintaining the ecological integrity of our unique bushland.▣

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FURTHER READING LIST

Fire ecology is a particularly complex issue, the intricacies of which are difficult to explain in a short article. The following reading list is recommended for those who want to follow up the issue further:

Impact of fire in the eucalypt forest ecosystem of southern Western Australia: a critical review, by Per Christensen and Ian Abbott (a technical paper available free from CALM's Como Office).

Effect of prescribed burning on the flora and fauna of south-west Australian forests, by Per Christensen and Peter Kimber (also available from the CALM office in Como).

Fire and the Australian Biota, edited by A.M. Gill, R.H. Groves and I.R. Noble.

Rock-wallabies threw down the gauntlet to scientists trying to trap them for research. Who ended up winning the catch-me-if-you-can contest?
See page 35.

Shells, tiny crabs and sundry other creatures are sure to please the curious naturalist who invades the intertidal zone at low tide. Explore the place where the shore meets the sea on page 23.

Waterbirds flock to the Vasse-Wonnerup wetlands in their tens of thousands, some travelling over 10 000 kilometres from summer breedings grounds in northern China and Siberia. Turn to page 17.

LANDSCOPE

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Scientists will use modern technology to restore two rare and endangered mammals to an area in the Gibson Desert from which they have become extinct.
See page 10.

It's the burning question! Is prescribed burning in spring or autumn better for the jarrah forest? Or is there another alternative?
See page 28.

FEATURES

REGULARS

COVER

The designs of desert artist Benny Tjapaltjarri show events associated with the Pakuru or golden bandicoot dreaming in the Gibson Desert. The three central roundels depict rockholes and the others represent hills. The background dots show the vegetation of the area.

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