Fighting wildfires: breaking the triangle

by
Rick Sneeuwjagt and Nigel Higgs

Every year, Western Australia has hundreds of bushfires, many of which, if not contained quickly, can threaten life and property. Most are put out before they develop; some become raging wildfires with flames soaring 100 metres or more, leaving a wake of blackened bush.

In this article we look at how the Department of Conservation and Land Management tackles the problem.

The basic science of fire is simple—it is a combination of heat, fuel and oxygen that together form the sides of the 'fire triangle'. Break the nexus along just one side of the triangle and the fire goes out.

The home owner, burning a backyard pile of leaves, can easily remove any one of the three ingredients. The fuel (the leaves) can be raked away from the flames; the heat can be removed by squirting with water using a garden hose; the oxygen can be excluded by smothering the fire with earth.

The same principles hold for big, intense wildfires. Control can be achieved by cooling the heat of the fire (by wetting the fuel) or by constructing fuel breaks with machinery, and lighting controlled back burns to starve it of fuel. The strategy depends on the size and intensity of the fire and the resources available.

Although fire has been part of Australia's natural environment for thousands of years, it now poses many problems. Where once vast tracts of forests and woodlands stretched untouched across the south-west, today there is a mosaic of farms, towns and settlements among bushland. Timber, water catchments, national parks and many other resources and community assets face the threat of damage or destruction by uncontrolled fires.

Wildfires in natural areas are not static. They can move rapidly, often across difficult and inaccessible terrain, and their behaviour is not always predictable. Most wildfires don't stop at night and can often run unabated for days on end.

In WA's long, hot, dry summers, there may be numerous fires burning at any given time. The more extreme the weather, the more likely there will be a series of intense fires. For example, during the passage of Cyclone Alby, through the south-west of Western Australia on 4 April 1978, more than 60 fires were burning within or near forests. In this situation, fire controllers not only had to assess and set suppression priorities, they had to keep a constant eye on the predicted behaviour of all fires, as any change in the weather could mean a dramatic rearrangement of those priorities. Fires in light fuels that were not threatening life or property were allowed to burn until the more dangerous fires had been suppressed.

Each year, Western Australia's hot dry summer brings with it hundreds of wildfires as a result of natural causes such as lightning, or through human activities including arson, carelessness and accidents. Ninety-five per cent of these wildfires are caused by human activity—a strong pointer to the need for public education, regulation and, where necessary, prosecution.

Department of Conservation and Land Management (CALM) fire crews attend an average of around 300 fires each year, more than half of which are on private property and other lands not managed by CALM. In some years, such as the summer of 1994–95, the number of fires may exceed 500. And yet despite this high number of fires, an average of more than 90 per cent are extinguished before they reach 10 hectares in size, and relatively little damage is incurred.

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The intense heat generated by 30-metre flames, burning through this heavy ground vegetation near Walpole, represents a serious hazard to firefighters.
Photo – Kim Howe

Left: When fires jump from tree crown to tree crown, no amount of equipment or human resources can stop them.
Photo – Kim Howe

Once the running fire has been stopped, the hard work of making it safe and mopping up burning material begins.
Photo – Lachlan McCaw

Firefighters must be well trained and alert to sudden changes in fire behaviour if they are to avoid being caught out by erratic fires. Fortunately, no CALM firefighters have been killed during fire control operations in the past 40 years.
Photo – Lachlan McCaw

PREVENT, PREPARE, SUPPRESS

The fact that relatively few fires in the South West forests develop into major incidents hinges on the successful application of the preparedness, prevention and suppression measures that are the foundations of CALM's fire management policy. The principal goal of this policy is to protect lives, property and environmental values from damage or destruction from wildfires. But while protection of human life, property and community values is the priority, fire controllers also have to consider the impact of the suppression action—particularly on the environment and its ecosystems—and the cost of the operation compared with the values under threat.

Fire prevention itself has two key areas of activity. The first is reducing the risk of fires starting. This involves public education, liaison with local fire brigades and local shires and enforcing the Bush Fires Act. The second focuses on reducing the fire hazard on CALM-managed lands and adjoining areas by reducing the amount of fuel available through prescribed burning.

The Scout motto 'be prepared' also applies to fire management. The degree to which wildfires can be extinguished before they develop depends on rapid detection and fast access by fire crews. Throughout the native hardwood forests of the south-west, CALM maintains a constant surveillance during the fire season—from October to April—using a network of lookout towers and spotter planes. The towers enable 'smokes' to be identified early, so that spotter aircraft can be scrambled to the fire. Pilots can plot exact locations to provide fire controllers with information on fire behaviour and details of factors such as access and values threatened.

The faster fires are detected and crews despatched, the greater the chance that the flames can be quelled before the fire develops into an inferno. This means having rapid access, fire breaks, water points and fuel-reduced buffers that must be regularly maintained. Other aspects of preparation include providing adequate numbers of appropriate fire appliances and heavy earth-moving equipment, training for fire crews and supervisors, communications networks, maps and recording systems.

STAGES OF FIRE

The speed and intensity of wildfires—and the damage they can cause—depends on the prevailing weather, the topography and the quantity, make up and moisture content of litter and ground vegetation, which fuels the fire.

Bushfires, particularly forest fires, don't 'explode' into conflagrations, but rather, develop in stages. In the first stage, within an hour of the first start, fire behaviour is determined by the surrounding environment such as the weather and topography. The speed and intensity of the fire builds up steadily. If fire crews can get to the fire during this initial stage, extinguishing it using hand tools and pumper units is a fairly simple task.

If fuel levels are low as a result of a recent prescribed burn, wildfire behaviour will rarely build up beyond the first stage. However, if fuel loads are high, fire behaviour will quickly increase to the second stage. Here, the fire goes through a transition and other factors arise that have a big bearing on how the fire behaves. It begins to create its own environment—even its own winds and currents. Its intensity increases, with flames reaching three metres or more. Embers will be blown ahead of the fire, starting new fires: this is known as 'spotting'. Suppression becomes exceedingly difficult and heavy earth-moving machinery is required as the heat and ferocity of the flames make it unsafe to attack the fire with hand tools.

The third stage is when the fire reaches the tree canopy. The build up in fire intensity and size depends directly on the existence of both high loadings of ground fuels and hot, dry, windy weather.

When these factors come together, flames soar high above the tree tops and the crown fire creates intense fire whirlwinds. Burning embers can be thrown many kilometres ahead of the main fire front and the energy released can be the equivalent of a medium size nuclear explosion—every 10 minutes. That's enough energy to power a city of about 20 000 inhabitants. Suppression by ground forces or aircraft is impossible and extremely dangerous to attempt. Control of such infernos can only be possible once the weather moderates and the fire runs into a low fuel area.

FIVE RESPONSES TO FIRE

No two wildfires are the same. They vary in size, intensity and pattern of development. Even different sectors of the same fire can vary greatly because of varying winds, fuels and slopes. Fire controllers often have to make value judgments on where and how they deploy their resources most effectively. But invariably they have five basic response options.

First, they can try to suppress the fire immediately by attacking the flames. This is the direct approach where crews can reach the fire quickly and extinguish it with hand tools such as 'rake-hoes', knapsack sprays or vehicle mounted pumping units and earth-moving machinery. If the fire is too hot to be attacked head on, crews may still be successful by working along the flanks and pinching in the fire front. An indirect or parallel attack, involving the construction of a fire line a short distance from the fire edge, can be effective where fires are too hot to handle by direct attack.

Second, they can allow the fire to run until it reaches a wide fuel break, such as an area in which fuel loadings have been reduced through prescribed burning, or a natural barrier such as a lake, sand dunes or the ocean. Pastures that are irrigated, ploughed or eaten-out also offer effective fire barriers. Narrow breaks, roads and rivers are rarely effective as barriers to well-developed fires.

A third option is to 'back burn'. This is one of the most highly demanding tactics fire controllers can use, and if things go wrong, and the back burn 'back fires', the fire bosses can soon find themselves with not just one raging wildfire, but several. The key to successful back burning is lighting up the bush well ahead of the 'headfire'. This is done from a road, or prepared fire break or areas with low fuel loadings. CALM research has shown that timing is critical. Usually an hour or more is needed for the back burn to cross a sufficiently wide strip to prevent the main fire from leaping through it and possibly threatening the safety of fire crews. Escapes from back burns are highly likely where weather is hot, dry and windy, or where there are insufficient forces available to suppress the numerous spot fires that inevitably occur across the back burn boundary.

The fourth option is the 'let it burn' option, in other words, to let it burn until it rains or the fire runs out of fuel, and the final option is a combination of two or more of the above.

The foremost considerations in selecting the most appropriate suppression option are the safety of the fire crews and the likely threats to the values at risk. The direct or parallel (indirect) approaches are used where it is safe to do so, life and property values are present and environmental resource values are high. The 'let it burn' tactic is only applied where the likely impact on community and environmental values is very low, the cost of suppression is greater than any benefits gained, firefighting resources are scarce or the country is remote and inaccessible.

ATTACK!

In most forest areas and near towns and farmlands, there are too many values at stake to risk allowing fires to simply burn out in the hope that it will rain. Long experience shows that the chance of successfully suppressing wildfires is highest when fires can be attacked in the initial development stage.

WHY WE USE BUFFERS

The use of strategically placed buffers—areas of reduced fuel loads—is the major tactic in suppressing fires burning in areas of high fuel loads, especially in severe fire weather. These low-fuel buffers not only provide zones from which the fire can be attacked when the fire behaviour decreases, they are also vital in providing fire crews with safe refuges and accessible areas from which they can suppress spot fires that appear ahead of the main fire front.

The success of this option hinges on the buffer's width and proximity to the headfire. On open grasslands, low-fuel buffers about 100 metres wide are generally sufficient to contain fast-running fires. But for very high intensity forest fires that are crowning and throwing spot fires well ahead of the flame front, these low-fuel zones have to be up to six kilometres wide.

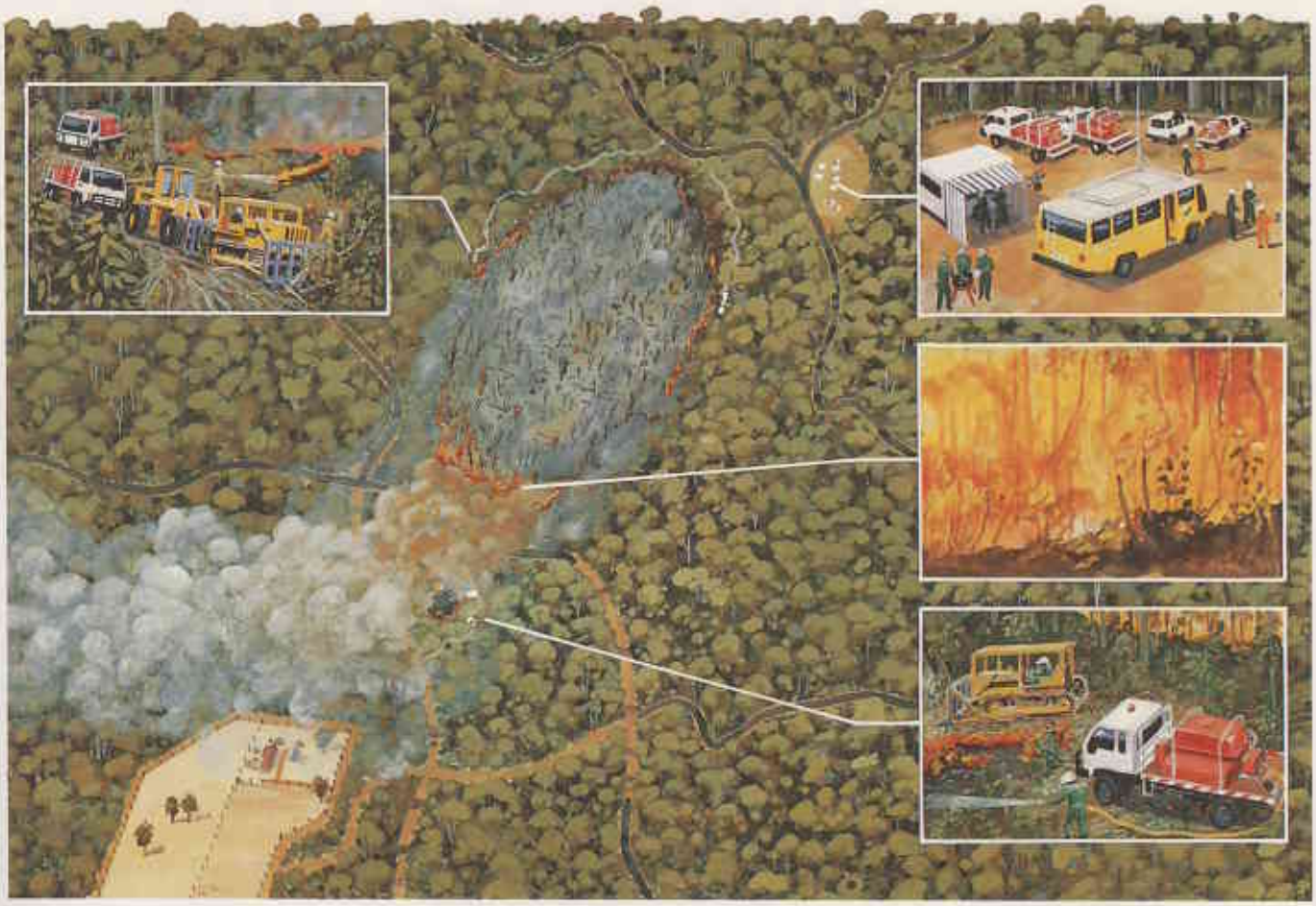
The effectiveness of fuel-reduced buffers was clearly demonstrated during the Cyclone Alby fires in April 1978. Dozens of fierce wildfires—driven by cyclonic winds of more than 120 km/h—were contained to relatively small areas when they ran into areas that had been prescribed burned two to four years earlier. Even in the pastoral country of the Kimberley, strategic buffers have been effective in preventing whole nature reserves—such as the Prince Regent Nature Reserve—from being burned out in dry season wildfires.

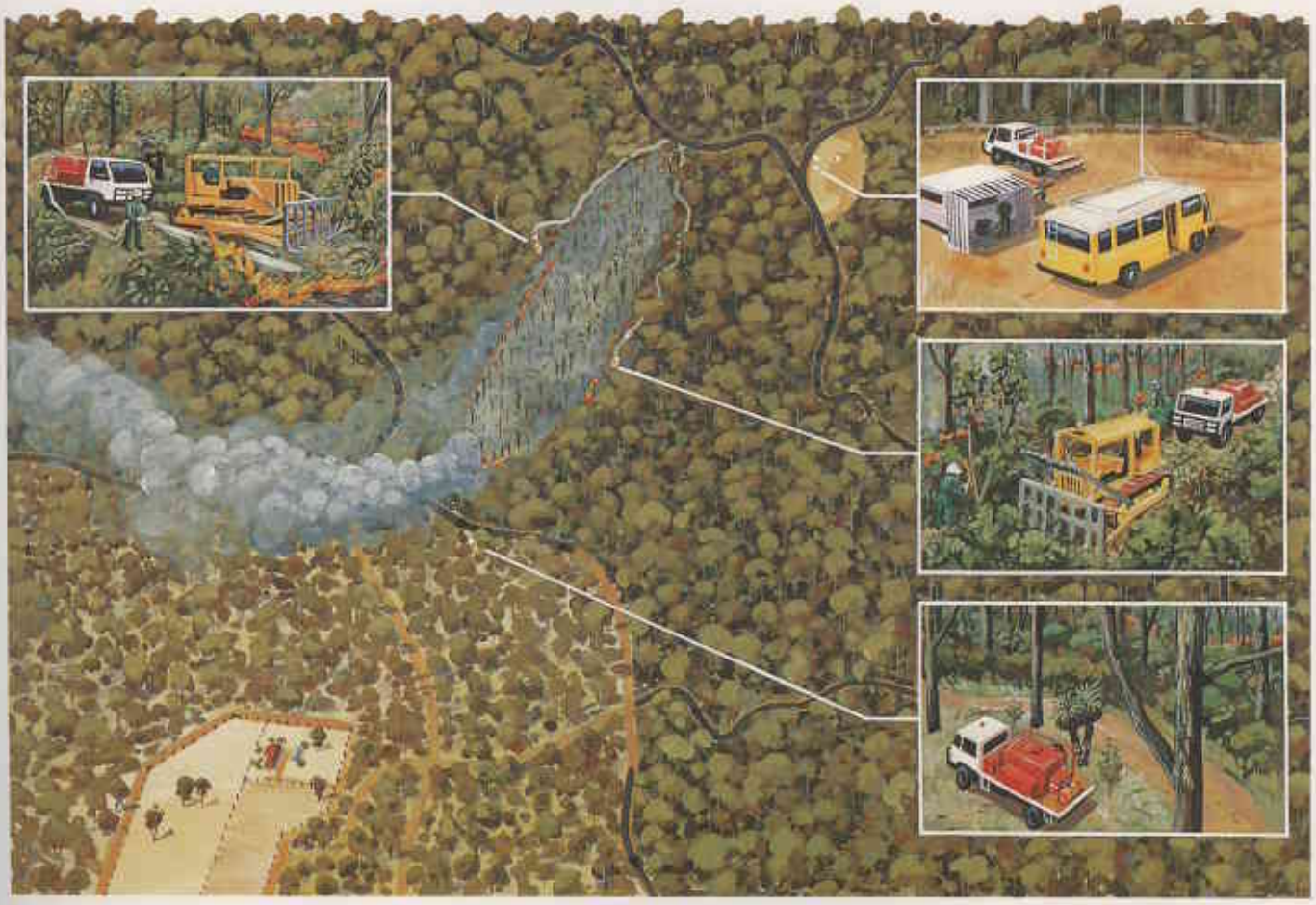
Fuel-reduced buffers are an integral part of CALM's Wildfire Threat Analysis strategy, which identifies factors such as values at risk, response times and access for fire crews, fuel loadings and likely fire behaviour. A good example is at Dwellingup, which was devastated in the wildfires of 1961. Around this forest community, CALM maintains fuel-reduced buffers six kilometres wide on the northern perimeter and three kilometres on the southern edge.

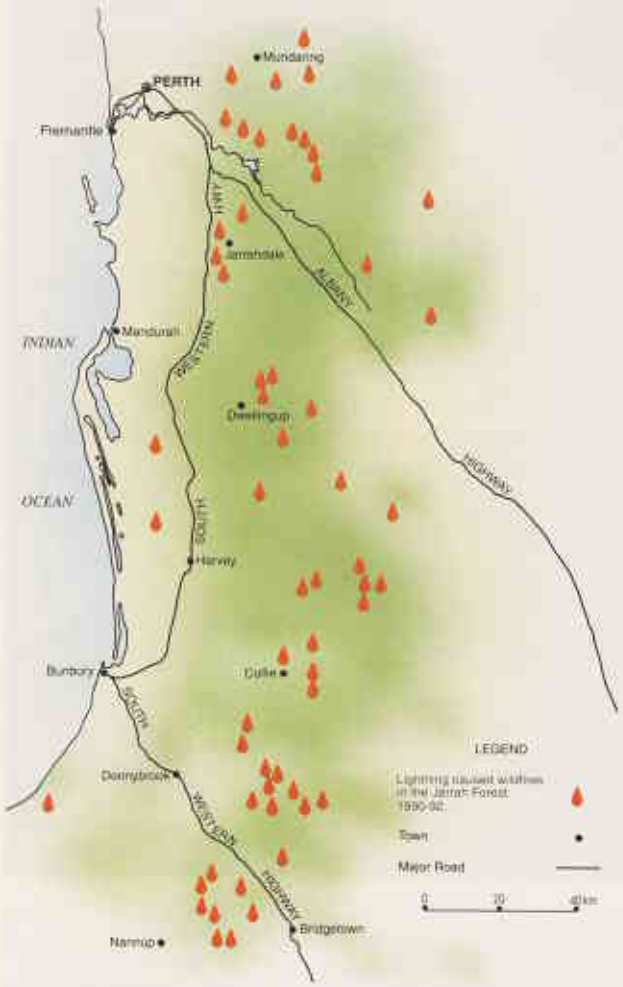
In the karri forest, these buffers are placed so that serious wildfires can be contained before they exceed 500 hectares; in the jarrah forest, the maximum loss area ranges between 2 000 and 6 000 hectares, as this forest type can survive severe fires better than karri.

Low-fuel buffers are also a key protection measure for high value conservation reserves to minimise the possibility of wildfires consuming big areas in one hit. These reserves include the Shannon, D'Entrecasteaux, Walpole-Nornalup and Leeuwin-Naturalist national parks, the Lane Poole Reserve in the forest areas and Fitzgerald River National Park in the south coast heathlands.

Opposite: High intensity wildfires in heavy fuels (*above*) demand many resources and pose a severe threat to firefighters and private property. Such headfires cannot be attacked directly. Moderate fires require fewer resources. The fuel reduced buffer will provide a refuge for firefighters from which to mount a direct attack (*below*).







Map indicating the location of fires caused by summer lightning strikes between 1987 and 1992.

The old bushmen's adage of extinguishing fires while they're 'the size of yer hat' is all too true.

To ensure rapid suppression of fires threatening high community values, it is necessary to keep natural fuel loads at relatively low levels, either by mechanical means, grazing or prescribed burning.

Potentially, the direct attack approach is the most hazardous to fire crews and requires a high degree of training and expertise by fire crews and control staff. Environmental considerations also have to be taken into account. These include preventing the spread of dieback by firefighting units, and ensuring fire access lines do not lead to soil erosion and irreparable damage to fragile and susceptible ecosystems.

The direct attack strategy can be costly, as it demands big numbers of machines, pumpers and fire crews. But in the south-west of the State and in the agricultural lands where community values are high, and in cases where it is necessary to prevent an entire reserve of special conservation significance from being burned out, there is no alternative if the damage is to be minimised.

In the open rangelands, such as the Goldfields, Nullarbor, Pilbara and Kimberley regions, and in the deserts of the interior, direct attack generally isn't feasible except where wildfires threaten communities, homesteads, or accessible recreation sites. In remote regions, the fire controller's only real option is to monitor the fire using aircraft, ground reconnaissance or satellite imagery to alert isolated communities and residents of possible danger and to take suppression action when the fire presents a serious threat to these values.

COORDINATING THE FORCES

Fighting wildfires is not only arduous and hazardous, it requires an enormous degree of planning and coordination of resources. Big fires, such as those that burned parts of the Gnangara pine plantation, 30 kilometres north of Perth, on New Year's Eve in 1994, and at the Pinjar plantation two months later, can involve organising 200 or more firefighters and officers on the ground and as many as 100 more personnel providing back up support in coordination, administration, catering, transport and first aid, and handling inquiries from the public and the news media.

Often, these personnel belong to a number of different organisations including the firefighting agencies, police and emergency services, first aid and community services.

The crew at the fire face is just one element in an organisation that varies in size and complexity according to the problem. A fire crew may consist of a crew leader, two or three firefighters in a heavy duty pumper unit, and perhaps an earth-moving machine and operator. If the fire escalates, more crews are brought in and the fire ground is divided into sectors, each with a commander who works directly under a fire operations officer. A forward control point is established and a fire management team consisting of a controller, operations officer, planning officer and logistics officer takes control. At very big fires, several sectors may be coordinated into divisions, each with a divisional commander, who in turn reports to the Operations Office.

COOPERATION IS THE KEY

Controlling big wildfires such as the one described above is too big a task for any single organisation in Western Australia. CALM works closely with the WA Fire Brigade and the volunteer bush fire brigades, through the Bush Fires Board, with back up from other agencies such as the Police, State Emergency Service, St John Ambulance, Western Power, the WA Water Authority and the armed forces. Agencies such as these have been consistently involved in training exercises.

Protecting life, property, wildlife and resources are the main reasons for fighting wildfires. In many cases, this needs the close cooperation of many organisations, sharing information, and coordinating expertise, personnel and equipment. The expertise is not something gained overnight. It takes years of training and practice at prescribed burns, small fires and in fire simulation exercises. Collectively, the prevention, preparedness and suppression measures adopted by agencies such as CALM is helping to conserve the South West forest areas and make them a safer area in which to live.

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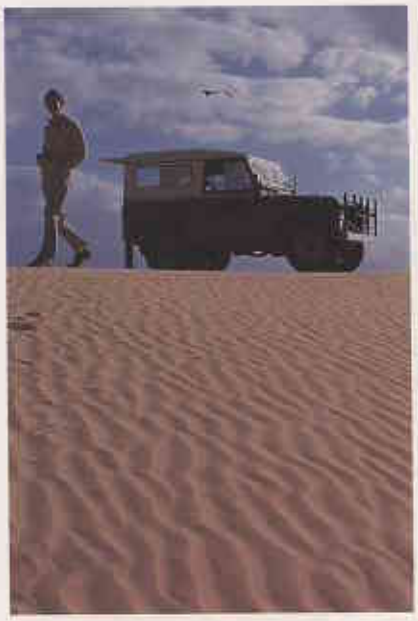
LANDSCOPE

VOLUME TEN NO. 4 WINTER ISSUE 1995



Cooperation between 4WD clubs and CALM is helping to protect WA's special recreation spots through a program of education. See 'Go Lightly' on page 17.

The noisy scrub-bird is one species that is responding well to its recovery plan. 'Recovering from the Brink' (page 10) discusses how such plans are drawn up.

Mt Augustus is the biggest rock in the world; yet few people know it exists. Find out more about this natural wonder on page 28.

There is a great deal written and talked about our forests. But what are the facts? 'Looking Beyond the Obvious' (page 22) dispells some of the myths.

Specially developed computer software is helping speed the identification of plant species in 'The Smart Collection' (page 49).

FEATURES

REGULARS

COVER

The rainbow bee-eater is a common bird found throughout most parts of the State, including Mt Augustus National Park.

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Marketing: Estelle de San Miguel ☎ (09) 334 0296 Fax: 334 0489
Subscription enquiries: ☎ (09) 334 0481
Colour Separation by Prepress Services
Printed in Western Australia by Lamb Print

Published by Dr S Shea, Executive Director
Department of Conservation and Land Management,
50 Hayman Road, Como, Western Australia 6152.