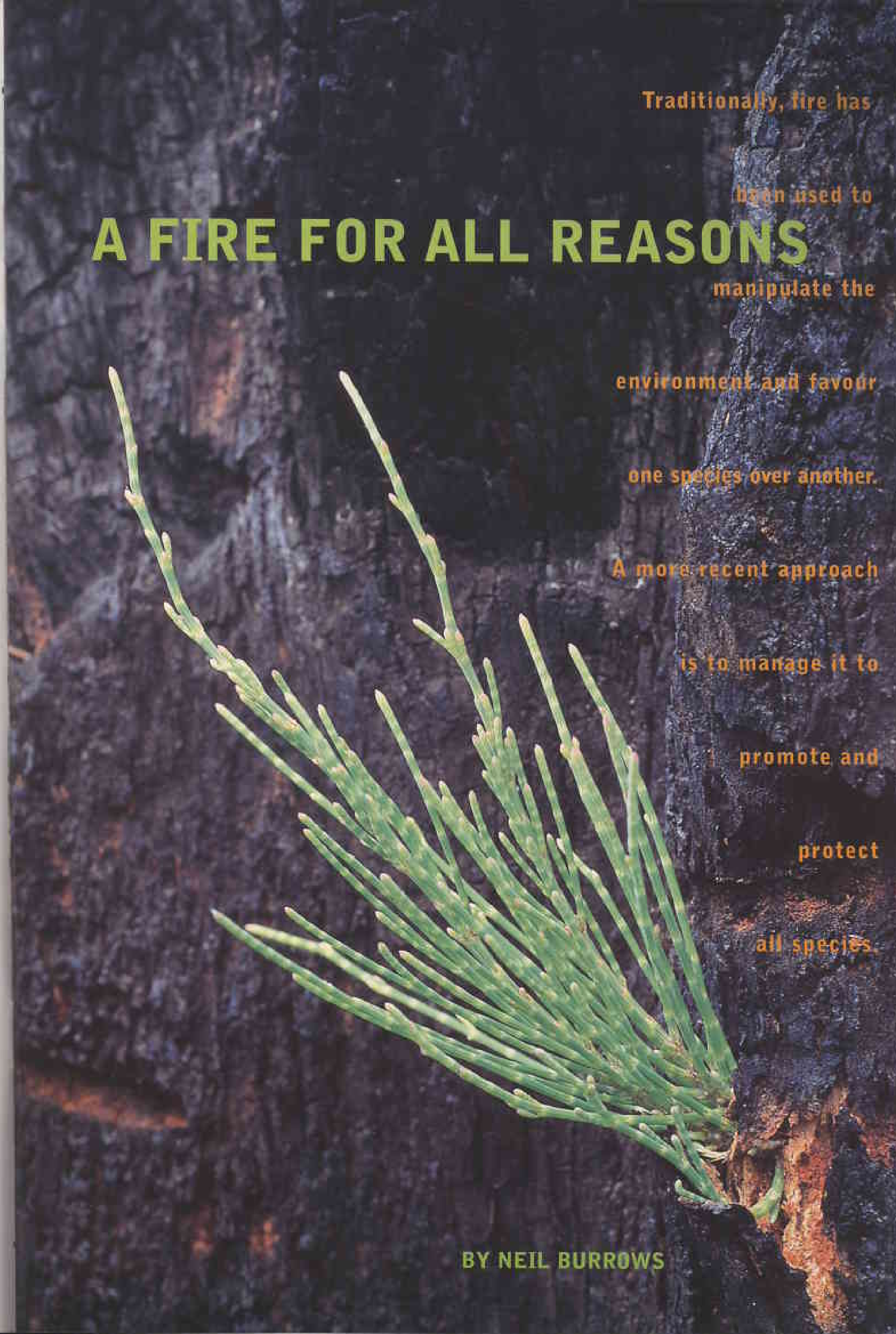
A FIRE FOR ALL REASONS

Traditionally, fire has been used to manipulate the environment and favour one species over another. A more recent approach is to manage it to promote and protect all species.

BY NEIL BURROWS



Throughout history, humans have used fire to clear forests and woodlands, usually to improve hunting or create pasture. Frequent use of fire by Aborigines in many parts of Australia, including parts of the south-west of Western Australia, maintained grasslands beneath tuart, jarrah, marri and wandoo forests and woodlands. Some scientists believe the hunting carried out on these grasslands, and the frequent fires required to maintain them, played a role in the demise of Australia's large indigenous mammals over 40 000 years. Similarly, when Polynesians arrived in New Zealand about 700 years ago, they used fire to convert vast tracts of rainforest to tussock grassland. There is also ample evidence that North American Indians used fire to clear the land and manipulate the environment to suit their needs. European settlers, too, used fire as a cheap and effective management tool either to clear land or maintain pasture grasses.

But the notion of using fire to maintain or enhance biodiversity (the diversity of life), rather than to encourage one desirable species or community over another, is fairly new. Today, bushland managers have a legal and moral obligation to minimise the damaging impacts of wildfire, and to maintain or enhance biodiversity. Not only should fire management provide protection to human life and property; it should also be ecologically sustainable, protecting and enhancing biodiversity and life-sustaining processes.

Modern fire managers therefore consider a range of factors: the interval between fires, the seasons in which they occur, and the intensity with which they burn. The scale or patchiness of fires is also important in determining their impact on bushland, and especially on resident animals. Fire managers continually strive to find the right combination of fire frequency, season, intensity, patchiness and scale to satisfy their objectives.

Using prescribed fire solely to manage fuel build-up, and thereby reduce the impact of wildfire, is technically straightforward, and is constrained mainly by socio-economic factors such as resources to do the job, air quality issues and damage to commercial tree species. However, maintaining biodiversity in fire-prone environments is considerably more complex. It implies a sound knowledge of biodiversity and the effects of fire on organisms and complex ecosystem processes. Knowledge of biodiversity, even at a local scale, is in most cases restricted to high-profile or charismatic species: the vascular plants and the vertebrate fauna. Knowledge of microflora and invertebrates is likely to be poor, yet these 'hard-to-see' species can make up 95 per cent or more of the total species within an ecosystem.

BIOLOGICAL INDICATORS—WORKING WITH NATURE

In the absence of perfect knowledge, fire managers have adopted a number of approaches:

- Do nothing, let nature take its course
- Mimic nature based on pre-historical or pre-European regimes
- Exclude fire until more is known (the so-called 'precautionary principle')
- Aim for a diversity of fire treatments

A useful and practical approach to formulating managed fire regimes is to identify key biological indicators, or vital attributes, rather than attempt to study the entire biota. The bio-indicators described below, which are far from exhaustive, are being used to help devise fire regimes for Western Australia's south-west forests that achieve wildfire protection and conservation objectives.

Previous page
A sheoak reshooting after fire.
Photo – G. Saueracker/Lochman Transparencies

Above: A slender hammer orchid flowering five months after fire.
Photo – Neil Burrows

Left: Central desert Aborigines practice fire stick farming.
Photo – Jiri Lochman

The first indicator is the rate of accumulation of fine vegetation, living and dead, which becomes fuel for a bushfire. Predictive models help determine the necessary interval between prescribed fires, to manage fuel build-up and wildfire intensity. Another bio-indicator involves identification of fire-sensitive species, or those species that have thin bark, take a long time to flower and set seed (juvenile period), depend on seed stored in capsules for regeneration, have a low seed production capacity, and have poor seed dispersal mechanisms. Flowering patterns, in particular the processes that take place during the juvenile period, and the time to set seed for key fire sensitive species, are another *indicator. Determining* the optimal fire and weather conditions for seed germination and survival, and understanding post-fire changes to the flora and vegetative structures also serve a valuable bio-indicator function.

Animal bio-indicators involve the identification of species that are likely to be fire sensitive, or species that have specialised habitats, long juvenile periods, low fecundity and poor dispersal capacity. The post-fire responses of fauna, particularly changes in the population density and structure of key fire-sensitive fauna, also play an important bio-indicator role.

These bio-indicators can be determined from space-for-time surveys, where scientists examine plants and animals in areas of different but known fire histories, or from carefully designed experiments. Bio-indicators can be used as surrogates for perfect knowledge and can be used to set the frequency, season, intensity and scale components of fire regimes.

FIRE: A FORCE IN FORESTS

The jarrah forests of the south-west are used as an example of how bio-indicators can be used to develop fire regimes to minimise the threat of wildfire to human life and property while maintaining and enhancing biodiversity.

The strongly Mediterranean-type climate of the region, together with flammable live and dead vegetation, has ensured that fire has had a long association with the jarrah forest, one which pre-dates the arrival of Europeans by many thousands of years. Consequently, the flora and fauna display a wide variety of physical and behavioural adaptations to fire. For example, mature jarrah and marri trees are able to survive very intense fires because their trunks are protected from flames by thick bark and they are able to replace their burned crowns by resprouting.

Using prescribed fire to burn off the flammable dead leaves and twigs that accumulate in the forest, is the cornerstone to managing the wildfire threat. The aim is to keep fine fuel levels in strategic areas to below eight tonnes per hectare. Experience has shown that if fuels accumulate beyond this, there are fewer days when wildfires can be controlled. The amount of fuel and the rate at which it burns determine the fire's intensity, or heat energy output, and its suppression difficulty. Fuel accumulation models developed for a range of jarrah forests show that the interval between fires necessary to maintain fuel levels below about eight tonnes per hectare varies from six years for high rainfall jarrah forests and eight years for low rainfall forests. So, for wildfire protection purposes, managers use low-intensity fires set under cool, mild conditions at intervals of 6–8 years.

Top: A banksia in jarrah forest near Manjimup blooms two years after fire.

Above: A Mangles kangaroo paw 18 months after fire in jarrah forest near Harvey.
Photos – Neil Burrows

FIRE AND CONSERVATION

On the drier, upland forests, about 70–75 per cent of the understorey plants have the capacity to resprout after fire, with the remainder regenerating from seed stored either in the soil, or on the plant in woody capsules. On wetter sites such as along creek lines, the proportion of seeders may be higher than sprouters. On upland sites, understorey plants flower within 3–4 years of fire, depending on the rainfall. Some understorey species in the jarrah forest can take up to six years to flower after fire, but these are usually restricted to wetter parts of the landscape such as along creek lines and valley floors.

The season when burning takes place does affect post-fire seedling density and survival, but it has little effect on the range of seedlings (see 'Seasoned with Fire', *LANDSCOPE*, Autumn 1990). The seedling density and survival of most species are significantly greater after fires in dry summer or autumn conditions than after fires in early spring; in fact there is very little germination of trees or woody shrubs without fire or some other disturbance. Dense seedling regeneration and survival are particularly important for thicket-forming species, especially where thickets are vital habitat for fauna. For example, thickets of *Melaleuca viminea* and *Gastrolobium bilobum* are very important for tammar wallabies. These thickets require intense fire under dry conditions to regenerate. Thickets of nitrogen-fixing species, such as the wattles, are also important for forest health.

For most jarrah forests, maximum plant species richness is reached 3–5 years after fire, then declines as short-lived herbs, shrubs and grasses (fire ephemerals) die. These species then persist as seed stored in the soil. So fires at very frequent and very infrequent intervals will result in lower species diversity. The seed of some species can remain viable in the soil for many decades, but for most the storage life is unknown.

In the absence of complete knowledge, information about the response of some jarrah forest animals to fire can also be used to develop appropriate fire regimes. For example, the medium to long-term impact of fire on birds largely depends on the extent to which the vegetation (habitat) has been affected, and the rate at which it recovers. Jarrah forest birds can be categorised according to the part of the forest in which they live. Most birds favour either the overstorey canopy, the mid-storey, or the near-ground shrub level. A few species use all three. Birds recover very quickly (1–2 years) after small, low-intensity, patchy and slow-

Top left: After patchy fire, quenda look for mature vegetation along creeks and around swamps.
Photo – Jiri Lochman

Centre left and right: Large, intense summer wildfires can have a devasting impact on the landscape and the wildlife.
Photos – Neil Burrows

Left: Low intensity, patchy fires have little impact on wildlife.
Photo – Jiri Lochman

moving fires with flames less than waist height. However, they take considerably longer to recover (4–5 years) after high-intensity fires, which burn out the landscape completely over large areas.

Jarrah forest mammals can also be loosely grouped according to their preferred habitat. Larger mammals, such as western grey kangaroos and brush wallabies, are most abundant in the first few years after fire, preferring open forests with succulent, new, green shoots on which to graze. Another group of animals prefers the cover of dense, mature vegetation usually found along creek lines, swamps and valley floors. These animals include the quokka, the tammar wallaby, the quenda and the honey possum. While these animals will forage in recently burned vegetation, they are unlikely to take up residence, preferring the dense cover of mature vegetation. Relatively small or patchy fires have little effect on the numbers of these animals, but large and intense fires, which completely consume available habitat, will have a severe impact on them. It could take 10–15 years, depending on the species and the habitat type, for the population of these animals to recover fully after such an event. Where foxes are not adequately controlled, such as adjacent to farmland, these populations may never recover.

Ground-dwelling mammals, such as the chuditch and the numbat, which use dens and hollow logs, are least affected by patchy, low-intensity fires burning under moist, early spring conditions. Logs will rarely ignite, and parts of the landscape that are damp or that carry light fuels are unlikely to burn. On the other hand, these animals can be severely affected by large and intense fires burning under dry conditions in late spring, summer or early autumn. Such fires consume a high proportion of hollow logs and usually burn out the entire landscape, leaving few unburned patches.

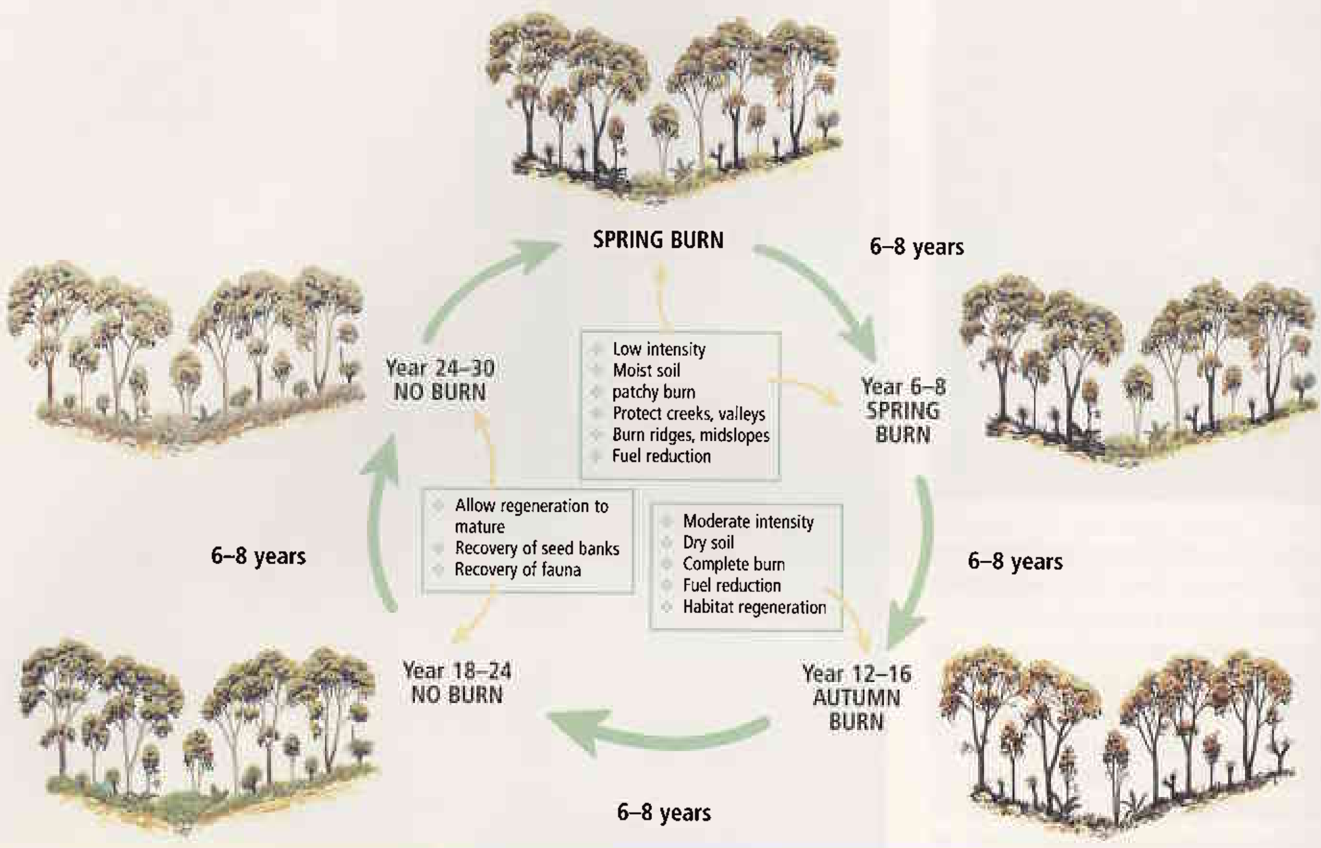
Above: Measurements of the rate of fuel build-up in jarrah forest are used to help determine fire frequency.
Photo – Dennis Sarson/Lochman Transparencies

Above left: Fire impact on birds depends on the size and intensity of the fire, and the season.
Photo – Babs & Bert Wells/CALM

A FIRE FOR ALL REASONS

Frequency, scale and patchiness of fire are paramount to both the immediate impact of fire and the capacity of birds and mammals to recover from it. These fire factors are particularly important today because the forests, adjacent woodlands, and the many plants and animals that inhabit them are not as extensive as they were before European settlement. Fragmentation of forests by agriculture and the virtual destruction of adjacent woodlands hampers the capacity of animals to recolonise when large areas

A MANAGED FIRE REGIME FOR JARRAH FOREST



are burned by intense fire. Together with introduced predators such as foxes and feral cats, and invasive exotic weeds, remnant forests and other vegetation types no longer have the tolerance to disturbances such as fire that they may have had before European settlement.

Based on the bio-indicators, there appears to be a conflict between the fire intervals required to maintain fuel levels below eight tonnes per hectare (6–8 years, depending on rainfall), and the requirements of river and creek line fauna and flora, which prefer longer intervals between fire. This can be resolved, however, by using the moisture differentials that exist across the landscape at different times of the year.

As the seasons change from winter to spring, the ridges and midslopes of the jarrah forest dry first and will be flammable for a period when wetter creeks and gullies will not burn. Prescribed fires can be set when strong moisture differentials exist so that the drier ridges and midslopes burn, but important low-lying, wetter sites do not. Moisture differentials across the landscape, particularly in late winter and spring, can also be exploited by skilful fire managers to create fire patchiness. The risk, however, is that as the forest dries over spring and summer, more of the landscape becomes flammable. If any ignition sources remain from the earlier spring burn, they could ignite other fuels as they dry. Even creek systems burn ferociously in the right weather conditions.

A fire regime that meets both protection and biodiversity objectives, based on current knowledge, contains a variety of seasons of fire and of intervals between fire. While such a regime may be appropriate, it may not be feasible to apply it to all parts of the forest, for a myriad reasons. For example, it would be undesirable to allow fuels to accumulate next to settlements that could be damaged by wildfire. It would also be unwise to link areas of heavy fuels, which means that 'no planned burn' areas would need to be small and scattered, rather than large, linked tracts.

Fire management is complex. Done poorly, it will lead to loss of life, damage to commercial values and degradation of conservation values. Fire managers must make decisions with incomplete knowledge; but use of bio-indicators, together with risk assessment and intelligent planning, can result in fire regimes that satisfy both conservation and protection objectives.

Below: A bull banksia resprouting after fire.
Photo – G. Saueracker/Lochman Transparencies

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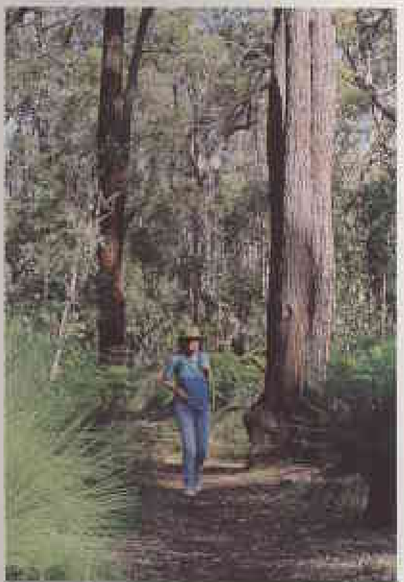
CALM's fight against feral cats gathers ground on Peron Peninsula with the development and testing of a cat bait. See 'Approaching Eden' on page 28.



A new CALM book gives bushwalkers a host of short and longer walks in Western Australia's south-west. See page 10.

LANDSCOPE

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Roadside vegetation often provides vital links between remnant habitats. See our story on page 23.

What attracted early pioneers to this barren corner of Western Australia? Find out in 'Eucla Pioneers' on page 35.

Fire is an important part of Western Australia's environment. Scientists continue to discover just how important. See page 17.

FEATURES

REGULARS

COVER

The splendid fairy wren was one of many birds collected by John Gilbert, whose collections of specimens have been fragmented over the past 100 years or so. Now, they are being tracked down in museums around the world, and a more complete picture of their original distributions is emerging from Gilbert's original notes and labels. See story on page 40.

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