$5.75

AUTUMN 1992

# LANDSCOPE

CONSERVATION, FORESTS AND WILDLIFE MAGAZINE

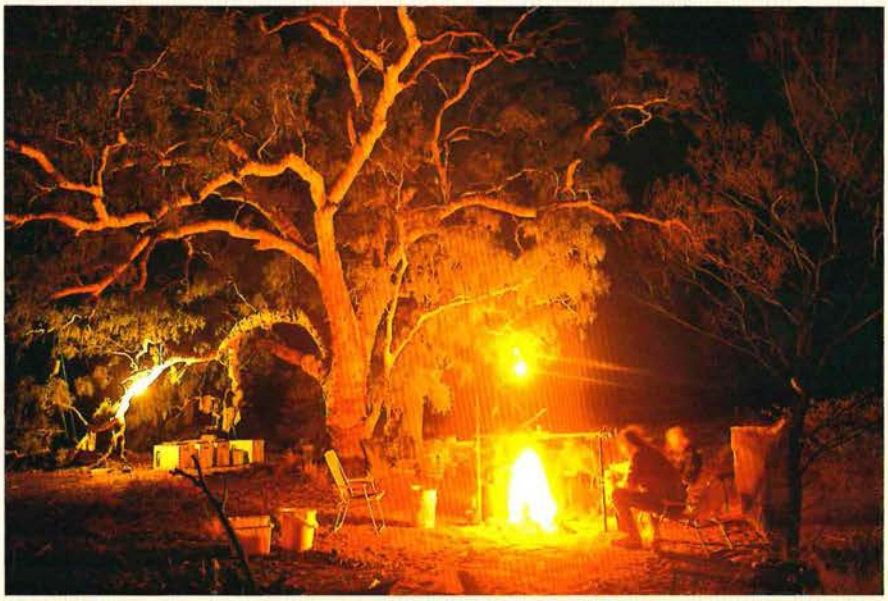

## POSSUM IN PERIL
*Will the tiny honey possum survive?*

## SHE'LL BE RIGHT, MATE!
*A guide to outback survival*

## WEBS OF THE FOREST
*River and stream zones to be extended*

INTRODUCING

# LANDSCOPE Expeditions



LANDSCOPE EXPEDITION No. 1

## Monitoring Endandered Mammals in the Gibson Desert

a 10-day volunteer program - September 1992
FEE: $1450.

*The 'Desert Dreaming' project is part of a plan by CALM to reintroduce native mammals extinct on the Australian mainland (see LANDSCOPE, Autumn 1990). The first exciting expedition provides an opportunity for members of the public to join research staff from the Department of Conservation and Land Management on this important project.*

*Working alongside CALM research scientists, volunteers will take part in pit-trapping, handling and identifying animals, and in radio-tracking boodies and golden bandicoots recently released into the Gibson Desert Nature Reserve from Barrow Island. Information collected through the project could help halt further extinctions.*

*The expedition party will camp in a desert wilderness area (with bush showers). The forward and return journeys will include stopovers at Carnegie Station and at a Kalgoorlie motel (twin share).*

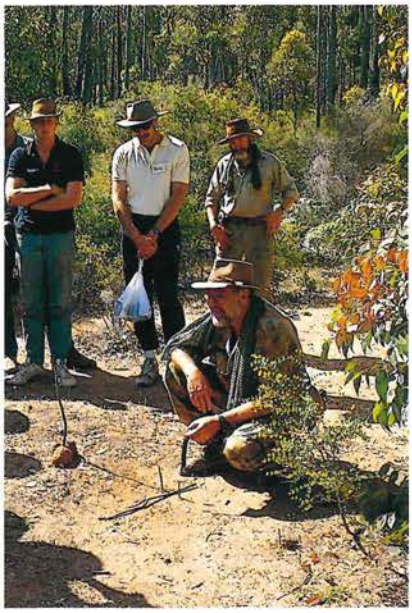
*LANDSCOPE Expeditions are offered in association with UWA Extension from The University of Western Australia. They provide opportunities for self-supporting volunteers to join CALM scientists in field-based research projects, often in remote areas of the State. Expedition fees are calculated to cover the considerable costs of the expedition, including food, accommodation, transport, camping gear and fuel, and to support further research. It does not cover personal expenses, such as travel costs to the Perth departure point.*

*Enquiries/bookings:*

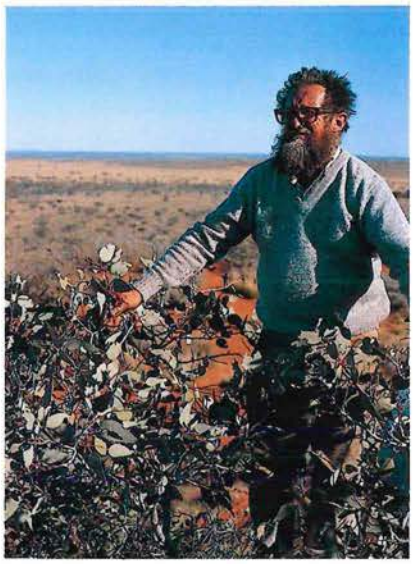
*LANDSCOPE EXPEDITIONS,*
*UWA Extension, The University of WA,*
*Nedlands WA 6009. Tel: (09) 380 2433*
*Fax:(09) 380 1066*

LANDSCOPE EXPEDITIONS

*LANDSCOPE Expeditions - Working at the frontiers of discovery*



*Each year more people seek wilderness experiences, but many are unprepared for the difficulties they might encounter. Learn about the basics of outback safety and bushcraft on page 35.*



*Botanists search for a eucalypt last seen by Giles in his expedition across WA deserts 115 years ago. See page 28.*

# LANDSCOPE

VOLUME SEVEN NO. 3 AUTUMN ISSUE 1992

*Will the honey possum become a secondary victim of dieback disease? See page 22.*

*Australia is a land of lizards - tough competitors evolving amid spinifex and wildfires in the Great Victoria Desert. Turn to page 10.*

*Straight and vigorous pines don't grow by accident. Years of research and breeding have gone into producing the perfect pine. See page 49.*

## FEATURES



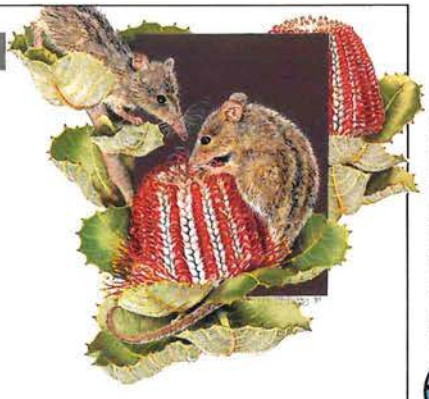
## REGULARS



## SPECIALS



## COVER



*The tiny honey possum (*Tarsipes rostratus*), seen in our cover illustration by Philippa Nikulinsky, feeds almost exclusively on nectar and pollen. However, most of its important food plants are threatened by dieback disease caused by the* Phytopthora *fungi. The endangered scarlet banksia (*Banksia coccinea*) is one plant species used by the possums that is highly susceptible to the dieback disease. See story on page 22.*

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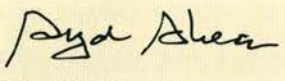
# IN PERSPECTIVE

*A MODEL FOR THE NATION*

*Recently, CALM released a nature conservation strategy and a review of forest management for public comment. The nature conservation strategy is a penetrating look at nature conservation in this State. The forest strategy is the most thorough scrutiny of our native forests since CALM's Timber Strategy of 1987. Both strategies tell Western Australians about our stewardship of the environment.*

*The forest review is linked to an historic agreement between CALM and the Australian Heritage Commission, establishing ways to protect heritage areas in WA's forests. The agreement is being hailed as a model for the rest of Australia and should satisfy the needs of conservation and development. Even if it reduces by a small per cent the waste of resources resulting from the conflict over our forests, those of us who have worked on it will be satisfied.*

LANDSCOPE *continues to inform the community so that they can make informed decisions. 'Webs of the Forest' describes vegetation corridors along roads, rivers and streams, and how CALM proposes to conserve them. Although* LANDSCOPE *will go on identifying problems in our environment, it also shows how good management and advanced technology can protect WA's economic future as well as conserve our native forests. Frankly, I can't see how anybody can be pessimistic about WA's environment after seeing the results of the* LANDSCOPE *photographic competition!*



*The Publisher*

## A SLAP ON THE WRIST. . .

In the summer 1991-92 issue of *LANDSCOPE*, a letter from Mrs E.J. Dempster, of Mingenew, was published. This letter concerned the sighting of an Echidna on her farm and included an inquiry about the possibility of keeping "a couple of Echidnas around the house to keep the ants down". As a public voice of WA's department responsible for conservation, I was greatly disappointed by the editorial response.

Mrs Dempster displayed a great deal of interest and concern for wildlife simply by writing her letter and I believe that it is important for the department responsible for that wildlife to capitalize on such interest. While it may be against the Wildlife Conservation Act (not to mention impractical) to keep "a couple of Echidnas around the house", there is much that farmers can do to encourage wildlife (including Echidnas) on their farms. Farms account for a large percentage of land in the South-West of WA and although clearing on farms has been extensive, much wildlife survives in bushland remnants on this private property. CALM should seize every opportunity to encourage the conservation of wildlife on this land.

Telling Mrs Dempster that she can't keep Echidnas in her garden because it is against the Wildlife Conservation Act does little to conserve Echidnas; advising her on how to make her farm more attractive to Echidnas does. Fox and rabbit control, fencing of remnant bush areas to exclude stock, leaving fallen timber on the ground to provide shelter, are the sorts of positive steps Mrs Dempster can take to encourage Echidnas on her farm. Who knows, if she has remnant bushland close to the farmhouse, she may one day find that Echidnas visit her garden of their own accord.

*(DR) MICHAEL J. BAMFORD*
*KINGSLEY*

*Thank you for your comments, which we feel sure will be of help to Mrs Dempster - Ed.*

## ... AND A PAT ON THE BACK

Having just spent three months enjoying camping in WA, delighting in the wildflower displays from the desert to the coast, I was delighted to find the Spring issue of your *LANDSCOPE* publication with so much information on the State in general and wildflowers in particular. I look forward to receiving four issues in 1992.

I would also like to congratulate CALM on its National Park Rangers. Whenever we met and spoke to an officer, from the outback parts to those in the south-west, we found them polite, enthusiastic, and full of information about the country, and its flora and fauna. Some went to great trouble to look up, in books, the answers to some of our more obscure questions. We really appreciated their efforts.

*JAN EASTAUGH (MRS)*
*WESLEY VALE*

*We are proud of our staff. The affinity they have with the environments in which they work often gives them a unique knowledge of those areas, and the desire to share that knowledge with others. Such dedication goes a long way to giving thousands of visitors each year a deeper insight into the special places that are our parks, forests and nature reserves- Ed.*

## WHERE IS TRUSCOTT?

I have been a delighted reader and supporter of the CALM magazine *LANDSCOPE* for a number of years and trust you can help me with an enquiry.

In 1944, I was a member of 12 Squadron RAAF stationed at Darwin, but during a period of a couple of months we flew out from an airstrip at Truscott, which I thought was in the Kimberley region of your State. I would be delighted if you could give me information on this region, especially if the centre is still in existence. I can remember that while we were at Truscott we used to collect oysters from the nearby coastline during our recreation breaks.

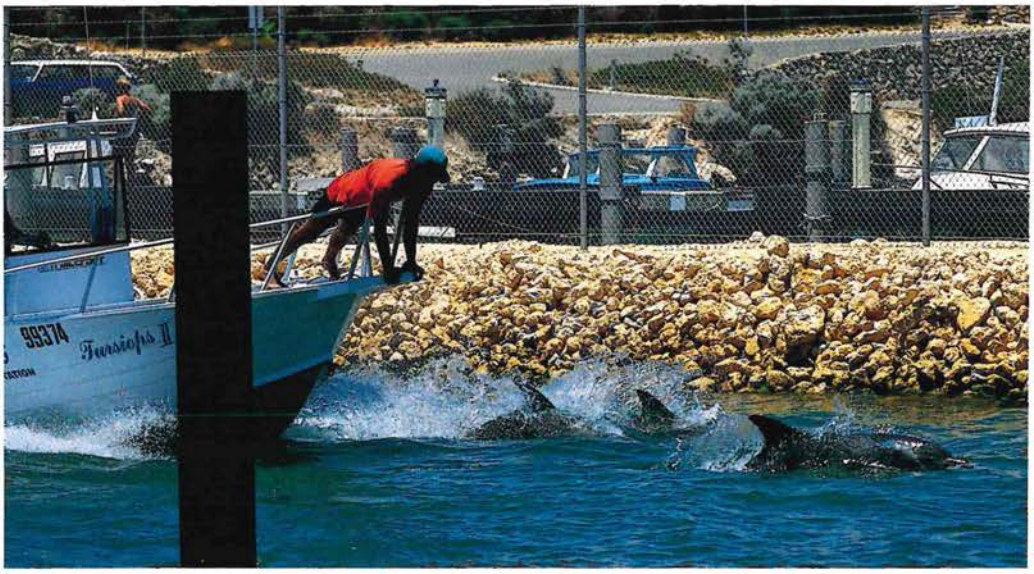
I thoroughly enjoy your magazine, even though I reside here in Queensland, and I always wish that this State could start something similar. My wife and I visited your State in October and November 1982, and travelled by camper-van through the south-west corner and reaching east as far as Wave Rock, so that is why our interest still remains.

*JIM BIGELOW*
*COORPAROO*

*The abandoned Truscott airforce base is situated some 40 km north-west of Kalumburu in the Kimberley. The strip is still serviceable for light aircraft and there are remnant World War II buildings and aircraft around the site and in adjacent areas.*

*Mr Lindsay Peet, a leading Western Australian military historian, has researched the whole of the Anjo Peninsula on which Truscott is located, and has sent a submission to the National Trust for various sites to be listed and protected under the Heritage Act - Ed.*

# BRAVE NEW WORLD



Nine bottlenose dolphins from the former Atlantis Marine Park are back in the wild for the first time in more than 10 years. The five adults were captured from the Yanchep area, north of Perth, in 1981.

The adults have been fitted with radio transmitters and will be extensively tracked during their first few months in the wild. Marine mammal expert and veterinarian Nick Gales is overseeing the research project, which is funded by the former Park's owners Tokyu Corporation.

Before the release, the dolphins had to be taught how to catch live fish and be gradually exposed to bacteria and parasites found in the natural marine environment.

The release and research program is a world first and offers some exciting opportunities. Researchers should be able to gather detailed information about dolphin home ranges and movements. They will see how the former captives associate with other wild dolphins.

A great deal of data on the wild dolphins of the area has already been collected, regarding pod size and structure, daily movements and foraging activity of the local dolphin population. The researchers can recognise more than 100 individuals.

Dolphins live in one area, and the former Atlantis dolphins were not expected to move far from the release site. The animals were taught to recognise and approach the research boat, so that their condition could be closely monitored.

However, the animals' transition to the wild was not easy. The dolphins were at first reluctant to leave the enclosure at Two Rocks Marina that had been their home for the last three months.

It took two hours and dozens of fish before the three-year-old calves, which had been born in captivity, were tempted to make brief sorties out of the enclosure. However, over the next few days the dolphins became more confident and all left.

One dolphin, Mila, had a newborn calf, and another, Rani, is pregnant. Her calf will be born in the wild.

Sadly, Mila's calf has disappeared and Mila has lost condition. In the wild there high mortality rates of young dolphins, predators such as sharks to cope with, and even the possibility of harmful interactions with humans (such as getting entangled in fishing nets).

Since being released, however, the dolphins have provided a few surprises. Contrary to researchers' expectations, the female dolphins failed to stay together. Frodo, one of the males, has been seen as far south as Margaret River. Rajah and Echo lost weight and are being kept in the Two Rocks enclosure. The release will now have to proceed more slowly.

*The former Atlantis dolphins are now the subject of an important study during their transition to the wild.*
*Photo - Nick Gales*

*The adults have been fitted with radio transmitters so as to track their movements.*
*Photo - Nick Gales*

# FOREST REVIEW RELEASED

A major review of forest management in Western Australia has been released.

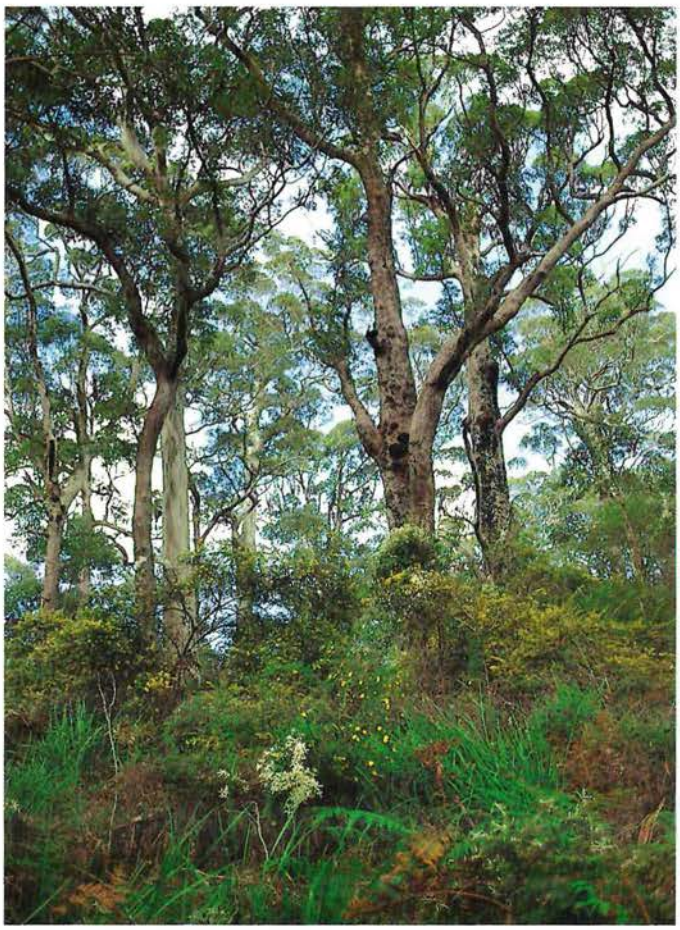
A new 80 000 hectare national park is proposed, containing 32 000 hectares of virgin jarrah, karri and tingle forests and the highest quality wilderness values in the south-west.

The national park will stretch from the Frankland River to the Denmark River, linking the Mt Frankland and proposed Mt Lindesay National Parks and the Lake Muir Nature Reserve.

The park is only one of 18 new conservation reserves proposed in south-west forests, totalling 124 000 hectares.

Despite these massive additions to the conservation reserve system, the review maintains that existing levels of wood yield from the forest can be sustained in perpetuity.

Forest managers realised that estimates of the level of wood production in the 1987 Timber Strategy were too conservative, as a result of sophisticated technological developments that made it possible to make precise estimates of the standing volume of wood, the size class distribution, and growth rates of the forest.



*Tingle forest will be included in a new 80 000 hectare national park that is proposed under the review of forest management. Photo - Grant Wardell-Johnson*

*Below: The Albany pitcher plant, which is confined to a few swampy areas near Albany, is one of the unique plants that will be protected under the new plan. Photo - Grant Wardell-Johnson*

The level of sustainable wood harvest from the karri and jarrah forest is 1 360 000 cubic metres of jarrah, 417 000 cubic metres of karri and 508 000 cubic metres of marri.

'Operation Foxglove' is another initiative of the review. Research has shown that the introduced fox is the most serious cause of small mammal decline in forest areas and is arguably the greatest threat to conservation and biological diversity of the forest fauna.

CALM will dramatically increase fox control in WA forests to boost the numbers of threatened native animals in key areas. The Department has set a 10-year target to make 20 per cent of the forest fox-free.

Important changes to timber harvesting operations have also been recommended. More old trees will be retained, smaller and more dispersed sites will be cut, harvesting will follow natural vegetation lines to minimise visual impact and the size of individual areas to be harvested will be reduced dramatically.

If the recommendations of the review are accepted, every stream in the forest will be protected from timber harvesting, extending existing river and stream zones by five times their present area. In total, 63 100 hectares in the Southern Forest and 91 400 hectares in the Central Forest and Swan regions will be allocated to river and stream zones - a total of 154 000 hectares (see article on page 40).

Sites with cultural, water, aesthetic and conservation significance will also be given special protection.

Another highlight of the review was a cooperative study between CALM and the Australian Heritage Commission.

The two agencies have worked closely to assess WA's southern forest for heritage values worthy of listing in the Register of National Estate, a national inventory of significant places in Australia's cultural and natural history.

More than 100 day use visitor sites in WA forests will be redeveloped or upgraded over the next 10 years, and at least 10 new campsites in forest areas will be developed to cater for increased demand.

The public is invited to make submissions on the review of forest management, which is open for comment for three months.

## *LANDSCOPE* EXPEDITIONS

It is now possible for people with an interest in nature conservation to work alongside scientists and researchers from the Department of Conservation and Land Management (CALM), as paying volunteers in important field-based research projects, often in remote areas of Western Australia.

*LANDSCOPE* Expeditions is a program designed to improve public understanding of native plant and animal species, ecosystems and natural processes in natural habitats throughout Western Australia.

According to Ron Kawalilak, CALM's Director of Corporate Relations and Managing Editor of *LANDSCOPE*, the expeditions will be open to people from all walks of life.

"The only qualifications needed are general good health, common sense, enthusiasm, an ability to adapt to other people, and a sense of humour," he said.

*The Gibson Desert Nature Reserve, the site of an important study into endangered mammals and the destination of the first* LANDSCOPE *Expedition. Photo - Ray Smith*

The program is offered in association with UWA Extension from the University of Western Australia. CALM has assisted in several successful extension courses over the past two years (see 'Desert Coast', *LANDSCOPE* Summer 1991-92 issue).

People interested in going on *LANDSCOPE* Expeditions will pay a fee or financial contribution, which will vary with each expedition in the program. This will be used to cover costs in planning, mobilising and supporting the expedition, and will include the cost of scientific and research staff, a field camp, expedition vehicles, food, accommodation, equipment, instrumentation and fuel. Part of the fee will support further research. Personal expenses, such as travel costs to the assembly point, and medical treatment or emergency evacuation expenses (though we hope that would never be necessary), are the responsibility of the individual.

The first *LANDSCOPE* Expeditions are planned for later this year (see inside front cover).

Information collected could help halt further extinctions and ensure the future survival of endangered species.

Further information can be obtained from *LANDSCOPE* Expeditions, UWA Extension, Nedlands WA 6009. Telephone (09) 380 2433.

## KIMBERLEY RAINFORESTS

Most people associate Australian rainforests with Queensland, but the Kimberley has its own rainforests .

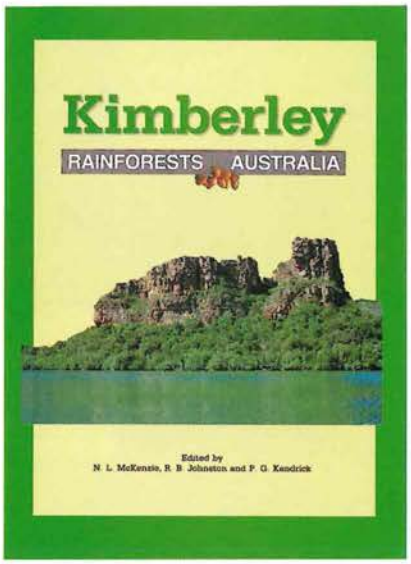
*Kimberley Rainforests of Australia*, a major new book published by Surrey Beatty and Sons, details a three year study of these rare communities, which have a total area of only 8 000 hectares.

Tiny patches of rainforest occur mainly along the Kimberley coast, completely cut off from similar areas across northern Australia by the arid country that surrounds them.

*Kimberley Rainforests of Australia* is the result of the first comprehensive ecological study of the area, begun in 1987 with a grant from the Federal Government's National Rainforest Conservation Program.

The study was carried out by CALM, combining the skills of 15 scientists - specialists in remote sensing, botany, zoology, soils, conservation ecology and biogeography.

Landsat satellite information, was used to detect more than 1 500 stands of rainforest down to about the size of a suburban house block in an area more than twice the size of Tasmania. The largest measured nearly 100 hectares, although the average area was less than four hectares.




The intensive ground surveys have given us a wealth of information about our rainforests.

More than 450 plants have now been collected, 80 per cent of which are found nowhere else. One hundred and forty bird species have been recorded and about 120 species of land snails.

*Kimberley Rainforests of Australia* contains 21 scientific papers covering all aspects of this work. It will be welcomed not only as an important reference, but as a source for future research, monitoring and management.

# DUCK STAMPS ARE FLYING

Following the success in the United States of sales of special issue stamps to raise funds for the preservation of wetlands, a similar program is providing funds for wetlands conservation in Australia.

Managed by the Australian Wildlife Fund, the Australian Federal duck stamp was first commissioned to validate the entrance permit to Kakadu National Park. The innovative design of the ticket, with stamp fixed and cancelled, has itself become popular with collectors.

Each year's program commences with the commissioning of a painting of a waterfowl subject. Both the stamps (which must have an official fiscal function), and the limited edition prints are produced for sale from the selected painting.

Earlier this year, Western Australia's Department of Conservation and Land Management (CALM) became the first State conservation authority to adopt the stamp, making it mandatory for use on national park annual passes to be introduced in 1992.

The stamp is marked by an overprint, reading:

W. A. C .A. L .M.
MANDATORY FOR USE
ON NATIONAL PARK
ANNUAL PASS

The Australian Federal duck stamp issue is now in its third year. The 1989 issue was designed by celebrity US artist Dan Smith, and the 1990 issue by US multi-award-winning artist Jim Hautman.

Both of these artists are recent winners of the US Federal Duck Stamp Art Award, the most prestigious of all US Wildlife Art contests.

The 1991 stamp, issued September 30, is the work of New Zealand-born Queensland artist, P Brent Harvey,



winner of the $50 000 first prize in the 1991 James Hardie Wildlife Art Prize.

The illustration of this stamp shows the overprint in place, although stamps may be obtained with or without the overprint.

Duck stamps, and the combination duck stamp and print are a component in a growing nexus between wildlife art and conservation, with collectors able to accumulate a collection of some of the most beautiful and interesting issues available today.

In the United States, 400 million duck stamp dollars have financed the preservation of nearly four million acres of wetland refuges.

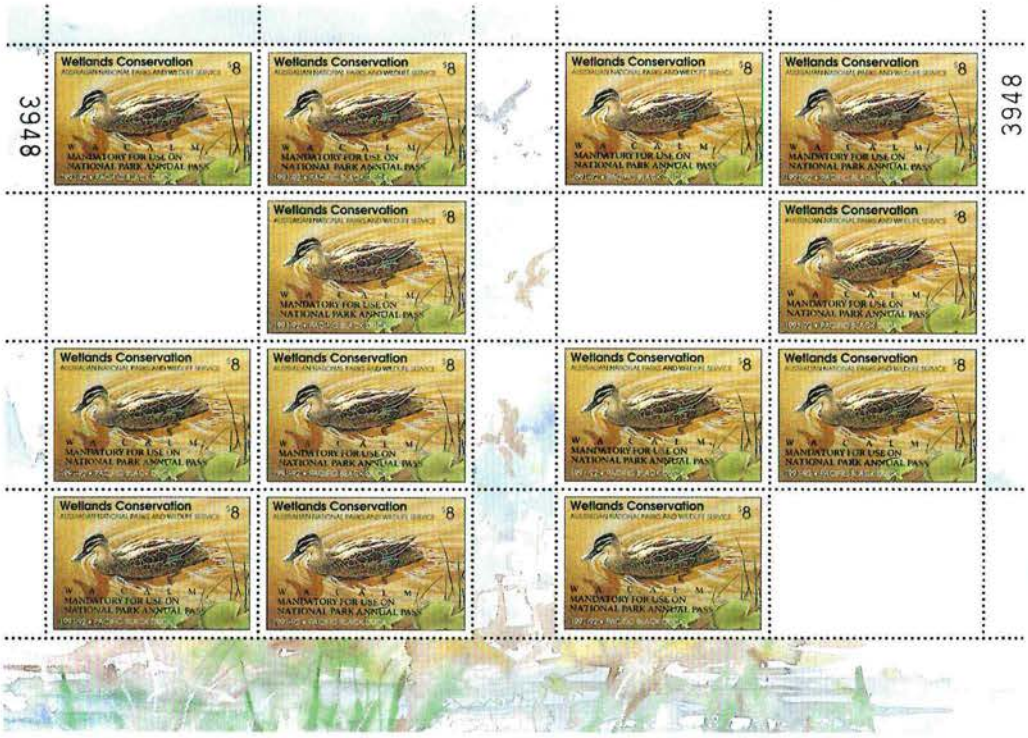
In Australia, proceeds from duck stamps are directed toward wetlands conservation projects through the Australian National Parks and Wildlife Service which disburses them to appropriate projects in all States and Territories.

CALM enjoys a direct and substantial proportion of all income raised by the overprinted issue including the worldwide sale of the mint overprinted stamps.

The mint overprinted stamp and the regular Australian duck stamps may be obtained by completing the order form inserted with this issue for direct supply from The Australian Wildlife Fund, PO Box 653, North Sydney, NSW, 2059, Telephone (02) 957 3304. Duck stamps are also stocked by City Models, 13-15 Piccadilly Arcade, Perth, WA, 6000, Telephone (09) 321 4339. The WA mint overprinted stamp is available from CALM State operational headquarters, 50 Hayman Road, Como, WA 6152. Telephone 364 0333.

The community benefits immeasurably from the preservation of wetlands. An essential component of our environment, wetland ecosystems provide habitat for many species of plants and animals, are important in maintaining water quality, and are valued as important areas for recreation.

The purchase of the duck stamps provides an opportunity for every citizen to make a small investment in an enormous endeavour - the preservation of our natural heritage.




# FROM FAMINE TO FAME

These two engaging pygmy possums, nursed back to health after being abandoned by their parents, were photographed by CALM wildlife officer Ray Smith.

Last winter, Betty Avery of Scott River contacted animal carer Rita Watts of Busselton about a family of young pygmy possums that desperately required rearing.

The Averys do not keep cats on their farm and have put up nesting boxes around the house. One of the boxes, placed in a bushy yate, was taken over by pygmy possums and six babies were seen in the box. However, after several days the parents were no longer returning to feed the young.

The youngsters had only a thin covering of silky fur, had not developed ears, and were completely blind. Each animal was thinner than a ball point pen and, when curled up, was smaller than a 20 cent coin. Each weighed less than 2.5 grams.

They had not had food for several days and were in a bad way. Four soon died, but Rita persevered with the remaining two, feeding them five times a day with a mixture of honey and Dietelact from the smallest eye dropper she could find.

The animals soon put on weight. Their ears developed and their eyes opened. Each day the agile creatures would play in branches and blossoms in their cage. When Rita approached, they scurried up to her, propping their head and fore paws on her thumb to be fed with an eye dropper. After six weeks they had reached adult size and were ready to be rehabilitated into the wild.

*These pygmy possums were smaller than a 20 cent coin when they were abandoned by their parents.*
*Photos - Ray Smith*

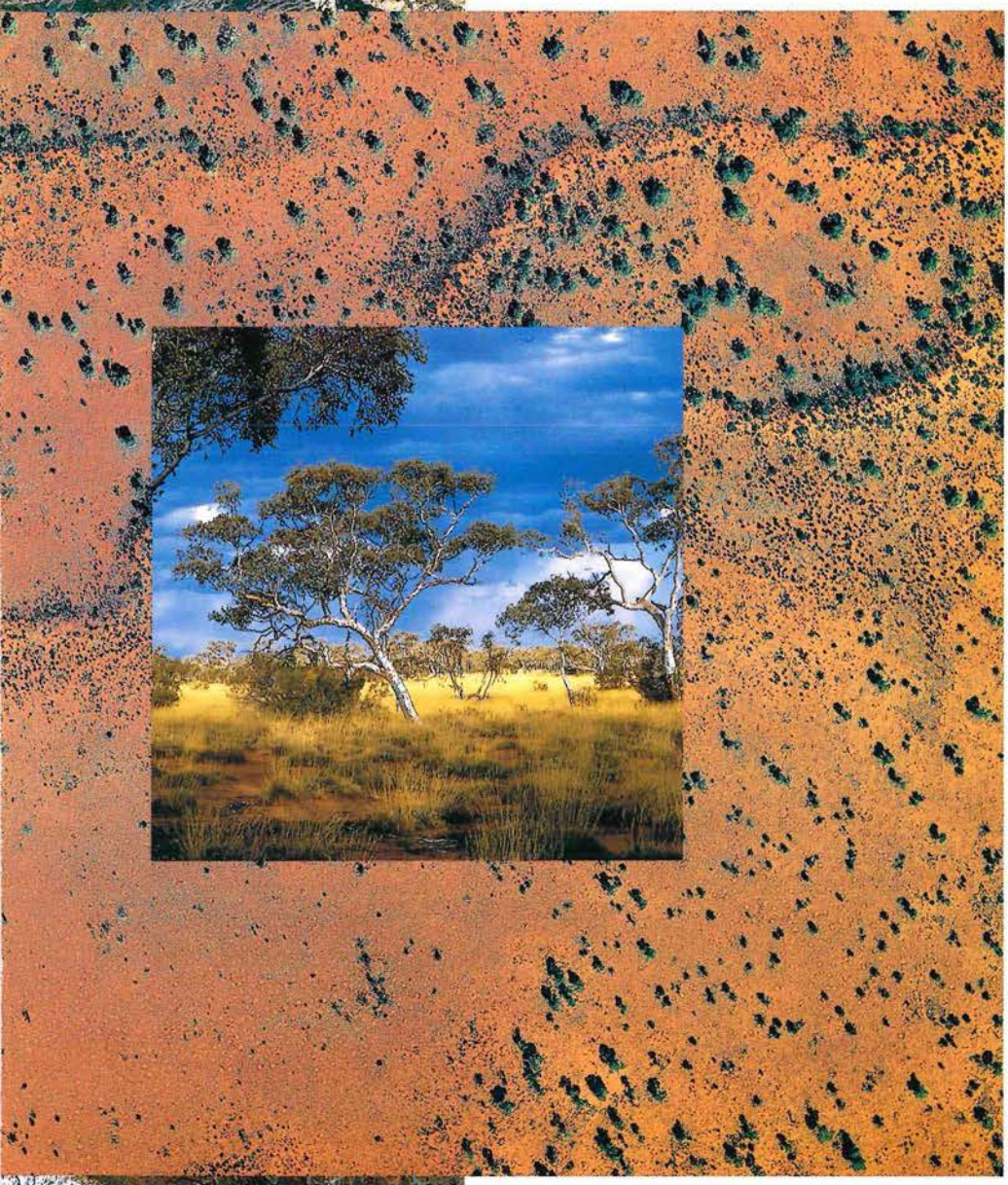
Ray set up his photographic equipment on the branches of bushy yate, showy banksia and scarlet banksia.

"The possums jumped from branch to branch, feeding and chasing each other with boundless energy," said Ray. "I observed and photographed their antics for two and a half hours. One would suddenly stop moving, eye the camera mischievously and then spring out of sight of the view-finder. When I looked up to see where it had gone I would find it sitting smugly on top of the camera lens."

It was soon time for the release. More nesting boxes were set up around the Averys' house and after several days they were released, quickly disappearing into the bushes. To the Averys' delight, they were found several weeks later curled up in the original nesting box in which they were first found.

Since then, pygmy possums have been seen in the vicinity on several occasions.

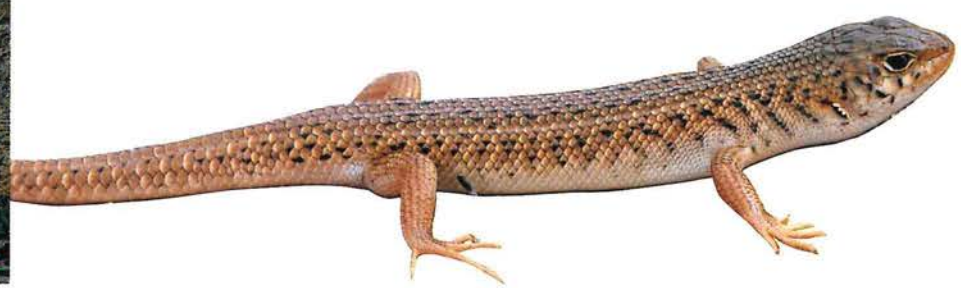
# A LAND OF LIZARDS



***Story and pictures by Eric R. Pianka***

*Why are there so many lizards in Australian deserts? How do they live through wildfire? How can they compete so well with each other, and with other species? What is the future of their spinifex home? Professor Eric Pianka, a research scientist from the University of Texas, is fascinated by the beauty and the lizards of Australia's deserts.*

- *Inset: Ground-level view of a study area before a thunderstorm. This site supports 35 species of lizards.*
- *Middle Photo: Low-level photograph of a study site (about 1km x 1km), showing sandridges, marble gums (larger dark green spots) and spinifex (light green ground cover). Termite mounds are small circular patches of open red sand. Forty-seven species of lizards occur here.*
- *Outer Photo: Satellite image showing a 150km x 150km patch of the Great Victoria desert. Light beige and pale green patches are fire scars. (Australian Centre for Remote Sensing)*



Within the Great Victoria Desert of Western Australia, sands are rich in iron, usually a delicate pale rusty red, almost flesh coloured. Long undulating sandridges provide attractive curves to create a sensuous image of mother Earth. Equally curvaceous, evergreen marble gum trees (*Eucalyptus gongylocarpa*) with their smooth white bark adorn this splendid landscape. The dominant ground cover is spinifex (*Triodia basedowi*), a perennial grass that grows in hummocks or tussocks, a growth form found only in Australia. Rain is infrequent and blue skies prevail most of the time. Taken together, it is a clean, spectacular and most enchanting place, an extensive wilderness area of Crown land containing largely pristine habitats, still relatively undisturbed by human activities aside from the introduction of exotics, which include camels, cats, foxes, and of course rabbits.

Few people have much of an inkling of just what a tremendous biological treasure lies in the Australian deserts. Nowhere else on earth are so many kinds of lizards found living together - at least 47 different species occur on one sandridge site! In addition to familiar forms such as the thorny devil *(Moloch horridus)* and the perentie *(Varanus giganteus)*, there are a dozen species of exquisitely beautiful nocturnal geckos and another dozen-plus wary and secretive skinks, as well as many others including flap-footed legless pygopodid lizards.

Why are the Australian deserts so rich in species of lizards? The challenge of explaining this high diversity, and of understanding what goes on between component species, is awesome. Compared with Australia the North American deserts are impoverished, with only a dozen species of lizards; in the Kalahari semidesert of southern Africa, only 20 species occur. How do so many lizards avoid competition and manage to coexist? How do they partition resources such as food and microhabitats? Ecologists still know surprisingly little about exactly how diverse natural ecological systems function - ecological understanding that is much needed and will be critical to our own survival as well as that of other species of animals and plants. In fact, the Australian deserts probably offer the last opportunity to study the regional effects of disturbance on local diversity.

## LIVING TOGETHER

Lizards divide up environmental resources in three major ways: by being active at different times, by spending time in different places, and by eating different foods. Such ecological differences reduce competition, allowing coexistence. Many lizard species are food generalists, eating a wide variety of arthropods. Some other species of lizards are dietary specialists, with certain species eating only ants, others termites, and still others almost nothing except other lizards. One species, *Pygopus nigriceps*, preys heavily on scorpions. Like the North American iguanid horned lizards *(genus Phrynosoma)*, the Australian agamid (*Moloch horridus*) eats virtually nothing but ants. Such pairs of convergent species are known as ecological equivalents, occupying roughly similar ecological roles in different biogeographic regions. Lizards also differ in their choice of microhabitats: some climb, others are terrestrial, while still others are fossorial, swimming through the sand. Some species frequent the open spaces between spinifex tussocks, whereas others seldom leave the protective cover of spinifex.

Lizards are *ectotherms* - they obtain their heat from the environment. Animals that usually produce their own heat internally are called *endotherms*. All plants and nearly all animals are ectothermic; the only continuously endothermic animals are birds and mammals (though even some of these become ectothermic at times). Many ectothermic lizards actually regulate their body temperatures very precisely during periods of activity by appropriate behaviour. An active desert lizard may have a body temperature every bit as high as that of a bird or mammal; the terms 'warm-blooded' and 'cold-blooded' are misleading and should be abandoned.

Lizards constitute an extremely conspicuous element of the vertebrate faunas of most deserts, especially warmer ones - indeed, in his book *The Red Centre* the Australian mammalogist H. H. Finlayson referred to the vast interior deserts of Australia as 'a land of lizards'. The reason is ectothermy, which enables the body's metabolism to slow right down, allowing lizards to capitalise on scant and unpredictable food supplies. Moreover, along with other ectotherms, lizards are low-energy animals. In contrast, endothermy is much more energy-expensive; one day's food supply for a small bird will last a lizard of the same weight for over a month. Ectothermy thus has distinct advantages

*Top left*: Australia's largest lizard, the perentie (*Varanus giganteus*), which reaches a total length of more than two metres and eats rabbits. Presumably these lizards originally preyed on small marsupials such as hare-wallabies.
Photo - E Pianka

*Middle left:* A climbing nocturnal gecko (*Diplodactylus ciliaris*), found on large shrubs and small trees, often in association with sandridges. These geckos defend themselves by squirting out a noxious mucus from glands in their tails.
Photo - E Pianka

*Below left:* A large herbivorous desert blue-tongued skink (*Tiliqua multifasciata*).
Photo - E Pianka

over endothermy under the harsh and unpredictable conditions that prevail in deserts. By means of this thermal tactic, lizards can conserve water and energy by becoming inactive during the heat of midday, during resource shortages, or whenever difficult physical conditions occur (such as during heat waves or droughts). Birds and mammals must weather out these inhospitable periods at a substantially higher metabolic cost. Hence ectothermy confers a competitive advantage on lizards over endotherms in desert environments.

## FIRE IN THE DESERT

Hummock grass, a plant life form unique to Australia, is very flammable. Spinifex tussocks are perfectly designed for combustion, consisting of hemispherical clumps of numerous match-stick sized blades of dry curled grass filled with flammable resins, loosely interpenetrating one another and laced with ample air spaces. With such ideal tinder, one match is all that is required to start a bonfire. Spinifex has been called an 'ideal pyrophyte'. Some authorities think that the extensive grasslands in Australia were formed and maintained by regular Aboriginal burning, and that over many thousands of years Aborigines acted to select members of plant communities for resistance to fire or for an ability to come back quickly following a fire. Most early explorers and historians of Australia commented on the extent to which the Aborigines exploited fire. Spinifex grasses give off dark smoke which can be seen from afar. Australian Aborigines used fire to send long-distance smoke signals, to manage habitats and keep terrain open, as well as to facilitate capture of various animals for food.

Upon ignition, an isolated grass tussock generates an egg-shaped thermal field around it. At low wind velocities, isotherms for such a field are symmetric and close to the tussock, but as wind speed increases, the thermal field

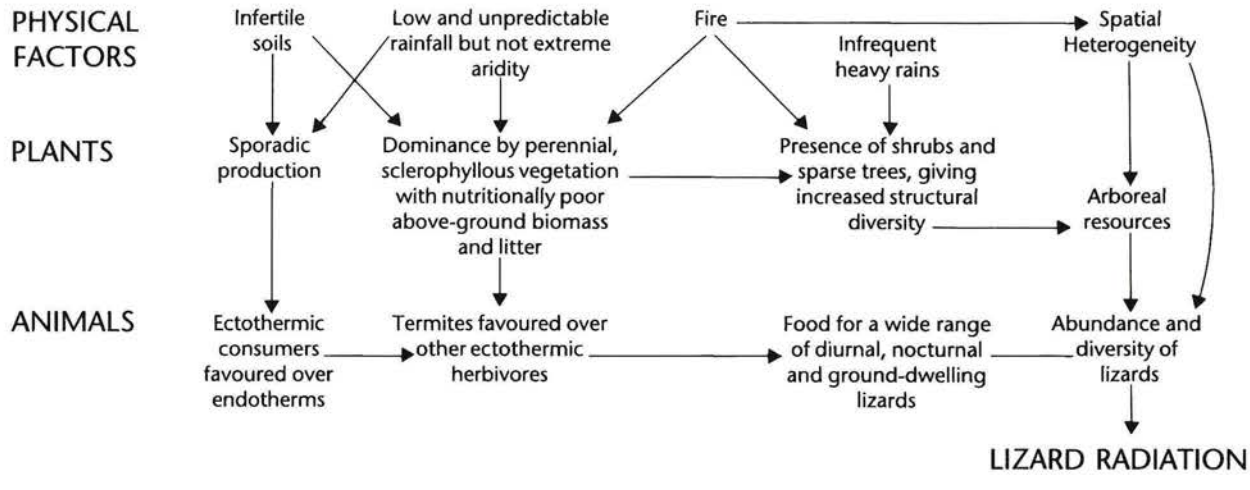

*Morton, S.R. and C.D. James. 1988. 'The diversity and abundance of lizards in arid Australia: a new hypothesis.' *American Naturalist* 132: 237-256.

**FACTORS INFLUENCING LIZARD DIVERSITY**

At least a dozen different factors contribute to the high diversity of lizards in arid Australia:

1 unpredictable rainfall
2 nutrient-poor soils
3 the unique hummock life form and physical structure of spinifex grasses
4 the low nutrient content of spinifex
5 abundant and diverse termite faunas
6 nocturnality
7 fossoriality (sand swimming)
8 arboreality
9 habitat specificity
10 usurpation of ecological roles occupied by other taxa elsewhere
11 biogeographic and historical factors
12 a complex fire-succession cycle that creates and maintains habitat variety via disturbance

Most of the above mechanisms were incorporated into a megahypothesis recently proposed by Steve Morton and Craig James at the CSIRO.* This causal network relates a wide range of factors to the diversity of lizards in arid Australia, as follows. Unpredictable rainfall and nutrient-poor soils result in scant and erratic primary production, favouring spinifex grasses that are poor in nitrogen and relatively unusable fodder for most herbivores except termites, which in turn constitute a food resource particularly suitable for ectothermic lizards. Moreover, aperiodic heavy rainfall promotes woody vegetation, therefore supporting arboreal and litter-dwelling species of lizards. Although not included in their scheme, fire and fire-induced spatial heterogeneity are easily added.



Left: This nocturnal gecko (*Diplodactylus elderi*) seldom leaves the protective cover of large, long-unburned spinifex tussocks. It also defends itself with a tail-gland mucus secretion.
Photo - E Pianka

Right: The thorny devil (*Moloch horridus*), a spiny agamid that has specialised on ants as food.
Photo - E Pianka

becomes asymmetric and begins to elongate, especially downwind. If other tussocks are then captured within the field, they too ignite and the fire spreads. Due to the geometry of thermal fields, fires tend to burn along broad continuous fronts at low wind velocities, whereas at higher wind velocities, elongated narrow tongues of flame are produced. Fires are more likely to break up at higher wind velocities due to these elongated tongues of flame.

Previously burned areas have sparser vegetation and act as gigantic firebreaks. Sandridges and termitaria (termite nests) create smaller vegetationless areas that also act as local firebreaks, but with fundamentally different geometries and at very different spatial scales. Airborne flaming materials, termed 'firebrands', may jump over unburned areas to rekindle new fires on the downwind side of a fire, sometimes resulting in multiple fire fronts (these can extinguish one another when one runs into another's swath). 'Sleepers', embers created from burning eucalyptus hardwood, lie dormant in burned areas, only to re-ignite at the edges days or even weeks later when new strong winds come up. New secondary bush fires begin that take off at an angle, resulting in an interesting net-like pattern that generates a patchwork of refuges. Major factors that determine the frequency, extent and geometry of grass fires include temperature, combustibility, plant biomass and spatial distribution, natural firebreaks, and of course winds, which as explained above are of paramount importance.

A fire-succession cycle helps to explain the high lizard diversity of the Australian interior. Fires are a predictable event in arid Australia, and generate a mosaic of patches of habitat at various stages of post-fire succession. As a more or less regular agent of disturbance, fires contribute substantially to maintaining diversity in Australian desert lizard systems. Bush fires are usually started by lightning, and can rage completely out of control for weeks on end across many square kilometres of desert. Fires vary considerably in intensity and extent. Eucalyptus trees are fire-resistant and usually survive a hot but brief ground fire carried by the exceedingly flammable *Triodia* grass tussocks. Moreover, fires frequently spread like a net, missing an occasional isolated grass tussock or even large tracts. Effects on lizards and lizard microhabitats are drastic, yet vary from place to place. Many or even most individual lizards may live through the burn itself, only to succumb in the fire-reduced habitat that can last for years. Fires attract hawks and crows, which feed on fire-killed animals and take advantage of the lack of cover to catch survivors.

Some lizard species with open habitat requirements (such as *Ctenophorus isolepis*, *Ctenophorus inermis* and *Ctenotus calurus*) reinvade and repopulate burned areas rapidly. Other species (such as *Delma butleri*, *Omolepida branchialis*, and/or *Diplodactylus elderi*) require large spinifex tussocks for microhabitats, and become very rare or vanish after a burn. However, such 'climax' species (those living in long-undisturbed habitat) continue to exist in isolated pockets and patches of unburned habitat. Spinifex rejuvenates rapidly from live roots as well as by seedling establishment. Newly burned areas are very open with lots of bare ground and tiny, well-spaced clumps of *Triodia*. Unburned patches, in contrast, are composed of large ancient tussocks, frequently close together with little open space between them. As time progresses, *Triodia* clumps grow and 'close in', gradually becoming more and more vulnerable to carrying another fire.

Throughout this process, lizard microhabitats (and associated food resources) change. Lizard numbers fluctuate along with them. Numbers also alter substantially through fire succession, with some common species becoming quite rare. Rare species do not always remain rare and may be vitally important to hold a system together, allowing the system to respond to changing environmental conditions. A particular lizard species can even go extinct within a given area (known as a 'sink' habitat), but by surviving in an adjacent patch (a 'source' habitat) can still survive in the region. Periodic recolonisation of 'sinks' from 'sources' allows such species to persist in the overall landscape.

Satellite imagery provides a powerful new way to study the dynamics and geometry of wildfire. In inland Australia, cloud cover is usually low or non-existent, and excellent imagery is the rule. This facilitates analyses on a region-wide basis.

Top: The snake-like flap-footed pygopodid lizard (*Delma butleri*), another denizen of large spinifex tussocks that have gone long unburned.
Photo - E Pianka

Middle: Another flap-foot (*Pygopus nigriceps*), which is nocturnal and feeds primarily on scorpions.
Photo - E Pianka

Bottom: The knob-tailed gecko (*Nephrurus levis*)is nocturnal and is found in spinifex habitats on sandplains. A sister species (*Nephrurus levis*) is found on sandridges.
Photo - E Pianka

Fire spreads rapidly through spinifex grassland under suitable wind conditions.
Photo - David Pearson

Whereas ash absorbs infrared, unburned vegetation reflects it. The sizes and geometry of fires can be readily measured and fire scars traced through time. Frequency distributions of the ages and sizes of fire scars can also be estimated and examined to see how often a particular area is burned.

In such a large natural region, habitat patches at different stages of post-fire recovery can reach a dynamic equilibrium: new burns continually arise from older, thicker, more combustible stages of fire succession. Reflectance properties (visible and invisible reflections) recorded in space could allow scientists to estimate the present state of all animal and plant life (biotas) in the region, as well as the climate during the immediate past. Careful field work is needed to learn the extent to which changes over time in patterns of reflectance can be extrapolated to fire-succession patterns on the land. Although a great deal more remains to be known, monitoring habitats and biotic diversity from satellites could ultimately prove to be possible in arid regions.

## VANISHING WILDERNESS

Many people consider biology, particularly ecology, to be a luxury that they can do without. Even many medical schools in the USA no longer require that their pre-medical students obtain a biological major. Basic biology is not a luxury at all, but rather an absolute necessity. Despite our human-centred attitudes, other life forms are not irrelevant to our own existence. As proven products of natural selection that have adapted to natural environments over millennia, they have a right to exist, too. With human populations burgeoning and pressures on space and other limited resources intensifying, we need all the biological knowledge that we can possibly get.

Ecological understanding is particularly vital. There has to be a great urgency to basic ecological research, simply because the worldwide press of humanity is rapidly driving other species extinct and destroying the very systems that ecologists seek to understand. No natural community remains pristine. Pathetically, many will disappear without even being adequately described, let alone remotely understood. As existing species go extinct and even entire ecosystems disappear, we lose forever the opportunity to study them. Knowledge of their evolutionary history and adaptations vanishes with them: we are thus losing access to valuable biological information itself. Indeed, as H. Rolston remarks in 'Duties to Endangered Species' (*BioScience* 35, 1985), 'destroying species is like tearing pages out of an unread book, written in a language humans hardly know how to read'. Just as ecologists in many parts of the world are finally beginning to learn to read the unread (and rapidly disappearing) 'book', they are encountering governmental and public hostility and having a difficult time attracting support.

Australia has been undergoing a gradual natural process of desertification for the last million years, but that process has accelerated greatly during the past century due to human activities, particularly agricultural clearing and overgrazing and the burning of fossil fuels. As our population burgeons and we destroy the last remaining natural habitats, earth's atmosphere is being altered at an ever-increasing rate, leading

Typical west Great Victoria Desert vegetation - spinifex and marble gums. Photo - David Pearson

Gould's sand goanna, a generalist predator of insects, other lizards and small mammals. Photo - David Pearson

to weather modification. Long-held meteorological records the world over are being broken: a few years ago, the lowest low ever recorded (during Hurricane Gilbert) in late summer was followed in winter by the highest high on record. On 21 February 1991, Perth experienced the highest temperature (46.2°C) ever recorded in 150 years of habitation. Global warming is having its impact on virtually all plants and animals, including humans, and its effects will continue to intensify into the foreseeable future. Crop failures and other ecocatastrophes seem to be inevitable.

Fires were once a major agent of disturbance in all grasslands and semideserts, including African savannas and the North American tall grass prairies. Most of these ecosystems have now been reduced to mere vestiges, and controlled burning and/or fire control are practised by humans almost everywhere. The inland Australian desert is one of the last remaining areas where natural wildfires are still a regular and dominant feature of an extensive natural landscape largely undisturbed by humans. (Aborigines do increase the frequency of fires, but most are started by lightning.) The Australian deserts constitute an exceedingly valuable system for the study of large-scale community ecology.

Inroads on the wilderness have gone far enough. In both North America and in the Kalahari, most of my study sites have succumbed to farming and urbanisation, as have deserts almost everywhere. So far, the spinifex desert has been able to resist the advancing human exploiters. Some people dream of the day that technological 'advances', such as water movement plans or distillation of sea water, will make it possible to replace the desert with vast agricultural fields or even cities. I fervently hope that this never happens, for if it ever should, the quality and dignity of our lives will be sadly diminished.▣

*Ctenotus piankai* and *Ctenotus helenae*. During 1966-68, Eric Pianka and his ex-wife Helen discovered half a dozen undescribed species of skinks.

Eric Pianka is Denton A. Cooley Centennial Professor of Zoology at the University of Texas at Austin. His textbook, *Evolutionary Ecology*, has been translated into Japanese, Polish, Russian and Spanish. He has researched lizard ecology in North America and the Kalahari Desert as well as in Western Australia. In 25 years he has made four trips 'down under', once as a Guggenheim fellow (1978-79), living four full years in the outback. He is the acknowledged pioneer of research on the ecology of lizards in the WA part of the Great Victoria Desert; one of his two doctorates is a D.Sc from the University of Western Australia. In 1990-91, he came back as a Fulbright Senior Research Scholar under the auspices of the Australian-American Educational Foundation. He was hosted by the Zoology Department at the University of Western Australia and by CALM, and funded by the National Geographic Society.

Professor Pianka describes his work in Australia as 'rediscovering what Aborigines once knew and writing it down in scientific English'. He seems to have taken Australia to his heart; even 'those pesky face flies' haven't kept him from coming back again and again. He hopes to return several more times during the coming decade, although global warming threatens to alter the landscape.

He recently received grants from NASA (the US National Aeronautics and Space Administration) and NSF (the National Science Foundation) to undertake a fullscale landscape ecology analysis of fires using satellite imagery.

# Webs of the Forest

**by Alan Walker**

Tall eucalypt forests growing close to the water's edge, tranquil forest streams and moist, green gullies are not just important for their scenic qualities. The web-like network of rivers, streams and wetlands forms a vital life-support system for native wildlife in WA's jarrah and karri forests. A review of forest management now proposes to improve the system of zones that protects these watery areas.

As well as having great scenic beauty, areas that fringe forest streams and rivers are important for protecting water quality. Undisturbed vegetation along streams protects rivers and streams from salination, sedimentation, changes in water temperature and erosion.

Above all, they are important sites for wildlife. River and stream zones are a small but critical source of diversity within the forest ecosystem. Because of their high nutrient and moisture status these areas are exceptionally rich in species. For example, the streams of the karri forest are home to nine species of fish, several species of freshwater crustaceans and several hundred species of other invertebrates. Many of these water-dwelling invertebrate species have yet to be named.

River and stream zones are also rich sites for birds. The greatest spectrum of bird species are found close to rivers and streams and these areas also support greater numbers of individuals than upland sites. Small mammals are found in the greatest numbers (species and individuals) in sites lowest in the landscape. The water rat and quokka are most common in these sites. Stream terraces in the south-west forests have been found to be critical habitat for the quokka. Several species of frogs and reptiles are also most common in and near rivers and streams. Some frogs, such as the yellow-bellied frog (*Geocrinia lutea*) and red bellied frog (*G. rosea*), are largely restricted to the karri forest. All reptiles known in the karri forest occur in stream zones, including two that are most common there - the long-necked tortoise (*Chelodina oblonga*) and mourning skink (*Egernia luctuosa*).

However, river and stream zones are highly sensitive to disturbance, particularly soil compaction, erosion and sedimentation.

*Previous page:*
Shannon River.
Photo - Robert Garvey

This river in the jarrah forest will be protected by formal river and stream zones for the first time, if recommendations of a new report are accepted.
Photo - Marie Lochman

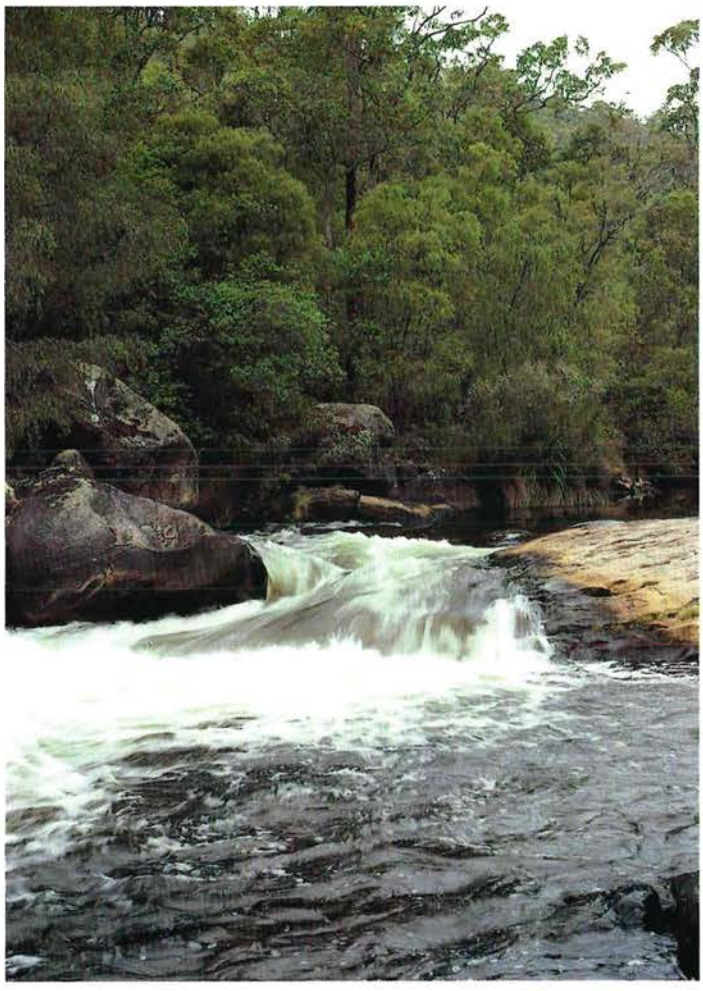
The quokka will be favoured by the protection of stream zones.
Photo - Jiri Lochman

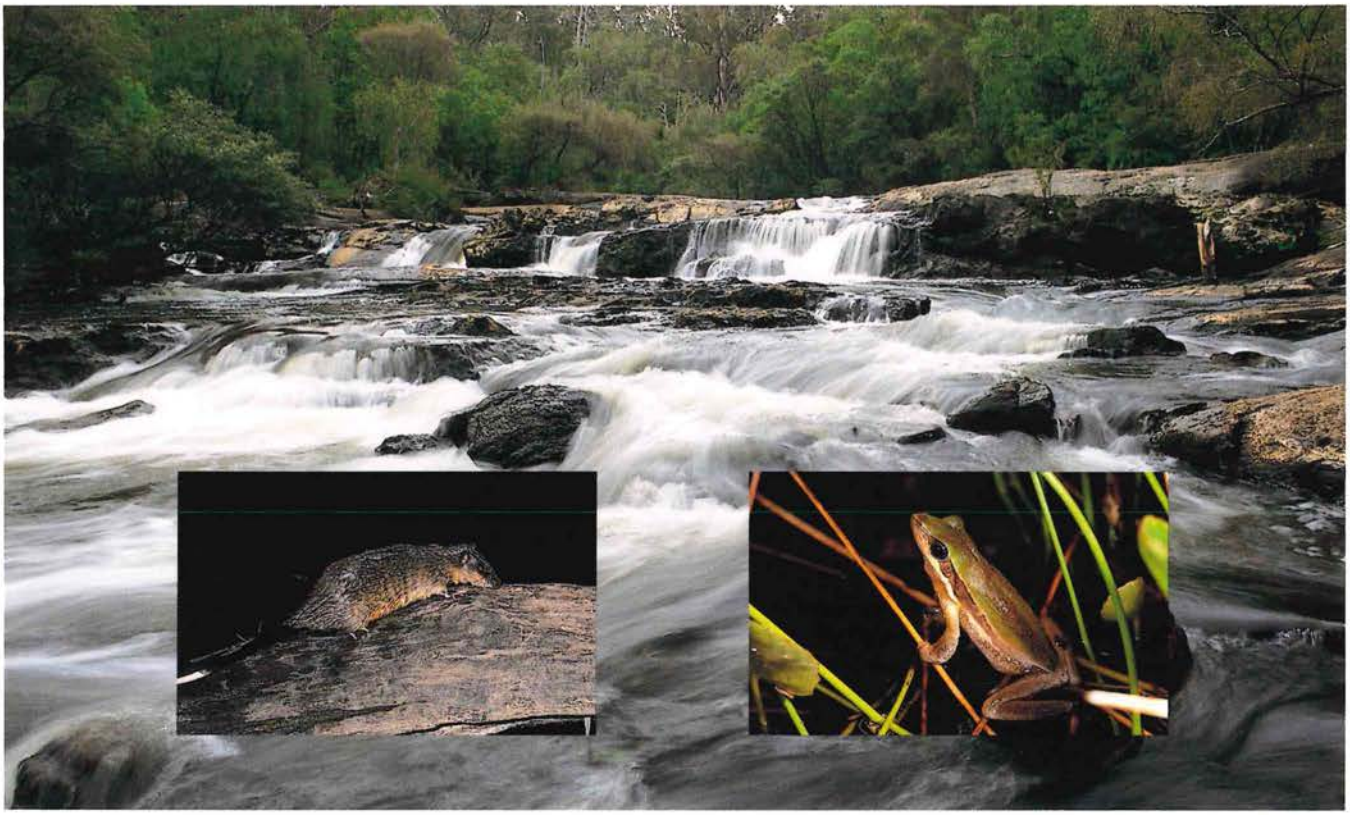
Rivers and streams in south-west forests are very important habitat for several hundred species of invertebrates, including this water spider.
Photo - Jiri Lochman

## PAST TO PRESENT

Until the late 1960s, there were no restrictions on timber harvesting in State forest. Operators could harvest timber right up to the edge of streams and roads. This was widely by the community.

But community attitudes began to change, and the forest became increasingly valued for its scenic beauty and as wildlife habitat. No longer was the forest seen only as an economic resource. At the same time, overseas research





findings on the importance of streamside areas had come to the attention of forest managers and research scientists in WA.

The importance of areas along rivers and streams was formally recognised in 1973 in the Environmental Impact Statement for the proposed woodchip licence - the first environmental impact statement to be produced in WA. A network of road, river and stream reserves was recommended, and these were formally established in 1974. No timber harvesting could be carried out in these areas. Reserves were situated along the major permanent streams in the forest. There had been no specific research into the optimum width. However, along selected streams 100 metres of forest either side of the stream was protected; this width increased to 200 metres on either side of rivers. This was based in part on the height of a karri tree (up to 87 metres) and the impact it would have if it was felled towards a stream.

It was also decided to leave substantial strips along major roads to provide vistas of undisturbed vegetation for tourists travelling on major roads. The Impact Statement required that 200 metres on either side of these roads be left unharvested. This was subsequently doubled to 400 metres by the Forests Department, partly to improve fire management in the forest.

A network of road, river and stream reserves, which were protected from timber harvesting, was formally established in 1974.
Photo - Marie Lochman

*Inset:*
Wildlife is richest in these zones, including species such as the water rat and the slender tree frog.
Photo - Jiri Lochman

## STREAMING AHEAD

Since 1974, an increasing amount of research was conducted into hydrological and wildlife values within river and stream zones. For instance, CALM scientist Grant Wardell-Johnson has reviewed the importance of streamside zones and other areas of retained native vegetation in forest areas of Australia, established a study of bird populations in the karri forest and examined the ecology of rare and restricted frogs confined to stream zone habitat in the south-west. The WA Water Authority has examined the hydrology of streams in the karri and jarrah forests and Murdoch University and the University of WA has studied freshwater fish. With this research came the realisation that the system of stream zones designed in the 1970s was inadequate to protect these sensitive areas properly. For one thing, the reserves were confined to the Southern Forest region. And, for another, they did not protect minor streams or wetlands.

As a result of the EPA report on the 1987 Forest Region Management Plan and the WA Chip and Pulp Environment Review, the Minister for the Environment asked Department of Conservation and Land Management (CALM) to review road, river and stream reserves in the southern forest.

Because of this and other requirements, and because this presented a great opportunity to apply increased knowledge about the forest ecosystem and improvements in technology, CALM decided to conduct a major review of native forest management in Western Australia. The draft review was released in February this year.

Besides looking at river and stream zones, the review has proposed 18 new national parks and other conservation reserves, recommended more sensitive timber harvesting techniques, and established sustainable levels of wood yield from native forests (see Bush Telegraph).

In addition, it proposes to extend river and stream zones through the whole forest, including the northern jarrah forest, for the first time. In fact, it says that every single forest stream and wetland, including valley head-waters and seepage areas should be protected in

river and stream zones. If the recommendations are accepted, 63 100 hectares in the Southern Forest and 91 400 hectares in the Central Forest and Swan regions will be allocated to river and stream zones - a hefty total of 154 500 hectares. This compares with the 30 800 hectares currently protected in stream and river zones in the Southern Forest.

The review recommends that the width of river and stream zones should vary according to soil type, slope, type of harvesting, rainfall zone and, of course, the width and importance of streams. The width of the zones themselves would vary from 30 metres on either side of minor streams to 200 metres on either side of major streams or rivers. Natural features would be used to select river and stream zone boundaries.

## MOSAIC OF CORRIDORS

The forest management review also recognises the significance of the mosaic of heath, sedge, herb and woodland formations, rock outcrops, swamps and wetlands throughout the forest (diverse ecotype zones).

River and stream zones provide corridors for the movement of animals, and because of their web-like pattern they automatically provide diversity in forest structure, which promotes wildlife and aesthetic values. Under the proposals, 3 200 hectares of mature karri forest will be allocated as linkage corridors. This will ensure that the maximum distance between patches of retained forest in areas harvested for timber is about 400 metres.

To make river and stream zones even more valuable to wildlife, additional movement corridors and patches of mature forests will be set aside to link them with aesthetic zones and diverse ecotype zones, resulting in a mosaic of interconnected strips and patches.

The map of Jane Block, in the Pemberton District, shows the extent of the various reserves that will be kept free of timber harvesting and the typical pattern they create across the forest.

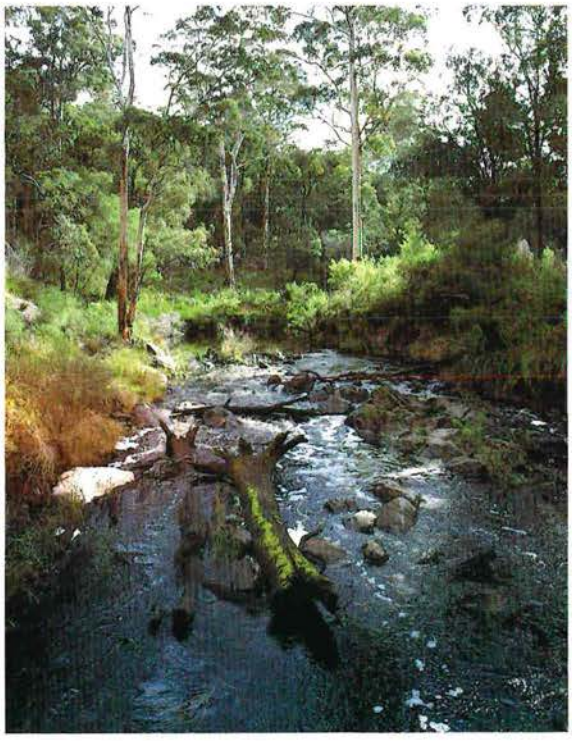
Like the current system, roads, trails and tramways through the forest are earmarked for special protection. A 200-metre zone on either side of major travel routes and a 100-metre zone on either side of minor travel routes will be left undisturbed in the southern forest region. A total of 63 roads, trails and tramways in this region will have zones on either side of them, compared with 38 roads under the current system. However, the total area of road zones will be reduced from 41 000 to 18 000 hectares. This reduction has been made to allow increases in stream and river zones and allocation of retained patches of mature forest distributed throughout the multiple purpose forest. However, the redistribution has been made without compromising the region's aesthetic values.

The new system of river and stream reserves, if accepted, should provide lasting benefits to the forest system and its water and wildlife for a long time to come. However, taken together with other recommendations of the Forest Strategy, they will be even more effective. The road, river and stream reserve system will ensure habitat trees and wildlife corridors are left intact and water remains pure; other initiatives such as Operation Foxglove will considerably reduce predation pressure on our unique wildlife. ▣

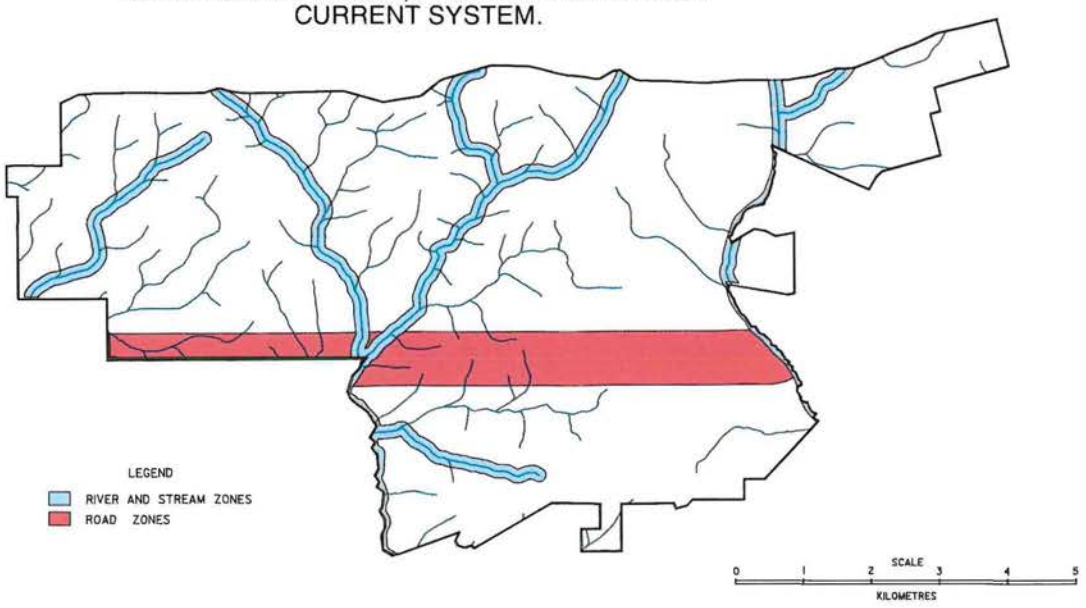
Alan Walker was Regional Manager of CALM's southern forest region for 5 years and helped to prepare the review of native forest management in WA. Submissions on the review should be forwarded to Forest Strategy Submissions, c/o CALM, PO Box 104, Como, 6152. Viewing copies are available at public libraries and all CALM offices. Copies can be purchased for $10 each from most CALM offices.

*Below:*
In the past, clearing for agriculture occurred to the edge of streams resulting in problems of erosion and salination.
Photo - Jiri Lochman

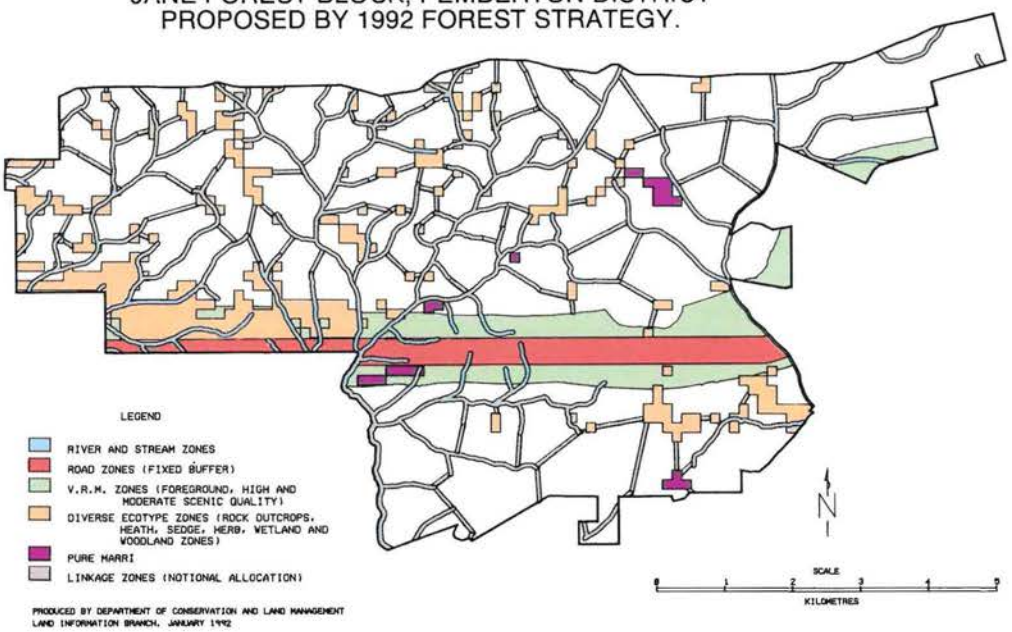
*Right:*
River and stream zones in the State forest will be increased from 30 800 to 154 500 hectares.
Photo - Jiri Lochman



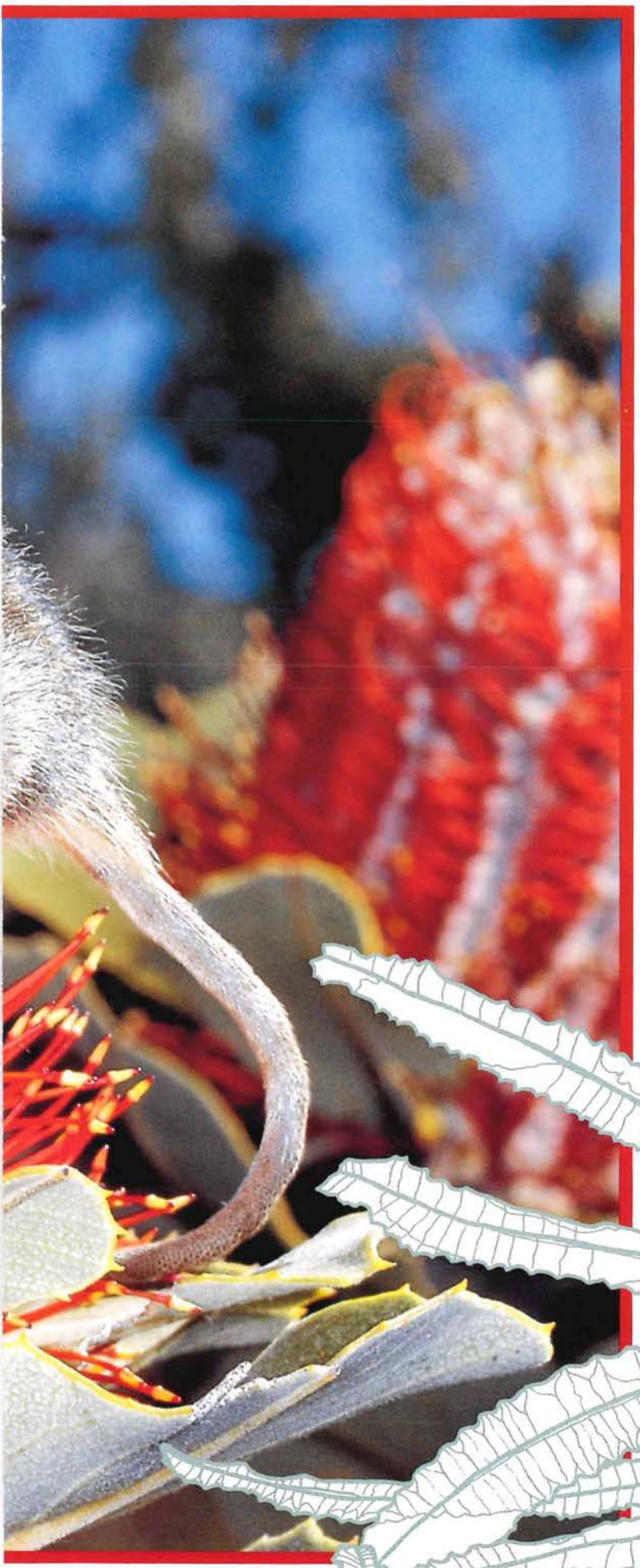
DISTRIBUTION OF ROAD, RIVER & STREAM ZONES
JANE FOREST BLOCK, PEMBERTON DISTRICT
CURRENT SYSTEM.




DISTRIBUTION OF ROAD, RIVER, STREAM & OTHER ZONES
JANE FOREST BLOCK, PEMBERTON DISTRICT
PROPOSED BY 1992 FOREST STRATEGY.



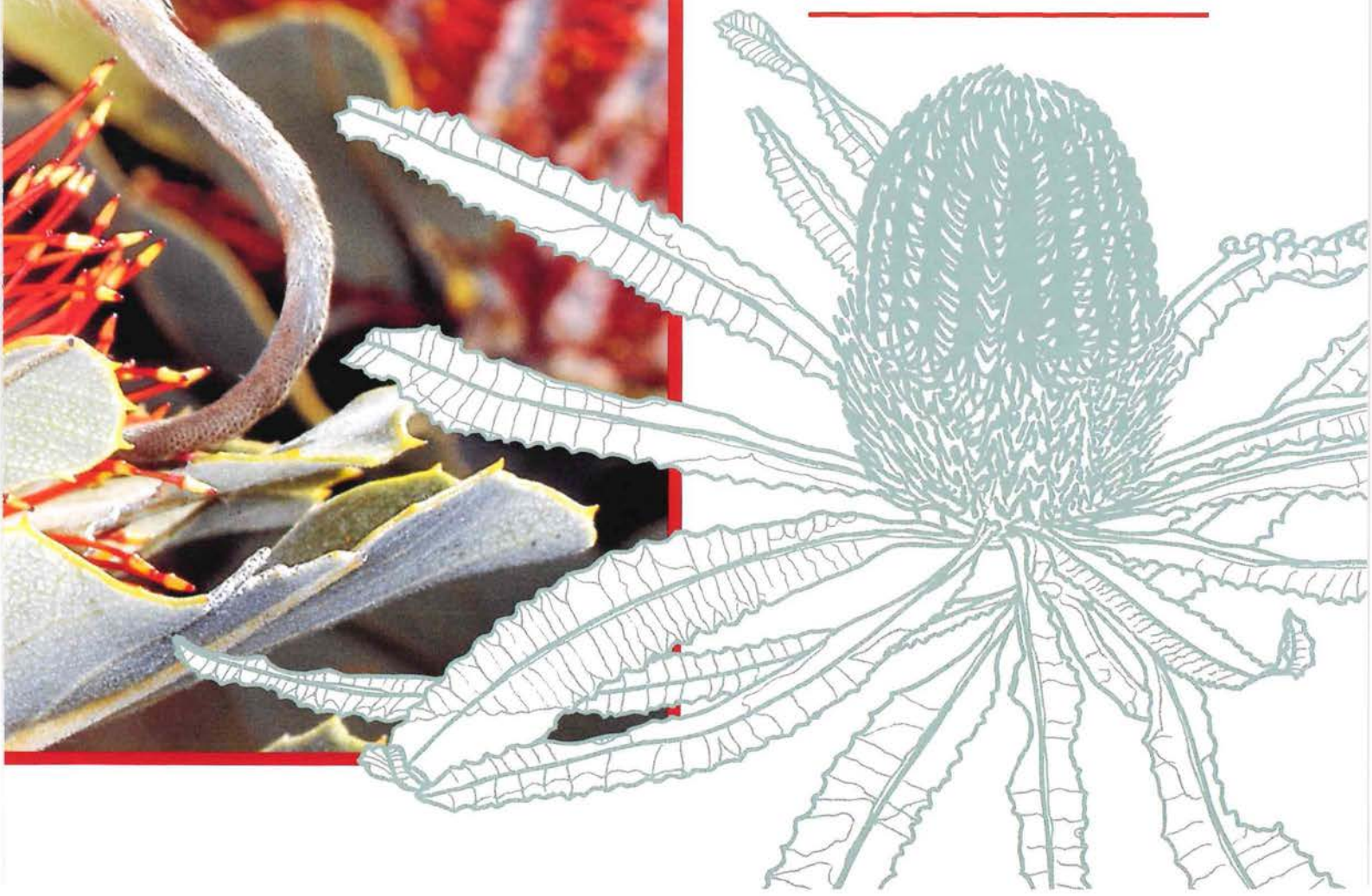

PRODUCED BY DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
LAND INFORMATION BRANCH, JANUARY 1992



# POSSUM in Peril

*by Gordon Friend*

*Tiny honey possums are still common in heathlands of the south-west... but for how much longer? They rely on a range of flowering plants for a year-round supply of nectar and pollen - the very same plants that are threatened by the killer dieback fungus.*



The species-rich heathlands and shrublands of the south-west of Western Australia are home to one of Australia's most unusual mammals, the honey possum, or *noolbenger*, as it was known to the Aborigines. In fact, it is no more a possum than it is a bandicoot or a dunnart, being so distinct that it is in a category all of its own: the superfamily Tarsipedoidea.

This tiny marsupial is highly specialised for feeding on nectar and pollen. Its long, pointed snout and brush-tipped tongue are perfectly suited for probing the flowers of banksias and other plants. Apart from some bats, the honey possum is the only mammal in the world that feeds exclusively on nectar and pollen. This amazing species has the smallest newborn young of any mammal, but the largest sperm. Reflecting the latter's size, the testes are suspended in a large scrotum which represents a significant proportion of the animal's body weight (the testes alone being more than four per cent). Its breeding is not related to seasons, but is closely tied to the flowering patterns of the nectar-producing plants on which it relies.

Although the honey possum is of great scientific interest, there was little, if any, ecological research on the species until the late 1970s. This was mainly because no-one knew how to catch the animals, as they would not enter the usual metal or wire-cage trap. In 1976 a team of Murdoch University researchers (Ron Wooller, Marilyn Renfree and Eleanor Russell) working in the Albany area heard that local farmers often found honey possums in newly dug post holes, particularly in sandy areas near remnant bush. These scientists established a pitfall

*Previous Page:*
The honey possum, seen here feeding on a *Banksia coccinea,* pollinates several heathland banksia species.
Photo - Bert and Babs Wells

*Above:*
*Banksia grandis* and *Banksia caleyi* are important food sources for honey possums.
Photos - Jiri Lochman

*Below:*
The honey possum is so distinct it is in a category all of its own.
Photo - Jiri Lochman

trapping technique which readily caught the possums, and over the next 15 years the Murdoch team, together with researchers from other organisations, assembled a vast amount of information on the population dynamics, habitat preferences, breeding and diet of the species. Ken Richardson and Ron Wooller gathered much of the recent data from the Fitzgerald River National Park, in a project supported by the World Wide Fund for Nature Australia (WWF).

Honey possums are found only in the south-west of Western Australia, where they occur in heathlands on sandy soils which support a rich assemblage of plant species of the families Proteaceae (banksias, dryandras, grevilleas and so on) and Myrtaceae (such as eucalypts and bottlebrushes). This habitat restriction reflects the animal's specialised diet of pollen and nectar. Studies of pollen samples from the head fur of honey possums have shown that, although the plant species used differ between areas in accordance with species' distributions, the possums consistently relied on proteaceous species, particularly banksias. For example, in the heathlands along the south coast near Albany, Ron Wooller and his colleagues from Murdoch, and Steve Hopper from the Department of Conservation and Land Management (CALM), found that honey possums collected food from at least 13 species of plants, 11 from the Proteaceae and two from the Myrtaceae (see Table). Particularly important were a bottlebrush (*Beaufortia anisandra*), which was used during summer, nodding banksia (*Banksia nutans*), which was important from autumn to spring, and scarlet banksia (*Banksia coccinea*), used throughout spring and early summer.

*Above left:*
Young possums accompany their mothers for the last three to four weeks of a 12-week suckling period.
Photo - Bert and Babs Wells

*Top right:*
Honey possums probe banksia flowers with their long pointed snouts and brush-tipped tongues for nectar and pollen.
Photo - Jiri Lochman

*Above right:*
Honey possums sometimes shelter in abandoned bird nests.
Photo - Bert and Babs Wells

*Right:*
They have the smallest newborn young of any mammal.
Photo - Bert and Babs Wells

More recent work by Ken Richardson and Ron Wooller in the western half of Fitzgerald River National Park showed that nodding banksia is the main summer food there, with woolly banksia (*Banksia baueri*) and four species of *Dryandra* important over winter. Scarlet banksia, however, was relatively unimportant.

Further north, in the heathlands within the jarrah forest near Dwellingup and Pinjarra, consultants surveying mammals for the Worsley Alumina project found that the possums relied mainly on various species of *Dryandra*, particularly couch honeypot (*Dryandra nivea*), as well as woollybush (*Adenanthos cygnorum*), one-sided bottlebrush (*Calothamnus quadrifidus*) and graceful honeymyrtle (*Melaleuca radula*). Similarly, near Mt Lesueur north of Perth, Steve van Leeuwen from CALM found the possums relied on a number of Proteaceous and Myrtaceous species, in particular pine banksia (*Banksia tricuspis*), *Banksia micrantha*, couch honeypot and silky-leaved blood flower (*Calothamnus sanguineus*).

This work on the food preferences of honey possums showed that, in some areas, the possums' reliance on certain plant species differed somewhat from that of the honeyeaters. In the jarrah heaths, for example, the honey possum appeared to be a major pollinator of ground-hugging species with inconspicuous flowers, plants that are seldom visited by honeyeaters. This research also showed that in any

## A CONFUSION OF NAMES

Photo - Michael Morcombe

This diminutive creature (males weigh only about nine grams and females 11 grams) came to the attention of the scientific world in the 1840s, when specimens from the King George Sound area were sent to England. It was given the generic name *Tarsipes* because its long, slender foot (*pes*) was similar to that of the small primate *Tarsius* from Indonesia and the Philippines. However, there was considerable confusion over the specific name; it was called *rostratus* by Gervais and Verreaux and *spenserae* by Gray, both in early 1842. Gray named the species after Eliza Lucy Spencer, wife of Governor George Grey, but misspelt it. There were thus three specific names in common usage - *rostratus, spenserae* and *spencerae*, and this caused turmoil in the scientific literature. In the early 1980s some careful detective work by Jack Mahoney from the University of Sydney established that a communication by Gervais and Verreaux, in which they describe *Tarsipes rostratus*, was published on 3 March 1842, only five days before Gray's description was published. By the law of taxonomic priority the honey possum is therefore called *Tarsipes rostratus*.

heathland area there are always several plant species in flower, providing a source of pollen and nectar for the possums throughout the year.

The honey possum and the plants on which it lives have thus evolved together, with the possum relying on the plants for food, and the plants being pollinated by the possum. The honey possum's highly specialised adaptations enable it to respond in a very fine-tuned way to the seasonal and annual changes in its habitat and its food. This may become the species' downfall, however, in an environment increasingly subject to disturbance.

### UNDER THREAT

Apart from direct destruction of heathlands through clearing, two kinds of disturbance threaten the honey possum. The first, fire, is likely to be a problem mainly on a local scale, and then only if large tracts of habitat are burnt by high intensity wildfire at frequent intervals leaving few unburnt patches. Research being carried out by CALM on the south coast is showing that honey possums can use areas burnt at low to moderate intensity, provided there are nearby patches of unburnt vegetation from which the animals can recolonise. Management strategies that reduce the intensity, frequency and extent of wildfires are therefore likely to enhance the survival of local populations of honey possums.

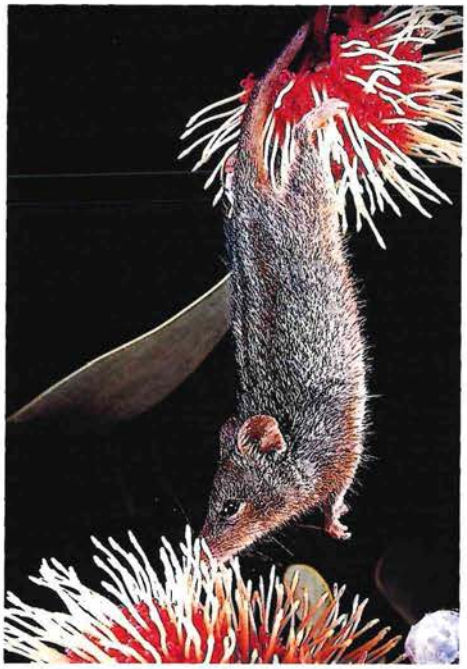
The other threat to the future of this species leaves no room for complacency. Soil and airborne fungi which attack and kill plants through either their aerial shoots or root systems are an enormous threat to south-west ecosystems (see *LANDSCOPE*, Spring 1991). There is, as yet, no practical cure for these diseases.

The best-known and most widely researched of these pathogens is the dieback fungus, *Phytophthora cinnamomi* (see *LANDSCOPE*, Spring 1989 and 1991). Since the soil-borne fungus was shown to be the cause of the mysterious death of patches of jarrah forest in 1965, scientists have learnt much of the dynamics of the organism, the conditions under which it rapidly spreads, and the quarantine techniques needed to limit its spread. Most of this research, however, has concentrated on the jarrah forest, and only in the last few years did work commence on the

heathland and shrubland ecosystems which are just as susceptible to dieback. Furthermore, a poorly known group of aerially dispersed canker fungi was recently identified as the cause of the crown-induced dieback of many south coast heathland species, particularly in the Fitzgerald River National Park.

Many of the plants most susceptible to dieback and the canker fungi belong to the Proteaceae and Myrtaceae families that dominate the heathlands. These are the same plants upon which the honey possum is dependent. Of the 13 major food plants used by honey possums on the south coast near Albany, five are highly susceptible to dieback (80 per cent killed at any site), seven are of variable susceptibility (20-80 per cent killed depending on site conditions), and one species (*Calothamnus gracilis*) is resistant (see Table). Similar statistics are likely to apply to areas where honey possums occur in the jarrah forest, and in the heathlands north of Perth.

More than any other small vertebrate, the honey possum is on a collision course with these dieback fungi. If their advance cannot be checked in the near future, we may witness a dramatic alteration in the structure and composition of heathland animal and plant communities, and our unique honey possum may become a new species under threat. ⊡



*Top:*
Typical honey possum habitat in the south-west heathlands.
Photo - Bert and Babs Wells

*Above:*
The mammals are extremely agile and use their tail and unusual feet for climbing.
Photo - Michael Morcombe

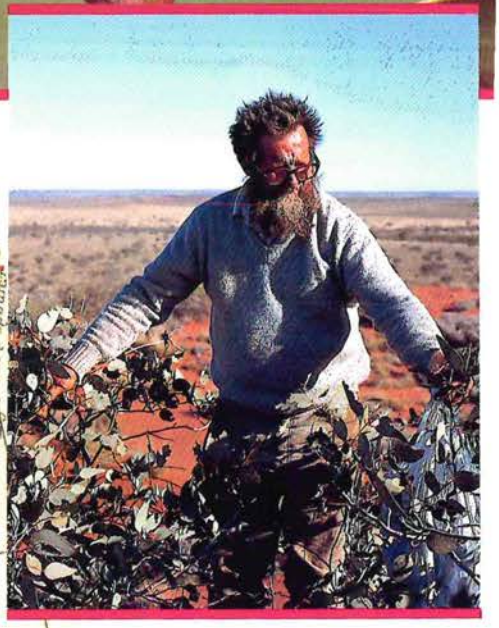
**Some major food plants of honey possums on the south coast near Albany and their susceptibility to *Phytophthora cinnamomi***

| Species[1] | Susceptibility[2] |
|---|---|
| Proteaceae | |
| *Adenanthos cuneata* | *** |
| *Banksia attenuata* | ** |
| *Banksia baxteri* | *** |
| *Banksia caleyi* | ** |
| *Banksia coccinea* | *** |
| *Banksia gardneri* | ** |
| *Banksia grandis* | *** |
| *Banksia nutans* | *** |
| *Banksia occidentalis* | ** |
| *Banksia quercifolia* | ** |
| *Banksia sphaerocarpa* | ** |
| Myrtaceae | |
| *Beaufortia anisandra* | ** |
| *Calothamnus gracilis* | R |

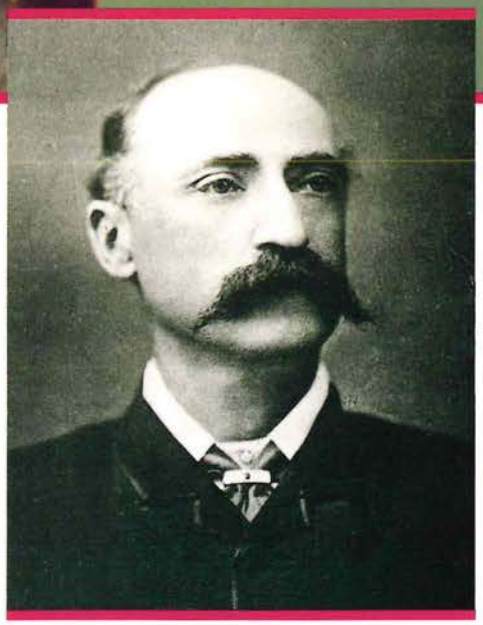
** variable susceptibility (20-80% killed, depending on site conditions)
*** highly susceptible (>80% killed at any site; species at risk)
R resistant
1. Data from Dr R D Wooller and colleagues, Murdoch University, and Dr S D Hopper, CALM.
2. Data from Dr R T Wills, CALM.

Gordon Friend is a CALM research scientist studying the impact of fire on small vertebrates in the south-west heathlands. He can be contacted at CALM's Wildlife Research Centre on (09) 405 5100.

# In the footst

# eps of Giles



by Steve Hopper

For 115 years, Giles' mallee (Eucalyptus rameliana) was known only from a few leaves, flowers and a bud collected by the explorer Ernest Giles on his final expedition across the Western Australian deserts in 1876. It was the only one of about 800 eucalypts presumed to be extinct. Steve Hopper describes the search for the elusive species.

The original specimens of Giles' mallee (*Eucalyptus rameliana*) were handed to Victoria's government botanist Baron F. von Mueller, who immediately recognised the species as new to science. The specimens are still in the National Herbarium in Melbourne. Mueller recorded the collection locality as 'beyond the Alfred and Marie Range'. These small hills are 180 km north-north-west of Warburton, and 300 km west of the WA-Northern Territory border.

Ernest Giles named the Alfred and Marie Range on his third expedition in 1874, approaching from the east, but had to turn back with the ill-fated Gibson before reaching the Range. (Gibson, dehydrated and fatigued, became lost while riding Giles' horse back to camp, and perished without trace - Giles named the Gibson Desert after him.) Giles and company passed the northern end of the Alfred and Marie Range on his fifth expedition, two years later. His travels are documented in the two-volume work *Australia Twice Traversed*, published in 1889.


Although he diligently recorded landscape and vegetation, Giles made no reference to the handsome-flowered and large-leaved mallee, either when he was near the Alfred and Marie Range or elsewhere on the 1876 expedition. This contributed to much of the intrigue and frustration of many subsequent searches for the elusive mallee.

## THE SEARCH BEGINS

Specimens of Giles' mallee have sat in relative obscurity in the National Herbarium. But interest in the mallee increased dramatically over the last decade, and several fruitless expeditions to the Alfred and Marie Range area were mounted in search of the tree. The Range, in the Gibson Desert Nature Reserve, lacks any clearly defined tracks. The Gary Highway lies 80 km to the west, and a track to the Clutterbuck Hills is 40 km to the east. In 1983 Andrew Burbidge, Phil Fuller, Ron Sokolowski and I, then staff of the former Department of Fisheries and Wildlife, explored the Clutterbuck Hills area, and travelled along seismic survey tracks to Lake Gruszka, 50 km from the Alfred and Marie Range. No Giles' mallee was seen.

Eucalypt enthusiast Peter Grayling began searching for Giles' mallee in November 1985. With local guides from Warburton, he went north of Lake Gruszka along a seismic line to its termination about 40 km from the northern end of the Alfred and Marie Range. He, like us, viewed the range in

*Previous page:*
Nick Foote's specimen of Giles' mallee (*E. rameliana*), the first collection made since that of Giles in 1876.
Photo - Steve Hopper

Part of the map from Giles' book *Austalia Twice Traversed* showing the route of his fifth and final desert expedition in 1876.

Nick Foote among Giles' mallees in August 1991.
Photo - Steve Hopper

Ernest Giles (1835 - 1897)

*This page:*
Giles' mallee differs from all other desert eucalypts in its solitary buds and fruits, its smooth bud caps, and its broad leaves. These are the first flower buds collected since 1876.
Photo - Steve Hopper

the distance, but had to turn back without the rare mallee.

Early in 1988, horticulturist Susie Bright spent some time in the area with an eye open for Giles' mallee, but to no avail. In July 1988, Andrew Chapman, Mike Tagliaferri and David Pearson of the Department of Conservation and Land Management (CALM) drove cross-country from the Clutterbuck Hills to the Alfred and Marie Range. They spent four days exploring its entire length, without finding the eucalypt.

A young eucalypt enthusiast, Dean Nicolle, and his family, also made expeditions to the Alfred and Marie Range. They travelled across trackless country from the Gunbarrel Highway North to the western side and then to the north end of the Alfred and Marie Range in 1990. Giles' mallee was again elusive, but the family became enthusiastic about a more enterprising venture.

In April 1991, the party, which now included eucalypt botanist Ian Brooker, of the CSIRO, and seed collector David Kleinig, followed the Nicolles' old wheeltracks to the north end of the Range. The next morning Bob and Dean Nicolle began a four-day 80 km walk westwards from the north end of the Range along Giles' 1876 path. Brooker and Kleinig spent a day exploring the northern end of the Range, seeing only a single eucalypt tree (appropriately, a ghost gum) before leaving empty-handed the next morning.

Bob and Dean Nicolle, however, found two smooth-fruited plants in a population of Kingsmill's eucalypt (*E. kingsmillii*) about 30 km east of the Gary Highway, and believed that at last they'd found Giles' mallee. They also found another mallee with smooth fruits and long, sharply pointed buds on slender stalks that didn't match anything previously recorded. Subsequent examinations revealed these were probably the first collections ever made of a rare hybrid of Kingsmill's eucalypt and *E. leptopoda* (the plant with sharply pointed buds) and of a poorly known Gibson Desert relative of *E. oxymitra* or Oldfield's mallee (*E. oldfieldii*).

After returning to Adelaide and sending specimens to Ian Brooker, a third expedition was mounted immediately. They drove to the Gary Highway pick-up point, and then across

The spectacular flowers of the Rose Mallee *(E. rhodantha)*, with a Yellow-throated miner probing for nectar upside down. The Rose Mallee may be the closest relative of Giles' mallee.
Photo - Babs and Bert Wells

trackless terrain east to the interesting mallees. Thousands of Kingsmill's eucalypt were seen during the search, but no plants matching Giles' single-flowered specimen were found. So exhaustive searches in this remote part of the Gibson Desert had still not located a population of Giles' elusive mallee.

As a stimulus to further exploration, on 17 May 1991 the species was officially listed on Western Australia's Schedule of Declared Rare Flora. It joined 52 other species under Item 2 of the Schedule, the inaugural listing of 'taxa presumed to be extinct'.

## REDISCOVERED AT LAST?

In July 1991, three months after Dean Nicolle's collection, Nick Foote and family were searching trackless country for a well on the old rabbit-proof fenceline 100 km south-east of Newman. Foote, an intrepid prospector, wildflower picker, artisan and keen natural historian, was interested in establishing a lease over vacant Crown land in this remote part of the Little Sandy Desert. He drove over a sand dune and '...bang, there it was. It had a bluey-red look and broad leaves, a bit like seedlings of caesia (*Eucalyptus caesia*), and was growing in spinifex and low heath dune country with grass trees, a bit like Badgingarra'.

The 1-2 m high mallees looked like nothing else they had seen in the area. Nick knows his eucalypts fairly well. He noted the large solitary fruits of this mystery mallee, a feature he'd seen elsewhere only in the rose mallee (*E. rhodantha*) and mottlecah (*E. macrocarpa*) of the Wheatbelt a thousand kilometres away. He was aware that Giles had travelled near the site of the mystery mallee in June 1876. Could this be Giles' mallee?

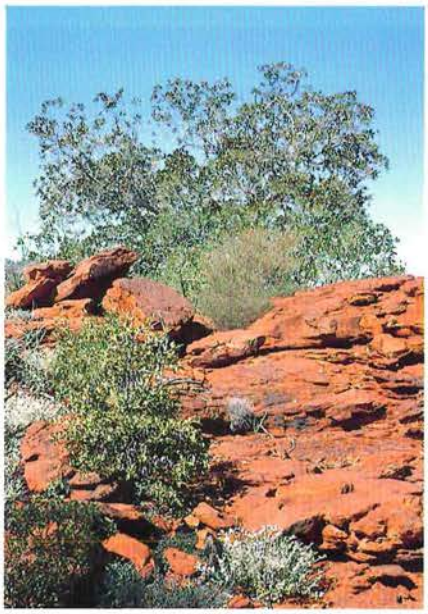
On July 15 I was working in my lab at CALM's Wildlife Research Centre when I received a broken radio telephone message via the Royal Flying Doctor Service at Meekatharra. It was Nick Foote, who excitedly recounted his discovery, and answered detailed interrogation about the mallee he'd found. Only fruits were present, not buds or flowers (Giles' specimen lacks fruits). Most of the fruits were solitary, but a few were in pairs and one plant had them in threes. The leaves were broader than those of Kingsmill's eucalypt, and the bark was smooth, not rough at the base like that tree. After a year of unrewarded searches near the Alfred and Marie Range, I was keen to establish that this was not another false alarm.

From Nick's description, knowing his expertise in finding rare and unusual wildflowers, I became increasingly confident that Giles' mallee had at last turned up. But his collection site was 500 km beyond the Alfred and Marie Range!

Nick arranged to have a few specimens sent to me via the bus service from Newman to Perth. They fitted his description perfectly - Giles' mallee at last. But without mature buds and flowers, I could not match specimens exactly with that of Giles'. I extracted seed from the fruits and saw that they were large (3-4 mm long) with a prominent basal wing, a type seen only in the large colourful flowered group of Western Australian mallees such as mottlecah, rose mallee, large-fruited mallee (*E. youngiana*) and Dowerin rose (*E. pyriformis*). The solitary fruits and broad leaves suggested a close affinity between the mystery mallee and a rare form of rose mallee (*E. rhodantha* var. *petiolaris*). Even if Nick's discovery was not Giles' mallee, it was still a remarkable find, establishing a hitherto poorly documented link between the flora of the Wheatbelt and that of the Little Sandy Desert.

I decided to mount an expedition to see the mallees myself and search for more. Giles' journal was read repeatedly to attempt to map his course through the Little Sandy Desert. He frequently determined the latitude and longitude of his campsites, but the lack of a reliable chronometer meant that only his latitude readings were likely to be accurate. These readings, combined with interpolating his landform descriptions on modern topographic maps, provided some idea of where his expedition travelled. Perhaps the distribution of Giles' mallee might help determine their route more accurately?

*Grevillea wickhamii*, a spectacular shrub seen by the CALM survey party in the Little Sandy Desert.
Photo - Steve Hopper



A rock fig tops a red stone outcrop in the Little Sandy Desert. Such rocky ridges sometimes contain pools of water vital to desert life.
Photo - Steve Hopper

Giles wrote of his final push across the Western Australian desert: "...the country was almost destitute of timber, except that upon the tops of the parallel lines of red sandhills, a few stunted specimens of the eucalypt known as blood-wood existed..."
Photo - Jiri Lochman

## CONCLUSIVE PROOF

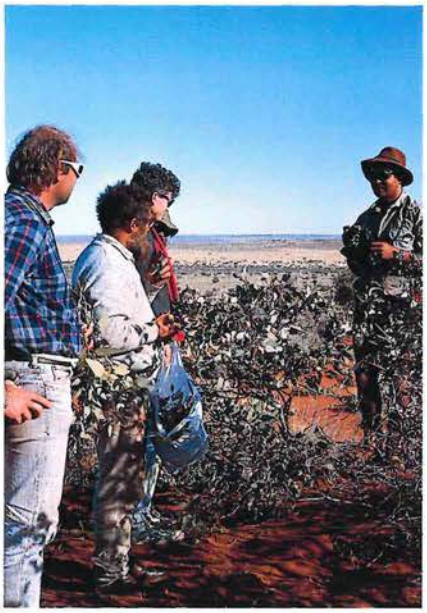
CALM Technical Officer Andrew Brown and consultant botanist Leigh Sage accompanied me. We met CALM Karratha research staff Steve van Leeuwen and Bob Bromilow at Collier Range National Park on August 7. The next day, Nick Foote joined us, and we followed his trail into the Little Sandy Desert.

It is difficult to describe the sense of excitement and history that pervaded our first view of the mallee. Extensive vistas of spinifex plains, dunes and red gravelly ridges extended in all directions, with scattered grey-green shrubs and mallees dotted here and there. Stunted bloodwood trees stood on the dune crests and slopes, pale yellow against the red sand, their leaves few and pendulous. As we neared the site of Nick's discovery, an unusual shrub with darker foliage caught my eye.

Not only was the stunted mallee unusual (most of the 50 or so plants were 1-1.5 m tall), but it was associated with a mix of common desert plants (wattles, spinifex, grevilleas, cassias) and genera more common in the south-west (such as *Lamarchea*, a peculiar one-sided bottlebrush with one species here in the desert and the other confined to the Shark Bay region; grasstrees and an early Nancy lily).

Moving on, more and more plants not previously recorded in the Little Sandy Desert were seen. Of special interest was a new species of one-sided bottlebrush (*Calothamnus*). This genus was previously thought to be confined largely to south-western Australia - the nearest known representative is found some 600 km away, at the foot of Exmouth Gulf. The Foote's track was a

*Gompholobium polyzyga*, a soft shrub found growing on the slopes of red sand dunes with Giles' mallee.
Photo - Steve Hopper



Members of the CALM survey party and Nick Foote located Giles' mallee on the crest of a high dune in the Little Sandy Desert.
Photo - S.D.Hopper

botanical windfall in more ways than one!

We followed the track as far as it went, encountering the two other mallee populations found by the Foote family, and finding two more. Despite examining several hundred plants, not a single bud nor flower was seen. Life was clearly harsh on the subdued dunes favoured by the mallee, where summer temperatures often exceed 45°C. Even new vegetative shoots were scarce.

Believing we were within 10 km of the well on the old rabbit-proof fenceline, the party pushed on through trackless terrain in the darkness, until a large sand dune halted progress. The next morning, we drove round the southern end of the dune and within a few kilometres came across a clay pan and well with tall sheoaks, but found no sign of the rabbit-proof fence.

After retracing our path, we took a final look at the biggest population of Nick's mallee. Shortly before we were due to leave, an excited shout rose from the top of a distant dune. The party converged rapidly on the spot. Nick was standing beside a single flower, resplendent with pastel pink stamens. The plant had about 100 mature buds on it, and this was the first to open. It was Giles' mallee without question. The buds and flower were an excellent match with those collected by Giles 115 years ago. This great desert mystery was solved at last!

## FOLLOW-UP

In response to media coverage of Nick Foote's rediscovery of Giles' mallee, I received a telephone call from Denis O'Meara, Manager of the Marble Bar nursery firm Outback Trees of Australia. He advised seeing plants very similar to the published photos of the mallee a decade ago, but to the north of Nick Foote's populations. He was not aware of their possible identity, and thought nothing more of them.

By striking coincidence, Denis was Leigh Sage's uncle. Leigh's enthusiastic recounting of our expedition led Denis to plan a trip retracing one of his previous trips. He and Leigh found two small populations of Giles' mallee, and managed to clarify where the rabbit-proof fence was in relation to the well and clay pan encountered on our earlier survey. These observations show that a population of the tree on or close to Giles' probable path has yet to be located.

Subsequently, Nick Foote and family have pushed beyond the rabbit-proof fence into the heart of the Little Sandy Desert, and found another population of Giles' mallee. This population is closer to Giles' path. In autumn 1992, a second major expedition of CALM staff will seek Giles' original collection locality, and follow up other leads generated by Nick Foote and Denis O'Meara. Giles' footsteps will no doubt be the source of interest and intrigue for intrepid modern-day bushmen for many years to come. ▣

Giles' mallee bud, and the only flower collected since those by Giles. This flower measured five centimetres across with pink stamens two centimetres long.
Photo - Andrew Brown

Steve Hopper is a Senior Principal Research Scientist at CALM's Wildlife Research in Woodvale. He can be contacted on (09) 405 5100.

## GILES' MALLEE
## (*Eucalyptus rameliana*)

When describing *E. rameliana* in 1876, Baron F. von Mueller pointed out its difference from all other desert eucalypts in its large smooth solitary buds on long stalks. The reproductive structures lack the prominent ribs on related desert species such as *E. kingsmilli* and *E. pachyphylla*, both of which have their buds and fruits in threes, unlike the single-flowered *E. rameliana*. Giles' mallee also has broad thick leaves and a bushy habit, which gives it an unmistakable appearance to the desert traveller, even from a few hundred metres away. Mueller dedicated the new species 'to Prospero Ramel, who introduced Australian eucalypts into southern France and Algeria'. To this day, nothing else has been published on Ramel and he remains as mysterious as his namesake eucalypt was for so long.

The species was first illustrated in Volume 2 of J.H. Maiden's monumental *A Critical Revision of the Genus Eucalyptus* (1914). Maiden was the first botanist to devote most of his career to eucalypts, and founded the National Herbarium in Sydney. He proposed that *E. rameliana* should be merely a variety of the Dowerin rose (*E. pyriformis*), but all subsequent eucalypt botanists have supported Mueller's original view that *E. rameliana* is a species in its own right.

More recently, drawings and descriptions of Giles' specimen appeared in Stan Kelly's *Eucalypts*. Vol 2 (1978), and in George Chippendale's treatments of eucalypts in the *Flora of Central Australia* (1981) and the *Flora of Australia*, Vol. 19 (1988). In addition, *E. rameliana* was featured in Anna Napier, Anne Taylor and Steve Hopper's *Survey of Rare and Poorly Known Eucalypts of Western Australia: Field Guide No. 4 Goldfields Region* (1988), a four-year project funded by the Australian National Parks and Wildlife Service. Most recently, it appeared in CALM's *Western Australia's Endangered Flora* (1990) by Steve Hopper, Stephen van Leeuwen, Andrew Brown and Susan Patrick. These works generated interest in the nation's most elusive eucalypt.

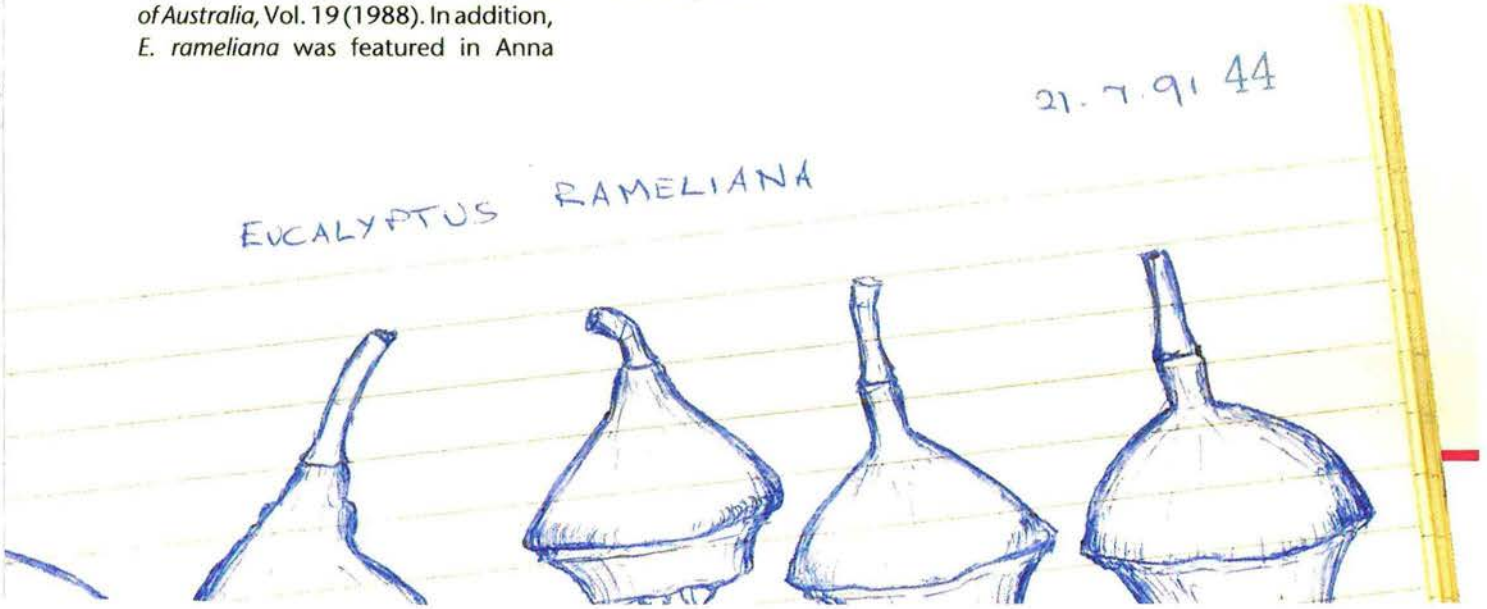
A three-year study by Dr Jane Sampson, begun in 1992, is aimed at establishing the evolutionary relationships of *E. rameliana*, and in documenting its reproductive biology. This will assist the development of a conservation plan for the species.


**A flower of *E. rameliana* from Giles' original collection sitting on the label with von Mueller's intriguing inscription '. . . beyond the Alfred and Marie Range'.**
**Photo - Steve Hopper**

**A dissected bud, an intact bud and a flower provided conclusive proof that the elusive *E. rameliana* had been rediscovered.**
**Photo - Steve Hopper**

**Sketches from the author's notebook of the fruits, seed and leaves of *E. rameliana* collected by Nick Foote from the rediscovery site in July 1991.**

CALM has prepared interim management guidelines to help introduce Giles' mallee into horticultural use. While the species remains listed as rare flora, seed or other material from wild plants can be taken only with a Ministerial permit. Before too long, Giles' mallee could become an attractive addition to native plant gardens and landscaped areas in Australia and elsewhere.



# She'll be right, mate!

## A Basic Guide to Outback Survival

**by Bob Cooper and David Gough**

*More and more people are searching for wilderness experiences, but many are unprepared for the dangers they may encounter. David Gough learned some of the basics of outback safety and bushcraft on a CALM course run by outback survival trainer Bob Cooper.*

Western Australia contains some of the world's harshest and most isolated areas. These areas can give everyone the opportunity to experience 'last frontier feelings'. Their untouched beauty tempts people to undertake journeys for which normal education has left them unprepared. Yet, as the quest for new outdoor pursuits and adventure grows, so, too, does the number of people venturing into the unknown.

Our arid land has claimed many lives, particularly over the past two decades. The victims were not just visitors, but also people who were professionals working in outlying areas. 'She'll be right, mate' and 'it won't happen to me' are attitudes that have cost thousands of dollars in search and rescue operations and have often resulted in the ultimate penalty - death. Such tragedies could have been prevented if the victims had been aware of the dangers they were likely to encounter, and if they had carried emergency supplies. But the effort to organise such emergency procedures can be arduous or time consuming and 'she'll be right' attitudes take the place of common sense. Sadly, these were the famous last words of someone who died of dehydration in 1988 after being warned by a local garage attendant about the condition of an outback track he was about to take. (Reported 8 January 1988 *DAILY NEWS*, Perth.)

## ZEN AND THE ART OF SURVIVAL

In WA 'remote' means just that. It also means abandoning the usual comforts and facilities, and immediate help when getting into difficulty - there's no RAC in Woop-Woop! Surviving unexpected emergencies in remote areas is a problem that, in essence, is yours alone. Whether or not you survive largely depends on your attitude and the decisions you make in the first few hours. These decisions can be made easier if you have had some training in what is now often called 'survival', but is more akin to what our outback-orientated ancestors called 'bushcraft'. The consequences of not having the necessary knowledge in an emergency can be very severe - even tragic.

But before you go on any trip into the outback, remember to inform people of your intended routes and estimated times of arrival, and seek the advice of the locals about road conditions and likely hazards. Remember, no-one will look for you if no-one knows you are lost.

*Previous page*: An abandoned vehicle in the Great Sandy Desert
Photo - Jiri Lochman

The Hamersley Range, in Western Australia's Pilbara region, is typical of the wilderness areas being visited by increasing numbers of people each year.
Photo - Robert Garvey

Bob Cooper demonstrates the bushman's technique of extracting fresh water from pigface.
Photo - Noel English

If an emergency does arise, you should remain with your vehicle and sit in the shade. Only if you are certain of the direction and distance to help or provisions, should you leave the site, and then only with much caution. A vehicle is easier to find than a lone person and it is also a huge source of materials for making life much easier. Remove any bright objects from the vehicle - mirrors, chromium strips, hub caps - and hang them high in a tree with empty drink cans, aluminium foil, and any other bright objects you may have available. These will blow around in the breeze and will be visible by search parties. If there are no trees nearby, lay the objects on the ground.

Remove the spare tyre, deflate it, and set it alight. The smoke will be visible for many kilometres and the fire will remain visible at night.

If you are on foot, sit in whatever shade you can find and curb the natural urge to panic.

## MANAGING YOUR BODY

There are four important factors you need to remain alive: water, warmth, shelter, and food. In different situations the relative importance of shelter and warmth may change, but dehydration and exposure are the prime killers, especially here in Australia.

If water supplies are perilously low, it is better to bury any food to avoid the temptation to eat. You can live longer without food than without water, and it takes precious body fluids to digest it. If you have water, **never** sip it. Always have a good drink. Sipping does not prevent dehydration and severely reduces your chances of remaining lucid. There are many cases where people have been found with sufficient water on them, but have still died through dehydration.

Rest during the heat of day and be active at cooler times. Wear clothes to protect the body from sun and wind;

both cause water to evaporate through the skin, which in turn speeds the dehydration process.

## OBTAINING WATER

Water sources can be found, but you need to know the signs to look for. Animal tracks form natural arrows pointing towards water. Seed-eating birds, like pigeons and finches, rarely stray more than a few kilometres from a water source. They can be seen heading towards or leaving such places in the morning or evening. If they are flying straight and hard they are probably heading towards the water source. If there are no water holes nearby, there are many other ways to obtain water.

If your vehicle has an air-conditioning unit, use it to condense water from the air. This water can be collected from the overflow pipe, near the condenser. The car may also contain another water source in the windscreen washer reservoir, but only drink this if you are sure there are no harmful additives. **Never** drink radiator water, as nowadays radiators contain anti-freeze and anti-corrosive chemicals.

About one litre of water in four or five hours can be obtained through transpiration.
Photo - Noel English

Water in old water tanks, such as this one near Mt Augustus, must still be purified before drinking.
Photo - Robert Garvey

In the early morning, dew can be collected by walking through grass and low herbage, wearing tufts of grass, sponge or absorbent cloth tied around your ankles.

On the coast, dig carefully behind the first row of dunes until water begins to seep into the hole. When this happens, stop digging and allow the water to settle. Fresh water will become suspended above the denser salt water and can be scooped from the top of the pool that forms in the hole.

A large clear plastic bag tied tightly around the branches and leaves of a healthy non-toxic tree or shrub can yield about one litre of water by transpiration in four or five hours. The bag should be tied on the sunny side of the tree or shrub and angled downwards so condensation will drain to the bottom corner. Remember to shake the branch first to remove insects and as much leaf debris as possible before tying the bag in position.

## WATER PREPARATION

All water **must** be purified before you drink it. Bacteria and germs can lead to severe illness that, if left unchecked, may kill. Diarrhoea, for example, is very serious in a hot climate. It can cause rapid dehydration and death within a matter of hours. Purification of the water will help prevent illness and greatly increase the chances of survival.

There are two stages to making water safe to drink: clarification and purification.

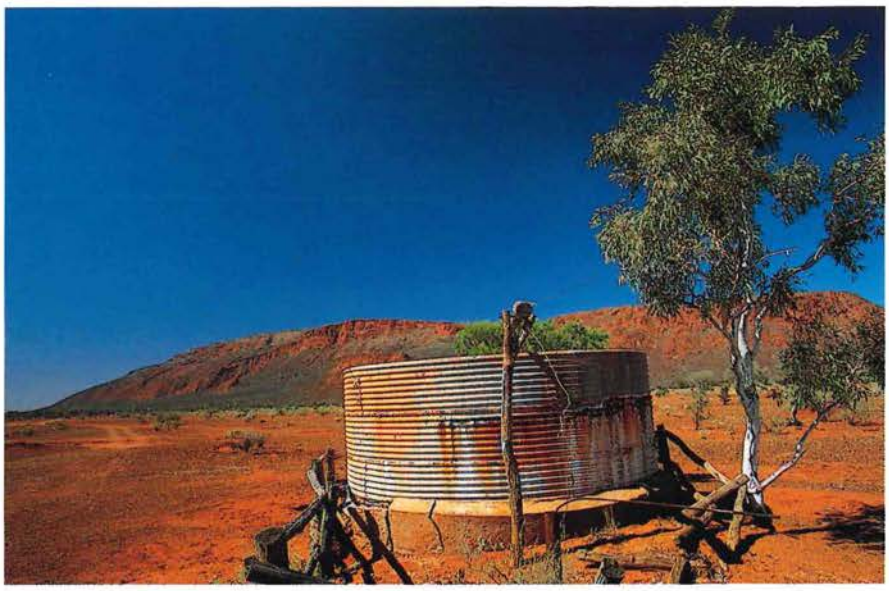
**Clarification** is the process by which suspended matter - dirt, insects, leaf debris - is removed from the water. This can be done by pouring the water through a cloth such as a handkerchief or tee-shirt, or through a more elaborate filter system such as fine sand contained in a cloth bag, trouser leg, or shirt sleeve. However, clarification alone does not make the water safe to drink, it only makes it clearer and more palatable.

**Purification** follows clarification and is the process that kills organisms which can cause anything from nausea to death. If time and resources are limited, the clarification stage, which is largely cosmetic, should be hastened to make as good a job as possible of the purification.

There are several ways of purifying water. Before venturing into the outback, try each method to see which taste you prefer and to determine whether you have any adverse reaction to the chemicals used in some of the preparations.

Boiling is the best known and one of the simplest and most effective water purification techniques. It requires no special equipment or chemicals and leaves no aftertaste, which is particularly important if the water is for an infant or someone whose stomach may react to water purification additives. Water should be boiled for at least 10 minutes.

Condy's crystals (potassium permanganate) are a useful item to take on any trip. They can be used in varying strengths for water purification, as a mouthwash, or as an antiseptic. For water




The twenty-two items that make up the standard Outback Survival Kit supplied free of charge to all course participants.
Photo - Noel English

purification, three or four crystals should be added to a litre of water and stirred until dissolved. The water should then be left to stand for 30 minutes. If the correct dosage has been used, the water will have a slight pink tinge to it.

Puritabs® are water purification tablets that are chlorine based and give a 'swimming pool' taste to the water with no discolouration. The tablets are tiny and lightweight, making them ideal for bushwalking where space and weight are a major consideration. One tablet should be added to each litre of water and left for 10 minutes.

Iodine solution is the most effective water purification agent, but its method of use is the most complex. Before your trip, make a saturated solution of iodine by putting 7 g of iodine crystals into a 30 mL glass bottle with a sealed screw cap. When you are ready to purify water, carefully pour the 30 mL of saturated solution off into one litre of the untreated water, keeping the remaining crystals in the bottle. Wait for 30 minutes. When the water has been treated it will have a slight brownish tinge and a very faint taste. Meanwhile, top up the small bottle with water and after an hour you will have a fresh bottle of saturated solution ready for the next treatment.

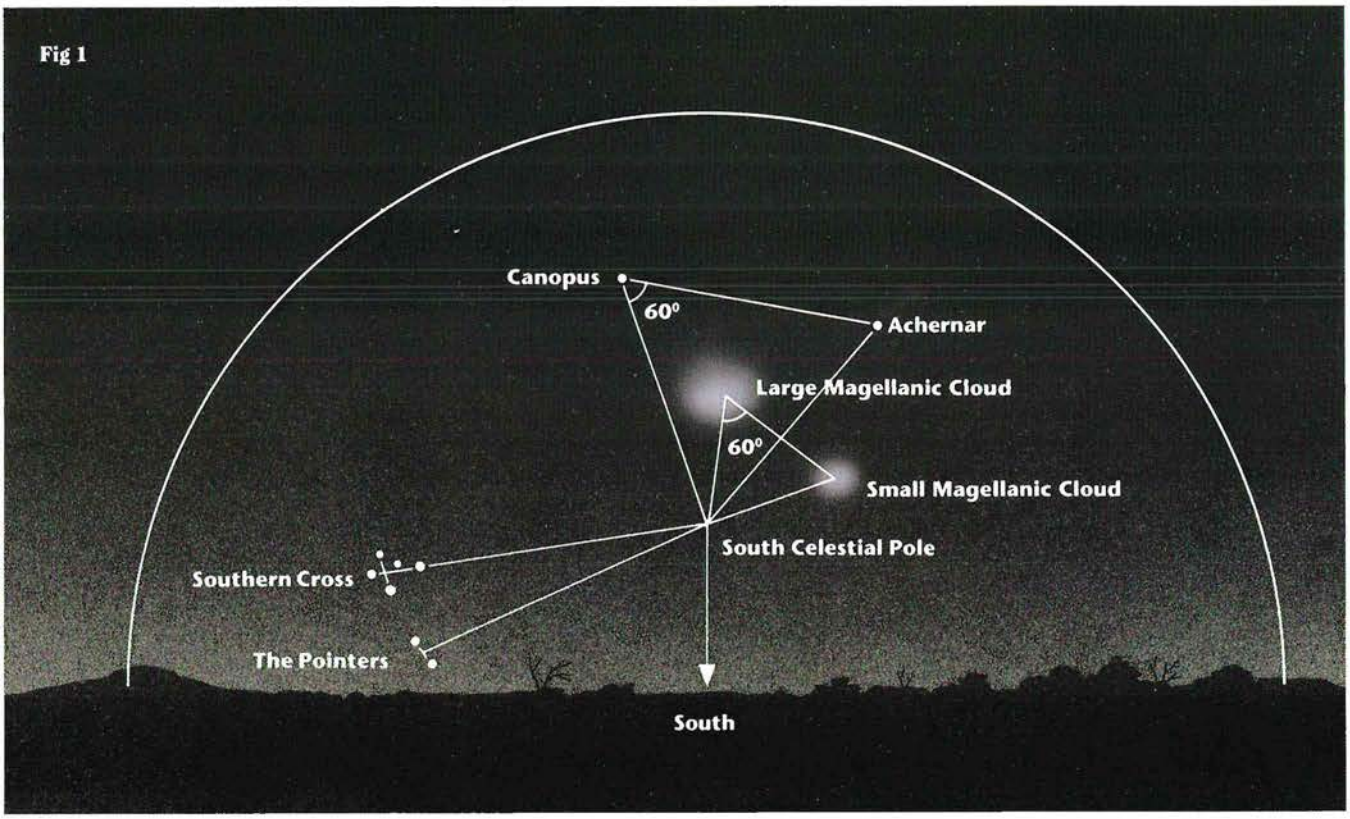
## DAY AND NIGHT NAVIGATION

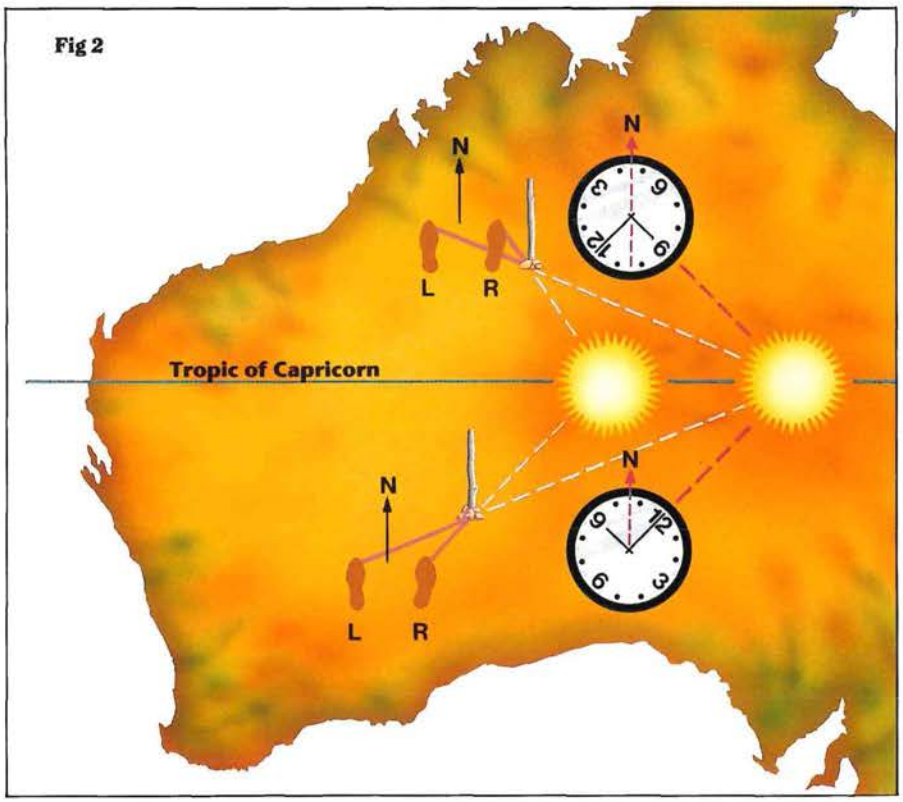
If you do decide to walk in search of help, you must be able to determine your direction of travel and destination. If you have a compass and know how to use it, it is relatively simple to navigate along your chosen bearing. But what if you have no compass?

A wrist watch can be used with the sun to find north, and a compass face can be drawn on the ground to determine your direction of travel. There are two methods of doing this, but the method you choose depends on whether you are north or south of the sun. In Australia it is quite possible to be north of the sun in the summer (if you are north of the tropic of Capricorn), so it is vital to establish your position in relation to the sun's latitude (see fig 1).

Place a stick vertically in the ground, using stones to keep it upright if necessary. Mark the end of the shadow with a small stick, stone or scratch on the ground. After 15 or 20 minutes, mark the end of the shadow again. Place your left foot on the first mark and your right foot on the second mark; you are now facing north. If the stick is in front of you, you are south of the sun; if the stick is behind you, you are north of the sun.

Fig 1






Having determined whether you are north or south of the sun, you can now take a bearing frequently and quickly using your wrist watch.

If you are south of the sun, point the 12 o'clock mark at the sun. Bisect the angle between the hour hand and 12 o'clock and you have north.

If you are north of the sun, point the hour hand at the sun. Bisect the angle between the hour hand and 12 o'clock and you have south.

However, you must remember to deduct one hour if daylight saving is in operation.

Surprisingly, you can still perform this direction-finding technique if you have a digital watch or a radio. Trace a watch face on the ground and insert 'clock hands' according to the time displayed on the watch or given out on the radio. Then follow the above procedure. Again, you must remember to deduct one hour if daylight saving is applicable.

After the sun has set, sit or stand with the sunset on your right and wait for the first stars to appear. The two brightest stars in the southern sky are *Canopus* and *Achernar*, and these can be used with the southern cross (if it is visible) and two distinctly visible galaxies to determine the position of the south celestial pole and hence the compass points (see fig 2).

## MESSAGES

Finally, make sure you leave meaningful messages for search and rescue personnel, both at the vehicle and frequently along your route. The basic information must include: the time, date, and direction of departure (with a visible arrow on the ground to confirm the direction); how much water you have available; the names and ages of the people in the party; and details of any injuries or illness. Along your route, leave markers - arrows on the ground, stones, or pieces of coloured material - to make your trail as visible as possible, and again leave a note giving the date and time you left each marker.

By following these simple guidelines you would have a much better chance of survival in an outback emergency. In such situations, these basic bushcraft skills become survival techniques. Skills weigh nothing and can be carried with you on any journey in any climate or terrain. Remember, many have perished needlessly in Australia's interior as well as closer to the coast. Many have had the resources they needed to survive, but lacked the skills to use them. ⊡

# A B C
## FOR SURVIVAL

If you are lost or stranded:

**A** - Accept the situation. Don't waste time and energy chastising yourself or blaming others.

**B** - Brew a drink. A cup of tea or coffee will help you keep calm and focus your attention.

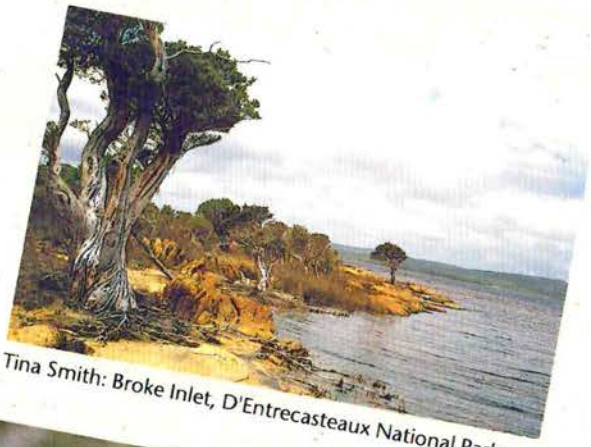
**C** - Consider. Consider your options while drinking your tea or coffee.

**D** - Decide. After you've considered all your options, make a decision.

**E** - Execute. Execute your decision and stick to it.

Bob Cooper learnt his bushcraft skills while living with traditional Aborigines, and as a qualified instructor with the Australian special forces. In 1983 he formed his own company, Outdoor Education Pty Ltd, and began teaching bushcraft survival techniques to school children. He runs a successful Basic Outback Safety and Bushcraft Course for the Department of Conservation and Land Management (CALM). The course, which is ideal for anyone contemplating a trip into the outback, comprises four evenings of theoretical training and a weekend practical phase. Course participants receive a certificate of training and an outback survival kit containing essential items that have been tried and proved under survival conditions.
Further details of the courses can be obtained from Bob Cooper Outdoor Education, PO Box 8486, Stirling Street, Perth WA 6000, telephone (09) 377 1767, or from CALM's Head Office on (09) 367 0437.
David Gough is a Communications Officer with the Department of Conservation and Land Management, and Editor of *LANDSCOPE*. He can be contacted on (09) 389 8644.

Peter Sanderson: Male musk duck *(Biziura lobata)*
Yanchep National Park



Tina Smith: Broke Inlet, D'Entrecasteaux National Park

Eddy Wajon: Cranbrook Bell *(Darwinia meeboldii)*

Lesley Jackes: Gecko on *Eucalyptus macrocarpa*, Dryandra Forest

# LANDSCOPE Photographic Competition

Stephen Elson: Western silvereye feeding young, Mundaring Forest

The 1991 Konica-sponsored *LANDSCOPE* Photographic Competition had the theme of 'National Parks, Nature Reserves and State Forest', and all entries had to have been taken in one of these areas.

The new under 16 category attracted good quality photographs, but a low number of entries. The winner of this category was Michael Wenham of Wembley, who receives a Konica MT100 camera and film, and an enlargement of his winning entry.

The open section attracted the same high volume and quality of entries as in previous years. The winner of this section was Peter Sandersen of Kardinya, who receives a Z-up80RC camera and film from Konica and an enlargement of his winning entry.

As well as the two winning entries, the judges chose 27 entries of merit, some of which can be seen here.

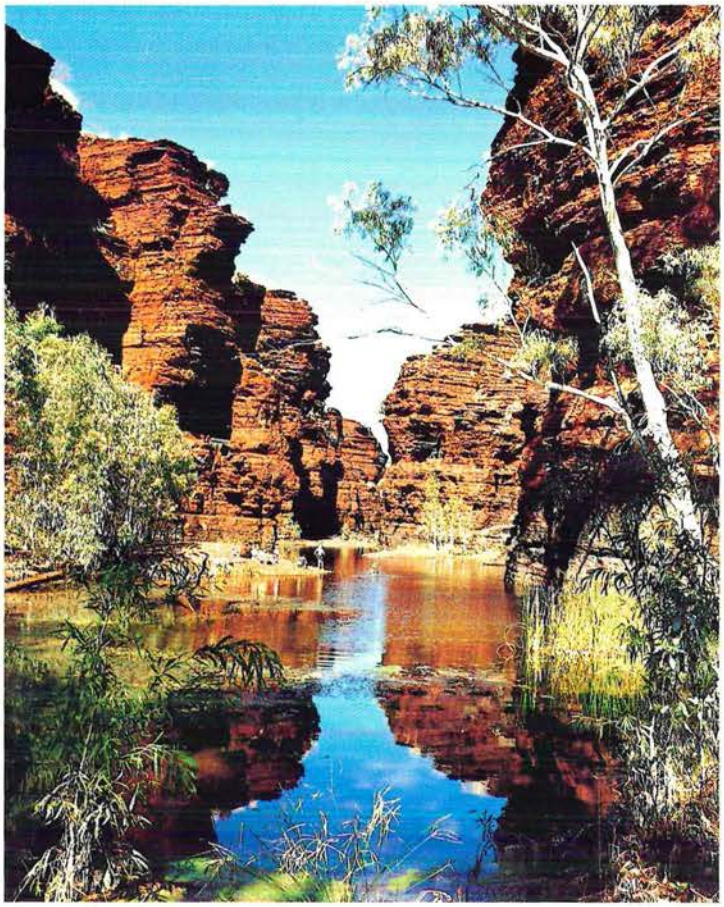
These entries will also be enlarged as prizes.

The winning entries and the entries of merit will be on display in the foyer of the R&I Bank, Town Hall Branch, Barrack Street, Perth from April 6-17, during bank opening hours.

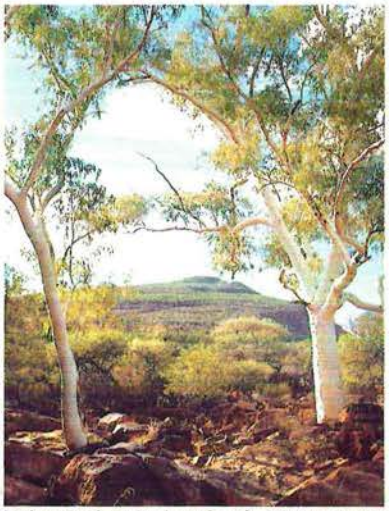
Chris Green: Injidup sand drift, Leewin-Naturalist National Park.

Penelope Thomson: Yardie Creek, Cape Range National Park

Michael Wenham: Verticordia harveyi, Fitzgerald River National Park



John Quilty: Kalamina Reflections, Karajini National Park



Helen Taylor: Spring Creek, Mt Augustus National Park

Peter Sanderson: *Kunzea baxteri,* Walyunga National Park

Marlene Stanley: Rock Formation East Mylies Beach, Fitzgerald River National Park.

Noel Ryan: Mountain Flora Stirling Range National Park

Harry Shugg: Paperbarks, Stokes National Park

# KING LEOPOLD'S TREASURES

*The north-west Kimberley supports the last intact ecosystems in mainland Western Australia. One part, to be added to the State's conservation estate, is a section of the King Leopold Ranges, whose jagged hogback scarps were shaped by tremendous geological forces.*

*by Norm McKenzie, Kevin Kenneally, Chris Done and Tim Griffin*

Containing some of the Kimberley's isolated patches of remnant rainforest, the King Leopold Ranges - named in 1879 after King Leopold of Belgium - extend for some 300 kilometres from Walcott Inlet to Margaret River about 100 km west of Halls Creek.

About 350 million years ago in the Devonian times the ancient scarps were fringed by a barrier reef. Today the ridges of the King Leopold Ranges rise to 300 metres above the surrounding plains (950 metres above sea level). They overlook the Oscar and Napier ranges, remnants of the reef, and the grassed plains of the Fitzroy river valley to the south-west.

Open savannah woodlands cover the sunburnt landscapes. Groves of river gum, stately paperbark trees and dense thickets of screw pine shade watercourses. Water lilies and other aquatic plants fill permanent pools in the creeks and rivers, providing cool relief from the starkness of the harsh escarpments.


Following wet season rains, great volumes of water cascade from the ranges. In the dry, tourists are attracted to waterfalls, such as at Bell Gorge, that feed the larger creeks and rivers. Visitors also marvel at the spectacular Lennard River Gorge and the incredibly folded and faulted scenic rock formations of the ranges along the Gibb River Road.

For nearly 20 years, the Government has been trying to establish a network of reserves to represent the diversity of the north-west Kimberley, an area that comprises the only intact examples of

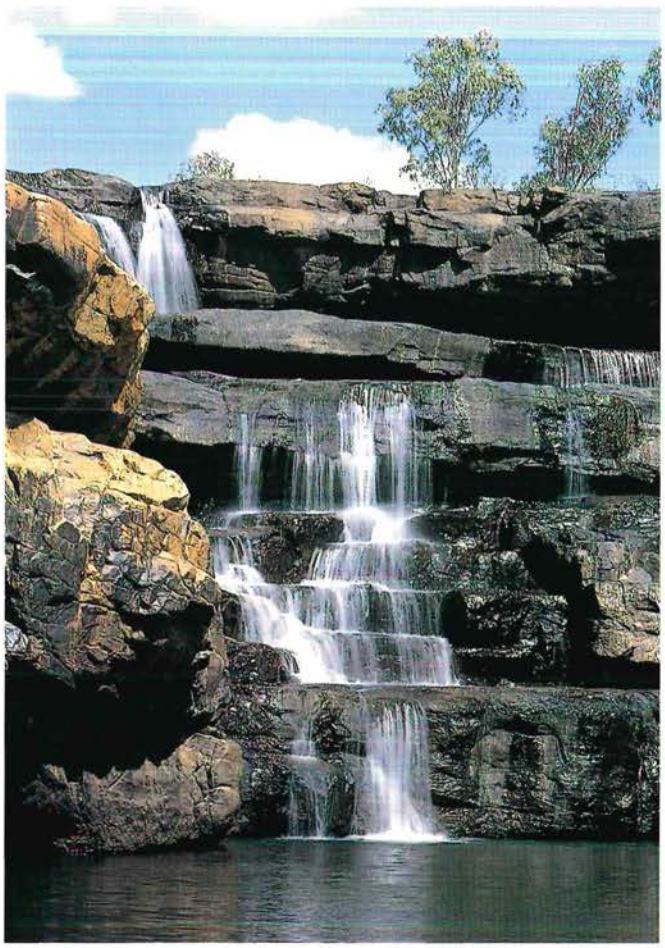
*Previous page:*
Bell Gorge, one of the lesser-known gorges on the edge of the King Leopold Ranges.
Photo - Bill Bachman

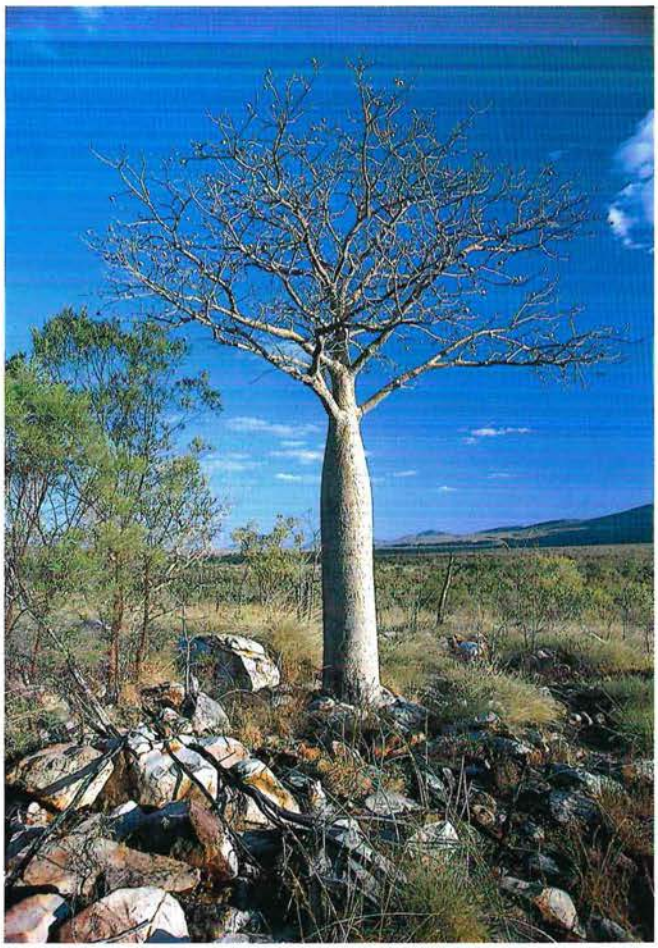
*Previous page:*
Blue water lily (*Nymphaea violacea*).
Photo - Bill Bachman

Contorted strata of the sandstone rock are clearly visible along the Gibb River Road near Mt Bell.
Photo - Norm McKenzie

*Below left:*
A spectacular waterfall on Bell Creek along the Gibb River Road.
Photo - Marie Lochman

*Below:*
A young boab tree (*Adansonia gregorii*) growing from a rock scree in the spinifex grasslands of the King Leopold Ranges.
Photo - Bill Bachman





indigenous ecosystems remaining in mainland Western Australia. It is the only part of the State in which no species are known to have become extinct in the period of European settlement. Even its rich fauna of native mammals - many of them rare species - still persists despite the recent appearance of feral cats, pigs, donkeys and cattle in its furthermost corners.

Along with the Drysdale River National Park and the Prince Regent Nature Reserve, the total reserved area in the north-west Kimberley is now some 1.4 million hectares - six per cent of the district. Prince Regent was the first major conservation reserve declared in 1964, and its flora and fauna values are such that it has since been listed as a World Biosphere Reserve. The Drysdale River National Park, declared in 1974, was the next major reserve.

Last year the State Government announced plans to add a central part of the King Leopold Ranges to the conservation estate following the purchase of the 370 000 hectare Mount Hart pastoral lease.

## BIRTH OF THE RANGES

The steep ridges and hills of the King Leopold Ranges are developed in a thick sequence of layered rocks. The most abundant of these are white and pink quartz sandstone, buff siltstone and brown mudstone. There are also layers of grey-green basalt that solidified from lava flows, and grey dolerite formed from similar molten rock that did not erupt at the earth's surface but invaded the older sedimentary rocks to form layers. This group of rocks accumulated in a region known as the Kimberley Basin (Figure 1).

The sequence of rocks in the Kimberley Basin is more than 5 000 metres thick. It was deposited in shallow water on a slowly subsiding large continental mass in Precambrian times, about 1 800 million years ago. After a long interval of time these rocks were partly covered by sediment associated with an ice age about 600 million years ago.

About 560 million years ago these generally flat-lying strata were thrust (pushed on flat faults) from the north-east over older granite, volcanic rocks and metamorphosed sedimentary rocks

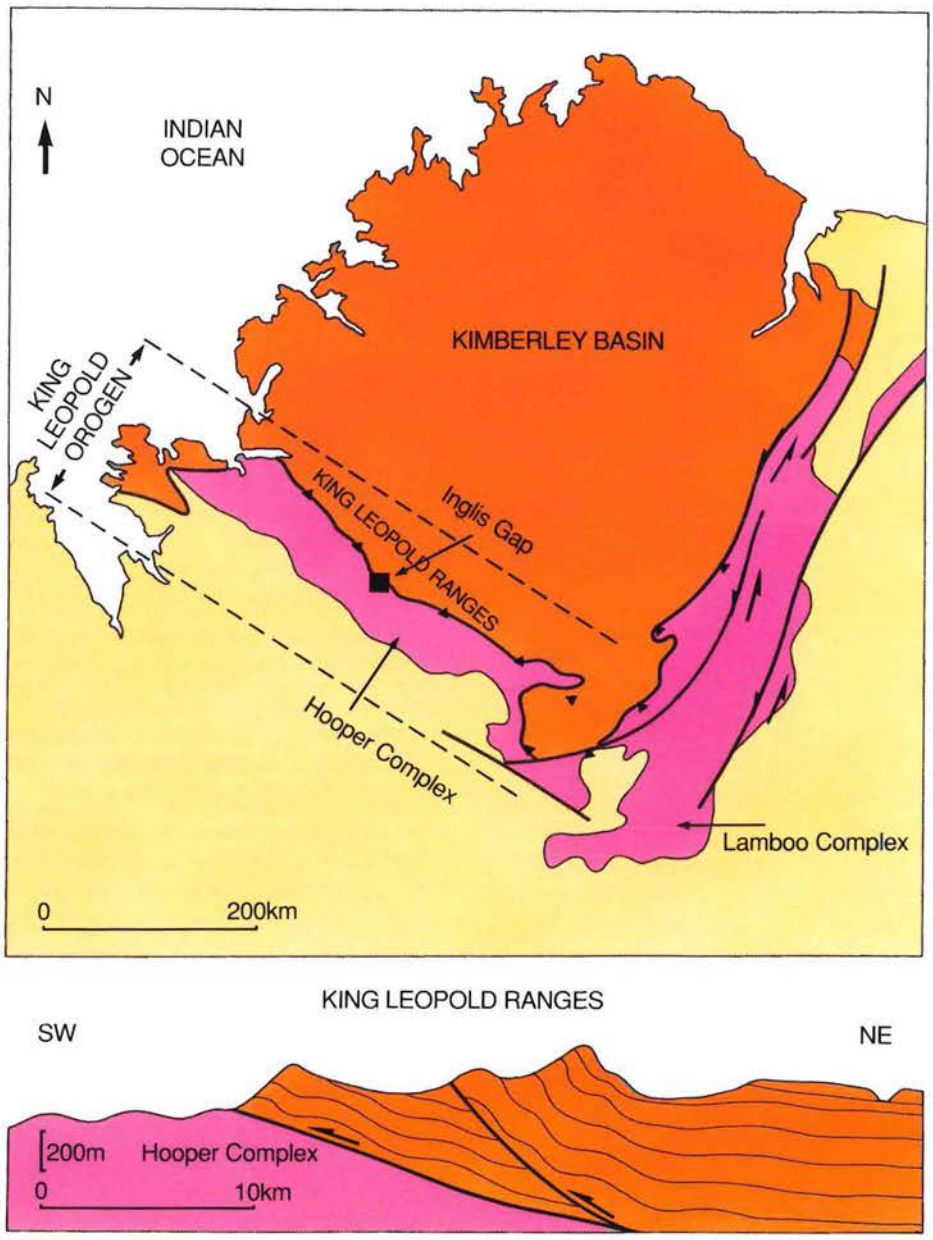



**Fig 1**

Map and cross-section showing the geological setting of the King Leopold Ranges.

of the Hooper Complex (Figure 1). This caused the rocks on the leading edge to crumple in a major mountain-building episode known as the King Leopold Orogeny.

Erosion of this mountain chain then led to the rugged terrain that forms the ranges, with the characteristic hogbacks, steep valley walls and often flat valley floors seen today. North of the ranges the strata of the Kimberley Basin remain flat-lying, occupying the whole of the Kimberley Plateau extending north to the coast.

Approaching the King Leopold Ranges through the foothills in the south-west along the Gibb River Road, one passes the smooth rounded pink granite, jagged grey volcanic rock and red-brown metamorphosed sedimentary rock of the Hooper Complex. The ranges are entered through Inglis Gap, beyond which dramatic evidence of the deformation caused by the King Leopold Orogeny - the folded and faulted rock formations - become visible as the road winds its way eastwards through the valleys.

The resistant, massive, white and pink quartz sandstone strata form steep and very rugged ridges. Weathering along joints and cracks produces large angular boulders. The valleys between the ridges have been formed by erosion of the less resistant brown and purple mudstone and basalt, as well as the Hart

Dolerite, which weathers to black soil and rounded black boulders. The valleys offer the only access to this rugged country.

## FLORA AND FAUNA STUDIES

The first plant specimens were collected from the King Leopold Ranges during an expedition by Alexander Forrest from the De Grey River to Port Darwin in 1879. He sent them to Baron F. von Mueller, Australia's first colonial botanist in Victoria (see also 'In the Footsteps of Giles' in this issue). Forrest named the ranges after King Leopold of Belgium in recognition of His Majesty's interest in exploration. Mount Matthew was named after his brother, and Mount Humbert after the King of Italy, who was a promoter of science in his kingdom. It's not known after whom Mount Hart was named.

In 1905, William Vincent Fitzgerald collected plants from the King Leopold Ranges during Charles Crossland's trigonometrical survey expedition. The expedition travelled from Derby to Inglis Gap, then proceeded northwards, crossing the Isdell River to reach the Packhorse Range. Many spectacular features of the ranges, including Mounts Herbert, Broome and Vincent, are thought to have been named during this expedition. Mount Bell, Bold Bluff and Mount Ord were named during earlier explorations by Frank Hann in 1898. Fitzgerald kept a diary of the pastoral suitability and geology of the areas explored. He also collected numerous plant specimens, many of which were new to science and were subsequently described in the *Journal and Proceedings of the Royal Society of Western Australia*.

These are the 'type-specimens' of many Kimberley species. Some, such as *Eucalyptus collina* and *Eucalyptus confluens*, are now known to occur in other places throughout the region; others, such as the cycad *Cycas furfuracea* and the mistletoe *Decaisnina biangulata*, are endemic to the north-west Kimberley.

Since then, only a few studies have been made into the area's flora and fauna. A general description of the area's vegetation formations and land systems was conducted by CSIRO in the early 1960s. Mammal collections were made near Inglis Gap in the 1960s by zoologists Professor Jock Marshall, Harry Butler and others. An isolated rainforest patch at the far northern extremity of the Mount Hart pastoral lease was inventoried in 1987, and various studies on the botany and zoology of the area were undertaken by the British-Australian Kimberley Research Expedition during the 1988 dry season. Systematic collections have yet to be made in the area during the wet season.

Looking north from Napier Range, the King Leopold Ranges can be seen in the distance.
Photo - Jiri Lochman

Stripe-faced dunnart (*Sminthopis macroura*).
Photo - Babs and Bert Wells

A cycas (*Cycas furfuracea*), one of the plants that is endemic to the north-west Kimberley.
Photo - Kevin Kenneally

Despite these promising beginnings, little is still known about the biota of the area, compared with the Prince Regent and other parts of the north-west Kimberley. But some indication of the area's biological values can be drawn from the ease with which new species records were found during brief, dry-season visits by biologists in 1988. Examples include a new eucalypt allied to *E. lamprocalyx* and several new grasses for Western Australia.

Granite outcrops, such as those that occur on the plains south of the ranges, are not represented in other Kimberley reserves or proposed reserves. Although the biology of their ecosystems is virtually unknown, scientist Marianne Sawle reported in 1988 that a distinctive small vertebrate fauna, including the stripe-faced dunnart, long-tailed planigale, Forrest's mouse and a blind snake *Ramphotyphlops unguirostris*, characterised plains closer to the ranges. Sawle also recorded the little-known rock ringtail (*Pseudocheirus dahli*) from scree slopes in the King Leopold Ranges during the 1988 studies. The red goshawk, a declared threatened species, has also been recorded on the station.

## FUTURE PLANS

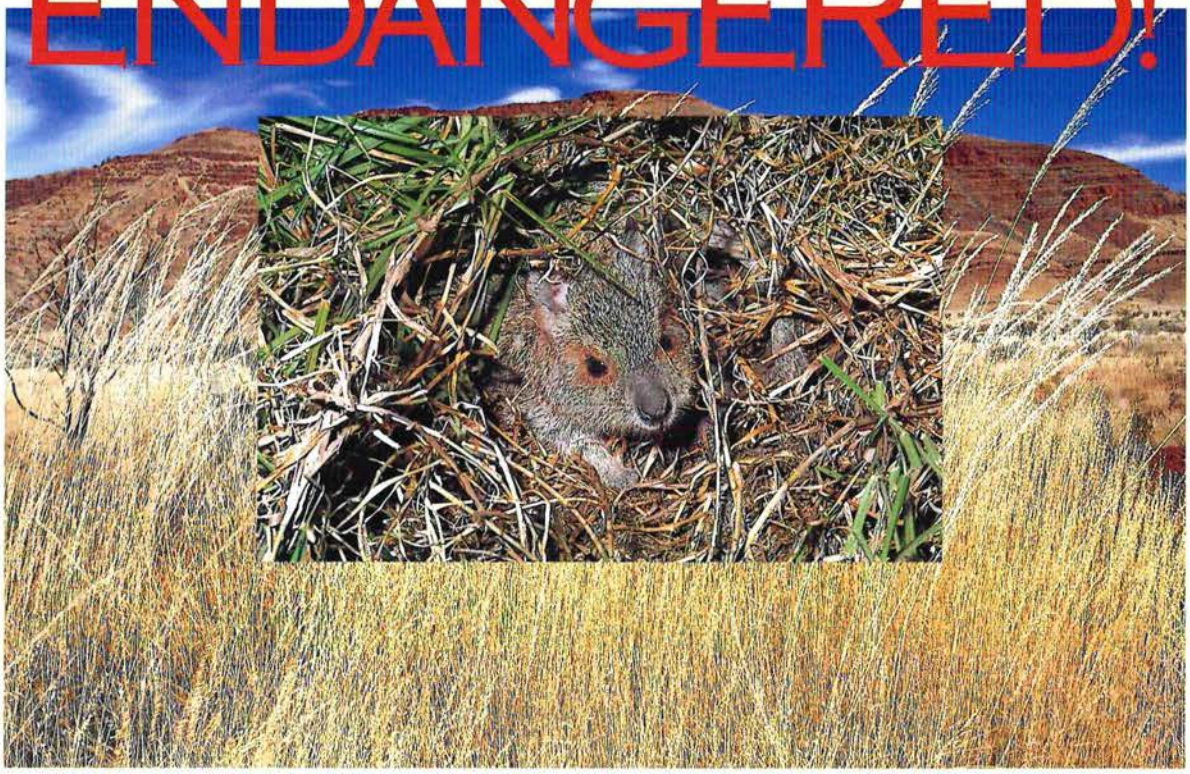
When the State Government purchased the Mount Hart pastoral lease, it emphasised that the boundaries of a national park in the King Leopold Ranges would be defined following investigations and consultation with pastoral and mining interests. Discussions regarding its future management would also be held with local Aboriginal communities.

The addition of the area into the conservation estate will enable its unique ecosystems to remain intact and give scientists more time to explore and learn about its biota. Its addition also represents the State Government's long-term commitment to represent fully the north-west Kimberley's diversity in our national park and nature reserve system, thereby protecting the King Leopold Ranges for future generations to admire, study and enjoy. ▣

Norm McKenzie is a principal research scientist with CALM and can be contacted on (09) 405 5100. Kevin Kenneally is a principal research scientist with CALM. He can be contacted on (09) 367 0500. Tim Griffin is a principal geologist with the Geological Survey of Western Australia and can be contacted on (09) 222 3333. Chris Done is CALM's Kimberley Regional Manager. He can be contacted on 091 680 200.

Typical rugged Kimberley landscape in the area of Bell Gorge near the old Silent Grove Homestead.
Photo - Neil Wehlack, Lochman Transparencies

# ENDANGERED!



## SPECTACLED HARE-WALLABY

Hare-wallabies are a group of small wallabies, so named because of their perceived similarity to European hares. However, the only real resemblance is their habit of sheltering in 'squats' in dense vegetation, from which they erupt if disturbed, often from almost under a person's feet.

Two hundred years ago there were five species of hare-wallaby in Australia. The eastern hare-wallaby and the central hare-wallaby are now extinct. The banded hare-wallaby is extinct on the mainland and found only on Bernier and Dorre Islands in Shark Bay, while the rufous hare-wallaby (or mala), which also occurs on these islands, remains on the mainland only in one very small colony in the Northern Territory. The fifth species, the spectacled hare-wallaby, has been least affected since non-Aboriginal settlement, but has declined so much in Western Australia that it is considered threatened.

Spectacled hare-wallabies weigh about three kilograms and live in tropical grasslands. In Western Australia they lived in spinifex grasslands in the Pilbara, the Great Sandy Desert and the Little Sandy Desert, and in tussock grasslands, sometimes with a shrub or tree overstorey, in the Kimberley. Today, they are abundant on Barrow Island, but have become very rare in the Pilbara and are infrequently sighted in the Kimberley. They have disappeared completely from the deserts and are extinct on the Monte Bello Islands. They are still fairly common in parts of the Northern Territory and Queensland, but have disappeared or become rare in some parts of both.

Spectacled hare-wallabies browse shrubs and graze most grasses in their habitat, including the tips of spinifex leaves, which become a major part of their diet in times of drought and in long unburnt spinifex country. Although usually solitary animals, up to three may be seen together on occasions. On Barrow Island, breeding takes place throughout the year, with peaks of births in March and September. There, they spend the day in hides tunnelled into large spinifex hummocks where temperatures seldom rise above 30°C. Each wallaby constructs several hides within a home range of eight to ten hectares.

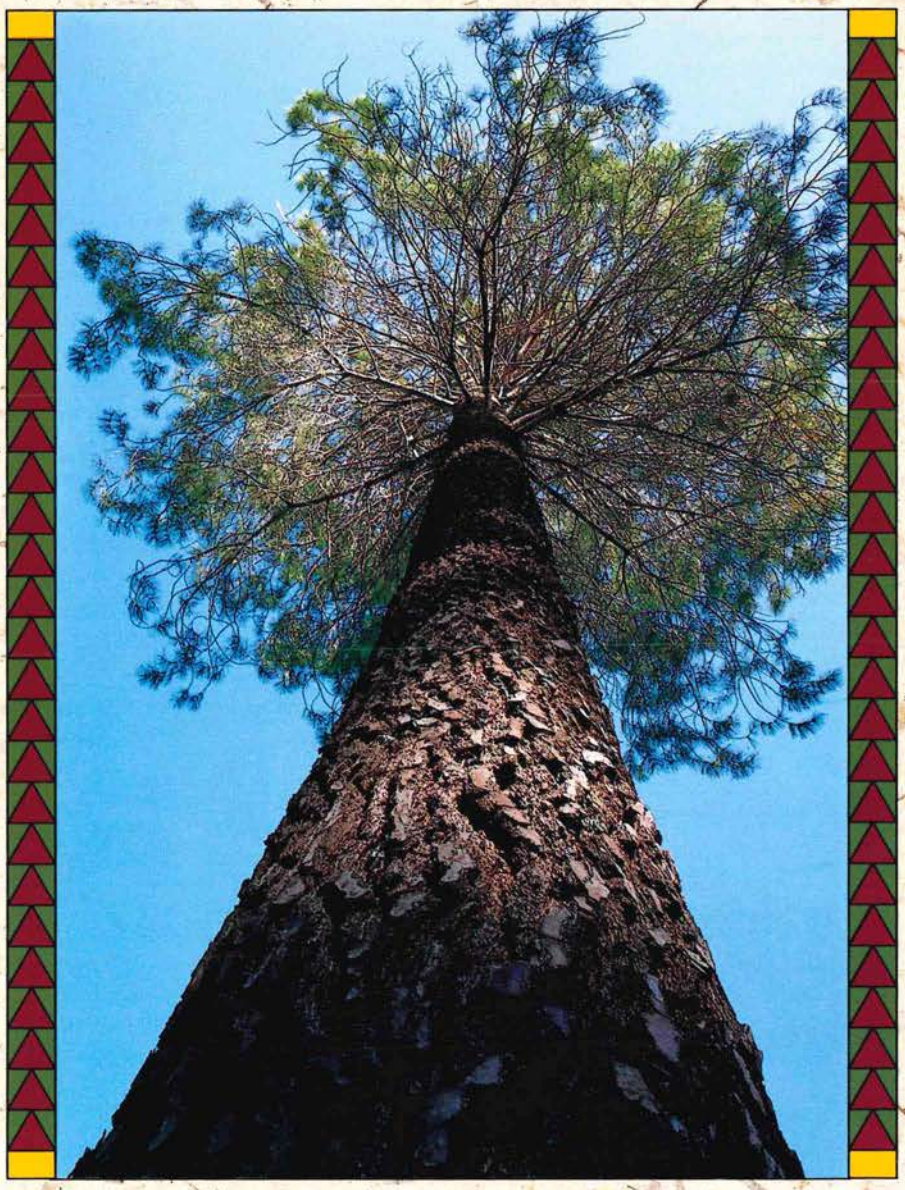
Being well adapted to the harsh conditions of the dry tropics, they do not drink, even when water is available. They are able to produce highly concentrated urine; indeed studies have shown that they have lower body water turnover than any other mammal of comparable size.

Spectacled hare-wallabies are vulnerable to fox and cat predation (cats eliminated them from the Monte Bellos) and to changed fire regimes; very large, hot fires remove all their cover and food, leaving no unburnt areas from which animals may recolonise regenerating vegetation. Smaller, more frequent fires favour the wallabies since this regime produces a mosaic of vegetation ages that provides shelter with food nearby.

**Photos**
**Jiri Lochman (inset) and Robert Garvey**

ANDREW BURBIDGE

# *In search of the* PERFECT PINE



BY DAVID GOUGH

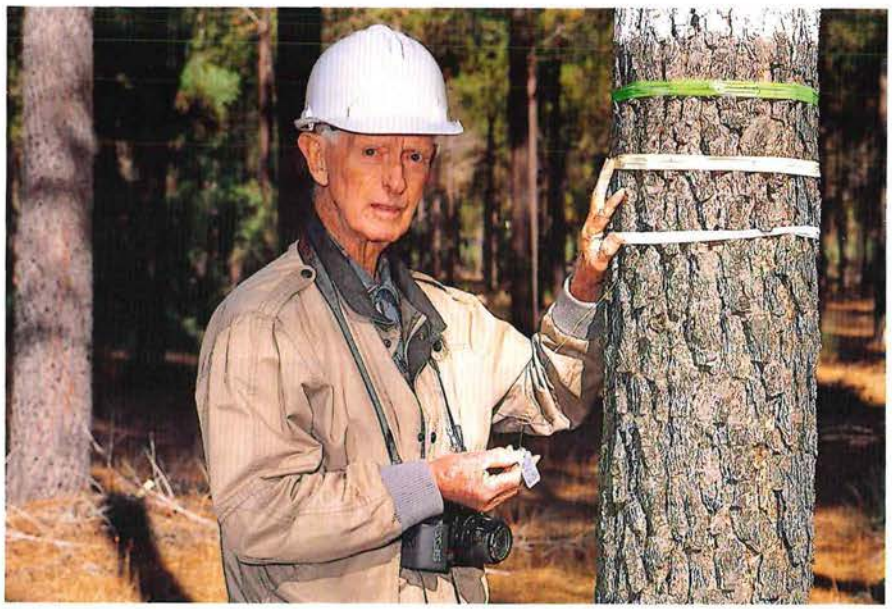
**Some little-known pioneering work began in 1896, when foresters planted the first maritime pine in WA. David Gough describes how innovative WA foresters took this hardy European pine and improved it for harsh WA conditions, with a great deal of trial and error along the way.**

When the first Western Australian colonists began to build settlements at Perth and Fremantle, they had problems with the local timber. The native softwood was only good for orange boxes, and the jarrah was so hard that they couldn't drive nails into it. Softwood was used for most European buildings so the carpentry tools of the day weren't designed for working hardwoods like jarrah, and the builders weren't used to working them either.

The immediate problem was resolved by importing 'Oregon pine' (Douglas fir), but this only worsened the colony's balance of payments problem. Importing timber was a serious drain on sparse resources. To avoid costly expenditure, it was decided to employ the apparently useless (from the agricultural and urban viewpoints!) jarrah and banksia woodlands on the Swan Coastal Plain to grow the colony's softwood requirements. The idea stemmed from the success of extensive softwood reforestation programs in the 17th and 18th centuries in western Europe, particularly in the south-east of France. The Cape Colony of South Africa was also actively developing pine plantations at that time.

*Previous page:*
Maritime pine
Photo - Jon Green
Bark
Photo - Bill Bachman

Mature and immature maritime pine cones.
Photo - Jon Green



Dick Perry, the officer responsible for plus tree selection in Portugal, beside a 20-year-old tree grafted from one of the buds he forwarded to Australia.
Photo - Jon Green

## WOODY IMMIGRANTS

The WA Lands Department, and later the Forests Department, began a worldwide search for a conifer that suited local conditions. Trials of many species were planted at the department's tree nursery at Hamel, near Waroona, in 1896. Monterey pine (*Pinus radiata*) did well on the better soils, but on the poorer sandy soils maritime pine (*Pinus pinaster*) gave the best results. Maritime pine occurs naturally on the northern and southern coasts of the Mediterranean sea and the Atlantic coasts of France and Portugal. Its common name is derived from its preference for coastal or maritime environments, although in recent times it has been grown in the inland parts of the countries concerned. After these early trials established that maritime pine was suitable for growing in sandy soils, it was decided to establish plantations on the poor sandy soils of the northern parts of the Swan coastal plain, to the north and east of Lake Gnangara.

It was first thought that seed from the French forests in the Landes region near Bordeaux would be best for the project, and a nursery of this variety was established by forester Dick Perry at Gnangara in 1926. This was real pioneering work - in the early 1920s the only way to reach the area from Perth was by walking, riding a horse or, if something had to be transported, driving a horse and iron-tyred cart many kilometres along a deeply rutted, sandy track winding its way between the banksia trees.

Despite the early optimism, it was soon obvious that there was something seriously wrong. Seed that had been sown in September produced plants that were only two inches high and a bright yellow colour by the following July, when they should have been 10 to 12 inches high and deep green in colour. After much trial and error, it was discovered that the little seedlings needed the cooperation of a special fungus known as a mycorrhizal fungi, which attaches itself to roots and helps them to take up nutrients from the soil. Once the fungus was introduced to the nursery, the trees began to thrive.

By 1929, foresters were finally growing healthy pines in the Gnangara

CALM researcher Trevor Butcher, who has worked on maritime pine improvement for almost 30 years, with Dick Perry, now retired.
Photo - Jon Green

Considerable variation in tree form and vigour required the planting of many trees for adequate selection of crop trees.
Photo - Jon Green

Orchard seed produced straight trees and uniform stands. This enabled the planting of fewer trees and more efficient management.
Photo - Jon Green

nursery and began to plant them out in the field. The transplanted trees stayed green, but only grew very slowly, except in areas where the forest workers had heaped the banksias up and burnt them. The problem appeared to be a nutritional one, but foresters in those days were hesitant about using fertilisers to grow trees.

'The assumption was that if you had to use fertilisers you'd have to apply them every year for the whole rotation,' recalls Dick Perry. 'Anyway, I requisitioned half a ton of superphosphate and a quarter of a ton of blood and bone to use for trials, but my request was knocked back by Treasury - they were just plain horrified.'

Eventually, Dick got his fertiliser and the results were excellent. Later research by scientist Eric Hopkins showed that it should be applied at the time of planting and then every seven years or so.

But the problems were not yet over. The native vegetation had to be completely removed if the trees were to thrive, as it competed with the pines for moisture and scarce nutrients in the coarse, sandy soils. It was back-breaking work just to clear the area for planting. The stump-jump mould board ploughs available at the time kept getting caught under the roots still in the ground and, in most of the early plantations, the scrub kept growing back.

'When the Depression came we had 100 men out there hand-grubbing the scrub, and during World War II people imprisoned because of their foreign connections, and conscientious objectors worked on it as well. Eventually

disc ploughs came in, and we were able to purchase heavy stump jump disc ploughs that were much more effective,' said Dick.

At this early stage, most of the seed was from the Forest of Landes in France, but seed was also purchased from Portugal, Corsica, Italy and South Africa. The seed from each of these regions produced trees that were so different they appeared to be different species.

Dick Perry established seed provenance trials of maritime pine in plantations at Gnangara and Sommerville (now the suburb of Karinya) in 1926. These pines conclusively showed that pines from Leiria in Portugal had the fastest growth rate and had reasonable form, Later research proved that the Leiran race had the best wood properties for sawn timber use. As a result, all seed imported since 1940 for extending the

plantations came from the Forest of Leiria, Portugal.

Despite the improvements that resulted, the department still had to plant about 1 200 trees per acre from which to select the best 80 for the final crop and it was necessary to grow them close together to keep the branches small. Maritime pines were also subject to 'butt sweep' and 'pistol butt', which means that the tree's butt logs were bent to varying degrees. As these were always the biggest logs that the trees produced, a lot of wood was wasted when they were cut up in a sawmill or peeled into thin sheets to make plywood.

## THE IDEAL TREE

Tree improvement by breeding was a new science in the 1950s. Forests Department scientist Eric Hopkins argued strongly for a breeding program to improve the stem form of the tree. He argued that this could be justified on the basis of reduced nursery, planting and tending costs, as fewer trees would be planted. He gained approval and the tree breeding centre at Wanneroo was set up in 1957. Considerable capital was invested into glasshouses, a laboratory, shadehouses and a general nursery. More

importantly, specialist technical staff were appointed to carry out the breeding program. It was these highly skilled technicians, in particular Alex Malajczuk and Joe Stritof, who guaranteed the success of the program.

Eric decided that they needed a set of 'plus phenotypes' - trees vastly superior to the others in the plantation. These trees had to be straight, with few branches, and the branches had to be at right angles to the trunk. They also had to be dominant trees, with a fast growth rate and superior height. At least 50 trees were needed to provide a wide enough genetic base to work from to avoid the dangers of in-breeding.

As a result, Departmental officers embarked on a thorough search of the WA plantations to find the superior trees. They located several that were suitable. However, local plantations could not supply all of the parents required for a comprehensive breeding program and in 1964 Dick Perry travelled to Portugal, where he was based for two years. After many months systematically walking through the Forest of Leiria, he found a further 85 superior trees. Once they were found, each tree had to be climbed about five times - right to the top. They had to be accurately measured by tape, from top to bottom, and two core samples had to be taken to measure the density of the wood. When the trees were flowering, the buds were collected and sent back to Australia for grafting. Seeds and pollen were collected at other times. Cones were also collected and the seed extracted and sent home to WA.

All this material was sent back for testing in Western Australian conditions. In all, 51 local and 85 Portuguese trees were tested for parental qualities. The buds were used to clone the parents. This involved taking a bud from a superior tree - which may be up to 130 feet high and perhaps 80 years old - and grafting it to another small seedling. The resulting plant is effectively an 80 year old tree that is genetically identical to the parent tree and only a few inches high. Instead of having to wait 15 years for it to develop pollen and female flowers, it is already sexually mature.

The grafts were pollinated each spring, to a planned mating design, to provide families for testing in the field. During the main program, about 1 000 grafts were pollinated each year. To protect the cones from cockatoos (who love to eat pine seed), the successfully pollinated conelets had to be covered with calico bags.

But when the buds from Portugal were grafted in the Australian spring, they showed no signs of growth until autumn, because of the differing seasons of the northern and southern hemispheres. It was decided to try some grafts in the Australian autumn. These took immediately, and the seasonal problem was overcome by forcing new buds in a glasshouse during the dormant period. No such problems were encountered with growth from seed.

The first maritime pine progeny trials in WA were planted in 1965, with seedlings raised from the 1961 pollinations, and were expanded each year as more seed became available. By 1978, 85 trial plots were planted over 195 hectares.

However, testing the suitability of a potential parent takes at least eight years. The department wanted to use the gains that had been made immediately. So, in the meantime, the first maritime pine seed orchard, containing 16 local clones, was planted with 2 462 grafts over a 10.5 ha area at Joondalup between 1963 and 1964. The first commercial seeds were collected from the orchard in 1968.

A second seed orchard, designed to take advantage of the imported clones, was established between 1969 and 1972, at Mullaloo. It occupied 10.1 hectares of fertile sands near Wanneroo. Up to 96 clones were planted and these were culled to the best 40 as progeny test data became available. These 40 parents are now used for all seed produced for WA plantations.

A third seed orchard, incorporating

Maritime pine seed is a favourite food of the white-tailed black cockatoo. Photo - Jiri Lochman

the best original clones and outstanding second generation selections from the controlled crossing program, was completed by Trevor Butcher at Manjimup in 1989. This will eventually replace the Mullaloo orchard and should meet all plantation requirements after 1994. The Mullaloo orchard now forms part of the Joondalup Campus of the Edith Cowan University. It will be retained as a recreational park while continuing to serve as a genetic resource bank of maritime pine.

## BREEDING SUCCESS

The maritime pine improvement program has been a major success. Gains from the first stage have been very large; the pedigree tree is straight, has smaller branches and is more vigorous, and the stands are notable for their uniformity.

Results from the yield trials, planted at Gnangara and Yanchep in 1973 with the first Joondalup orchard collection, are impressive (see graph). The 18-year-old pedigree stock pines are 36 per cent larger than trees grown from ordinary seed and the timber is of better quality. Added to this, a much higher recovery of timber can be sawn from the straighter trees with smaller limbs. The more even quality of the trees allows for greater efficiency in management and future harvesting.

Stem straightness was the most sought-after characteristic. Orchard seed produced 20 per cent of trees that were classed as very straight and suitable for the final sawlog crop, compared with only three per cent for the routine seed. This meant that the number of seedlings planted to produce the sawlog crop could be drastically reduced. Similar results had been achieved from assessment of progeny trials in 1971.

A new management regime for maritime pine was formulated in 1971. This takes the improved form into account by increasing plantation spacing, and takes advantage of improved growth rates by adopting a shorter rotation length. Stocking was reduced from 2 500 to 1 000 seedlings planted per hectare. Immediate benefits include large savings in seed, nursery, planting, pruning and early tending costs.

Since 1972, over 13 000 ha of maritime plantations have been planted with improved seed. The tree improvements, due to the additional growth rate alone, are returning an extra million dollars in income each year to the State. What is more, these gains will be magnified at the sawmill as a result of the greater volume that can be utilised because of the straighter stems and the smaller branching.

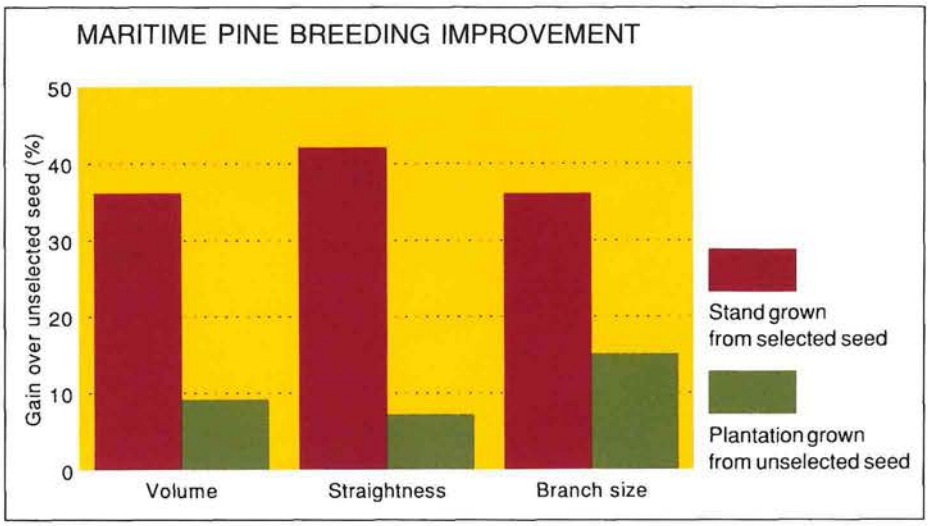
Seed from the genetically superior Mullaloo orchard was available from 1976. Progressive culling has further increased the seed quality and the expected growth rates of plantations.

CALM's new second generation seed orchard at Manjimup should produce an extra 20 per cent gain in tree volume while maintaining the current level of improved tree form.

With the foresight and hard work of early foresters like Dick Perry, today's foresters and scientists can continue to build a thriving maritime pine industry in WA. But advanced generation breeding can no longer rely on simple selection. Mathematical index procedures are now used to compute breeding values for individuals and families based on genetic parameters and economic weights of traits. Selection has to be efficient; it is the tool of the tree breeder and the key to maximising genetic gain.

Maritime pine is a secondary and minor species for pine wood production in the southern States of Australia. Nevertheless, there is potential for the improved breed of trees to be used in drought-susceptible areas and on infertile soils.

Who knows? One day maritime may even be exported back to Portugal - with our home grown improvements. ⊡



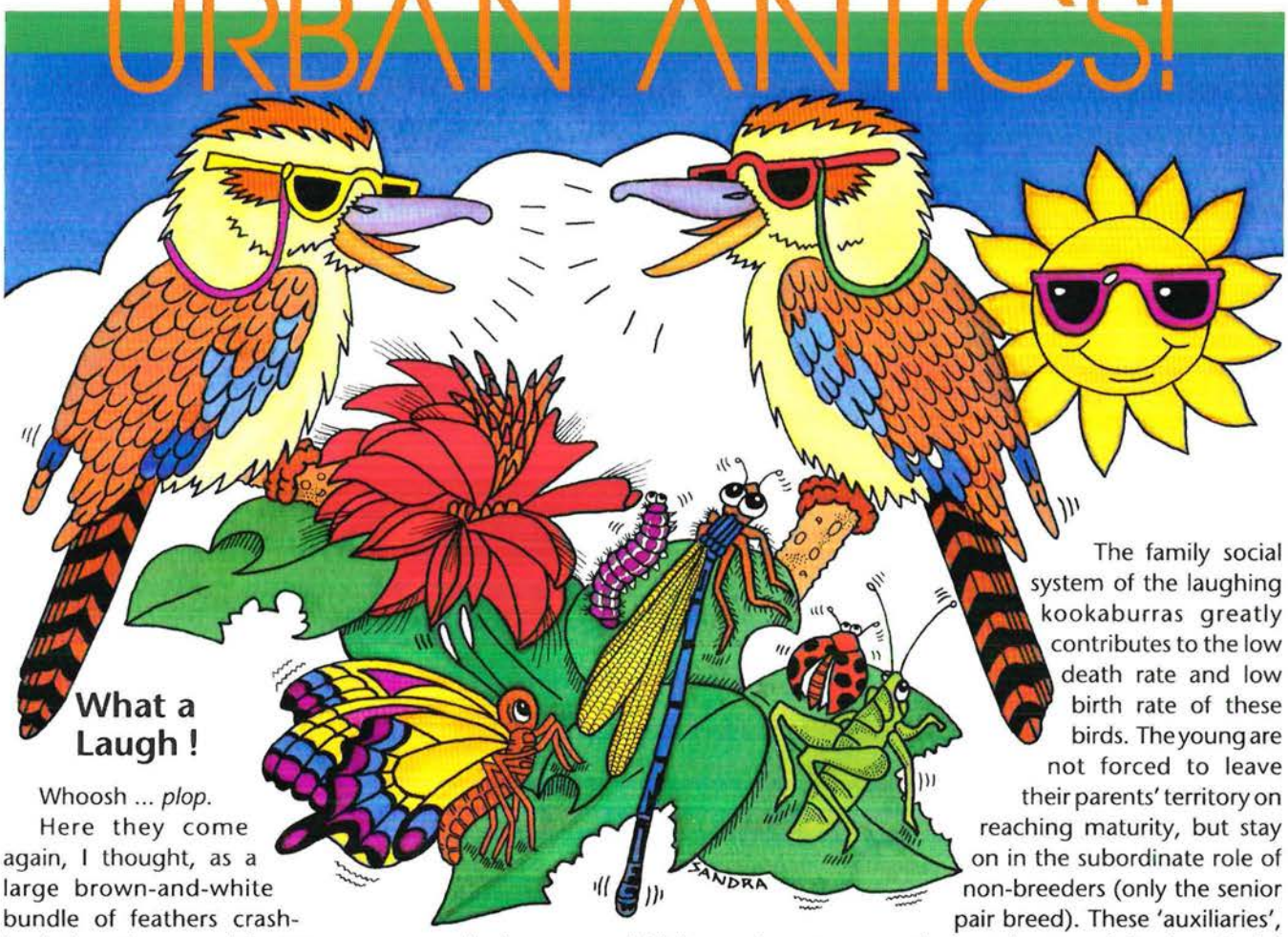

*Graph*:
These benefits have been transferred to 13 000 ha of plantation since improved seed became available in 1972.

A developing cone flower. These must be covered to avoid foreign pollen during controlled crossing. The bud scales open and are receptive to applied pollen for 3 to 5 days in September.
Photo - Eric Hopkins

Aerial view of the Gnangara pine plantation.
Photo - Jiri Lochman

David Gough is a Communications Officer with the Department of Conservation and Land Management, and Editor of *LANDSCOPE*. He can be contacted on (09) 389 8644.

# URBAN ANTICS!




## What a Laugh !

Whoosh ... *plop*.

Here they come again, I thought, as a large brown-and-white bundle of feathers crash-landed on the verandah steps.

Within seconds there were three more. Then, as if on cue, the afternoon whistle from the Subiaco timber mill boomed and reverberated across town, heralding the home-coming of my grandad and the feeding of the kookaburras.

In those days, I was reluctant to get too close to the birds. To me, they were as big as our chooks and had an enormous beak just the right shape and size to carve up a curious small boy. Still, it was fun to place dobs of mincemeat along the verandah rail and watch as they hopped arkwardly on stumpy legs and tiny feet to flick the food skilfully down their cavernous throats.

Occasionally they would crack a beakful of meat on the rail in order to further stun or tenderise what would normally have been live prey.

The laughing kookaburra (*Dacelo novaeguineae*) of south-western Australia is the largest member of the kingfisher family. It was introduced into WA in 1897 from the eastern states, and it now lives here successfully in woodlands, open forests and suburban areas which have adequate habitat and a food source.

Quite unlike other kingfishers, the laughing kookaburra is a bold bird, sedentary in its habits, and occupying the same territory the year round. As its common name implies, it has an extaordinary call. The sounds it makes range from a few chuckles to a pronounced *kooaaah*, but the main song is a rollicking laugh, usually sung in chorus.

Both sexes of the laughing kookaburra have similar plumage. They have an off-white to buff head and body, with a dark line through the eye. The back is dark brown, the wings brown with sky blue markings, and the tail is barred with rich brown and black leading to a white tip. The beak is black above and horn below.

Laughing kookaburras form permanent pairs and nest from September to January in a flat-floored cavity in a tree trunk, branch or termite mound. Two or three eggs are laid, which hatch at different times about 24 days later. The young fledge in 36 days, and are then looked after and fed for a further 8-13 weeks.

The family social system of the laughing kookaburras greatly contributes to the low death rate and low birth rate of these birds. The young are not forced to leave their parents' territory on reaching maturity, but stay on in the subordinate role of non-breeders (only the senior pair breed). These 'auxiliaries', as they are known, defend territorial boundaries, rear and protect offspring, and occupy areas that would otherwise be taken over by breeders.

Although reducing breeding potential, the social system of kookaburras actually improves the chances of survival of all family members.

JOHN HUNTER

*DID YOU KNOW ?*

- *Laughing kookaburras can live 20 years if conditions are favourable. They 'laugh' to advertise their territory boundaries, then wait to hear the replies of neighbouring groups.*
- *They are not selective feeders; they prey on snakes, lizards, the odd small bird and rodents, but live mainly on insects, especially during plagues, and other invertebrates.*
- *Senior auxiliary family members move up to become breeders on the death of a family breeder, or they may go to newly vacant positions in a neighbouring group.*

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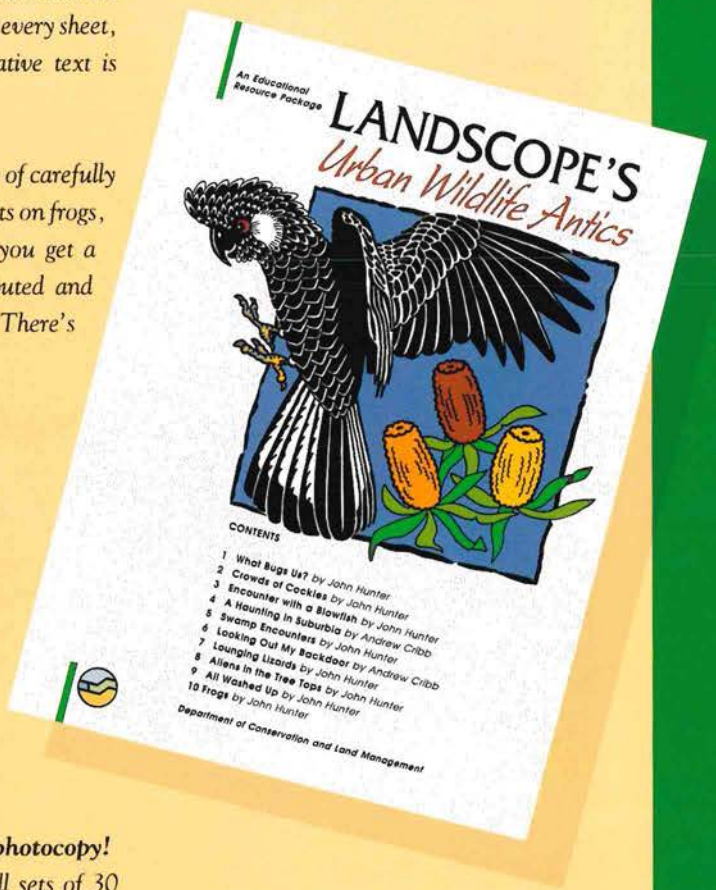


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# FIRST WINDMILL

*The last station on the edge of the Great Victoria Desert just before a storm. Wildlife officer Ray Smith photographed this moment on his way back from a research trip to the Gibson Desert, which will ultimately see endangered mammals reintroduced to an outback nature reserve.*

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