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SPRING 1992

# LANDSCOPE

W.A.'S CONSERVATION, FORESTS AND WILDLIFE MAGAZINE

## HUNTERS AND GATHERERS
*The life of the Swan River Nyungars*

## RATS OF THE TREE-TOPS
*Shy high-rise inhabitants*

## ORCHIDS OF THE STIRLING RANGE
*Diverse and spectacular*

Philippa Nikulinsky 92

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A CALM publication

Department of Conservation and Land Management


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*Small and shy and quite unlike their exotic, urban cousins, high climbing rodents live throughout the Kimberley.* *See page 10.*

*His name is connected with plants and places around Australia. He was interested in everything from Aboriginal customs to the size of trees. Read about* A Man of Science *on page 16.*

# LANDSCOPE

VOLUME EIGHT NO. 1 SPRING ISSUE 1992

*Once it was a traditional battleground for Aboriginal people. Today the competition is between sailboarders while families of picnickers look on.* *See page 23.*

*The various groups of Aboriginal people around the Swan River lived in harmony with the seasons.* *See page 28.*

*Learn about the incredible variety of orchids in the Stirling Range.* *See page 36.*

F E A T U R E S



R E G U L A R S

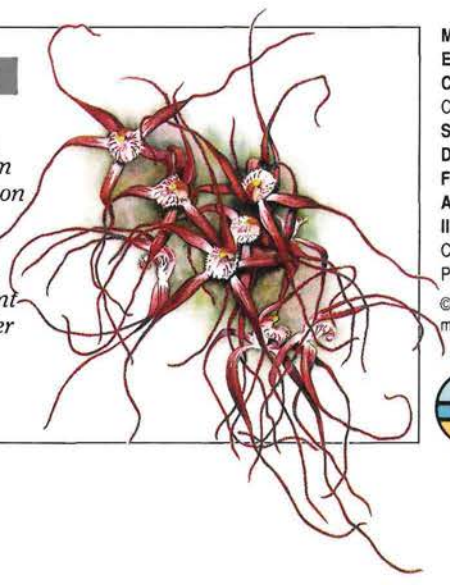


S P E C I A L S



C O V E R

*The many coloured orchid (*Caledonia polychroma *) is well named. Aside from the rich pinks there are clumps of lemon yellow and pure white. The orchid is found in the low areas of the Stirling Range, preferring wandoo and sheoak woodlands. While most years its vibrant flowers can be seen, it flowers best after fire. The illustration is by Phillipa Nikulinsky.*



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### *AN AFFINITY WITH THE LAND*

*The issue of Aboriginal involvement with land in Western Australia is highly charged with emotion and politics. The Department of Conservation and Land Management (CALM) cannot be involved in the political issues as they relate to land ownership. This is the province of the community through its politicians and, ultimately, the parliament.*

*But I believe there are few people who would not agree that Aboriginal people have a special affinity with the land. I have been privileged to speak to many tribal elders throughout the State and it is impossible not to be impressed with their sincerity when they speak about their special relationship to the land.*

*CALM's job is to manage the areas of the State set aside for conservation, recreation and production, which are vested in the National Parks and Nature Conservation Authority and the Lands and Forest Commission, on behalf of the community. The community, of course, is composed of many different constituencies and the challenge is to meet the requirements of all of them without conflict. CALM regards Aboriginal people as being part of a special constituency because of their skills and their special relationship with the land that CALM manages.*

*It is probably inevitable that we will continue to spend large sums of money on legal approaches to resolving conflicts with Aboriginal communities. But there is the potential for positive approaches.*

*There are many opportunities for CALM to interact with Aboriginal communities throughout the State in a way which provides benefits to CALM and Aborigines. For example, CALM has been involved in recruiting and training Aboriginal national park rangers and we are intensely proud of what these rangers have achieved and are achieving in the Karijini, Millstream-Chichester and Purnululu National Parks.*

*There are also excellent opportunities for Aboriginal people involved in the booming ecotourism industry. For example, CALM has been assisting the establishment of an Aboriginal enterprise, Aboriginal Safari Tours, in the Purnululu National Park. This has been established by Bonnie Edwards, one of the traditional (tribal) owners of that land. CALM national park ranger Hardy Derschow has developed a 'bush tucker tour' at the Yanchep National Park which is being utilised by a private tourist company.*

*We have been involved for some time in providing on-the-job training experience for young Aborigines in the southern forests and parks of the State. This is in support of an initiative by Mr Mike Hill, who incidentally has been recently appointed as the Aboriginal representative on the National Parks and Nature Conservation Authority.*

*CALM has recently concluded an extensive study of the use of land managed for the Department by Aborigines,* and Mr Noel Nannup, one of our most experienced national park rangers and a recent graduate of the University of Canberra, has recently been appointed as a full-time Aboriginal liaison officer.*

*In this edition of* LANDSCOPE, *we feature an article - 'Hunters and Gatherers' - by Peter Bindon and Trevor Walley, which is a fascinating documentation of how the Nyungar people utilised the natural resources of the south-west. The article only touches the surface of the amazing story about the interaction of Aboriginal people with their environment.*

*I am very confident that future editions of* LANDSCOPE *will feature more stories describing the unique understanding that Aboriginal people have for the land and its wildlife.*

*The Publisher*

*Aboriginal Activities and Nature Conservation in the South West of Western Australia. *Department of Conservation and Land Management, WA, December 1991*

### LANDSCOPE WRITERS REWARDED

Not in any boastful way, but we thought you would like to know that *LANDSCOPE* continues to attract accolades in important competitions throughout Australia.

Just weeks after it was announced that your magazine had earned a gold medal for design, pre-production and printing in an Australia-wide competition (the 9th National Print Awards) three articles published in *LANDSCOPE* earned their writers awards in competition for the annual Alex Harris Medal, which honours excellence in science and environmental writing.

Steve Hopper, for *Poison Peas: Deadly Protectors,* an article on WA native poison plants (Winter 1991, Vol. 6 No. 4), Jack Kinnear and Dennis King, for *1080: The Toxic Paradox,* an article on the role of WA's poison plants in controlling introduced predators (Winter 1991, Vol. 6 No. 4), and Paul Anderson, for his article on the dugongs in Shark Bay (Summer 1991 - 92, Vol. 7 No. 2), received three of the five commendation certificates awarded by judges.

Winner of this year's Alex Harris Medal was Wendy Prior of *The West Australian,* for a series of articles on threats to Perth's underground water supplies.

The medal honours the late Alex Harris, who worked for *The West Australian* for nearly 30 years and was one of this state's most influential scientific and environmental journalists. It was awarded for the first time last year to CALM scientist and *LANDSCOPE* writer Jack Kinnear.

*RON KAWALILAK*
*MANAGING EDITOR*

### INSPIRATION. . .

As an aspiring art student and concerned human being, I should like to congratulate you and your team on such an important and professional publication as *LANDSCOPE*.

The beautiful and effective illustrations contained are an inspiration to me. Thank you.
*GREGORY GREENFIELD*

### . . .AND EDUCATION

Congratulations on your well deserved 'National Print Award'. *LANDSCOPE* has been a source of great enjoyment and education for our family and friends for many years, and a yearly subscription has proved a handy gift for those people who have everything.

Of special interest to us was the superbly presented article by Jim Lane on aerodynamics. Our family has been involved with gliding and the relationship to the dynamics used by birds was very clearly demonstrated.

My sincere thanks to John Hunter for his prompt attention to the dispatch of *LANDSCOPE* to my granddaughter, a teacher at the Aboriginal Community in Jamieson.

She says the photographs are of particular interest to the children, so many of them are of subjects and animals familiar to them, and the text is of great assistance to her.

We are very proud of our special Western Australian magazine.
*MRS JOY BLACK*
*FLOREAT PARK*

*We have received many congratulations for the recent National Print Award and I speak for all the staff here when I say we are equally proud of LANDSCOPE and are pleased it gives pleasure to so many people, while providing a glimpse into the lives of our unique wildlife. - ED*

## CONSTRUCTIVE CRITISISM WELCOME

Your excellent publication is now one of the best wildlife magazines in Australia, so I hope you will accept a few words of constructive criticism about your Autumn 1992 issue.

The Albany Pitcher Plant occurs over a far wider area than just "a few swampy areas near Albany". It occurs further west towards Augusta and is found in a small reserve near Yallingup Siding in the Shire. As a south west Wildlife Officer in the late 1970s, I took it upon myself to pay the outstanding rates on this property.

On a more serious note, I must chastise you for not suggesting to Betty Avery of Scott River that a likely reason for the parent pygmy possums abandoning their six young was because she looked into the nest box too often! You could have also used the story that described Rita Watts' success at hand rearing two of the young to encourage more people to put nest boxes into their back yards or bush blocks on their farms.

Finally, it was disappointing that your "Urban Antics" page chose the introduced Kookaburra as its topic. City dwellers may see so little of our natural wildlife that they make these exotic birds welcome. But, in the country, the Kookaburra should be declared an unprotected species, since it is a recognised eater of native wildlife, including smaller bush birds and their young.

Your magazine provides a wonderful opportunity not just to glorify our wildlife, but also to educate us about how to live in harmony with nature.

I hope you will respond positively to this two-pronged challenge.

*BERNIE MASTERS*
*ENVIRONMENTAL & EARTH SCIENCE CONSULTANTS*

*It is our aim to do just that. - ED*

## INDEX

*LANDSCOPE* is an excellent magazine though I'd like to suggest an issue with an index would be very useful to people like me that have huge files of *LANDSCOPES* and your earlier 'Swans' and 'Forest Focus'' etc and often need to refer to the articles and photographs.
*L.G. SMITH*

*We have considered the matter of an index on several occasions, but we believe that the demand would not justify the cost - increased paper useage and postage. We have a photocopied index which we use in-house and we will certainly look at ways of presenting that information for external use. Look out for more details later. - ED*

## WILDLIFE IN DANGER FROM HUMANS

After I recently discovered the abundant number of pages in your magazine about endangered and harmed species, I would like to report on my feelings and concern about the issue.

I feel that the overall attitude of local people who have no consideration and the number of careless drivers who harm our wildlife is appalling. To care for and save our wildlife and the natural resources is one of the most important issues which affects the society that surrounds the problem.

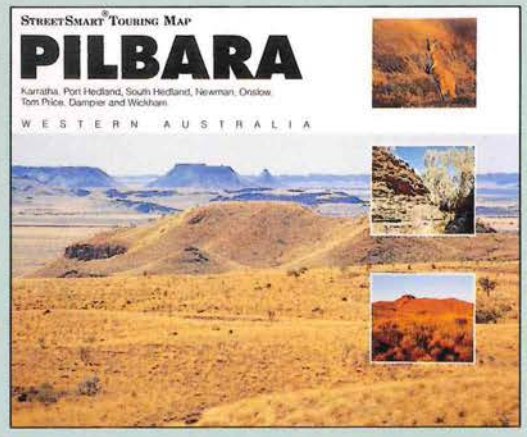
Wildlife is something we have to take into account and protect from its predators, these being humans. I hope that by the time our younger generation has matured, they will realise that nature is important and they will protect the future.

Lately I have discovered and rescued many hurt animals that are alive but unable to move to safety.

Wake up Australians, because it is time to realise that the wildlife we ruin is unique.
*SHANNON STEWART*
*GNOWANGERUP*

*It's often difficult to avoid collisions with animals on our roads, but we agree that a little more care would go a long way to reducing the numbers of animals killed in this way. Plants suffer from the carelessness of some walkers, who trample through bush areas without a thought for what lies beneath their feet. - ED*

## NEW PILBARA MAP




The Department of Land Administration (DOLA), in conjunction with the Department of Conservation and Land Management (CALM), has produced a comprehensive touring map of the Pilbara region.

The map's coverage begins just south of Carnarvon, on the North West Coastal Highway, and takes in the northern coastline to Broome, stretching inland to the communities of Tom Price, Wittenoom, Paraburdoo and Marble Bar, and as far east as the remote mining settlement of Telfer.

The Pilbara map highlights the many physical and cultural attractions of the region. As well as detailing the communities of the major town centres, it features useful information on CALM estate including the Hamersley Range, Millstream-Chichester and Karijini National Parks.

Individual enlargements of each of these parks provide visitors with details of picturesque picnic and camping locations, walktrails and road conditions, and also provides reminders of potential dangers from the natural environment.

The Pilbara map highlights existing and proposed conservation areas.The inclusion of this information is vital in educating and assisting visitors on their journey north.

This new map represents the vital link in the StreetSmart series, overlapping with the Gascoyne Coast, West Kimberley and East Kimberley touring maps.

A catalogue of DOLA's StreetSmart touring series and other mapping products is available free of charge from the DOLA Central Map Agency, 1st Floor, Central Government Buildings, Cathedral Avenue, Perth, telephone (09) 323 1370.

# BUSH RAT

The southern bush rat (*Rattus fuscipes*) is a common resident in the areas of thicker vegetation throughout the south-west of WA. Although it is common, it is rarely seen because of its nocturnal habits.

When a bush rat is seen, it is usually assumed to be a European or black rat (*Rattus rattus*). This species probably arrived with the first ships and has established itself through most inhabited areas around the coast of Australia. This is the rat with the sinister reputation as a disease carrier and general nuisance in urban areas.

So, what are the differences between our indigenous bush rat and the introduced black rat? The bush rat is a lot smaller than the black rat, and it has longer hairs which give it a fluffy appearance, but the most distinguishing feature is the difference in tail length. The bush rat's tail is equal to or shorter than its head and body length, whilst the black rat's tail is always considerably longer than its head and body length.

The habits of the two rats are also very different. Black rats are very good climbers and like to live in an urban environment, whereas bush rats are poor climbers, rarely found in dwellings and almost never in urban areas.

The black rat is very aggressive and fast moving. If caught in a confined area it will run and jump aggressively, often hissing, whereas the bush rat is much more docile, although it will jump in its efforts to escape confinement.

Bush rats eat seeds, fruits, insects, fungi and other plant material. They inhabit burrows in thick vegetation from which they venture out to forage for food at night. Bush rats breed mostly through the spring, summer and autumn periods, although they are capable of reproducing throughout the year.

Several litters may be produced in a season, each consisting of about five young. It takes about four to five weeks for the young to gain independence and they are capable of reproduction at four months of age.

Bush rats have disappeared from many areas due to loss of habitat and predation. After their dense habitat is changed by clearing, fire or grazing the bush rats fall easy prey to predators such as cats, foxes and native predators. If bush rats are present in adjacent bush they will recolonise these areas quickly if suitable habitat returns to the area (as happens after fire).

Competition for food from larger, more aggressive black rats will also have a negative effect on bush rat populations.

*The southern bush rat (*Rattus fuscipes*) is one of several attractive native rodents. This one was found in thickets of red swamp banksia* (Banksia occidentalis) *at Black Point in D'Entrecasteaux National Park. Photo - Ray Smith*

# FIRST WA STARFLOWER HYBRID

*WA's first starflower hybrid is a cross between summer starflower (*Calytrix flavescens*) and pink summer starflower (*C. fraseri*).*
*Photo - Ray Cranfield*

WA's first recorded starflower hybrid was recently discovered at Southern River, one of Perth's southern suburbs.

In January this year, Chris Wilkinson, a keen naturalist, was botanising through the banksia woodland at Southern River. In the grey sand he discovered a curious population of starflower (*Calytrix* species) unlike any he had seen before. It seemed to have characteristics of both summer starflower (*C. flavescens*) and pink summer starflower (*C. fraseri*), which both occur in the area. Chris sent his collection to the Department of Conservation and Land Management's WA Herbarium for identification. Herbarium botanist Ray Cranfield carefully examined the collection and was also puzzled by it.

Summer starflower is a small erect shrub, rarely exceeding 0.3 m tall with yellow petals 5-9 mm long. Pink summer starflower is a taller shrub with pink or pink-purple petals 8-12 mm long. This new collection seemed to fall between the two species and combine the petal colours to produce a beautiful apricot hue.

However, starflower hybrids had never been recorded in WA. To confirm Chris and Ray's findings, the specimen and photographs were sent to Lyn Craven at the Australian National Herbarium in Canberra. Mr Craven, Australia's foremost starflower expert, excitedly verified that it was indeed the hybrid they suspected and the first recorded evidence of starflower hybridisation in WA. In fact, it is only the fourth example in Australia.

The habit and flower colour of this new discovery could be of horticultural potential and Kings Park Botanical Gardens have expressed an interest in propagating it. *Calytrix,* a genus of 76 species with 53 occurring in WA, is concentrated in the south-west of the State. Several species are already being cultivated, including both parents of the hybrid.

# HATS OFF TO SUCCESSFUL BLUE BONNETS

Last year saw the successful breeding of 45 naretha blue bonnet parrots (*Psephotus haematogaster narethae*) in captivity, more than doubling the captive population.

While the Department of Conservation and Land Management (CALM) has long been involved in captive breeding programs, the naretha blue bonnet program has been unusual. It began with a submission to CALM from private aviculturists.

The submission was approved because it gave the bird breeders a chance to work with CALM in the conservation of a species which is poorly studied, rare in aviculture and a prime target for poaching.

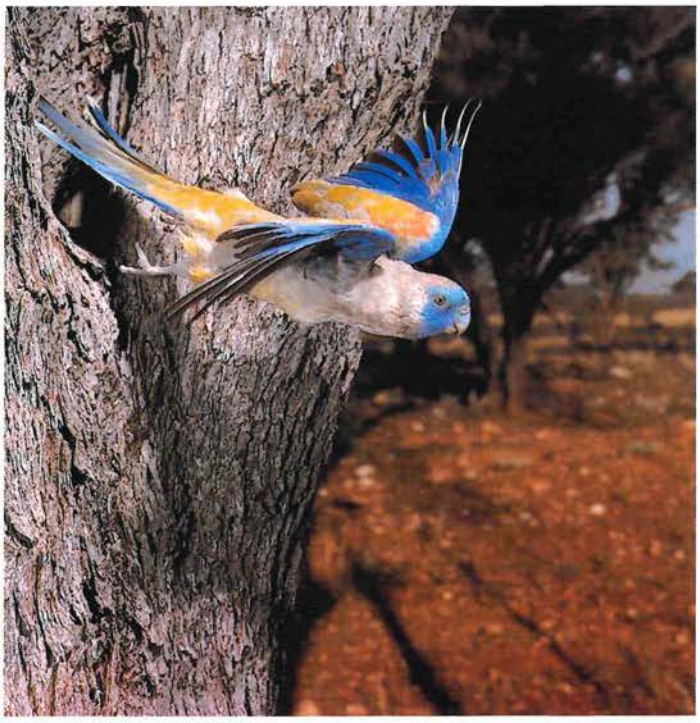
CALM oversaw the program and the bird breeders covered all the costs, including the supervision of the capture of the birds by wildlife officers, caging and feeding. In return, aviculturists were allowed to keep half the young birds.

The program was also unusual because, although naretha blue bonnets are rarely seen, as they come from remote parts of the Nullarbor Plain, they are not rare or endangered in their native habitat. They are subject to nest robbing - an operation which frequently results in permanent destruction of the few nesting hollows available to the birds.

The captive breeding program provided valuable information on determining the sex of birds in the wild, captive breeding and diseases. The birds have been DNA fingerprinted. According to Dr Syd Shea, Executive Director of CALM "In this way we can ensure that good numbers of blue bonnets exist in aviculture, all of which can have their origins verified by DNA analysis, thereby greatly reducing the scope for illegal taking."

Next year's breeding program will be extended with two pairs going to Perth Zoo and another two aviculturists joining the program.

*The naretha blue bonnet parrot occurs in sparse woodlands of south-eastern Western Australia.*
*Photo - Babs and Bert Wells*



# PHOTO - LANDSCAPES

One of the best ways to appreciate our State's natural qualities is by photographing WA's spectacular landscapes.

An inexpensive course run by University of WA Extension is designed to teach people the basics of landscape photography. The course, *Photographing Landscapes*, is led by freelance photographer Bob Litchfield.

The highlight is an expedition to catch the dawn light on sand dune country north of Perth. Participants stay overnight at Lancelin and rise before dawn to take advantage of the best photographic conditions. At this time of day the sand looks completely untouched.

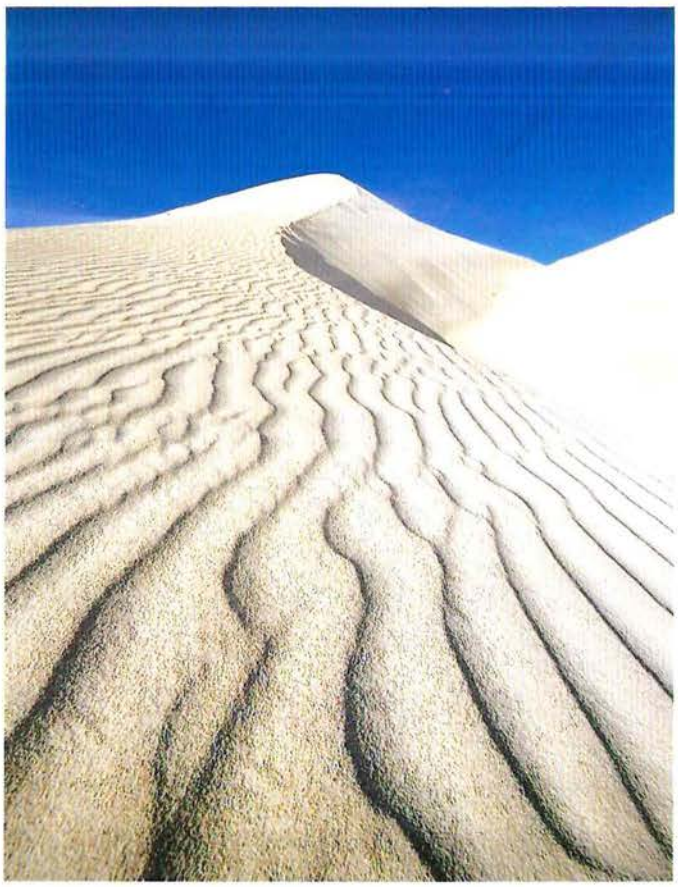
People separate and tramp up and down the bare hummocks of sand to find their own part of the dunes to work with. A few hours later they return to the hotel exhausted, for a hearty breakfast.

The weekend before the dawn raid, there is a full day workshop. Bob gives everyone handy tips on composition, exposure and timing, as well as focus, depth of field and hyperfocal distance. In the afternoon there is a slide viewing, where budding photographers analyse and discuss Bob's work.

A follow-up session is held after the trip to view the results and share each other's point of view.

"I find that the Lancelin dunes are amongst the most interesting places to work with - they are always changing," said Bob. "Everyone sees things in different ways and gives the area their own unique interpretation."

Bob and UWA Extension will hold another workshop in spring, this time on photographing wildflowers. To attend contact Sally Storie on 380 2433.



*Sand ripples on the Lancelin dunes.*

*Photographers set up a shot. Photos - Carolyn Thomson*

# WHALE OF A TIME

A beach laden with an interesting cross section of the 40 odd species of whales and dolphins known to frequent offshore areas of the south-west coast of WA, set the scene at Hamelin Bay on a recent long weekend.

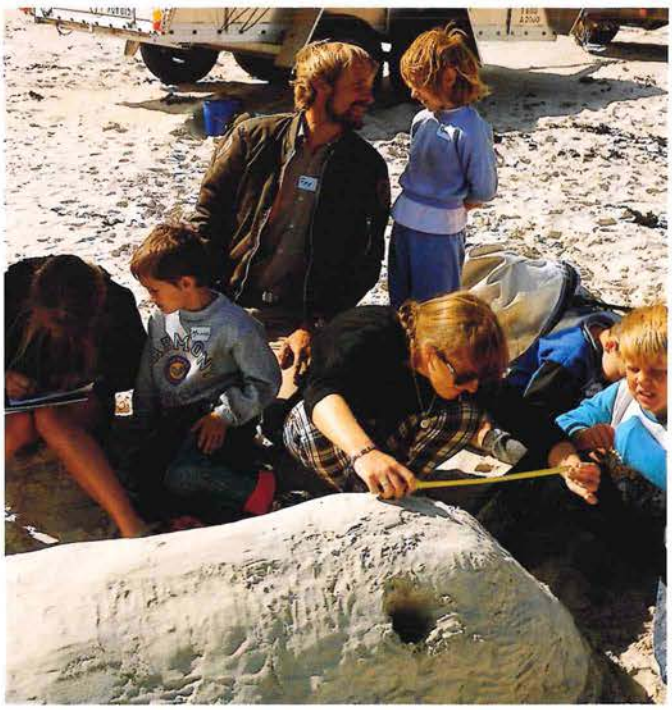
CALM Wildlife Officers Ray Smith and Sean Hazelden were conducting an educational workshop centred around dolphin and whale strandings as part of CALM's "On the Ridge" program.

About 40 children aged between 6 and 12 took part in the activity, where they were required to build sand sculptures of a whale or dolphin species present off WA's south-west coast.

In groups of about 10, the children worked diligently on their chosen whale sculpture with some guidance from Ray and Sean. Shortly afterwards, there were four excellent specimens to work with in formulating a whale rescue strategy, emergency first aid procedures and recording data on the chosen species.

After this they got down to the serious stuff, "the great whale rescue race", which involved the group carrying a substitute whale (one of the children from each group) as quickly as possible from start to finish.

All participants enjoyed the activity and left with a better understanding of these marvellous creatures that dwell off the coast of WA.



*Right:*
*CALM wildlife officer Ray Smith with a group of schoolchildren measuring their "beached whale".*

*Children participating in a "whale rescue race" during CALM's "On the Ridge" program. Photos - Emily Milne*

# HELP FOR THREATENED SPECIES AND COMMUNITIES

Western Australia, with its large land area encompassing three major biogeographic zones, has nearly half of all threatened species of vertebrate animals and higher plants in Australia.

For some time the Department of Conservation and Land Management (CALM) has been a leader in research into and management of threatened animals and plants as well as the control of the causes of extinction, such as introduced predators and dieback disease caused by *Phytophthora*.

Scientists and international bodies such as the World Conservation Union (IUCN) recognise that nature conservation must take place at three levels - ecosystem, species and genetic. Conservation at the ecosystem level is best achieved by ensuring that ecological communities are protected. Animals and plants cannot survive in the wild unless they are part of an interacting, integrated community.

Now CALM's efforts to save threatened plants and animals will be overseen by a new unit - the WA Threatened Species and Communities Unit. As part of CALM's Nature Conservation Division, the unit will be based at CALM's Wildlife Research Centre, and will focus on threatened animals, threatened plants and threatened communities.

For years CALM and its predecessors have worked towards the conservation of communities and ecosystems through the identification and declaration of national parks, nature reserves, conservation parks and so on. However many communities will never be protected in a conservation reserve. The Threatened Species and Communities Unit will help private land owners conserve threatened communities and species on their land. One goal of the unit is to produce a data base of threatened communities.

*The WA Threatened Species and Communities Unit can be contacted on (09) 405 5128.*

# RATS OF TH

# E TREE TOPS

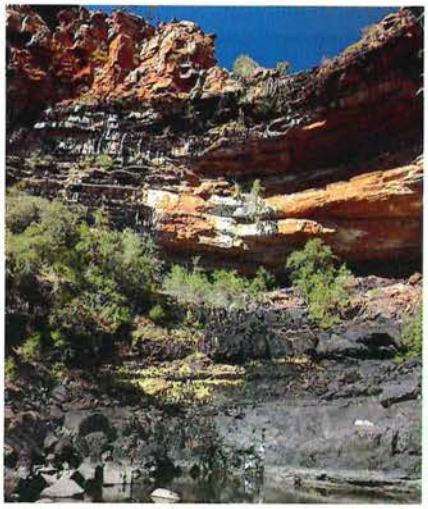
*Ask most Australians if they know what a tree-rat is and you would probably get a blank look.*

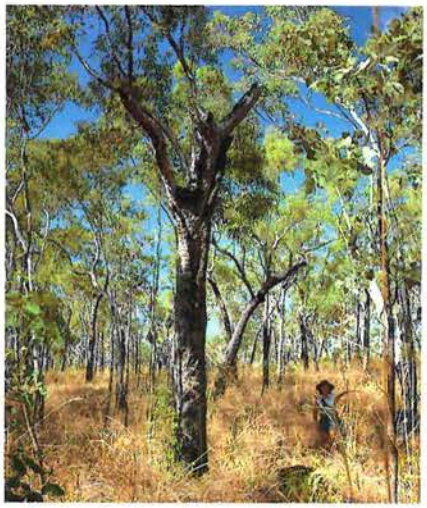
*Until recently, this group of fascinating native rodents was little known, even to most scientists studying small mammals.*

*Thanks to recent work in the Kimberley and the Top End of the Northern Territory, we now know something about the distribution and ecology of these tree dwellers.*

*by*
*Gordon Friend*
*Cath Kemper*
*and*
*Anne Kerle*

The three species in the tree-rat group are sparsely distributed throughout tropical northern Australia: the golden-backed tree-rat (*Mesembriomys macrurus*), the black-footed tree-rat (*Mesembriomys gouldii*) and the brush-tailed tree-rat (*Conilurus penicillatus*). Another species, the white-footed tree-rat (*Conilurus albipes*), occurred through much of south-eastern Australia in the 1800s but has not been recorded since the turn of the century.





*Top:*
Only the black-footed tree-rat has been studied in detail in the wild.
Photo - Gordon Friend

*Above:*
One of several nest trees used by a young black-footed tree-rat radio-tracked on the Mitchell Plateau.
Photo - Gordon Friend

*Above left:*
Sandstone gorges and rainforest patches in the Kimberley are a favoured habitat of the golden-backed tree-rat.
Photo - Gordon Friend

*Previous page:*
The brush-tailed tree-rat, smallest of the three species that inhabit the tropical north of Australia.
Photo - Cath Kemper

## APPEARANCE, TEMPERAMENT AND HABITS

The golden-backed tree-rat is particularly handsome, weighing around 300 g - it is about the same size as a female numbat. It has coarse, brown-grey fur with a distinctive golden colour on the head and shoulders and along the back. It is white underneath. This tree-rat's most notable feature is the long tail, about a third of a metre long, which is brown near the body, changes to white and ends with a white brush.

The black-footed tree-rat is more robust, weighing around 800 g, with the strength and agility to match. It, too, has a long white-tipped tail, but the body fur is coarser, and a grizzled grey-black colour. The Aboriginal people of northern Australia prized this species as a food item. They would locate animals in hollow gum trees, chop a hole in the trunk and seize the animal by the tail, then deftly whirl it around to make it dizzy before throwing it into a collecting bag. Such an operation took some skill and bravery - this species has a savage temper and a formidable bite. When aroused, individuals make a noise like a whirring machine-gun.

The brush-tailed tree-rat, weighing around 180 g as an adult, is more delicate. Its back is grey to golden brown with a rufous patch on the neck, and the underside is white to cream, often with a grey T-shaped patch on the chest. Its long, dark tail has a black or white brush on the tip; the proportion of white-tipped individuals varies according to the area from which the population comes. This species is often called the brush-tailed rabbit-rat because of its large ears and rabbit-like face. Like the black-footed species, these animals can vocalise when threatened, but they can usually be handled with reasonable ease

All three species are tree dwellers, nesting in gum tree hollows, screw pines (*Pandanus* species) and fan palms (*Livistona* species), or occasionally in buildings. They move effortlessly up and down trunks and along branches under the veil of darkness. The tail is not prehensile like that of large possums, but does curl around the branches a little and helps with balancing. On the ground, tree-rats bound along with the tail held high, almost like a signal or banner.

## DISTRIBUTION AND HABITAT PREFERENCES

Golden-backed tree-rats are most common in the north-western Kimberley, preferring rainforest patches, some woodlands with fan palms or screw pines and, occasionally, rugged sandstone screes. Most of the populations are near the coast. There are also a few sightings from the Northern Territory, the most recent being in 1967 from Deaf Adder Gorge in Kakadu National Park.

By contrast, the black-footed species is most abundant in tall northern woollybutt (*Eucalyptus miniata*) and stringybark (*Eucalyptus tetrodonta*) forest in the Top End of the Northern Territory. Areas with a relatively dense understorey of small trees and shrubs and fan palms or screw pines are preferred. These areas are often associated with perennial soaks that keep moisture levels high throughout the year

and provide some protection from fire. Black-footed tree-rats are considered rare in Western Australia, with populations known only from the Mitchell Plateau and Kalumburu. Here, the favoured habitat is similar to that occupied in the Northern Territory. A few specimens have also been recorded from the east and west coastal areas of Cape York, but little is known about the Queensland populations.

Brush-tailed tree-rats are less fussy about their habitat than the two other species. They are most common in open forest and eucalypt woodlands with a relatively sparse shrub layer and a ground cover of tall grass (such as sorghum). This vegetation type is widespread throughout northern Australia, but is frequently burnt. Populations of brush-tailed tree-rats are found in the Kimberley, the northern third of the Northern Territory and on a few islands in the Gulf of Carpentaria. The species also occurs in southern Papua New Guinea.

Records from some of the early naturalists who collected in the tropics during the middle to late 1800s (for example, Knut Dahl, 1894-95) suggest that the golden-backed and black-footed tree-rats were at one time more widely distributed in the drier inland areas of the Kimberley and the Northern Territory. Over the past 50 or so years, populations of these two species appear to have contracted to the wetter, more densely forested areas nearer the coast.

## RECENT ECOLOGICAL STUDIES

Survey work carried out by CALM and the WA Museum in the Kimberley, and by CSIRO and the Northern Territory Conservation Commission during the mid-1970s and 1980s, indicated that tree-rats were uncommon. Only a few animals were captured in widely scattered areas during any one of these surveys. In 1980, however, a thriving population of black-footed tree-rats was located in the CSIRO study area at Kapalga in Kakadu National Park. Detailed studies over the next three years provided the first field-based data on how these tree-rats lived in the wild. Little was known of the ecology of the other two species.

However, WA Museum surveys had shown one area where all three species occurred in proximity: the Mitchell Plateau in the Kimberley. Here, a patchwork of rainforest, open forest, woodland and scree slope habitats cater for the tastes of any tree-rat. We set about organising an extended field trip to the area to learn more about these unique rodents.

We spent three weeks on the Plateau in August 1987, and undertook extensive trapping, radio-tracking and spotlighting. Radio-tracking gave the most exciting insight into how these

The large fruits of screw pines (*Pandanus* spp.) are the favourite food of black-footed tree-rats.
Photo - Jiri Lochman

Like the other two species, golden-backed tree-rats are agile climbers. They use their tails to help with balancing.
Photo - Jiri Lochman

animals lived: where they nested, where they foraged, how far they moved, when they were active and how often they came into contact with each other. Collecting and analysing droppings provided much-needed information on what they ate.

We found that both *Mesembriomys* species tend to be relatively solitary and need quite a large area in which to forage. They can move large distances very quickly. For example, a young male black-footed tree-rat rapidly traversed about 500 m each night between his refuge trees and a feeding area on the scree slope at the edge of the plateau. Unfortunately, we were unable to fit brush-tailed tree-rats with radio-collars (because there were no collars that were small enough) so we have little idea of their movements.

Golden-backed tree-rats lived on the edge of the rainforest patches, feeding in trees in the woollybutt forest and the remnant rainforest. The need for a large home area means that a patch of suitable habitat cannot support many individuals - probably an important reason for their sparse distribution. The loss of many patches of remnant rainforest in the north-west Kimberley is also a concern. These remnant patches support most of the known populations of golden-backed tree-rats, though some are found elsewhere.

Black-footed tree-rats may use nest sites in several different trees but forage in areas well away from these refuges. This information made us suspect that suitable food supplies for this species may be very patchy. Since suitable hollows are quite common throughout these northern tropical forests, it is likely that the species' patchy distribution is tied more to food resources than to the availability of shelter. This reasoning also applies to the golden-backed species, but the factors influencing the abundance and distribution of the brush-tailed tree-rat are not yet known.

## DIET

Until recently, the food of the three species was poorly known. A detailed study of droppings from the Mitchell Plateau was carried out by Civa Morton at the University of Canberra in 1991. Golden-backed tree-rats ate mostly fruits, flowers and termites and occasionally grasses, leaves, ants and beetles. This explains why they live on the edges of the rainforest patches. Most of the fruits and flowers are rainforest species or are more common in the eucalypt forest along these edges, while the termites are most readily available in the mature open forests.

Similarly, the black-footed tree-rat ate fleshy and hard fruits and large seeds, supplemented by grass and termites. The large fruits of screw pines were particularly favoured. Hard-fruited plants like *Gardenia, Terminalia* and *Petalostigma* tend to grow as understorey species within the patches of tall, open forest frequented by this species. Not surprisingly, a large component of the brush-tailed tree-rat's diet was grass and seed, reflecting the species' preferences for areas with a grassy understorey. Like the others, this species also included some termites in its meals.

The fact that tree-rats eat termites is an exciting discovery. Termites are an important part of the Australian fauna, being much more valuable in breaking down plant material and recycling nutrients than herbivores such as kangaroos. No other species of rodent is known to include termites as a significant part of its diet and this may be part of the reason why these tree-rats are restricted to the tropical regions. Termites are much less common in trees in temperate parts of Australia.

Brush-tailed tree-rats are also known as rabbit-rats because of their large ears and rabbit-like faces.
Photo - Bert & Babs Wells

## BREEDING PATTERNS

The detailed work in Kakadu on the black-footed species showed that breeding occurs throughout the year. This is somewhat surprising given the highly seasonal nature of the climate (a wet season of six months, followed by a dry season of six months). However, although this species' food plants may not be widespread, most have prolonged fruiting periods. This means that there is always something highly nutritious available to eat. The close link between nutrition and reproduction explains their non-seasonal breeding patterns. Field data on the other two species are limited, but laboratory studies have shown that they are capable of breeding throughout the year.

Both *Mesembriomys* species usually have two young, but litters with one to three young have been recorded. Brush-tailed tree-rats may have up to four young, though three is most common. The periods of pregnancy are quite long for these rodents (especially the two *Mesembriomys*), but the young develop rapidly, are weaned in four to five weeks, and reach adult size at about three to four months. This means that populations can increase fairly rapidly under good conditions. However, limitations in food resources, and factors like predation and perhaps burning, are keeping populations in check.

## CONSERVATION

The patchy nature of food resources, and their susceptibility to disturbance, probably explains the decline of tree-rat populations, particularly in the more inland areas of their distributions. Grazing by introduced cattle and buffalo and changes in fire regimes since European settlement may have significantly reduced the understorey trees and shrubs that provide food resources for these animals. These factors probably had a more severe impact in the drier areas near the edges of the species' ranges, leading to populations contracting to wetter, more suitable patches of forest near the coast (for example, rainforest in the golden-backed tree-rat's case).

Although a reasonable body of information exists for the black-footed tree-rat in the Northern Territory, little is known about the other two species. We urgently need to commence detailed work on the ecology of the golden-backed and brush-tailed species. Following this, we should examine the marginal populations of all three species near the limits of their ranges and determine the critical factors affecting their survival. Only through such a strategy can we ensure that these fascinating and unique rodents are conserved in the long term. ⊡

Golden-backed tree-rats need a large area in which to forage, since they feed in both the woollybutt forest and the adjacent rainforest patch.
Photo - Jiri Lochman

*Top left:*
Black-footed tree-rats were a prized food for the Aboriginal people of northern Australia.
Photo - A. C. Robinson/NPIAW.

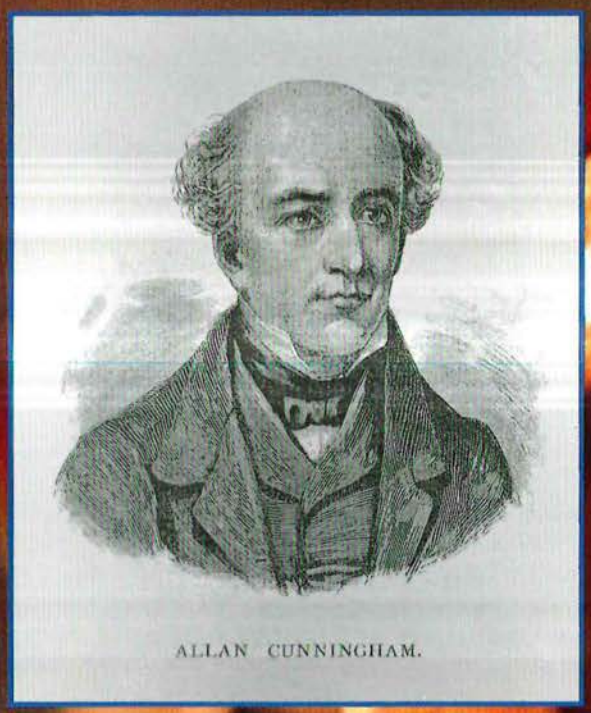
Habitat of the brush-tailed tree-rat on the Mitchell Plateau - an open woollybutt woodland.
Photo - Gordon Friend

Gordon Friend is a principal research scientist based at CALM's Wildlife Research Centre. He can be contacted on (09) 405 5100.

Cath Kemper is curator of mammals at the South Australian Museum, and can be contacted on (08) 207 7500.

Anne Kerle is a consultant biologist, based in Alice Springs. She can be contacted on (089) 52 6684.

# CUNNINGHAM
# A MAN OF SCIENCE



ALLAN CUNNINGHAM.

by Suzanne Curry

*Many of our plant and place names come from one of the foremost botanist-explorers to visit Australia. Suzanne Curry takes a look at Allan Cunningham, a man of science.*

Have you ever visited Point Cunningham, Western Australia? Have you stopped at Cunningham, New South Wales or Cunningham Gap, Queensland? Perhaps you've admired the beautiful *Crotolaria cunninghamii* commonly known as the green bird flower, and the swamp daisy (*Actinodium cunninghamii*). Who was the man so honoured by these names?

Allan Cunningham was one of Australia's foremost botanist-explorers. He was born in England in 1791. In 1814, under the direction of Sir Joseph Banks, Cunningham was appointed as a botanical collector. After a successful excursion to Brazil he was sent to New South Wales and arrived in Sydney in December 1816.

During his 17 years in Australia, Cunningham was responsible for collecting more than 3 000 specimens of plants and exploring much of New South Wales, southern Queensland and Tasmania.

## KING'S VOYAGES

Between 1818 and 1822 Cunningham visited a number of coastal parts of Western Australia. He accompanied Lieutenant Phillip Parker King on five voyages undertaken to survey various parts of the Australian coastline. John Septimus Roe, who later became the first Surveyor General to Western Australia in 1829, was also attached to these voyages.

Four of the five voyages included extensive surveying of the Western Australian coastline. Much of this work was concentrated in the then unknown waters of our northern shores (from King Sound to Brunswick Bay), but other visits included King George Sound, Rottnest Island, the Dampier Archipelago and Dirk Hartog Island.

As ship's botanist, Cunningham collected assiduously, acquiring between 300-400 specimens on each voyage. He kept meticulous journals which he wrote up at the close of each day. It was not unusual for his day to begin at sunrise and finish well after sunset when he would be busy pressing, drying and packaging his collections. It was a remarkable feat considering the cramped quarters in which he

*Previous page:*
The coastal or red-eyed wattle (*Acacia cyclops*). The name is based on Cunningham's collection made in January 1818 from King George Sound.
Photo - Bruce R. Maslin

*Inset:*
A portrait of Allan Cunningham.

*Above left:*
The dyaridany (*Hakea macrocarpa*). The scientific name is based on Cunningham's collection made in February 1822 from Point Cunningham.
Photo - Brian J. Carter

*Left:*
The swamp daisy (*Actinodium cunninghamii*) was collected by Cunningham. The name was published in 1836.
Photo - Greg Keighery

worked: the *Mermaid*, for instance, was a cutter of 84 tonnes with a complement of 19 crew.

Cunningham also gathered many living collections, bulbs and seeds that were shipped to Kew Gardens, where they were eagerly examined by Banks and the Superintendent of the Gardens, William T. Aiton. Banks wanted to keep one step ahead of the collectors working for Schönbrunn Austria, the only garden that rivalled Kew. A 'Memorandum of New Holland Plants of your introduction to us, taken down on a turn around the Garden this morning', appears in a manuscript at Kew dated 6 April 1827 and signed by Allan's brother Richard. It includes plants he knew as *'Pterostylis gibbosa'* and *'Pterostylis rufa'*, both of which were probably collected from Western Australia.

Cunningham would spend hours preparing the wooden boxes containing these valuable plants, which needed to survive the six months or longer journey to London.

## CUNNINGHAM'S NAMES

Cunningham gave manuscipt names to many plants that he collected that were unfamiliar to him. He also carefully annotated each collection with important details on the plant's distribution, habitat, habit, flower shape and colour, and so on. However, because he spent most of his life as an active botanical collector and explorer, he did not have the time to publish the many new species of plants that he had discovered. Others, such as English botanists Robert Brown and George Bentham, took on this task.

Cunningham collected numerous species unknown to science. Many of these have been named in his honour. Some Western Australian examples include the swamp daisy (*Actinodium cunninghamii*), the Albany woollybush (*Adenanthos cunninghamii*), the coast angianthus (*Angianthus cunninghamii*), and the green bird flower (*Crotolaria cunninghamii*).

Because of the quality and number of specimens Cunningham made from previously uncollected areas of Western Australia many subsequently became the most important collection, known as the 'type'. The type collection is the specimen on which the name of a species is based.

Colourful flowers, sometimes called bachelors buttons (*Gomphrena cunninghamii*) are another Western Australian plant bearing the name Cunningham.
Photo - Jiri Lochman

A sketch from Lieutenant Phillip Parker King's journal of the *Mermaid* at Careening Bay in 1820.

The Department of Conservation and Land Management's (CALM) Western Australia Herbarium houses 16 of these types, donated by Kew Gardens and the British Museum in London. One of these is *Acacia idiomorpha*, a wattle originally published in *Flora Australiensis* by George Bentham in 1854. The name is based on Cunningham's collection made in January 1822 from Dirk Hartog Island.

## A MAN OF SCIENCE

Although Cunningham's position on these voyages was that of Colonial Botanist he was very much a man of science with broad scientific interests, as shown by his articulate journals. As an example: in September 1820 the *Mermaid* stopped in a small bay forming the western bight of Port Nelson. There she was careened or tipped on her side to be cleaned and repaired. Nineteen days were spent at this site, subsequently named Careening Bay, which was revisited in July 1821. Cunningham's journal describes the pitching of tents, the discovery of fresh water streams (his attention to detail has allowed these springs to be relocated), comments on land recently burnt by Aboriginal people,

*Right:*
The green bird flower (*Crotolaria cunninghamii*). Cunningham collected this species at Goodenough Bay, King Sound, in February 1822.
Photo - Brian Carter

*Below right:*
Cunningham noted the presence of the frilled lizard (*Chlamydosaurus kingii*) at Careening Bay.
Photo - Marie Lochman/Lochman Transparencies

*Below:*
The wattle *Acacia idiomorpha*. Its name is based on Cunningham's collection from Dirk Hartog Island
Photo - Bruce Maslin

their language and the construction of their huts, the topography of the area, and the collection of a 'curious lizard of extraordinary appearance' (the frilled lizard *Chlamydosaurus kingii*) as well as many other remarks. He paints a remarkably clear picture of our country at that time. On this visit the large boab tree (*Adansonia gregorii*) in the bay was incribed 'HMC Mermaid 1820'. Cunningham recorded its girth as 29 feet (8.8 metres). Today it measures 12.2 metres with the inscription still very evident.

Cunningham was one of the first Europeans to botanise on our shores. Indeed he appears to be the first person to make botanical collections from the Kimberley. These factors, combined with the quality of his specimens and the details of his observations, form much of the basis for our current taxonomic knowledge.

His observations are also used to compare vegetation changes in an area and to assess whether plants still exist in these areas. They can help establish the distribution range of some species. In some cases, when plants are poorly collected, collections can be actively sought from areas mentioned by Cunningham. These observations assist in making sure that poorly known plants are adequately protected.

One of the major difficulties in researching Cunningham is that his journals and specimen listings have never been published. One may find, in numerous publications, very small portions of his work transcribed but these amount to only a fraction of the total. The original journals are not available to the public and are housed in part at the British Museum in London and the Mitchell Library and State Archives in Sydney. Therefore the journals must be examined using microfiche copies. Many painstaking hours are spent interpreting

the old style of writing (including Latin), of England in the 1820s.

Another problem is determining the currently accepted name of many of Cunningham's collections. Many names that he attributed to plants have since proven incorrect. This is understandable given the vast knowledge of botany that has been acquired since the 1820s. Correct identification of these collections requires close examination of the actual collection and the relevant observations in his journals. As most of Cunningham's collections are not in Australia, research is needed to ascertain where the collection is and a formal request made to borrow the relevant specimens.

Difficulties can also arise when place names used by Cunningham cannot be found on today's maps. Research has been conducted by the author and Bruce Maslin, Principal Research Scientist in the W.A. Herbarium, to establish each collecting site visited by Cunningham with Phillip Parker King and to establish its equivalent contemporary name. Copies of King's charts have been forwarded from the Hydrographic Office in London and are now kept in the Herbarium. In Western Australia, for example, Cunningham's Curlew River is now known as the Ashburton River, and, near Albany, French River is known as the Kalgan River.

Several people in Australia are actively researching different aspects of Cunningham's work. Kevin Kenneally, Principal Research Scientist in the W.A. Herbarium with botanical expertise on the Kimberley area, is transcribing Cunningham's journal entries that concern the Kimberley. The combined work is a long-term project and will eventually result in the transcription of Cunningham's entire journals.

## FINAL YEARS

In 1831, after 17 years in Australia, Cunningham was instructed to return to England, where he arrived in ill health. He took up residence at Strand-on-the-Green near Kew and spent his time arranging his collection of specimens in the herbarium and preparing papers for publication.

In 1832 he was offered the post of Superintendent of the Sydney Botanic Gardens. Cunningham declined but recommended his brother Richard, who took up the position in January 1833.

In April 1835 Richard was killed by Aboriginal people and Cunningham accepted the post, hoping the warmer climate would improve his declining health. He commenced duties in March 1837 but quickly became disenchanted with the gardens. They seemed to him little more than a pleasure ground for the public, and he objected to superintending 'the Government Cabbage Garden' where, amongst other things, he was expected to grow vegetables for the Governor's table. He resigned in late 1837 and left for New Zealand to continue his own biological investigations. Included in his collection was a specimen of what Cunningham regarded as 'that rarest of all the birds of New Zealand, the Kiwi'.

Cunningham returned to Sydney in October 1838 in extreme ill-health. His plans to revisit Western Australia with Captain John Wickham were abandoned and on 27 June 1839, at the age of 48, Allan Cunningham died. In 1844 an obelisk to his memory was erected in the Sydney Botanic Gardens. In 1901 Cunningham's remains were placed in this obelisk and a grove of bangalow palms (*Archontophoenix cunninghamiana*) was planted nearby.

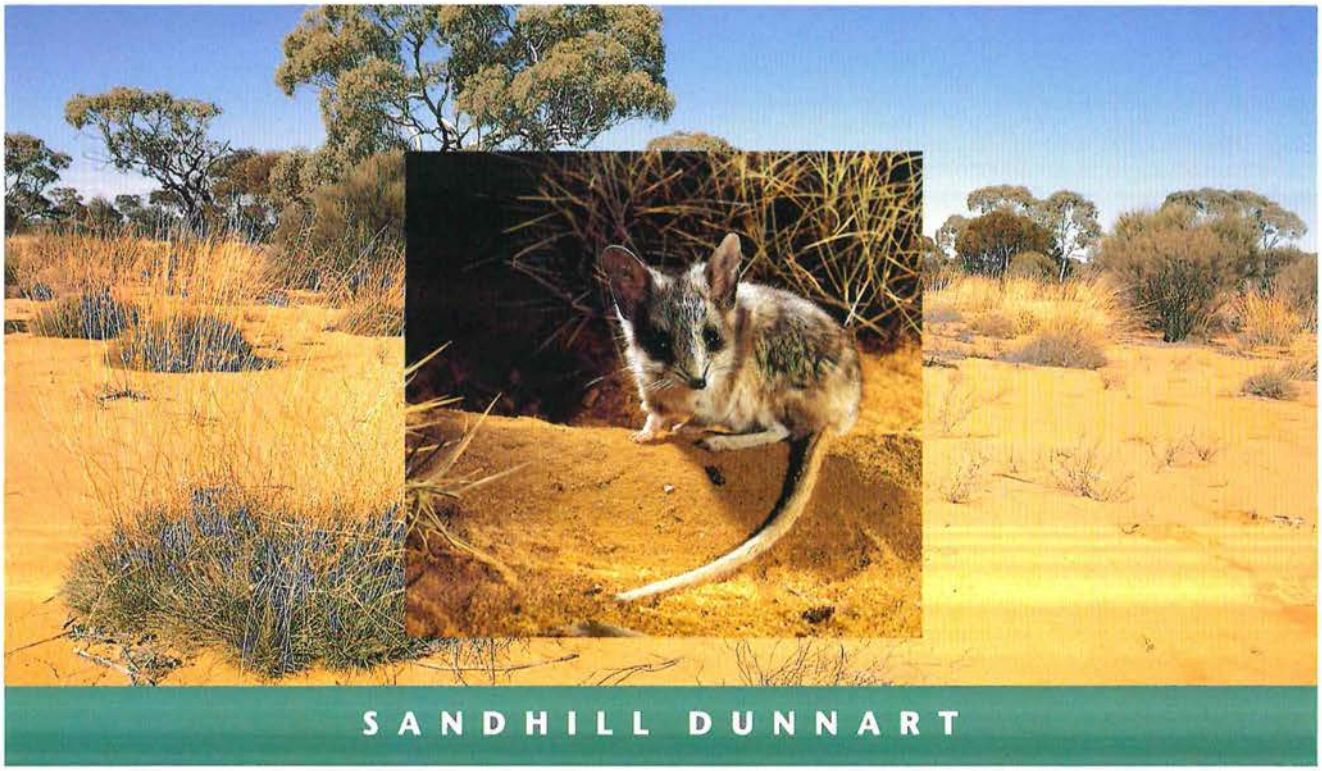
Cunningham's industry was boundless. He would take every opportunity either to look for something new or to re-collect a more perfect specimen. Many species that he recognised as new are still recognised as distinct today. We can be thankful that this remarkable man was able to pursue his work in Western Australia.

The bachelors button.
Photo - Jiri Lochman

Copy of Phillip Parker King's chart of the north-west coast of Western Australia from Montague Sound to Cape Londonderry.
Photo - Courtesy Hydrographic Office, London

Suzanne Curry is a Technical Officer at the CALM Herbarium, Science and Information Division. Suzanne has been researching Cunningham for the last eight years and may be contacted on (09) 367-0492.

# ENDANGERED!



## SANDHILL DUNNART

A well-directed throw of a boot was responsible for bringing the nocturnal sandhill dunnart to the attention of European science - and its own life to an abrupt end. This was in 1894, and in broad daylight members of the Horn Scientific Expedition flushed one from spinifex near Lake Amadeus in the Northern Territory.

The sandhill dunnart seemingly disappeared until 1969 when a bulldozer driver clearing mallee on Eyre Peninsula (South Australia) caught one as it fled burning spinifex. Four more were soon caught nearby.

Since then, sandhill dunnarts have been captured occasionally in the Great Victoria Desert of Western Australia and South Australia and remains have been found in owl pellets recovered from caves at Ayers Rock.

The sandhill dunnart is the largest of all the dunnarts. Males weigh 30-45 g and females, 25-35 g. It is easily distinguished by both its size and a long muscular tail terminating in a vertical feather-like crest of stiff hairs. A variety of climatic zones and vegetation types are occupied. All recorded habitats have sandy soils, sometimes with low dunes, and an understorey of spinifex grasses. A population in Queen Victoria Spring Nature Reserve has been studied by CALM staff while researching the effects of fire on desert vertebrates. Few have been captured despite intensive trapping, but nonetheless some information has been obtained on the species' ecology.

Reproduction occurs in spring and early summer. A lactating female has been captured in December and one with four dependent juveniles in January. From birth the young are carried in a rudimentary pouch comprising a circular flap of skin enclosing the mammary gland and a ring of eight teats. Once the young outgrow the pouch the mother cares for them in the nest. Other desert dunnarts shelter in burrows, but the sort of shelter used by sandhill dunnarts is still unknown.

The diet has not been studied, but may comprise insects, lizards and small mammals. A radio-tracking study is planned to find out more about its ecology and preferred habitat which should help pinpoint areas where other populations may exist.

The reasons for the rarity of the sandhill dunnart are unclear. Perhaps, like some other mammals, it suffers from the depravations of foxes and feral cats. Unfortunately, much of the habitat where sandhill dunnarts were first caught in South Australia has been cleared for agriculture. At present, there is no direct human threat on populations in the Great Victoria Desert, but research is needed to provide a better understanding of the needs of this mysterious and elusive dunnart.

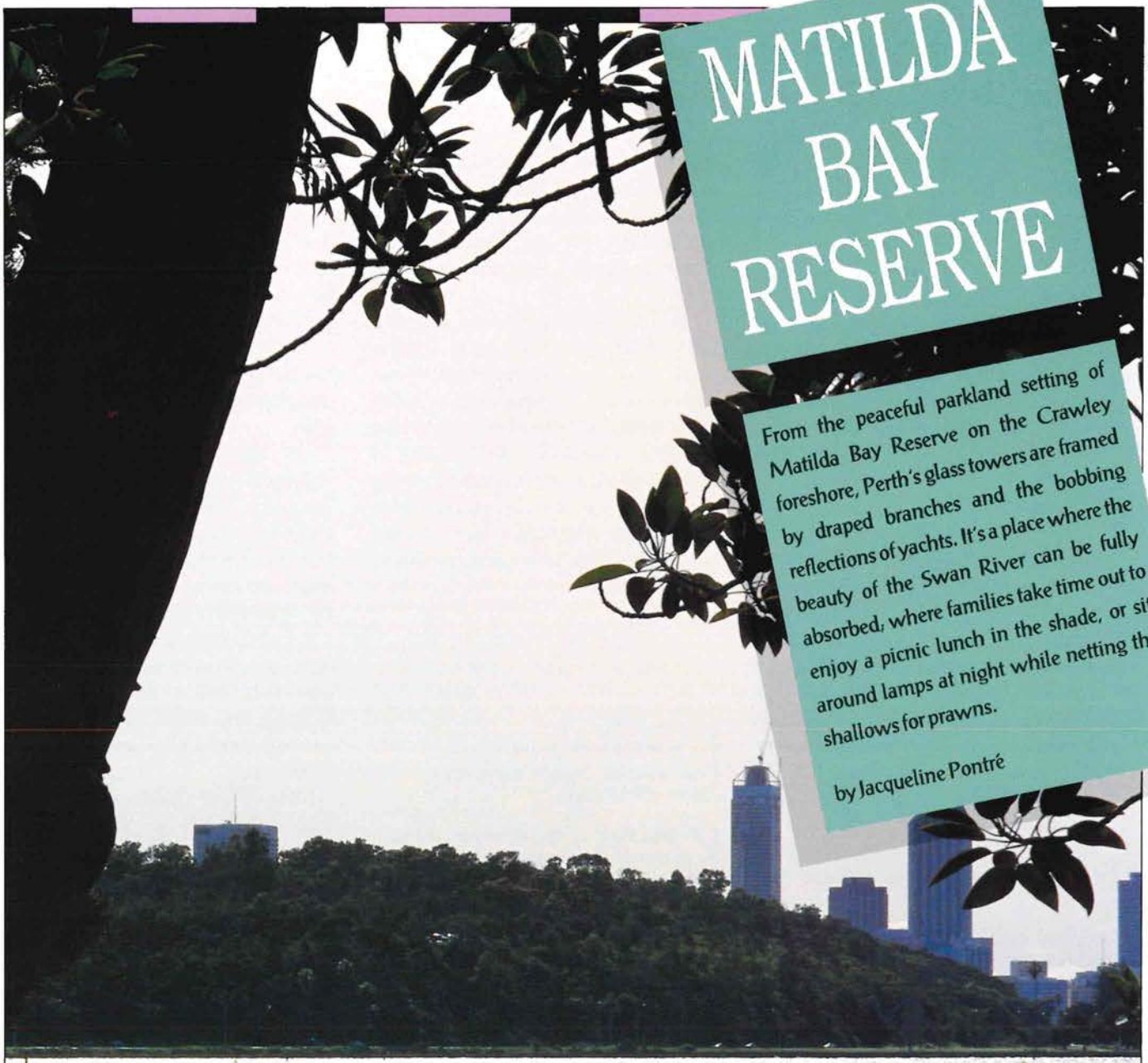
Photos
Babs and Bert Wells

DAVE PEARSON

# MATILDA BAY RESERVE

From the peaceful parkland setting of Matilda Bay Reserve on the Crawley foreshore, Perth's glass towers are framed by draped branches and the bobbing reflections of yachts. It's a place where the beauty of the Swan River can be fully absorbed, where families take time out to enjoy a picnic lunch in the shade, or sit around lamps at night while netting the shallows for prawns.

by Jacqueline Pontré



Matilda Bay, named after the wife of Sir John Septimus Roe, the first Surveyor-General of Western Australia, is a thin strip of land between Hackett Drive and the Swan River's low water mark on the Crawley foreshore. Managed by the Department of Conservation and Land Management (CALM), the reserve's primary purpose is for recreation, and it extends from Mounts Bay Road just north of Cygnet Hall to just south of the windsurfing ramp past Pelican Point, covering 20.6 hectares.

Matilda Bay lies adjacent to the University of Western Australia, the Swan River, Pelican Point Reserve, part of the Swan Estuary Marine Park, J.H. Abrahams Reserve and the Nedlands Foreshore Reserve. It was an important riverine and estuarine area for Aboriginal people for thousands of years, and was known as Godroo, Gurndandalup or Goodamioorup. It was favoured by Aboriginal people because of its abundance of fish, and water holes situated in the Pelican Point area, including the current reserve. Hot water springs were located where the University of Western Australia now stands and Aboriginal people used the area as a battle ground. The traditional Aboriginal custodians were the Ballaruk, who inhabited the area around the Swan River (see *Hunters and Gatherers* in this issue).

In 1829 Matilda Bay was part of a block of 32 acres taken up by Captain Mark Currie, Fremantle's first harbourmaster. Captain Currie was one of the official party from the sailing ship *Parmelia* which arrived off Fremantle in 1829. Captain Currie remained on the Crawley property for a few years with his wife, during which time two children were born. The only accommodation they had were tents, and they lived under primitive conditions, drawing water from a well they dug.

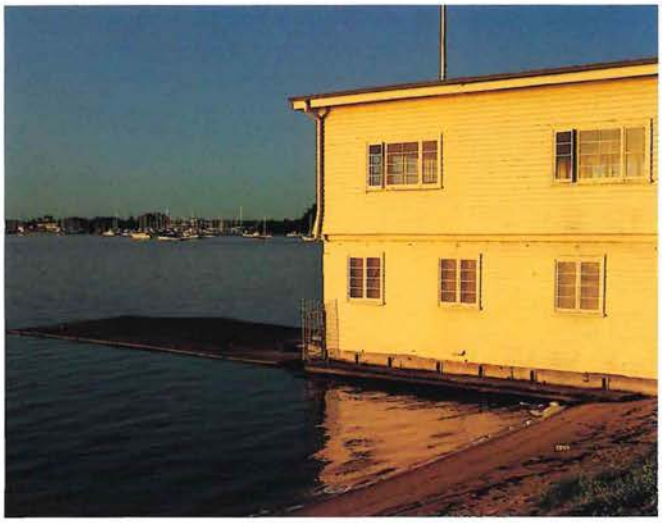
In 1837 ownership passed to Henry Sutherland, originally a surveyor and later Colonial Treasurer, who built the two-storey dwelling which still stands. In 1875, the Crawley Estate passed to Sir George Shenton, a Member of the Legislative Council and Mayor of Perth, who lived on the estate until his death in 1909.

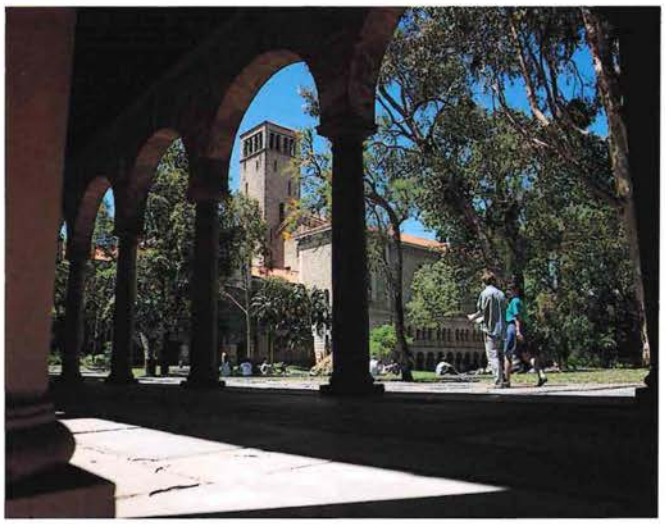
In 1910, the State Government resumed the property for public recreation, turning the foreshore into a camping ground. This was served by a tramline from the city which hugged the river's edge all the way to Nedlands Baths. The University of Western Australia acquired the bulk of the land in 1914 and Shenton's former home became the quarters of the Engineering school. The building, the oldest on the University campus, currently houses the University Chaplaincy.

The river landscape changed dramatically between the 1920s and 1940s because of public works programs. Extensive dredging of the shallows

*Previous page:*
A moody Perth framed by the branches of a tree in the reserve.
Photo - Allan Padgett

Perth's skyline and afternoon sailing are part of the view from Matilda Bay.
Photo - Robert Garvey





adjacent to Pelican Point's north side resulted in considerable landfill on the Point's south side, and increased the land area by four or five times. The larger part of the current land of Pelican Point was originally lagoon or river shallows.

During World War II, the Commonwealth Government requisitioned the foreshore reserve for defence purposes. Numerous existing features, such as the ablution blocks, owe their location to the military pipelines, sewerage and power systems.

Two bases for Catalina flying boats were established in the Crawley area after Japan entered the war in December 1941. (Indeed, the world's longest rescue mission was mounted with aircraft from Matilda Bay.) An Australian base, now known as the Qantas Ramp, was established west of Pelican Point. The American Navy established a base at Matilda Bay where Mounts Bay Sailing Club and Royal Perth Yacht Club now stand.

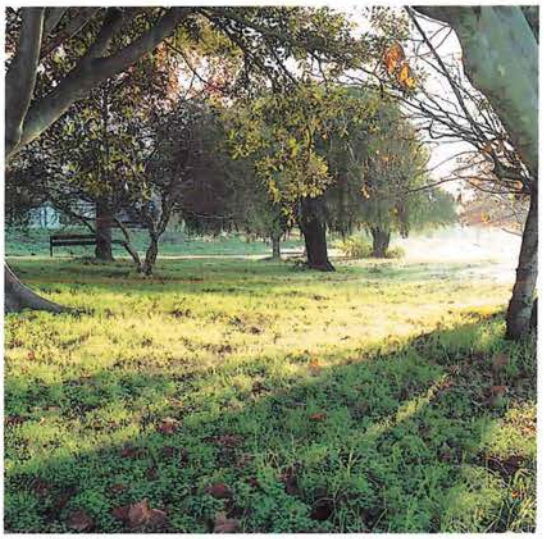
The Royal Perth Yacht Club launching ramp was built to launch the Catalinas, with hangars on the boat servicing area. Other foreshore buildings, including the University boatshed, were also used by the Navy during the war. Some of the University's nearby buildings were occupied by servicemen.

According to a spectator, 'the Catalina take-offs were a dramatic affair, with patrol boats racing ahead of the aircraft to remove floating debris. Then the heavily laden planes, often four tonnes overweight with extra fuel, roared into the wind, leaving a fan-shaped wake behind them as they gradually gained height like overweight pelicans.'

*Above left:*
The University Boat Club at sunrise.
Photo - Allan Padgett

*Above right:*
The University of Western Australia lies adjacent to Matilda Bay and students frequent the reserve and its shores during the week.
Photo - Robert Garvey

*Right:*
Stately trees planted earlier this century create a tranquil river setting.
Photo - David Gough



The Catalina route covered more than 3 500 miles of the Indian Ocean to Sri Lanka and Pakistan. The planes carried mainly documents, mail, service chiefs and civilian VIPs.

## A BAY OF SAILS

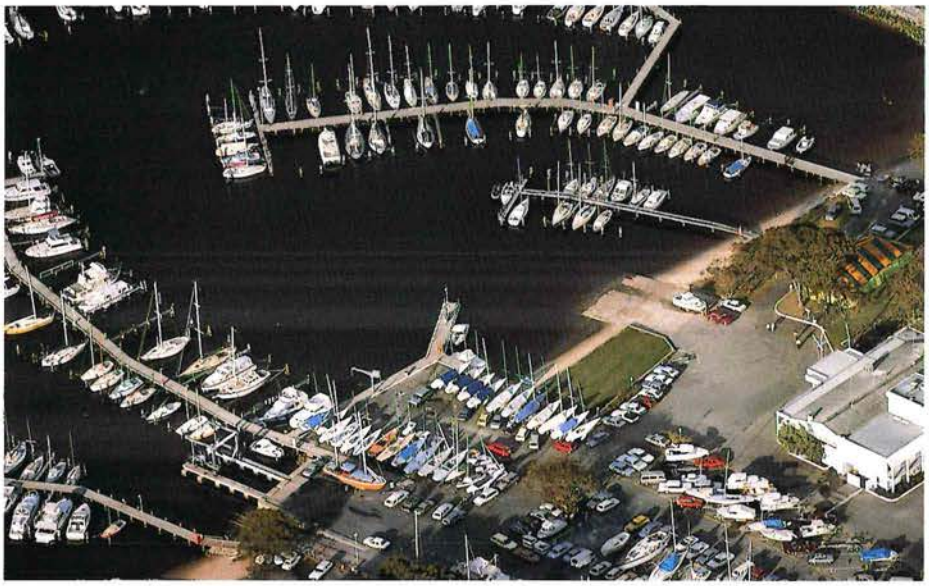
Leases located on Matilda Bay Reserve today include yacht and rowing clubs, a restaurant and kiosk. CALM also has two offices on the reserve, one on Australia II Drive and the other in Cygnet Hall near Mounts Bay Road.

Perth Dinghy Sailing Club, established in 1903, was originally located near the Barrack Street Jetty before moving to Matilda Bay in 1960. Royal Perth Yacht Club, established in 1865, was also originally located near the Barrack Street jetty, but moved to Matilda Bay in 1953. In 1979 the club organised the Parmelia race from Plymouth to Fremantle to commemorate the 150th anniversary of British settlement on the Swan River, and in 1983 the club won the America's Cup, mounting an unsuccessful Cup defence in 1987.

Mounts Bay Sailing Club was founded in 1897 and built its first clubhouse in 1939. During World War II the building was used by the United States Navy. Two rowing clubs are also situated on the reserve. Cygnet Hall was built in 1956 by the Governors of Hale School as the base for the school's rowing club, and today CALM's Corporate Relations Division is situated in office space above the rowers. The University Boat Club was opened on the reserve in 1929 and today provides a range of water activities for university students.

The 1st Pelican Point Sea Scouts, originally known as the 1st WA Sea Scouts, was established in Albany in 1913 and moved to Perth in the 1920s to be located briefly in Irwin Street, before moving to floating headquarters, the *Dolphin*, a wooden coastal steamer moored near the location of the present University Boat Club. In 1926 the group moved to its present area located at the


*Left:*
Water, sun, sails and cappuccino are part of the reserve's appeal.
Photo - Allan Padgett



*Below left:*
An aerial view of the Royal Perth Yacht Club.
Photo - Robert Garvey

end of a narrow spit of land known then as Point Currie. New headquarters were built in 1957 on land filled in from pre-war dredging of Matilda Bay.

The restaurant and kiosk are favourite venues for both locals and tourists. More than 40 per cent of the restaurant's patronage is from interstate and overseas. The reserve attracts about 400 000 visitors each year. This figure includes people who visit the restaurant (about 50 000 a year) and the yacht clubs (about 250 000 a year), as well as visitors using the reserve for passive or active recreation (about 100 000 a year). Public holidays are the busiest. Matilda Bay also becomes a focus for special events such as the 96fm skyshow, an annual fireworks display, and regattas, and in summer the reserve is also used by corporate organisations for parties of up to 300 people. Organisers of sporting events, such as marathons, occasionally use the reserve as a stopping point.

## TREES FOR ALL REASONS

Early photographs and paintings of Matilda Bay show there was a predominance of saltwater paperbark *(Melaleuca cuticularis)* and freshwater paperbark *(M. rhaphiophylla)* along the riverfront backed by flooded gum *(Eucalyptus rudis)*. While naturally occurring plants are still found on the adjacent Pelican Point Nature Reserve south of Australia II Drive, including grey stinkwood *(Jacksonia furcellata)*, coojong *(Acacia saligna)*, flooded gum and saltwater paperbark, very few of these are now found north of Australia II Drive.

Instead, the reserve is now largely planted with exotic trees. These include a drift of *Leptospermum laevigatum* along the central foreshore and a remarkable group of trees opposite Shenton House. In this group is a native species from the State's tropical north-west, *Albizia procera*, and pegunny *(Lysiphyllum hookeri)*, an Australian tree from the arid parts of the north-east coast of Queensland and the Northern Territory. The wood of this tree is used to make xylophones.

Also in this group is a magnificent 'Pride of Bolivia' *(Tipuana tipu)*, which produces unusual ash-like fruit with a long projectile wing and nut-like seed; a mature specimen of the South African tulip tree *(Spathodia campanulata)*; a mature *Agafus robusta* (one of Queensland's unique gymnosperms), and another Queensland tree, the bunya bunya pine *(Araucaria bidwillii)*. In Aboriginal culture each bunya bunya pine had a custodian who was responsible for its fertility. This custodial ownership is known to be handed down from generation to generation by Aboriginal people.

According to Professor George Seddon from the University of Western Australia, Matilda Bay Reserve is the westernmost occurrence of the alluvial soils of the Swan system and this explains why it is capable of supporting trees that do not thrive in the coastal suburbs of Perth.

Very little is known about the history of the tree plantings on Matilda Bay. Some people believe the existing trees were planted in colonial times when settlers wanted to recreate the landscapes of England, but historic photographs refute this theory. Another hypothesis put forward by Professor Seddon is that

most of the trees were planted in the 1920s by the University of Western Australia's head gardener, Oliver Dowell, at the behest of William Somerville, who occupied various positions on the University Senate between 1914 and 1955.

Each year on Arbor Day, CALM ceremoniously plants a native tree on the reserve with the help of Perth schoolchildren during a festival to celebrate the role of trees in the environment. In the future, a wider range of endemic native plant species will be encouraged in the area south of Australia II Drive to create visual continuity with the vegetation on Pelican Point Nature Reserve, while historic exotic trees will be preserved on the rest of the reserve.

## PLANNING AHEAD

Matilda Bay's fascinating history and natural values will be explained in interpretative material planned for the reserve, and developments such as new picnic facilities, and toilets for use by disabled people are to be undertaken.

The challenge for managers of the reserve will be to improve its facilities for use by an increasing number of people while preserving its special character. ⊡

*Top:*
Sunrise at Matilda Bay.
Photo - Allan Padgett

*Above:*
The reserve is a favourite spot for family and friends to get together for special occasions.
Photo - Allan Padgett

*Jacqueline Pontré is a planning officer based at CALM's Mt Pleasant office. She can be contacted on (09) 364 0777.*
*Much of the historical account was obtained from the Western Australian Historical Society by CALM's Debbie Bowra, and Marion Blackwell identified the reserve's exotic tree species.*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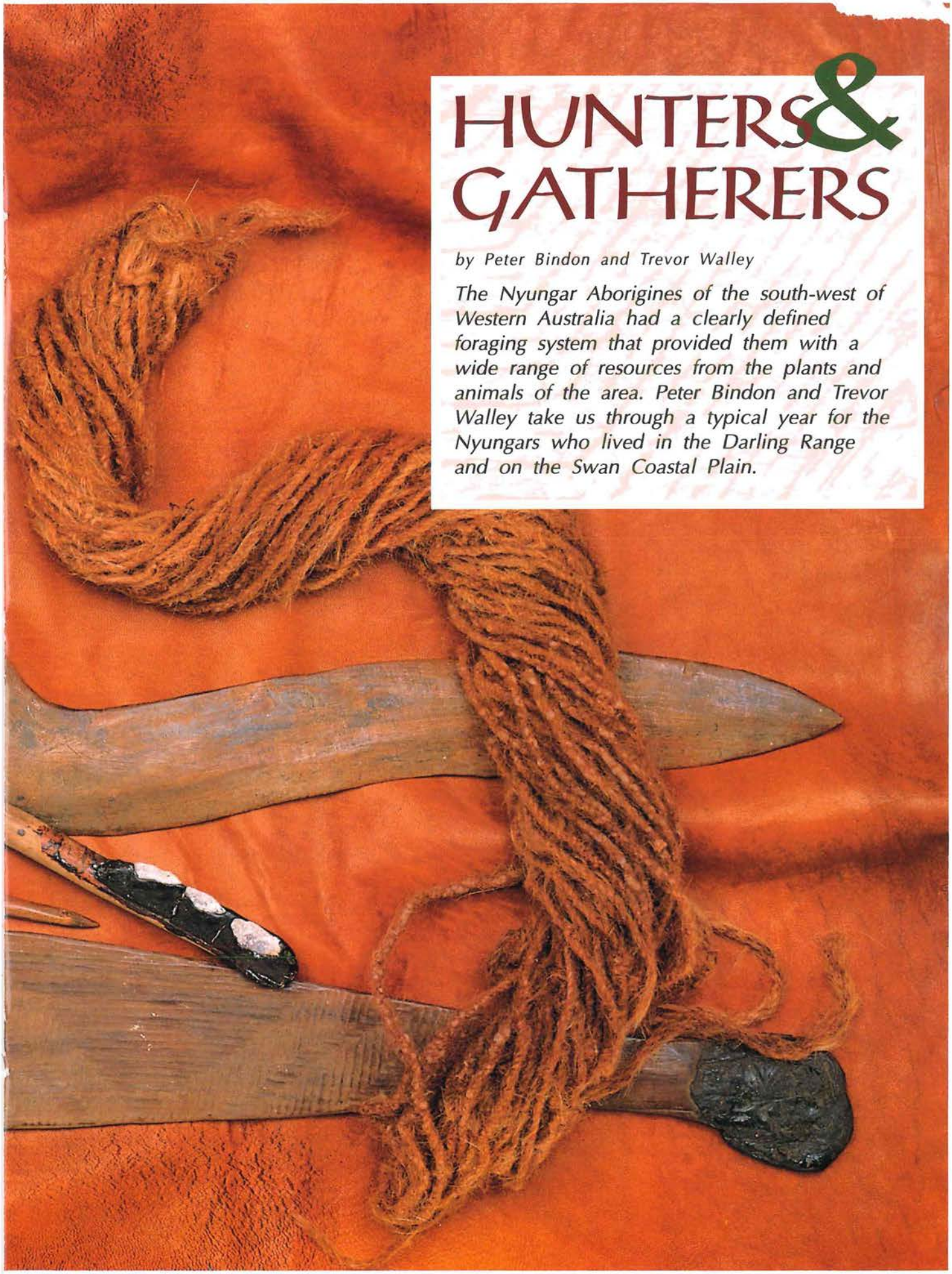


# HUNTERS & GATHERERS

by Peter Bindon and Trevor Walley

*The Nyungar Aborigines of the south-west of Western Australia had a clearly defined foraging system that provided them with a wide range of resources from the plants and animals of the area. Peter Bindon and Trevor Walley take us through a typical year for the Nyungars who lived in the Darling Range and on the Swan Coastal Plain.*

Nyungar is the collective name given to Aboriginal people whose country lies in the south-west corner of Western Australia, west of a line running from Geraldton to the east of Merredin down to Esperance on the southern coast. Socially and linguistically, Nyungars were divided into about 14 different groups each of which inhabited a particular tract of country. Each local group had access to a selection of different ecological habitats in accordance with a long tradition of territorial occupation.

Groups guarded their lands and resources jealously and permission had to be granted before neighbours could cross freely into the territory of an adjoining group. However, in times of plenty when there might be an abundance of fish, a whale stranding, or an exceptionally large harvest of plant food, invitations to neighbouring groups were carried by messengers with sticks bearing incised mnemonics which announced a festive gathering. Regular meetings like this were held in the Peel Inlet near Mandurah to exploit shoaling fish. The bulrush (*Typha domingensis*) rhizome harvest, in the area now known as Yanchep National Park, also provided an opportunity for large neighbouring groups to meet together.

According to Norman Tindale, who published an Australia-wide survey of Aboriginal tribal names and territories in 1974, there were three tribes living in the area we now know as Perth. The Swan River divided the territories of the Juet in the north from the Whadjuk, who lived on the southern bank. Inland from both these tribes lay the lands of the Balardong whose territory covered the Darling Range and extended to the York region. These tribal groups were subdivided into hordes or family groups which were the main unit for hunting and foraging. The land owned by family groups was loosely referred to as its *ka-la* (hearth).

The land of the Juet immediately north of the Swan River was known as Mooro, the territory of Yellagonga, who moved his foraging area away from the river bank to Monger's Lake after the formation of the white settlement. The Whadjuk lands just south of the Swan River and between the Canning and the coast was called Beeliar; this was the territory of Midgegooroo, the father of Yagan. The territory flanked by both the Swan and Canning Rivers was known as Beelo, where Munday's group hunted and foraged. Although there were small differences in the languages and customs of the tribal groups they could all communicate and each group used its territory and resources in a similar manner.

*Previous page:*
The range of weapons used on a typical hunting trip.
Photo - Doug Elford/WA Museum
*Inset: (map)*
Nyungar territories in the South West, based on Tindale (1940).

The unusual shaped boomerang of the Nyungar people.
Photo - Doug Elford/WA Museum

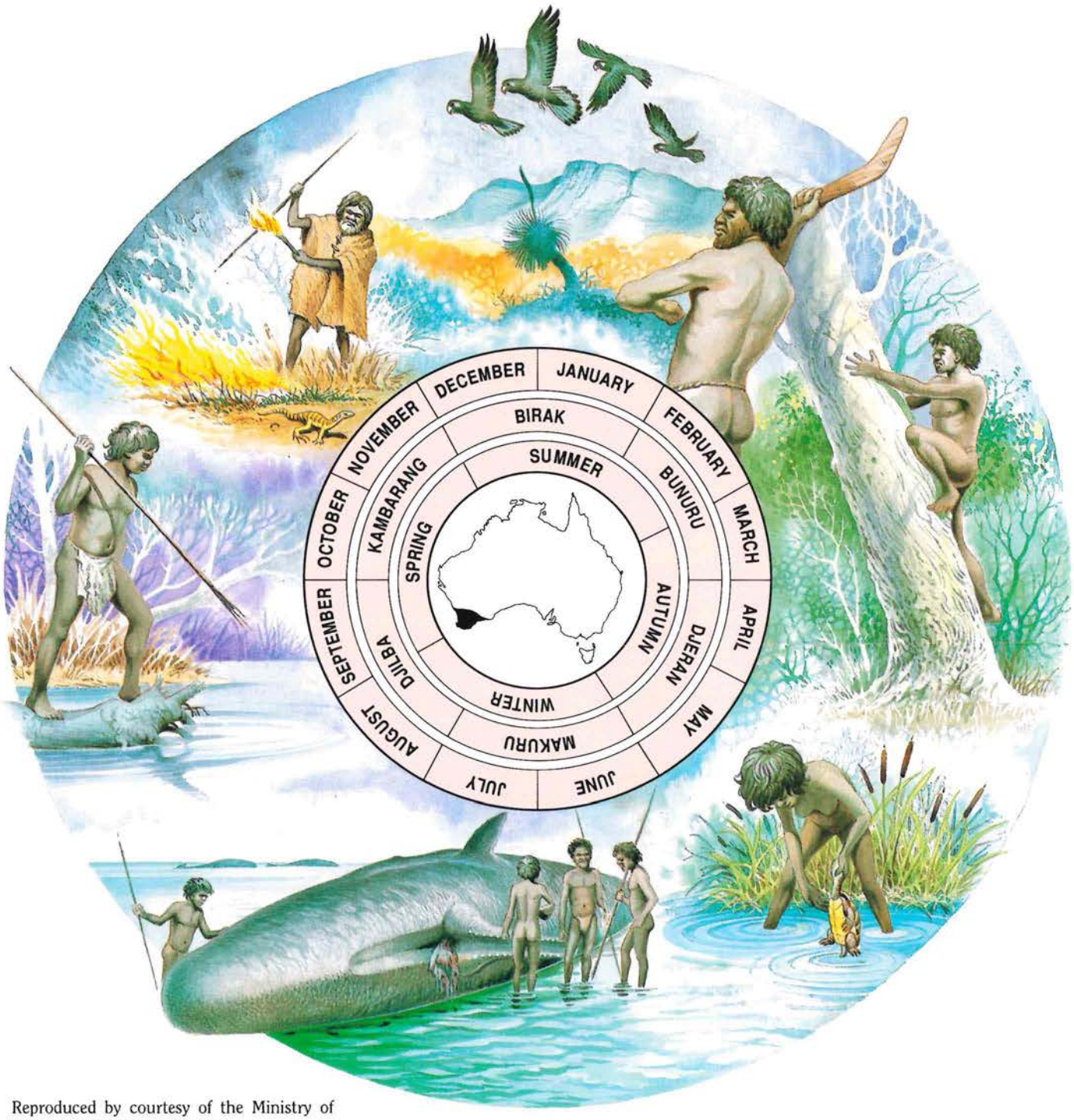
Emu and witchetty grub are typical of the Nyungars' diet.
Photos - Lochman Transparencies

## A YEAR IN THE LIFE

The Nyungar year was divided into six seasons, described by the prevailing weather conditions. Birak was the hot and dry time of December and January, with hot easterly winds during the day and cooler south-westerly sea breezes in the afternoon. Bunuru covered the late summer and early autumn months of February and March, with hot easterly and north winds. Djeran was the name for the period covering April and May. The weather at this time was cooler, with winds generally from the south-west. Makuru was early winter, spanning June and July. This was the time of when the weather was cold and wet, with squally westerly gales. Djilba covered the late winter and early spring months of August and September when the weather began to get warmer. Finally, Kambarang was the season of decreasing rain, covering the months of October and November.

Apart from the weather, Nyungars used a variety of other indicators which told them the best times to hunt particular animals. For example, when the sheoak (*Allocasuarina fraserana*) was turning a yellow-brown colour, kangaroos become fat, and Nyungars never ate animals until they were fat. When swan feathers began appearing on the lakes and waterways, it became obvious that swans were beginning to moult and would be easier to catch.

Nyungar people were quite aware of the products they could expect to harvest from various parts of their territories during each season. Their diet varied according to the weather within the six seasons, and foraging groups travelled to the most appropriate place within their territory to find food. Superimposed on the movements made in response to the climatic cycle were those in anticipation of pending ceremonies. These large group meetings, arranged during previous gatherings, were






**Bunuru:** hot easterly and north winds from February to March

**Djeran:** becoming cooler with winds from southwest from April to March

**Makuru:** cold and wet with westerly gales from June to July

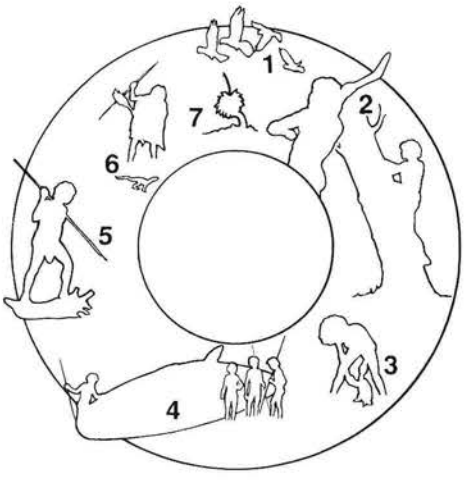
**Djilba:** becoming warmer from August to September

**Kambarang:** rain decreasing from October to November

**Birak:** hot and dry with easterly winds during the day and south west sea breezes in the late afternoon from December to January

**KEY TO WHEEL**

| | | |
|---|---|---|
| 1 | **KARRAK** | RED-TAILED BLACK COCKATOO |
| 2 | **KERI** | BOOMERANG |
| 3 | **BUYI** | TORTOISE |
| 4 | **MAMANG** | WHALE |
| 5 | **KITJ** | SPEAR |
| 6 | **KAADAR** | RACEHORSE GOANNA |
| 7 | **BALKA** | BLACKBOY |



scheduled to occur in specific locations. Despite its regularity, the foraging system remained flexible enough to take advantage of occurrences outside the expected, like thunderstorms, strandings or natural wildfires, which might suddenly provide abundant resources.

Fishing and hunting coincided in Bunuru (February and March). Large sections of the country were abandoned for lack of water. Near the sea coast and in estuaries, fish constituted a large proportion of the diet of this season, and large assemblies gathered.

Although fishhooks were not used and most fish were speared, other ingenious methods were used to catch fish. Stone fish-traps and wooden weirs were constructed to take advantage of the shoals of fish which frequented shallow or tidal areas. When shallow pools were found to contain fish, piles of spiky brush were pushed ahead of a line of wading hunters who surrounded the fish and forced them into shallow water where they were easily speared or dispatched with clubs. Another technique was to build a *mungur* (wicker fence) across the stream. The *mungur* was constructed with a central race, which was made shallow with bushes until there was as little as 20 cm of water for the fish to swim through. Adjacent to the race was a platform on which people stood and scooped the fish from the water by hand, throwing them to people waiting on the bank.

Towards the end of Bunuru, in March, the fruits of the western zamia (*Macrozamia riedlei*) were collected. To remove toxins, these had to be buried for some time, then soaked in water and finally roasted before being eaten. Also at this time the horizontal rhizomes of the bulrush (*Typha domingensis*) were pounded to remove the fibrous parts, moulded damper-like into a flattened shape and then roasted to produce tasty cakes. A sand-plain bulb, much used for food, was the blood-red and fiery tasting *Haemodorum spicatum*, which was roasted and pounded together with bland foods to make a spicy meal.

Makuru (June and July) was the time to dig granite pink tubers (*Tribonanthes* spp.). Swans began moulting in June and, being unable to fly, made easy prey. Together the women and children would drive the swimming birds across the open water of the lake or river to the men, who waited, concealed, for the birds to come within reach.

Isaac Scott Nind observed in 1831 that during winter when people were travelling they scarcely went anywhere without a smouldering branch of bull banksia (*Banksia grandis*) held beneath their *booka* (kangaroo skin cloaks). Fire was generated using the slender flower stems from blackboys (*Xanthorrhoea preissii*). Fire was perhaps their most useful and precious resource, used in tool and artifact production, in food preparation and cooking, for hunting and driving game, for warmth, and for signalling; the hearth provided comfort and company. Blackboy was the home of the luscious edible wichetty grub, up to a hundred of which could be found in a good tree. Skilled eyes could tell at a glance whether any particular plant held an abundance of grubs.

During Makuru and Djilba, the winter period, the people dispersed to their inland hunting areas once water supplies in the dry portions of their territory were considered reliable. The tubers of native potato (*Platysace cirrosa*) were dug from beneath the wandoo at this time; kangaroos, emus and quenda (*Isoodon obesulus*) were hunted, and possums were driven from their tree hollows with smoke.

Fruits of the zamia (*Macrozamia riedlei*) had to be processed to remove toxins before they could be eaten.
Photo - Jiri Lochman

Swans were easily caught during their moulting season, when they were unable to fly.
Photo - Jiri Lochman

Stones used to grind fruits and seeds.
Photo - Doug Elford/WA Museum

Possums were driven from their tree hollows with smoke.
Photo - Jiri Lochman

The flowering of the WA Christmas tree (*Nuytsia floribunda*) was a clear indicator to move to the cooler coastal areas.
Photo - Jiri Lochman

The sign to return to the coast as the warmer weather approached at the end of Djilba and on into Kambarang, (October and November) was the flowering of the Western Australian Christmas tree (*Nuytsia floribunda*). After taking slabs of bark from the trees to make shields, families returned later to collect and eat the raw, sweet gum that oozed from the 'wounded' trees, now spectacularly in flower. In the coastal heathlands many different berries and fruits were collected, particularly those of the native cranberry (*Astroloma* spp.), wild pear (*Persoonia* spp.) and native peach (*Santalum acuminatum*). Also sought at this time were supplies of gum from various wattle trees, and *Dioscorea hastifolia*, a yam which was dug up by women using a long *wanna* (digging stick). The shoots and tips of the yams were thrown back into the holes from which they had been dug to preserve the species. The season also brought a natural increase in game, some of which were trapped by being herded into trampled brush where they became tangled and were easy prey to armed hunters surrounding the scrubby habitats.

Also in Kambarang, the last red beak orchids (*Burnettia nigricans*) and native potatoes (*Platysace cirrosa*) were dug before the dispersed groups moved back towards the coast. This time, when small family parties linked to form larger bands, was also known as *man-ga* (nesting season). As the season advanced the people prowled the forests in pursuit of waterfowl, birds' eggs, and fledgling squabs, parrots, cockatoos, hawks and pigeons, which were all plucked from their nests. Hunting also focused on the swamps and wetlands, where freshwater crayfish and edible frogs were caught by hand in the shallows, and freshwater tortoises were easily caught in the dwindling pools. These delicacies, along with the starchy tubers of arrow grass (*Triglochin procera*), were roasted together in the ashes of camp fires.

Birak was the hot time of December and January, which saw the lighting of controlled local fires in the scrublands. Such fires forced kangaroos and western brush wallabies out into the open so they could be speared more easily. Burning continued until Bunuru (autumn) to reduce undergrowth and bring on the lush growth of grasses and young plants in Djilba (late winter, early spring), which in turn attracted animals later in the cycle. Women and children also fired the bush for animals up to the size of bandicoots. As the fires swept through selected patches of bush, many reptile species, such as race-horse goanna, shingle-back lizard, and small marsupials fleeing the flames were dispatched with clubs and sticks. As soon as the ground fire passed, the group searched the ashes for burnt lizards and snakes, which were collected in great numbers. Birak was also the time of large gatherings to participate in drinking the nectar from the banksia flower spike steeped in water. The resulting honey-sweet beverage was known as *mungitch*.

The onset of Bunuru brought the Nyungar people to the start of another year.

## PLANT RESOURCES

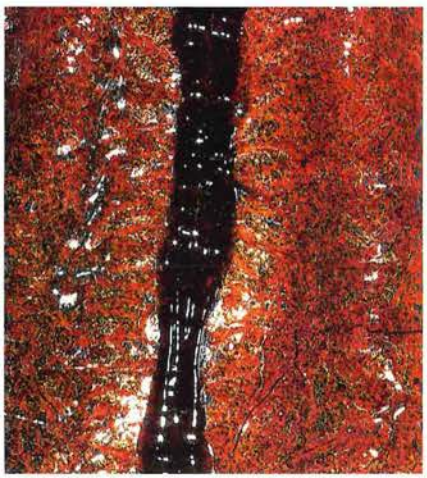
Aborigines looked at plants in a fundamentally different way from European explorers and colonists, and this presented problems for botanists trying to identify local plant species. The same plant species may have had several names, often linked with the use to which the plant could be put. If an individual example of a particular tree species had strong straight stems it might be called

a 'spear tree', because its stems were ideal for making spears. However, another example of the same species growing nearby might have had curved branches, so its name would be more appropriate to another possible use: for example, in the construction of a hut.

Looking at plants in this way enabled the Nyungars to make the best use of the resources around them. Each plant had its own use and some had several. One plant had so many uses it was almost held as sacred.

The *balga* (blackboy) probably provided the most resources of all the plants used by the Nyungar people. Its flowering stems provided an edible gum, honey, and frame poles for huts. When the stems were dry they were used for making fire-lighting drills. The leaves of the plant were used as a thatch for huts and for bedding. As well as being a popular habitat for wichetty grubs, the trunks provided an extremely strong resin used for cementing tools. Dead trunks made excellent firewood and would readily catch light.

The red gum from the marri tree also had several uses. The tannin in the gum gave it antiseptic properties. It was powdered and sprinkled into open wounds, or mixed with water in a low concentration as a mouthwash or in a higher concentration as a disinfectant. When mixed with clay and water it could be used as a medicinal drink for dysentry. Large quantities of the gum, when powdered, could have been used to tan leather. If powdered resin is put into a fresh kangeroo skin and rolled around for a few days, repeating the process several times, the tannin in the gum eventually tans the skin, making it strong and durable for use as a cloak, or as a bag for carrying food or tools. It is not certain whether this technique was practised by the local Aborigines, but it was certainly used by early settlers, who were also quick to take advantage of the medicinal



The stone blades of this axe are glued with *Bigo*, an extremely strong resin from the stem of the blackboy.
Photo - Doug Elford/WA Museum

The red gum from the marri tree has a variety of medicinal properties.
Photo - G. Saueracker/Lochman Transparencies

Kangaroos provided food and clothing for the Nyungar people.
Photo - Jiri Lochman

| Aboriginal Name | Common Name | Other Names | Scientific Name |
|---|---|---|---|
| | | arrow grass | *Triglochin procera* |
| | marri | | *Eucalyptus calophylla* |
| Baio | fruit of western zamia | | *Macrozamia riedlei* |
| Balga, balka | blackboy | | *Xanthorrhoea preissii* |
| Bardi | wichetty grub | | |
| Bigo | | strong resin from the blackboy stem | |
| Bohn, Mardje, Martje | | blood roots | *Haemodorum spicatum* |
| Boolgalla | bull banksia | | *Banksia grandis* |
| Cadgeegurrup | | native cranberry | *Astroloma* spp. |
| Cadgeegurrup | | wild pear | *Persoonia* spp. |
| Carta, kaadar | | racehorse goanna | |
| Conrick, mnkar | | red gum from marri | |
| Djubak | red beak orchid | potato orchid | *Burnettia nigricans* |
| Doonar | | edible frogs | |
| Gurhran | western brush wallaby | black-gloved wallaby | *Macropus irma* |
| Guroyl, marlee | | swans | |
| Jilgy | gilgies | freshwater crayfish | *Cherax* spp. |
| Jitta | granite pink | | *Tribonanthes* spp. |
| Kondil | sheoak | | *Allocasuarina fraserana* |
| Kunart | | wattle tree gum | |
| Mia | | hut | |
| Mimanga, mamang | | whales | |
| Modyar | WA Christmas tree | | *Nuytsia floribunda* |
| Ngon-yang | | banksia flower nectar | |
| Warrain | warrine | spear-leaved dioscorea | *Dioscorea hastflora* |
| Wonil | sweet quandong | native peach | *Santalum acuminatum* |
| Yanjet | bulrush | | *Typha domingensis* |
| Yargun, buyi | oblong tortoise | long-necked tortoise | |
| Yonger | | kangaroo | |
| Yoork, Youck | | native potato | *Platysace cirrosa* |
| Youern | bob-tail skink | shingle-backed lizard | *Tiliqua rugosa* |

properties of the gum.

The Nyungar people had a very ordered way of life. Their hunting and gathering patterns were guided by the six weather-based seasons, and their resource-based sense of observation enabled them to make the best use of the available plant and animal resources. Though they could never be called farmers in the accepted sense, some of the Nyungar land management practices helped to ensure that sufficient resources would be available to them the following year. While selective burning of bush areas enabled them to catch large numbers of mammals and reptiles for food, it also provided new vegetation to attract similar animals back in subsequent years. Essentially, they took from the land only what they needed to survive. Many of the plants and animals that were taken had more than one use for the Nyungars - kangaroos provided both food and clothing. Little, it seems, was wasted.

In conclusion, Josephine Flood states, in her book *Archaeology of the Dreamtime*, that:

> 'Hunter-gatherers have been described as the original affluent society, and an examination of archaeological and ethnographic evidence lends support to this view. Whether gathering Bogong moths or hunting seals, leaching poison out of cycads or re-planting yams, Aboriginal people evolved a series of successful, varied economies. These broadly based economic systems allowed them to exploit and to survive in a wide range of environments where European agriculture proved to be an abysmal failure. Extensive use was made of fire as a hunting tool, modifying the Australian vegetation so profoundly that contemporary flora has been called an aboriginal artefact.
>
> 'The achievements of early Australians are constantly under-estimated by those Europeans who judge a society solely by its material possessions. The real richness of Aboriginal culture is thus only now beginning to be appreciated, as anthropologists reveal their incredibly complex social and religious systems and archaeologists uncover the distant past of this heritage.'

The blackboy *(Xanthorroea preissii)* provided so many resources it was considered to be almost sacred.
Photo - Brian Downs/Lochman Transparencies

Peter Bindon is head of anthropology at the WA Museum, Francis Street, Perth. He can be contacted on (09) 328 4411. Trevor Walley is a member of the Nyungar Community and a wildlife officer with the Department of Conservation and Land Management (CALM). He can be contacted on (09) 367 0292.

## DISCOVERING THE DREAMS

The area that is now the Walyunga National Park was an important *kalleep* (favourite camping or meeting place) for the *gurr* (extended family) of a local Nyungar named Coondebung. The area is rich in Aboriginal legend, being significant to two creator beings - the *Waugul* (rainbow serpent) and the *Tjitti Tjitti* (willy wagtail). There are two Heritage Trails within the park. The Walyunga Heritage Trail runs along the Avon River upstream from Walyunga Pool and is guided by information boards along the trail. Coondebung's Kalleepgurr Heritage Trail is particularly important to the Nyungar people and can only be explored by groups accompanied by a guide from the Nyungar Community.

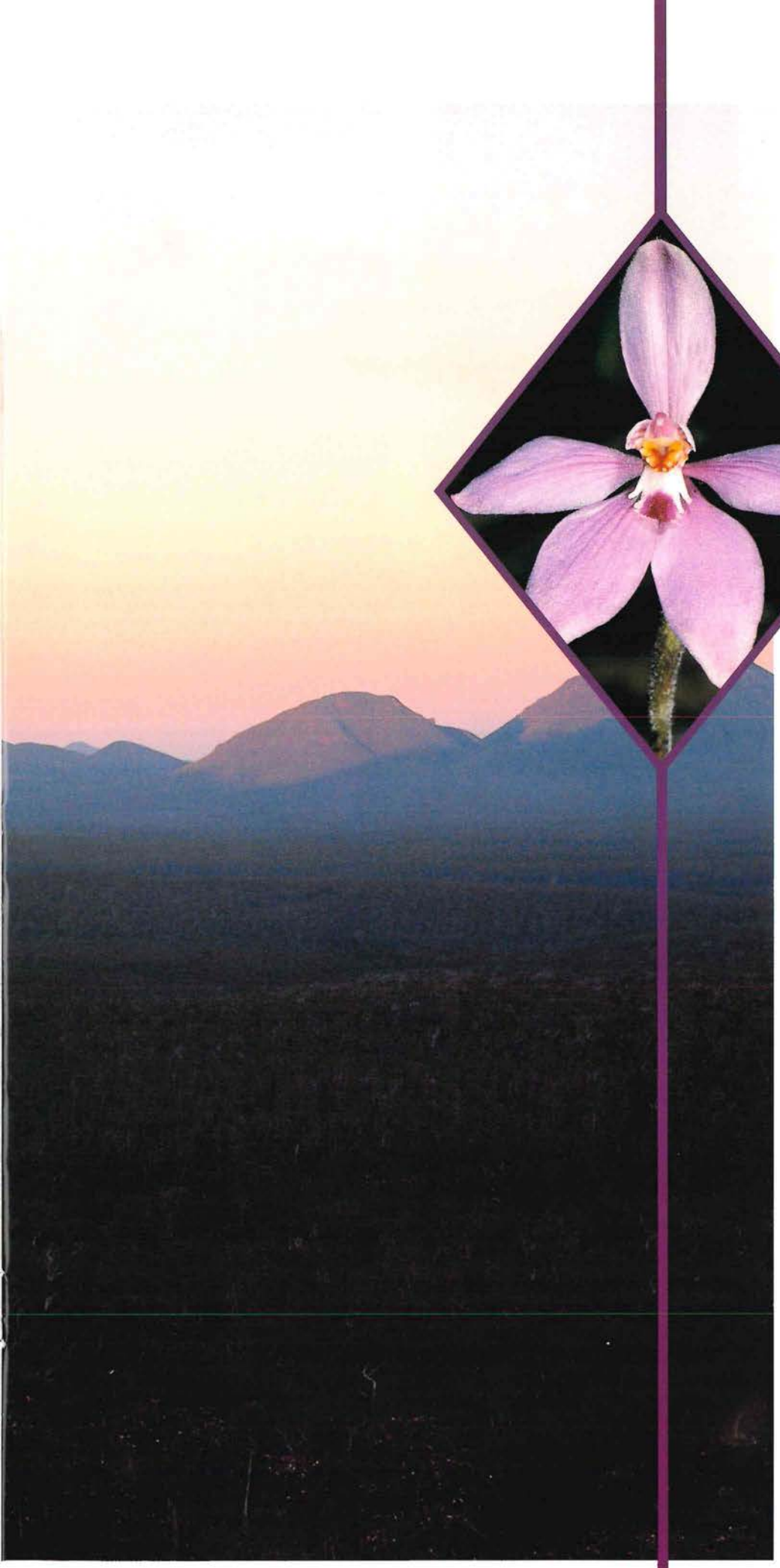
The Yaberoo Budjara Heritage Trail is a 28 kilometre walk from Lake Joondalup, in the Yellagonga Regional Park near Wanneroo, through Neerabup National Park to Yanchep National Park. The trail is based on the Yellagonga tribe's pathway linking the linear lakes of the coastal plain. It highlights features of natural, Aboriginal and historical significance.

The Yanjidi Trail, in Yanchep National Park, is a two-kilometre trail that runs through the heart of the Loch McNess wetland. This, and other trails, have been used for guided tours interpreted by Trevor Walley and other CALM Aboriginal staff. These guided tours have been a very popular part of seasonal activity programs in The Hills Forest and national parks.

Information on activity programs and Aboriginal Heritage Trails can be obtained from the Department of Conservation and Land Management (CALM), the WA Heritage Committee, or from the ranger's office in the appropriate park.

# Orchids

## OF THE STIRLING RANGE



Nestled between the wetter south-west and the drier inland regions, and rising some 1 000 metres above sea level, the Stirling Range National Park provides refuge for an astonishing 123 orchid species. This article is based on a chapter from a new book, Mountains of Mystery: A Natural History of the Stirling Range National Park, to be published by CALM next year.

BY ANDREW BROWN

The Stirling Range National Park contains about 38 per cent of all known Western Australian orchids and includes 23 of the 27 genera that grow in the south-west of the State. To find such a large number of orchids in such a relatively small area is remarkable by any standards, but is not surprising when you consider the diverse topography of the region. This varies from salt lake margins and deep, moist valley floors to rocky mountain tops. The wide range of habitats scattered throughout these areas include low-lying swamps, seasonal creeks, forests, woodlands, and the dense low shrublands that clothe much of the landscape. These vastly different areas display a magnificent array of orchid species, many of which are now rare elsewhere. Many species reach the limits of their distribution in the park and several species contain forms that are found nowhere else.

At least five Western Australian orchids have been named from collections made in or near the Stirling Range National Park. The narrow greenhood (*Pterostylis angusta*) and the tall snail orchid (*P. dilatata*) were both described from plants collected by botanist Alex George west of Mount Trio and below Bluff Knoll in July, 1969.

The first species named from the park was found in 1869, when Baron Ferdinand von Mueller collected the zebra orchid (*Caladenia cairnsiana*) north of the Stirling Range. The pink beak orchid (*Burnettia forrestii*) was discovered just a few years later by John Forrest, after whom it was named, and in 1903 the rare sandplain sun orchid (*Thelymitra psammophila*) was also found near the Stirling Range. Ironically, the last two are far more common elsewhere and probably were never very abundant in the Range.

More recently, a number of other new orchid species have been found in the park, several of which may be described from collections made there. They are: the big clubbed spider (*C. arrecta*), the Jerramungup spider (*C. flaccida* ssp. *pulchra*), Heberle's spider (*C. heberleana*), the painted spider (*C. polychroma*), the Christmas spider (*C. serotina*), the late spider (*C. ultima*), the common spider (*C. varians* ssp. *varians*), the late hammer (*Drakaea confluens*), the slender hammer (*D. gracilis*), the dwarf hammer (*D. micrantha*), the crinkle-leaved bunny (*Eriochilus dilatatus* ssp. *undulatus*) and the swamp bunny (*E. helonomos*).

*Previous page:*
Rising some 1 000 metres above sea level, the Stirling Range provides refuge for an astonishing 123 orchid species.
Photo - Jiri Lochman
*Inset:*
Dwarf pink fairy (*Caladenia reptans* subsp. *reptans*). A winter flowering species, the dwarf pink fairy forms attractive clumps in rocky areas of the park.
Photo - Gerhard Saueracker

*Above left:*
King spider orchid (*Caladenia pectinata*). An inhabitant of jarrah-marri woodlands the stately king spider is often found standing well above surrounding vegetation.
Photo - Andrew Brown

*Above:*
Blue china orchid (*Cyanicula gemmata*). Rarely flowering unless the bush has been burnt, the blue china orchid is common in mallee heathland areas of the park.
Photo - Andrew Brown


## WHAT IS AN ORCHID?

Orchids have several unique features that distinguish them from other plants. For example, orchids have combined their pollen-bearing parts (anthers) with their pollen-receiving parts (stigma), to form a single structure known as a column.

Orchids also amass all their pollen into one or two large bundles, which become attached to the body of a visiting insect. When these bundles are successfully transferred to the receptive stigma of another flower an exceptionally large number of ovules are fertilised at the same time, producing literally thousands of tiny seeds that are dispersed widely by the wind. The advantage of this strategy is obvious, when it is considered that most other plants require multiple pollination events to achieve a similar amount of fertilisation.

All orchids rely on soil fungi to infect the germinating seed and provide a food source on which the young plant can grow. This association continues throughout the plant's life and without it orchids would be unable to survive.

Most orchids also have a modified third petal, known as the labellum or lip, that looks quite unlike the other two. The labellum of most species provides a landing platform for visiting insects, and in some cases actually resembles a female insect.

While some species found in the park, such as the common snail orchid (*Pterostylis nana*), multiply freely by producing two or more new tubers each year, most are like the white spider orchid (*Caladenia longicauda* subsp. *eminens*), which rarely replaces its old tuber more than once and must therefore rely on seed dispersal to multiply.

This has led orchids to rely heavily

Cowslip orchid (*Caladenia flava* subsp. *flava*). The bright yellow flowers of the cowslip orchid are a common sight during the spring months.
Photo - Andrew Brown

on successful cross-pollination by insects (though in rare cases they self-pollinate). The resulting relationship between insects and plants makes for a fascinating study.

The lengths to which orchids go to attract pollinators are as varied as the species themselves. Some have flowers that resemble fungi, some smell like rotten meat, others have structures like the pollen-laden anthers of lilies and some simply mimic other flowers. The masters of deception are, however, those orchids that fool male wasps or flying ants by imitating the females of the species. A number of the park's orchids have these attributes. (See also 'Wicked Deceptions', *LANDSCOPE* Winter 1991 issue.)

## ORCHIDS IN THE PARK

Due to the Mediterranean climate of cool, wet winters and hot, dry summers, the park's orchids largely grow and flower during autumn, winter and spring. While a few species continue into summer, most die back to dormant tubers, resprouting again when autumn rains moisten the soil. The best time to look for orchids is from August to October, when up to 90 species can be found in flower. In good seasons you will be rewarded with massed displays.

The orchids of the Stirling Range are remarkably diverse. They range from the dainty dwarf spider (*Caladenia bryceana*), which grows only six centimetres high and produces flowers just two centimetres across, to the tallest of all Western Australian orchids. The king leek orchid (*Prasophyllum regium*) grows to well over two metres and has up to 100 or more flowers. Floral shape varies enormously and some species, such as the greenhoods (*Pterostylis* spp.) and hammer orchids (*Drakaea* spp.), have bizarre flowers that hardly resemble flowers at all.

Some species are quite common, such as the yellow-flowered cowslip orchid (*Caladenia flava*), which grows in most of the park's habitats and often blooms in large numbers. Other species are much rarer or are restricted to specific habitats. The rare dwarf spider, for example, is known from only one small area at the northern end of the park.

Other species appear only after hot summer fires have blackened the landscape. It is believed that ethylene gas produced by the fire promotes flowering. For instance, red beak orchids (*Burnettia nigricans*) appear only as leaves in unburnt bushland, but flower *en masse* after fire. The rabbit orchid (*Leptoceras menziesii*) produces dense mats of leaves in moist areas along creeklines and swamps. These come up year after year without ever producing more than one or two flowers. However, if the area is burnt, almost every plant bursts into bloom. Most leek orchids (*Prasophyllum* spp.), bunny orchids (*Eriochilus* spp.) and beak orchids (*Burnettia* spp.) are stimulated by fire.

Two named hybrids grow in the park. The prisoner orchid (*Caladenia* x *ericksoniae*) is a cross between the zebra orchid and the painted spider orchid, and the shy spider orchid (*C.* x *triangularis*) is a cross between the cowslip orchid and the white spider orchid. A careful observer may find them growing amongst their more common parents.

## WANDOO WOODLANDS

One of the best places to look for orchids is in the wandoo woodlands at the northern end of the park, just south of the Bluff Knoll turnoff. Over 50 species can be found in this habitat and, as it is fairly open, the majority are reasonably accessible and easy to spot. The best time to search is from August to early October when most are in full bloom.

The zebra orchid is instantly recognised by its upswept red-striped lip and distinctive stem-clasping petals and sepals. Clumps of the colourful painted spider orchid, with its red, white and yellow flowers and wispy spider-like petals and sepals, may be found scattered in open situations. In good seasons, thousands of white spiders flower in favoured areas. The unusual and attractive dark red flowers of the blood spider orchid (*C. filifera*) are far less common and often require a careful search before they are found. A patient observer may also discover the rare dwarf spider orchid growing in small colonies under low shrubs.

Other species of the wandoo woodlands include the bee orchid (*Diuris laxiflora*), which is often seen growing in small clumps in damp sites; the hairy greenhood (*Pterostylis ciliata*), an unusual species with four or five nodding flowers and a flat rosette of leaves; and the tiny, but common, laughing leek orchid (*Prasophyllum ringens*), which is often overlooked due to its diminutive flowers and rather drab colours.

## SHEOAK THICKETS

The sheoak thickets found along seasonal creeklines also have their own array of orchids. The dragon orchid (*Drakonorchis barbarossa*) often forms large colonies in these areas and is particularly abundant along Papacolla Creek. Its flowers, which appear from late September to October, have an unusual lip that resembles the size, shape and texture of a flightless female wasp. As with the hammer orchids, male wasps are initially attracted to the plant by an irresistible chemical lure that mimics a sexual attractant given off by the female wasp. When they clasp the lip and attempt to fly off with it, the flower's hinged stem throws them against the column. Pollen is thus removed or deposited during their frustrated lift-off.

The lazy spider orchid (*Caladenia multiclavia*) also inhabits these thickets. It is quite rare in the park and is only found along a few rocky creeklines near the north-eastern end. However, its unusual red and yellow striped flowers, with their humbug-like lip, are well worth looking for. Other orchids of the sheoak thickets include the fragile pale pink sugar candy orchid (*Caladenia hirta*), the clown orchid (*C. roei*) and the white bunny orchid (*Eriochilus dilatatus*), which is one of the first orchids to flower in the park.

## MALLEE HEATHLANDS

There are many orchids to be discovered in the mallee heathlands which dominate much of the Stirling Range National Park. These areas are rich in common species such as the red beak orchid, which appears year after year as large oval-shaped leaves, often called elephants' ears. Should its habitat be burnt, it will produce up to eight red and white striped flowers on each plant. A species which does not require fire is the magnificent Queen of Sheba (*Thelymitra variegata*). It is rarer than many other heathland orchids and appears to be confined to moist pockets in sandy or rocky soils. Like other sun orchids it remains closed on cool, cloudy days, but if the weather is right, its beautiful golden-yellow, red and purple flowers display their full glory. Sun orchids differ from all other Australian orchids in lacking a lip or labellum. Like many other flowering plants, their third petal is the same as the other two.

One of the first orchids to appear is the leafless orchid (*Praecoxanthos aphyllus*), which flowers in late March and April. As its name suggests, it has no leaves, just a flowering stem growing straight out of the soil. Each plant has one creamy-yellow flower which emits a

*Below left:*
Dancing orchid (*Caladenia discoidea*). The common name of this species is derived from its delicately balanced lip which vibrates in the slightest breeze.
Photo - Jiri Lochman

Blue sun orchid (*Thelymitra canaliculata*). A rarely seen species, the blue sun orchid can be found during late August and early September in swampy areas of the park.
Photo - Andrew Brown

delightful perfume. Other species of the mallee heathlands include the purple enamel orchid (*Elythranthera brunonis*), the blue china orchid (*Cyanicula gemmata*), the common donkey orchid (*Diuris corymbosa*) and the dark banded greenhood (*Pterostylis sanguinea*).

## SWAMPLANDS

The winter-wet swamplands are also very rich in orchids. Some 48 species are known from these areas. Many fire-stimulated species, such as the pale-yellow flowered nanny goat orchid (*D. laevis*) and the purple and white swamp sun orchid (*Thelymitra cucullata*), appear in burnt swamps during late spring, while earlier in the year, usually around September, bee orchids are often quite abundant. Some of the best places to see swamp-loving orchids in the Range are in the Moingup Springs area, along Stirling Range Drive and in creeklines along Salt River Road. The most common group found in and around winter-wet swamps are the leek orchids (*Prasophyllum* spp.). Following summer fires, as many as nine species can be seen scattered amongst the regenerating vegetation. The numerous tiny flowers found on leek orchids are the reverse of most other orchids - their lip or labellum is the uppermost rather than the lowermost segment. Growing to two metres high, the king leek orchid is easily the tallest orchid found in the park. Other species, however, are much shorter; the dainty red and white flowered swamp leek orchid is smaller but more than makes up for its size in colour and sheer numbers. Often thousands of plants can be found in areas of suitable habitat. Some other common inhabitants of swampy areas are the cinnamon sun orchid (*Thelymitra benthamiana*), the blue sun orchid (*T. canaliculata*) and the pink bunny orchid (*Eriochilus scaber*).

Helmet orchid (*Corybas recurvus*). Found in cool, damp places the tiny helmet orchid undergoes an amazing transformation once fertilised, pushing its flowers skyward for up to 30 centimetres on an elongating stem.
Photo: Andrew Brown

## ROCKY AREAS

The rocky mountain tops and slopes have their own suite of orchids. During December and January, the unusual flowers of the slipper orchid (*Cryptostylis ovata*) can be seen scattered along the paths to the tops of Bluff Knoll and Mount Toolbrunup. It is the only orchid species of south-western Australia that has leaves all year round, as all others die back to dormant tubers during the summer

*Below right:*
Purple pansy orchid (*Diuris longifolia*). Found predominantly in jarrah-marri woodlands it is one of Western Australia's donkey orchids.
Photo - Andrew Brown

Lazy spider orchid (*Caladenia multiclavia*). The bizarre flowers of the lazy spider orchid are designed to attract male wasps which attempt to mate with the humbug-like lip.
Photo - Andrew Brown

months. In January the drab flowers of the potato orchid (*Gastrodia lacista*) may also be found in a few rocky crevices. It has no need for either green colouration or true leaves, as it is able to survive on nutrients it receives from its association with soil fungi.

Much earlier in the year the tiny helmet orchid (*Corybas recurvus*) is seen in cool, damp areas along seasonal creeklines. Once fertilised, this species undergoes an amazing transformation. The tiny, ground-hugging flowers are pushed skywards for up to 30 or more centimetres by their elongating stem, resulting in the seed being dispersed more effectively by the wind. Then, a few months later, the minute flowers of the dwarf greenhood (*Pterostylis platypus*) appear among boulders and low shrubs in rocky slopes adjacent to Talyuberup picnic site. In October and November the butterfly orchid (*Caladenia lobata*) can be found in the low, dense jarrah-marri woodlands associated with the lower and more sheltered slopes.

## WOODLANDS

One of Western Australia's most bizarre orchids can be located in sandy areas in banksia and jarrah-marri woodlands at the Gold-holes on Chester Pass Road and in similarly sandy areas on the Stirling Range Scenic Drive. The hammer orchids have flowers so modified that it is hard to imagine that that is what they really are. The lip of these flowers resembles a flightless female flower wasp and is produced on the end of a hinged stem which allows it to move freely up or down. Thus they use a similar strategy to the dragon orchid to attract pollinators. Flowering from September to early November, they are generally found scattered in small groups. These can be seen in clearings between low shrubs, but they are never overly common.

Sometimes growing with the hammer orchid is the appropriately named flying duck orchid (*Paracaleana nigrita*). The lip of this species is irritable and springs over when touched so as to momentarily trap any pollinating insect. Also found in these areas is the bird orchid (*Pterostylis barbata*). Resembling a green beaked bird with its wings in a folded position, this orchid occurs in well-shaded dampish sites, along with several other greenhood species. Other orchids of the banksia and jarrah-marri woodlands include the shirt orchid (*Thelymitra campanulata*), the king spider orchid (*Caladenia pectinata*), the unusual ant-pollinated hare orchid (*Leporella fimbriata*) and the purple donkey orchid (*Diuris longifolia*).

## CONCLUSION

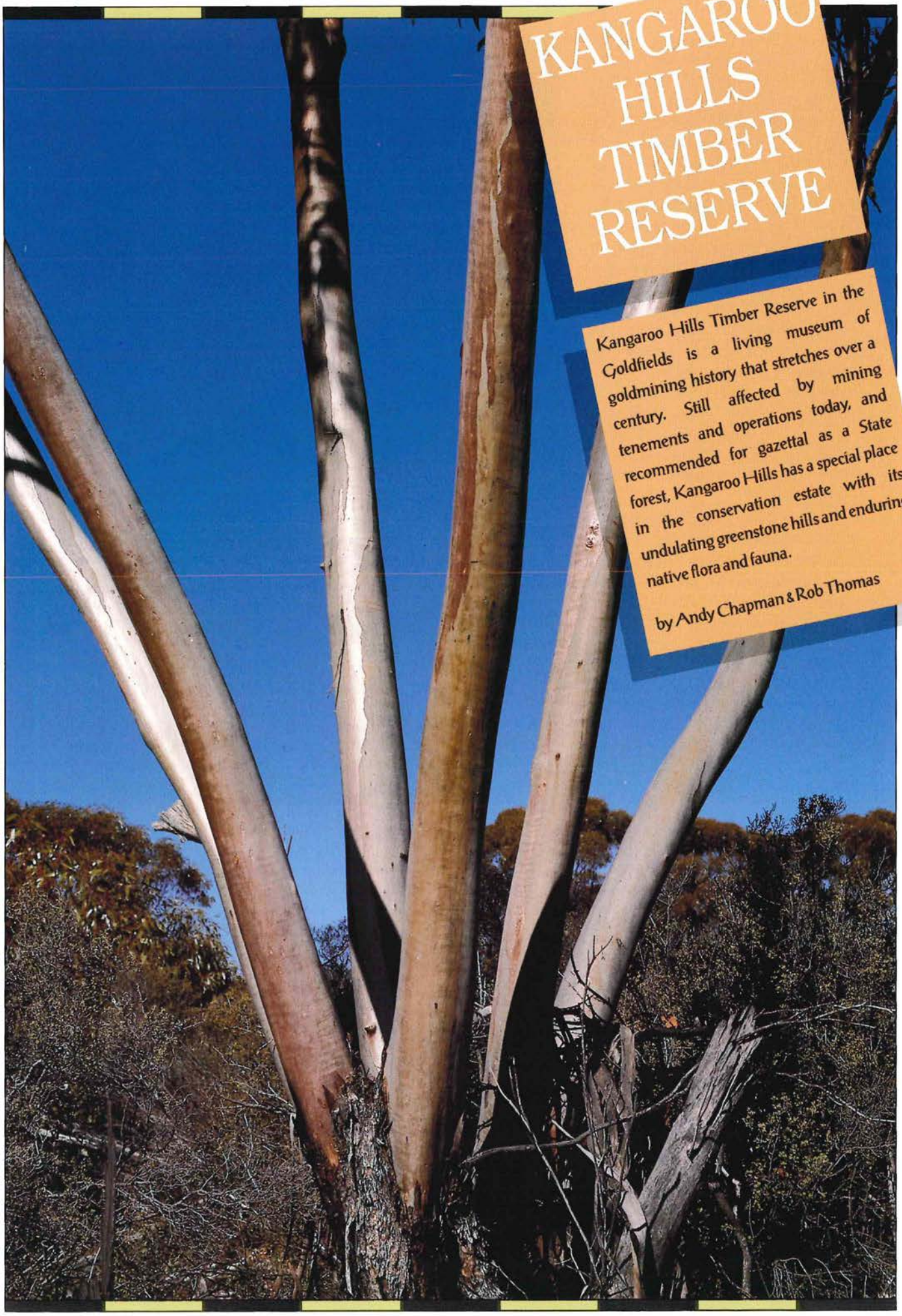
This brief insight into the orchids of the Stirling Range covers a fraction of what the park really holds. Just six habitats have been examined and, as many others contain their own suites of orchids, future biologists, park managers and visitors will undoubtedly discover many orchids not listed here. ⊡

*Below Left:*
White spider orchid (*Caladenia longicauda*). During the spring months literally thousands of white spider orchids can be seen in the wandoo woodland areas of the park.
Photo - Andrew Brown

*Below centre:*
Queen of Sheba orchid (*Thelymitra variegata*). In cool, cloudy weather the flowers of the Queen of Sheba remain closed, but on bright, sunny days they open to display their full glory of golden-yellow, red and purple.
Photo - Andrew Brown

*Below right:*
Ruddyhood (*Pterostylis platypus*). Found only on a few rocky slopes of the Range, it requires a keen eye to spot the tiny flowers of the ruddyhood.
Photo - Andrew Brown

Andrew Brown, a botanist with the Department of Conservation and Land Management, is just one of many authors who have contributed to *Mountains of Mystery: A Natural History of the Stirling Range National Park*, which will be published by CALM next year. Andrew can be contacted at CALM's Wildlife Research Centre, Woodvale, telephone (09) 405 5100.



# KANGAROO HILLS TIMBER RESERVE

Kangaroo Hills Timber Reserve in the Goldfields is a living museum of goldmining history that stretches over a century. Still affected by mining tenements and operations today, and recommended for gazettal as a State forest, Kangaroo Hills has a special place in the conservation estate with its undulating greenstone hills and enduring native flora and fauna.

by Andy Chapman & Rob Thomas

The Kangaroo Hills - home to their namesake, euros and red and grey kangaroos - were named by surveyor C.C. Hunt in 1864. Other early European visitors included prospectors as they began to surge from Coolgardie after the 1892 rush in search of gold (this year marks Coolgardie's centenary). One of the early prospectors credited with finding gold in the greenstone hills was J.E. Burbanks, who discovered gold about eight kilometres south-west of Coolgardie; the Birthday Gift lease was subsequently pegged in 1893. Other important leases were the Main Lode and Lady Robinson. All three are now contained within the reserve, and just to the east of it lie the remnants of the town of Burbanks, which sprang up as a result of these finds.

Another mine, the Londonderry (or, as it was first known, the Golden Hole), began life in the Kangaroo Hills in 1894 as six men returned from an unsuccessful prospecting trip south-east of Coolgardie. The men set up camp about 16 km south of the town and decided to have a last prospect. One of the men stumbled over a quartz reef with visible gold in it. A one-metre deep and two-metre-long hole produced about 8 000 ounces of gold for the prospectors, which in today's terms would be valued at nearly $4 million. (This equates to 190 000 grams of gold to the tonne of dirt moved; in comparison, Kalgoorlie-Boulder's Superpit has a grade of about 2.64 grams to the tonne.)

This find brought a flood of prospectors and entrepreneurs to the Londonderry area. A number of companies vying for the mine firstly wanted to blast the bottom of the hole to see if the gold persisted at depth. It was not until an English lord, Lord Fingall, came along that a purchaser was found who would consent to the prospectors' condition not to blast the hole prior to purchase.




Red kangaroo (*Macropus rufus*).
Photo - Jiri Lochman

*Previous page:*
Grey gum (*Eucalyptus griffithsii*) is a Goldfields mallee found in flat saline areas and rock slopes.
Photo - Allan Padgett

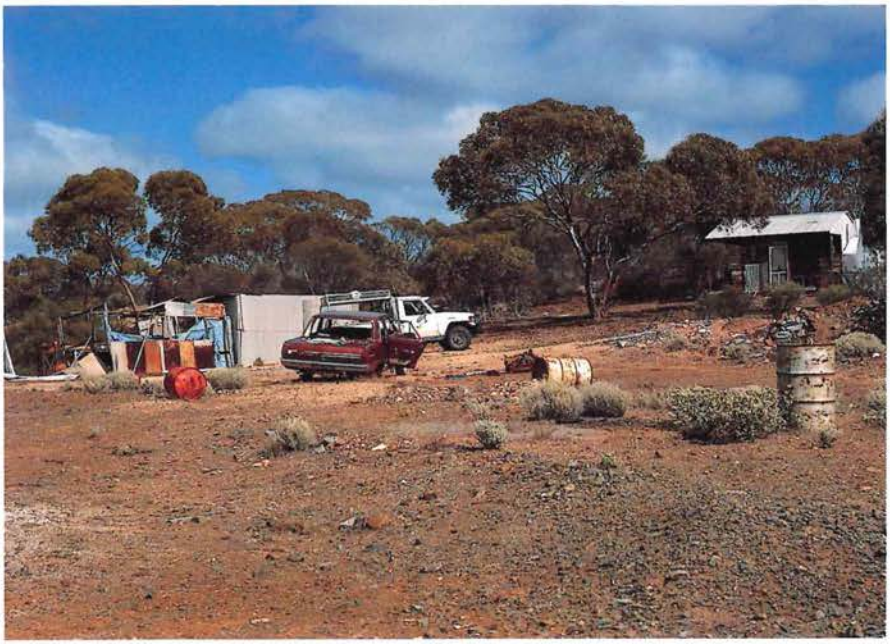
*Above right:*
The remains of old miners' camps are scattered throughout the Goldfields.
Photo - Andy Chapman

The gold mine was then listed on the London stock exchange to raise capital, while the hole was secured with cement, iron and a fence. There was an initial rush for shares which pushed the price high. Lord Fingall ordered work to commence, but after three days it became apparent that the gold had all but dried up. Twenty centimetres below the hole was barren quartz. The share prices collapsed as a result, and the Londonderry gold boom was over. It was not until more than 30 years later that suspicions arose regarding the

Some miners' camps, left to weather, are a fine example of crude bush architecture.
Photo - Andy Chapman

*Far right:*
Biologists found nine native mammal species on the reserve during a survey funded by Kalgoorlie Resources.
Photo - Andy Chapman

*Right:*
Silver gimlet (*Eucalyptus campaspe*) is a mallee of restricted distribution in the central Goldfields, and favours stony rises.
Photo - Allan Padgett



prospectors' knowledge of the gold not persisting at depth. It was claimed that the prospectors had sunk a shaft with a drive off it to just below the hole, then backfilled the shaft and built their camp over it.

Today all that remains of these sites are piles of rubble, some rubbish and more recent haphazard developments which do not fairly reflect the area's historical significance.

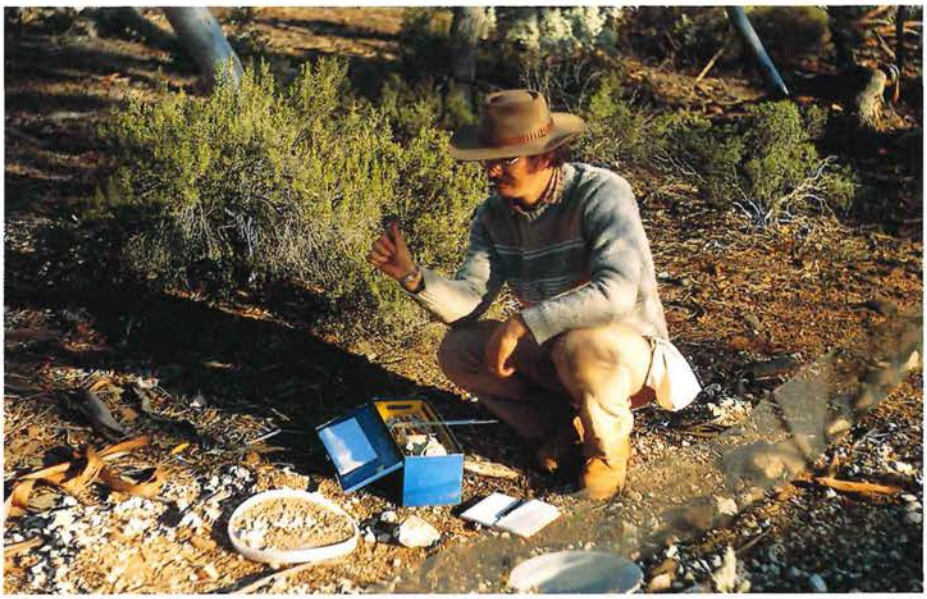
## FIREWOOD

At the turn of the century pastoralism spread to the Goldfields, bringing sheep to Kangaroo Hills, and there was a huge demand for wood for fuel and mining timber - a demand which continued until 1950. Even before 1903 when the Goldfields Pipeline was completed, the Coolgardie condenser alone used 100 tonnes of firewood a day.

Through the work of local foresters to conserve local tree species, Kangaroo Hills Timber Reserve, covering 6 600 hectares, was one of four timber reserves established in the Goldfields in 1975. It is situated between three and 16 kilometres south of Coolgardie and is bounded by Nepean and Victoria Rock roads. The reserve was resurrected from 243 000 hectares of State forests in the Goldfields that had been relinquished in the 1960s when the then Forests Department decided it could not accept responsibility for fire control in such remote areas.

Kangaroo Hills Timber Reserve was gazetted to conserve the locally restricted trees, the silver gimlet, *Eucalyptus campaspe*, and Cleland's blackbutt, *Eucalyptus clelandii*. But it is also a hive of mining activity. The reserve is of particular interest because the greenstone landform, due to its potential for mineral exploitation, is poorly represented in the conservation estate. Today about 167 existing and pending mining tenements occupy 80 per cent of the reserve, which is managed by the Department of Conservation and Land Management (CALM). These include 56 mining leases, 104 prospecting licences, one exploration licence, six miscellaneous licences (water and power lines), and a gravel lease. In managing the reserve, CALM has an ongoing liaison role with mining companies. This offers an opportunity for both CALM and the mining industry to be involved with each other's operations and better understand each other's point of view.

The Goldfield's mining legacy has not aided management of the reserve. Examples of this include unfilled exploration trenches and drill holes, inappropriately sited grid lines, and the usual rubbish and junk that used to accompany mining operations. In former times miners lived on their leases and many of their old camps still exist; most are just rubbish, though one old camp in particular is a fine example of crude bush architecture, and in another there is an interesting old hand-operated washing machine mounted on bush poles. These examples raise the possibility that the mining heritage might be included in the management of the reserve.



## SURVEY SURPRISE

In 1990 the mining company Kalgoorlie Resources funded a $35 000 biological survey of Kangaroo Hills as part of a compensation package for excision of 90 hectares to accommodate the Grosmont Joint Venture mining operation. The excision involved a boundary realignment to exclude a degraded portion of the reserve, and Kalgoorlie Resources agreed to fund a survey of the entire reserve rather than just the portion they were interested in.

Biologists Michael Bamford, Stephen Davies and Phillip Ladd spent a week in autumn, one in winter and another in spring on the reserve recording data on the vertebrates present, habitat relationships, and vegetation mapping. Their methods included pit-trapping for animals, bird censusing by quadrat and mist-netting, and recording vegetation using techniques identical to those of previous surveys, so that results would be compatible and could be incorporated into a final Goldfields biogeography database.

The survey recorded nine native mammal species, 70 birds, 32 reptiles, two frogs and 250 taxa of plants. No threatened rare flora or fauna were discovered, but there were some surprises, including the discovery of *Acacia duriuscula* - not recorded in WA since 1902 - and a grass, *Stipa blackii*, previously known only from South Australia. Fauna recorded in the reserve included the mallee fowl, Ride's ningaui (a small carnivorous marsupial more at home in central desert areas), and an abundance of Mitchell's hopping mice.

The birds of Kangaroo Hills include 12 species of resident passerines, which elsewhere have been shown to be sensitive to environmental change. There is also a small group of locally migratory species, including the golden whistler, western gerygone and regent parrot, which move in and out of the south-west. The woodlands of the Goldfields are of considerable importance to these species, whose habitat in the agricultural areas has been substantially altered.

The survey found that the reserve's biota was a blend of south-west and arid zone components with the former predominant; an example of the arid zone element is a mallee/spinifex formation with Ride's ningaui and *Hakea francisiana*, which is more to be expected of the Great Victoria Desert.

Future management directions for Kangaroo Hills Timber Reserve, as indicated in CALM's Goldfields Region draft management plan, are its incorporation with the adjacent Calooli Sandalwood Reserve and their joint reclassification as Kangaroo Hills State Forest. This will give both reserves better protection of tenure and purpose without unduly restricting other activities such as mining.

*Top left and right:*
To look at the alluvial geological profile, trenches (or costeans) were often dug. Today, many of these remain throughout the Goldfields and are not only an eyesore, but often contribute to gully erosion and pose a threat to wildlife and stock. CALM actively encourages companies exploring or mining on CALM-managed lands to backfill these trenches and rehabilitate previous disturbances on their leases.
Photo - Andy Chapman

*Above:*
A small carnivrous marsupial found at Kangaroo Hills is the nocturnal Ride's ningaui.
Photo - Babs and Bert Wells

*Rob Thomas is a CALM environmental officer involved in the management of mining on CALM-managed lands. Andrew Chapman is a regional ecologist conducting flora and fauna studies in the Goldfields. Both can be contacted at CALM's Kalgoorlie office on (090) 21 2677.*

# TREES for all reasons

The theme for this year's Arbor Day - Trees For All Reasons - inspired school children from all over Western Australia to express their environmental awareness and their appreciation of trees in the third annual Arbor Day Poster Competition, sponsored by *LANDSCOPE* magazine and Radio 6WF.

More than 7 000 primary school children from more than 140 schools used their artistic talents in colourful and imaginative ways to show that the trees and forests of WA play essential environmental, economic and recreational roles in their lives.

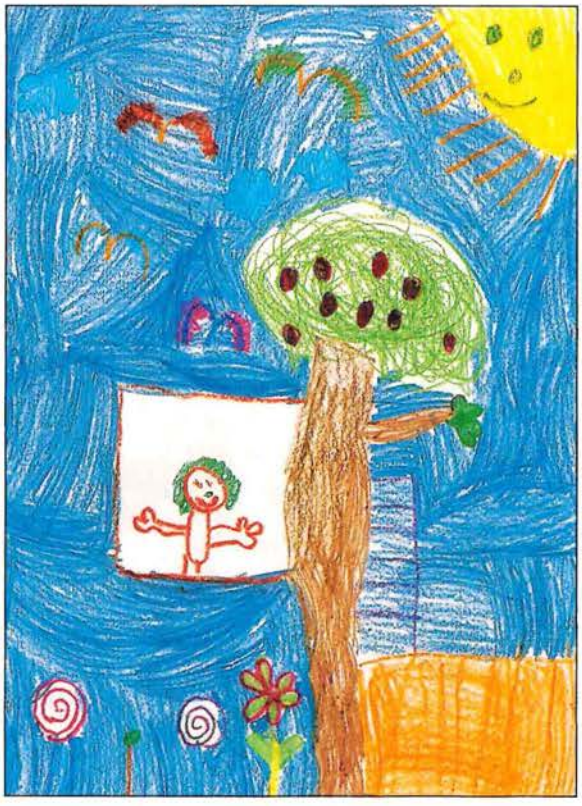
These children, who are the decision-makers of the future, prepared posters showing that trees give us oxygen, assist in providing us with quality water, minimise erosion and provide wildlife habitat. Others demonstrated an awareness that WA's forests ensure a high standard of living for many by supplying raw materials to forest industries and also provide a setting for our growing and valuable tourism industry. And, of course, the work of many of the children showed that trees are simply fun to climb, to swing on, and to admire. In short, there are trees for all reasons.

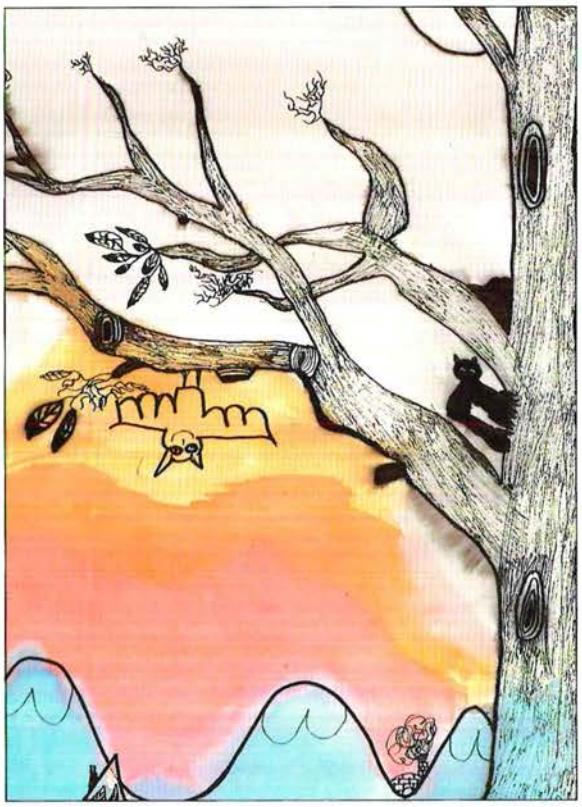
Arbor Day originated in the United States of America and was first observed in Nebraska in 1872. The idea was one of forest conservation, and the event promoted replanting following deforestation and the planting of treeless areas.

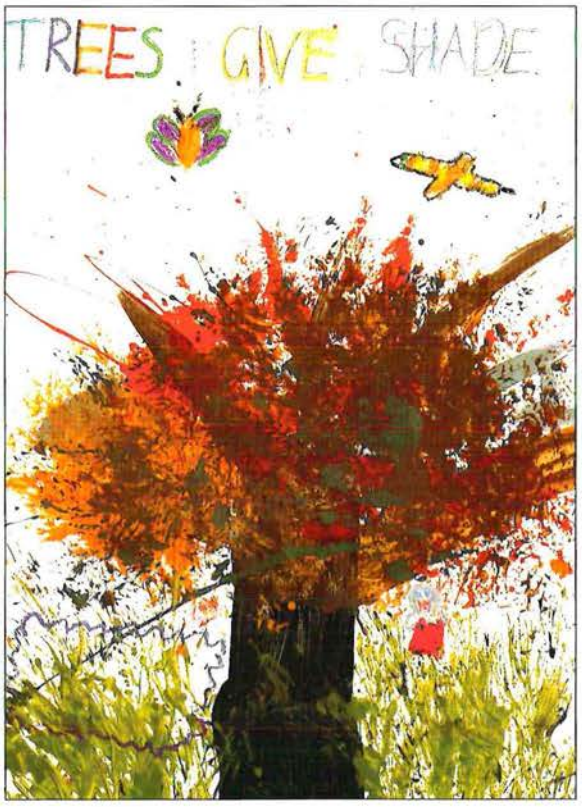
Arbor Day was first observed in Australia in June 1889, in Adelaide. In Western Australia, the celebration was provided for in the Forests Act of 1919, and now in the Conservation and Land Management Act of 1984. The date for its celebration is fixed each year by the Minister for the Environment to coincide with the Day of Trees during Western Australia Week.

**Kindergarten**: Matthew Anyalai (Assumption Pre-Primary, Mandurah) ...a vividly coloured tree.

**Year 1**: Eloise Wigger (St. Pius X, Manning) ... a young girl enjoying her treehouse.





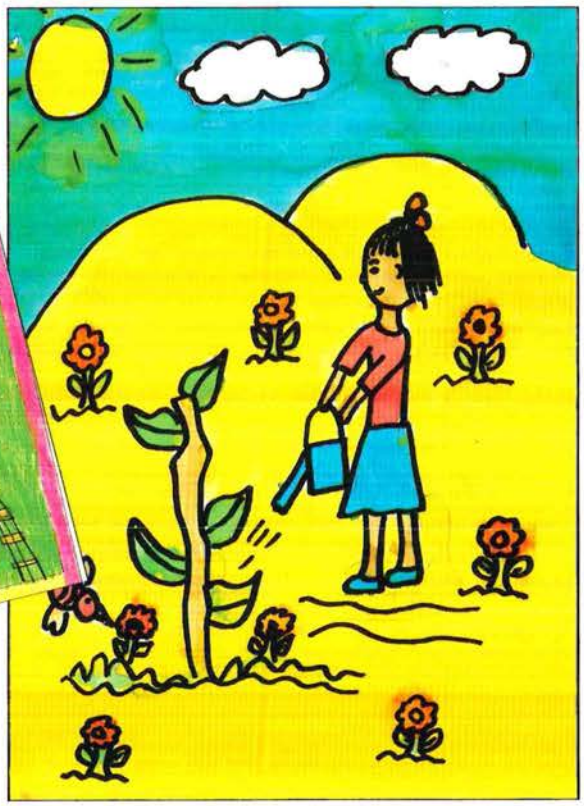


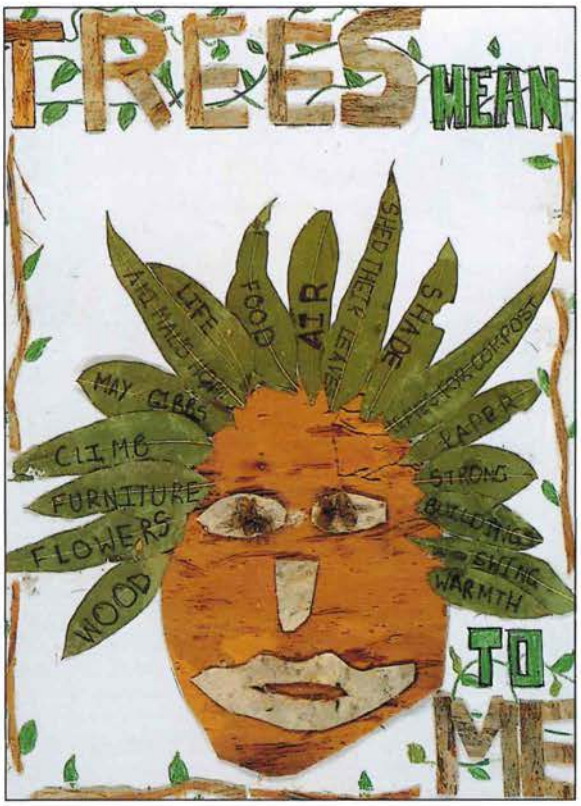

**Year 2**: (*above left*) Rick Wallis ( Mount Pleasant Primary School)
... gives you a bird's eye view from high up on a tree branch.

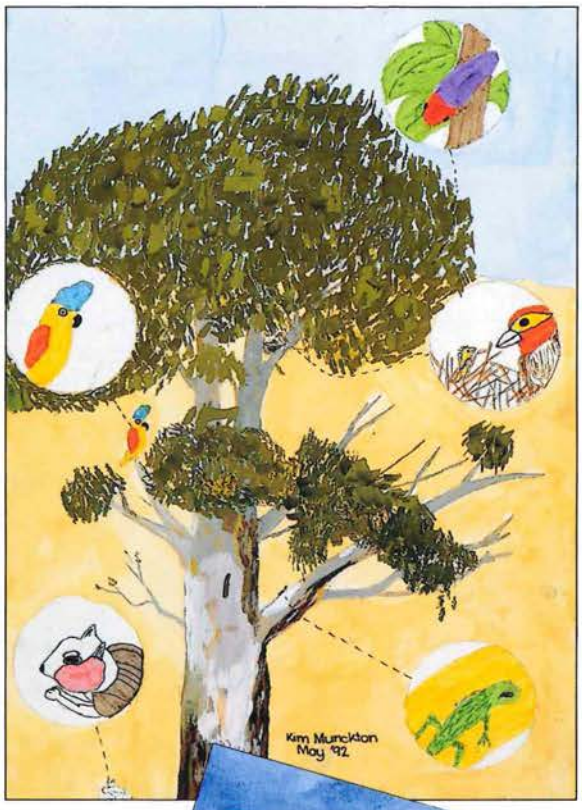
**Year 3**: Helen O'Meara ( St. Brigid's Primary School, Lesmurdie)
... *Trees give shade* is the message here.

**Year 4**: (*below left*) Sarah Latham (Ballidu Primary School)
... many tree houses up amongst the bird nests.

**Year 5**: Youn Duc (Brookman Primary School, Langford)
... a bright, cheerful painting of a young girl watering a seedling.

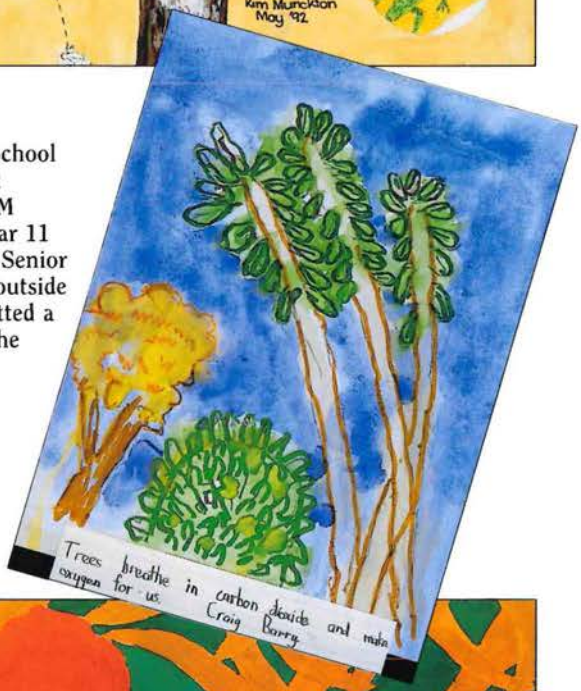


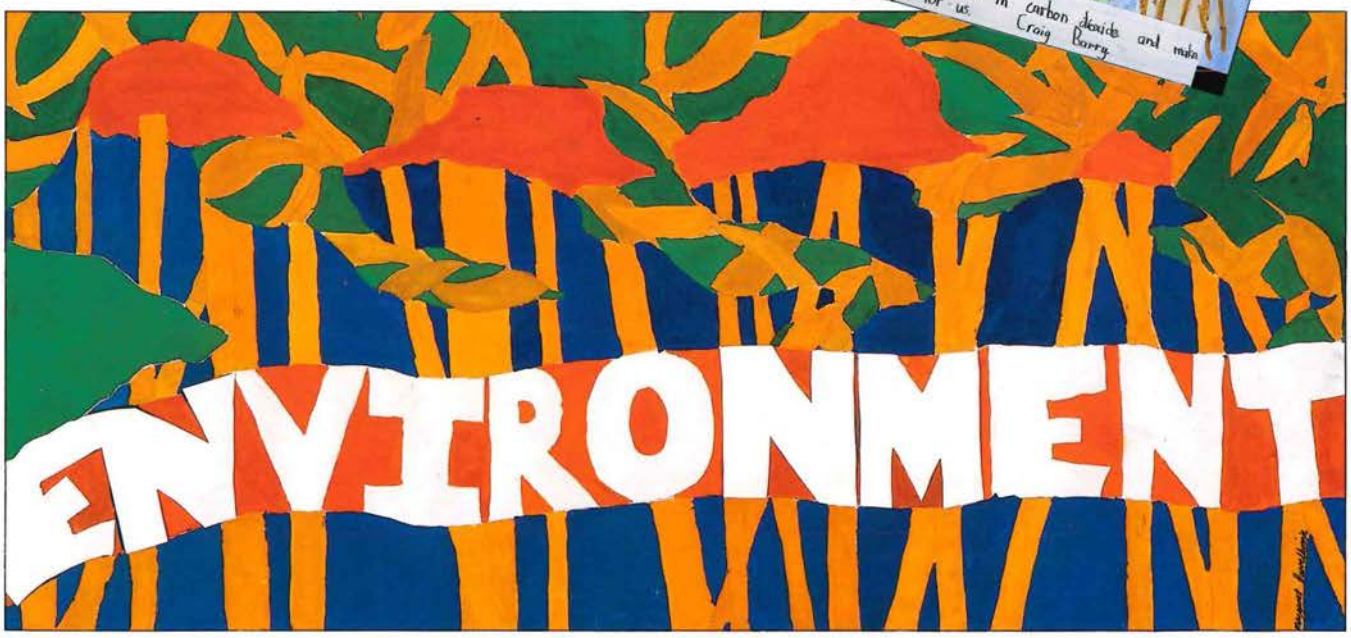




**Year 6**: *(above)*Vanessa Holm (St. Augustine's, Riverdale)
... a collage of tree parts.

**Year 7**: (*above right*)Kim Munckton (Heathridge Primary School)
...shows a eucalyptus with all the bird, mammal and insect population it supports.

Craig Barry from Buckland Hill School also won an award for his artwork (*right*). A special award of a CALM bookpack was presented to the Year 11 and 12 Applied Art class at Como Senior High School *(below)*. They were outside the normal categories, but submitted a portfolio of stunning posters on the theme that Arbor Day this year coincided with World Environment Day.



# lerps bugs and gum-leaves

BY JANET FARR

IN THE EARLY 1980'S, FLAT-TOPPED YATE TREES THROUGHOUT THE LOWER GREAT SOUTHERN STARTED TO LOOK AS THOUGH SCORCHED BY FIRE - YET NO FIRE HAD TAKEN PLACE...

The fire-scorched appearance of flat-topped yates (*Eucalyptus occidentalis*) was first officially recorded in June 1982 between Gnowangerup and Borden. Since then, damage has been observed throughout the entire range of flat-topped yate in the south-west of Western Australia. This tree species is now suffering severe crown decline and, in some instances, death. The cause? An insect commonly, though erroneously, referred to as a lerp.

Flat-topped yate, or swamp yate, is distributed throughout the Lower Great Southern in swamps and creek-lines, mainly as remnant stands of vegetation. Before European settlement these trees must have been a significant feature of the landscape; the town Jerramungup was named from an Aboriginal word meaning 'place of the flat-topped yate'. The timber from this species is extremely hard and was valued as a material for making strong, reliable cart-wheels. Today, its value is environmental. Flat-topped yate is salt-tolerant, and in farming areas is considered important in reducing salt encroachment. In fact its importance is not limited to Western Australia: the flat-topped yate has found its way to countries such as Lebanon, Israel and Portugal.

## WHAT IS A LERP?

The word *lerp*, which is Aboriginal, does not refer to an insect. It refers to the protective covering under which the insect, a psyllid, lives. Lerps are as diverse as the individual species that build them, but generally come in two forms: those with a high wax content and those with a high sugar content. Sugary lerps were eaten by Aborigines as a kind of confectionery.

The psyllid itself belongs to the order Hemiptera ('true bugs'). It is a sap sucker feeding from plants, much like an aphid or a mealy bug. Some psyllid species are free-living; the lerp-building species belong to the sub-family Spondyliaspidinae, and the lerps they construct are often used to differentiate between species.

The psyllid which affects flat-topped yate was at first identified from a lerp case as *Cardiaspina brunnea*, originally collected in NSW in 1923 on the grey ironbark (*Eucalyptus paniculata*). This suggested that the insect may have been introduced to Western Australia, which would explain the sudden occurrence of an insect which until 1980 was not known in this State. However, the host tree of *C. brunnea* belonged to a different group of eucalypts from that of the Western Australian host tree. Species within the insect genus *Cardiaspina* are known to have a fairly limited host range, restricting their food plants to eucalypts which are closely related. So this insect did not seem to fit the current knowledge on its genus. Also the only specimen of the NSW species as described in 1923 was a lerp case. Therefore, it was not known what the actual insect looked like.

It has now been verified that the psyllid affecting flat-topped yate is not *C. brunnea*,

Waxy lerp.
Photo - Peter Skinner

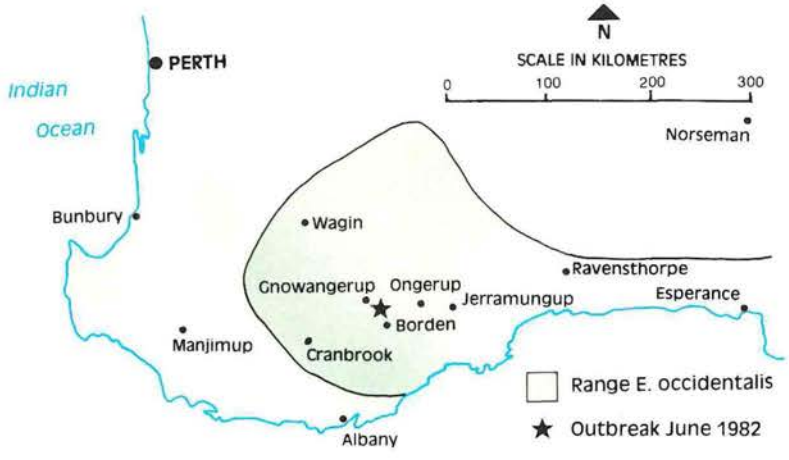
*Facing page:*

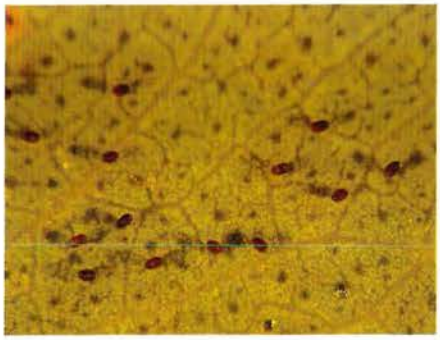
*Left:*
Lerp-infected leaf.
Photo - Ian Duncan

*Inset:*
Landscape showing healthy yate.
Photo - Ian Duncan

*Above:*
Landscape showing unhealthy yate.
Photo - Ian Duncan

*Right:*
Distribution of the flat-topped yate in south Western Australia.





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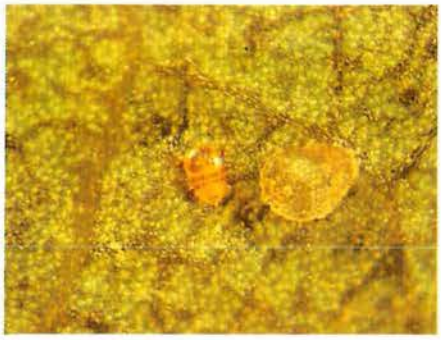

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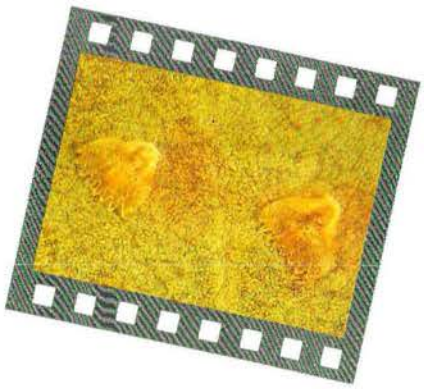

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but a new species now called *Cardiaspina jerramungae*. This means it is very likely to be indigenous to the outbreak area.

The new psyllid species builds a distinctive waxy, shell-like lerp, patterned with dark bands. There are two main hosts, the flat-topped yate and the coastal moort *(E. platypus* var. *heterophylla)*. Eggs are laid, preferably on mature leaves, and attached to the leaves by stalks. After hatching, the young nymph crawls over the leaf surface until a suitable feeding site is found. The insect then inserts its long needle-like mouth parts into the leaf and starts to feed and then starts to build its characteristic lerp case, which is a simple disc built up through five nymphal stages. The finished structure looks like an inverted basket in the shape of a sea shell.

During feeding, the leaf tissue around the feeding site changes from green through yellow, purple-green, purple-red, and red, to brown, when the leaf tissue dies. The red and purple colours reflect the plant's response to the psyllid's saliva and are due to chemicals such as tannins around the feeding site. Some scientists believe that such chemicals are the plant's counter-attack against its insect feeders. Severe outbreaks of this insect can result in most of the leaves in a tree crown turning purple-red - hence the scorched appearance of flat-topped yate.

Like other species of *Cardiaspina*, this insect has three generations a year. The long winter generation extends from May to December and is followed by the shorter summer and autumn generations (December-February and February-May respectively). It is the generations' timings and the insect's preference for mature leaves which contribute to its nature as a 'cyclic outbreaker'.

Most species of lerp-building psyllids exist in relatively low numbers within their natural habitat, sometimes so low that they can be very hard to find, which may be why the insect was relatively

*1* Psyllid eggs. Size, less than 0.5mm.
Photo - Janet Farr

*2* First stage lerp and nymph.
Photo - Peter Skinner

*3* Approaching second stage. Nymph has extended lerp with finger-like projections.
Photo - Peter Skinner

*4* Showing nymph with wing buds and lerp approaching final form.
Photo - Peter Skinner

*5* Fourth stage nymph and lerp (inverted).
Photo - Peter Skinner

*6* Adult female psyllid. Length from head to wing tip 3mm.
Photo - Janet Farr

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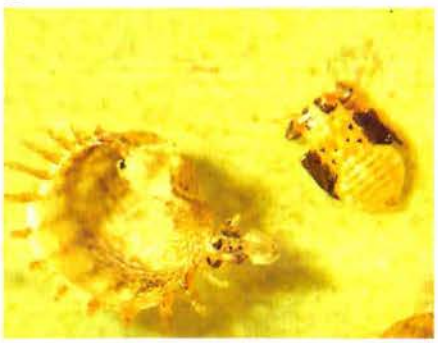

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unknown until now. Outbreaking psyllid species exhibit a cycle of rapid build-up in numbers followed by a rapid decline. This decline is often due to depletion of preferred food resources, the psyllids having literally eaten themselves out of house and home. During this decline psyllids may exist in moderately high numbers in isolated areas or on isolated trees, often on the fringes of the old outbreak. Such trees are termed 'out of phase'. Detection of resistant trees can therefore be difficult, as undamaged trees could be out of phase with the current outbreak.

## OUTBREAK CAUSES

Two main theories have been developed to explain psyllid outbreaks. One is that they are stimulated by waterlogging of food plants followed by drought, the stress leading to an increase in nutrients in the food; this in turn increases the survival rate of young nymphs. The second is that a number of factors may contribute to high psyllid numbers, including drought in the previous growing season, good levels of soil moisture for growth of the food plant in the present season, favourable autumn and winter temperatures, a low level of flowering on food plants, an abundance of leaves of the preferred age class, low levels of leaf damage by other insects, and inefficient natural control. Neither of these theories may be entirely satisfactory; leaves of the right age class having the preferred chemical components should

also be considered.

What has caused the outbreak in the Lower Great Southern is also a matter for debate. It seems that the life of a natural flat-topped yate stand is cyclic, relying on flooding and retraction of flood levels in successive years to ensure seed germination, survival and establishment. Many remnant yate stands are comprised of a high proportion of mature trees with very little age and species diversity, and it is the mature trees that are dying. Psyllids seem initially to outbreak on mature trees, moving on to young trees only after the older ones have been defoliated. Species and age diversity coupled with land management history (mainly in terms of stock access) may be major factors in the decline of remnant vegetation. Therefore fencing is considered one of the primary means of conserving the species.

## CAUSE OR SYMPTOM?

Such insect outbreaks may be more a symptom than a cause. Trees stressed by environmental factors such as weather extremes (e.g. drought and flooding), increased salinity and nutrient imbalances, some of which are a result of agricultural development, increase the trees' susceptibility to insect attack. This in turn induces further tree decline.

Research by The Department of Conservation and Land Management (CALM) into this problem began in 1988. With the co-operation of farmers within the region, mainly through liaison with Land Conservation District Committees and the Jerramungup Department of Agriculture, psyllid population levels and the impact of this insect on the tree have been monitored. A parasitic wasp which mummifies psyllid nymphs, and a predator, the striated pardalote, have been seen to cause significant decline in a psyllid population near Cranbrook. This is an isolated case, however, and in general parasites have little influence on psyllid populations in outbreak.

Farmer participation plays an important part in collecting data. A simple trapping method enables researchers to compare differences in psyllid populations throughout the outbreak region. Traps are erected in remnant yate stands during flight seasons. These traps are tended at weekly intervals by the farmer on whose property the trap is located. Experiments have shown that yellow is the colour that most attracts adult psyllids.

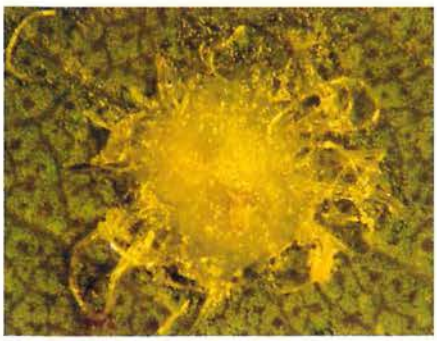
By studying the psyllid and its host within both farmland and national parks, research is aiming at conserving remnant flat-topped yate by either controlling the psyllid populations or promoting stand regeneration. With greater understanding of the interaction of the flat-topped yate with its environment, it is hoped that Jerramungup will remain the 'place of the flat-topped yates'. ⊡

*Right:*
Leaves of the flat-topped yate showing colour change.
Photo - Janet Farr

*Below right:*
Psyllid nymph mummified by wasp parasitoid. The body of the parasitoid can be seen as a white blob inside the nymph's skin.
Photo - Peter Skinner

*Below:*
Adult wasp parasitoid.
Photo - Peter Skinner

*Below left:*
A sugary lerp.
Photo - Janet Farr



Janet Farr is a CALM research scientist based at the Manjimup Research Centre. She can be contacted on (097) 711 988.

# URBAN ANTICS!


## Tabby or not Tabby

Faster than a speeding ... more powerful than ... able to leap long distances at a single bound. Look up in the ... Is it a plane? Is it a bird? No it's .... a cat.

Yes, there is probably no finer urban antic than your cat... purr-fect in every way.

The neighbours have a cat called Mog, a loving, cuddly fur-ball, that provides continual entertainment and companionship for his adopted family, day in and day out.

This particular day, Mog had been forced (because of a huge lunch) to spend an hour in front of the lounge room fire, pretending to be a Persian rug on a Persian rug.

Suddenly, as if by some alien command, Mog sprang to his feet, meowed and rubbed his body on the nearest human leg, which resulted in an open door. For a while he stood there, his yellow baleful eyes with their reptilian-like pupils staring into space. Then he was off, the world was at his feet, it was time to be a real cat.

Within three hours Mog had returned at least six times with the gory remnants of two wattle birds, a dove, a small bobtailed skink, half a rat and a live traumatised frog. Mog's owners weren't too put out; they scooped up the trophies and despatched them as though it was a daily event, and I think it was.

There are about three million pet cats and probably an equal number of feral cats in Australia. So you can imagine the number of animals being destroyed, particularly where unwanted kittens have been dumped by uncaring owners and left to go wild.

Scientists believe cats evolved from a small weasel-like animal called Miacis, which lived more than 50 million years ago. Members of the cat family first appeared about 40 million years ago, and the domestic cat of today is a direct descendant of an African wildcat that the Egyptians tamed - possibly as early as 3500 BC.

The Egyptians, Romans and Greeks valued cats for their ability to control rodents, with the cat eventually becoming a sacred animal in Egypt. Artists of the Orient admired the beauty and mystery of the cat, whilst those in Europe considered cats a symbol of evil.

Domestic cats share many characteristics of their wild relatives; lions, tigers and leopards. They are meat eaters, skillful hunters that move swiftly and quietly on padded feet.

The unique wildlife of the Australian continent evolved without cats. Regrettably, they must now be regarded as an established and significant member of the Australian mammal fauna.

To help maintain populations of our rare and unique fauna, there is a need for cats to be registered and for all but licensed breeders' animals to be desexed. A further need is for research into the control of feral cats.

JOHN HUNTER

*DID YOU KNOW?*

- *Cats have the same basic skeleton and internal organs as human beings.*
- *Unlike many animals, a cat walks by moving the front and rear legs on one side of its body at the same time and then the legs on the other side. Hence it seems to glide.*
- *When a cat falls, it whips its tail and twists its body, always landing on its feet.*

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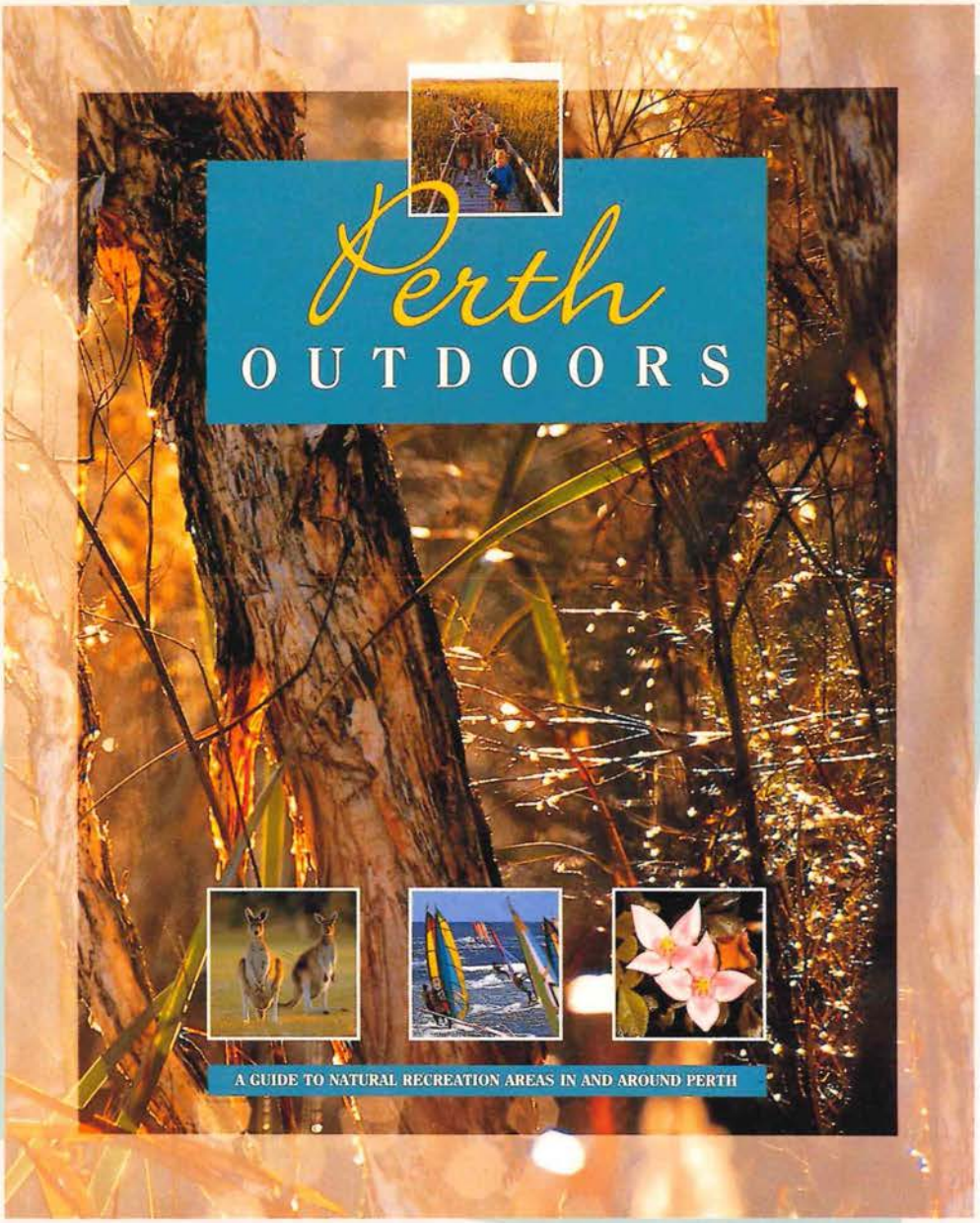


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*Photo - Marie Lochman*

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