$6.95

WINTER 2000

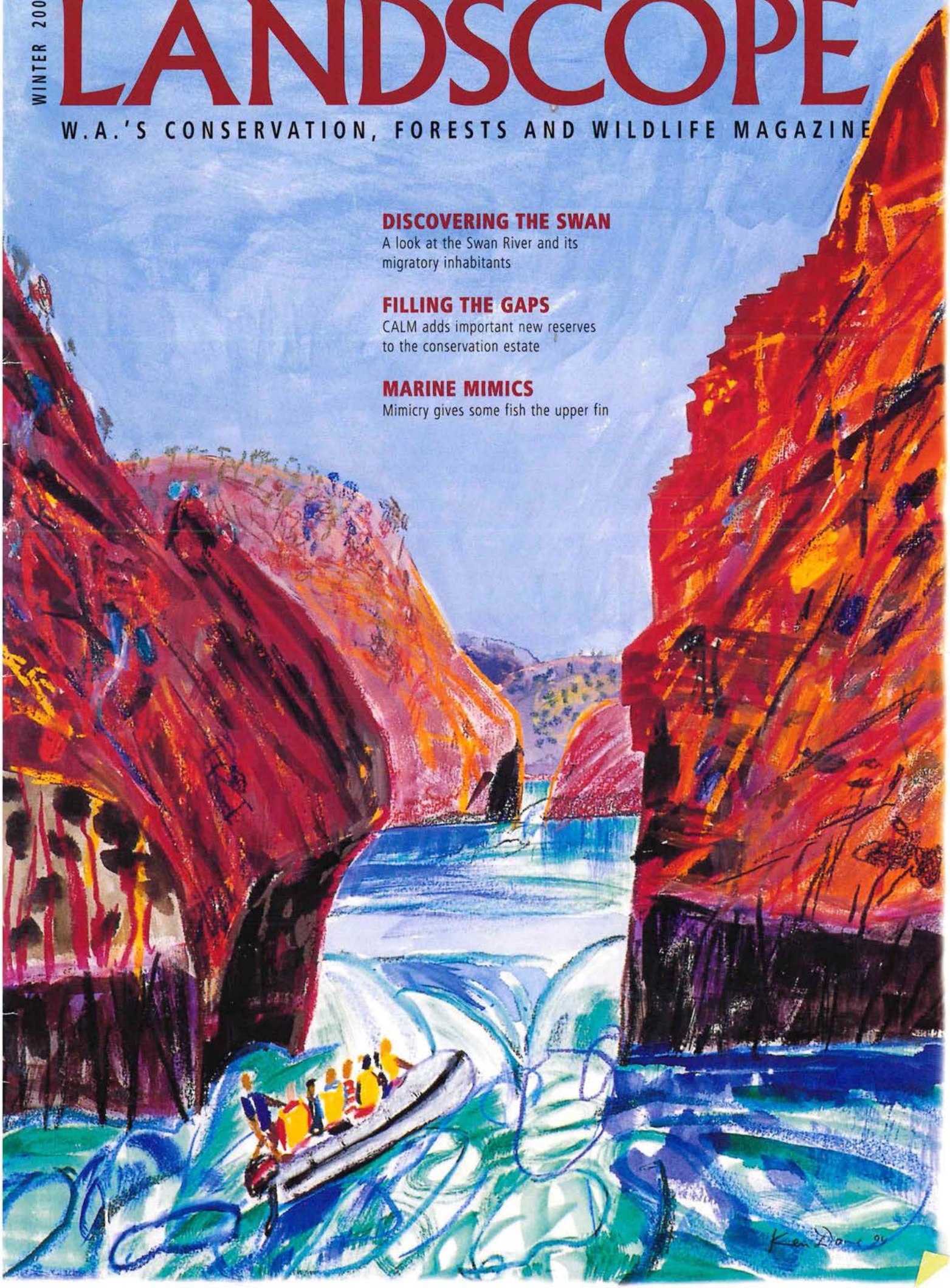
LANDSCOPE

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

DISCOVERING THE SWAN
A look at the Swan River and its migratory inhabitants

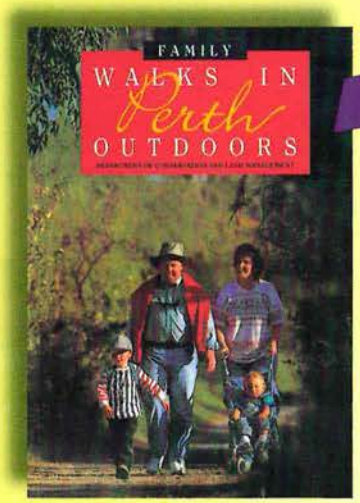
FILLING THE GAPS
CALM adds important new reserves to the conservation estate

MARINE MIMICS
Mimicry gives some fish the upper fin



Get out—and take the kids with you!

Stuck for an activity? We've got a great answer.
Choose from a range of handy books that tell you what to do and where to go, in and around Perth.
We've got dozens of walks in lovely surroundings. So get out of the house and take the kids with you.
And take the book!



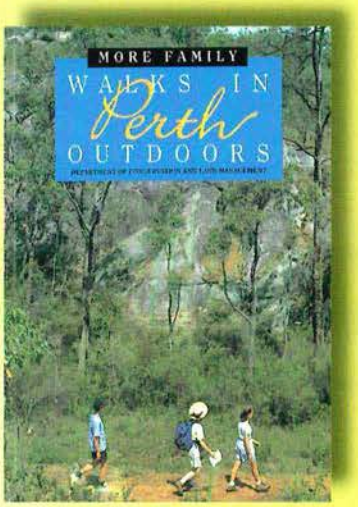
Revised!

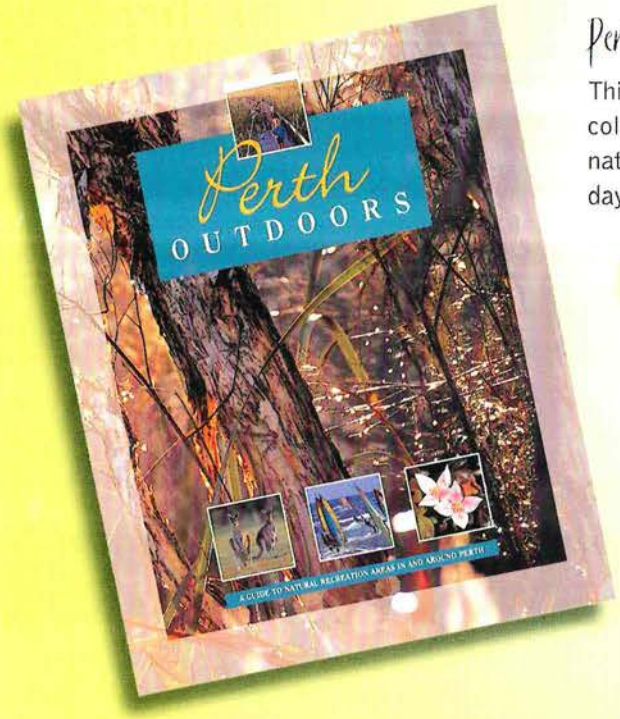
Family Walks in Perth Outdoors

More Family Walks in Perth Outdoors

Each little book describes 52 great walks in wonderful surroundings in and around Perth, often near picnic sites. Complete with brilliant mud maps facing simple, descriptive text. Easily fits in the glove box!

$16.95 each



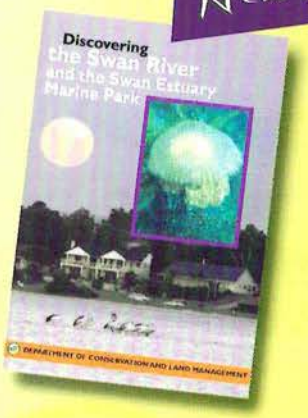


Perth Outdoors

This classic best-seller has 180 pages of full-colour photographs. It describes more than 300 natural recreation and walking areas within a day's return drive of Perth. Keep it in the car!

$21.95

New!



Discovering the Swan River and the Swan Estuary Marine Park

New! A pocket-sized lucky dip into the Swan River and its activities—swimming, diving, walking, etc. With photographs, maps, and descriptions of walks and dive sites!

$6.95 each

Other Discovering books available:

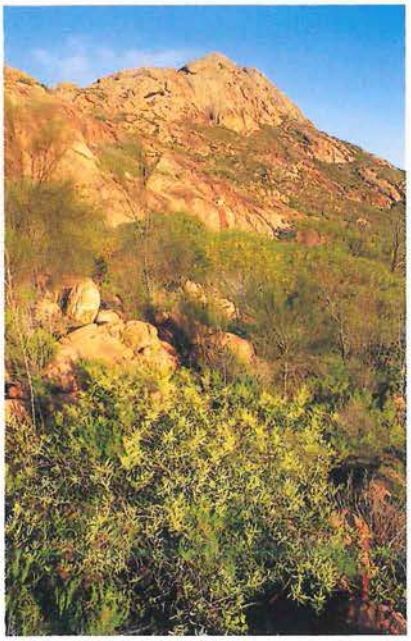
Penguin Island & the Shoalwater Islands Marine Park
Yanchep National Park
Shark Bay Marine Park and Monkey Mia
Nambung National Park
Valley of the Giants and Walpole-Nornalup National Park

CALM Publications
DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Locked Bag 29, Bentley Delivery Centre, WA 6983
Tel: (08) 9334 0333. Fax: (08) 9334 0498. TTY (hearing impaired) facility available (08) 9334 0546.
Order online at our award-winning web site NatureBase, http://www.calm.wa.gov.au

Winner of the 1998 Alex Harris Medal for excellence in science and environment reporting.

LANDSCOPE

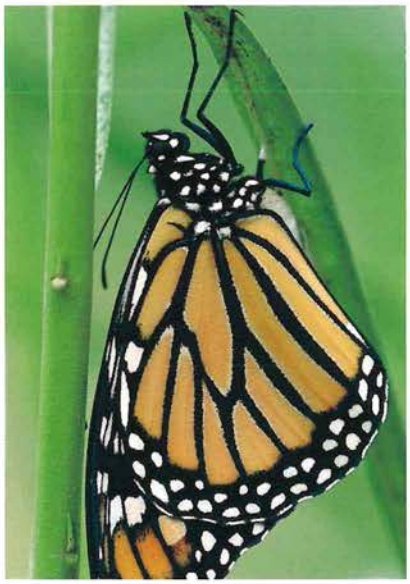
VOLUME FIFTEEN NUMBER 4, WINTER 2000



Peak Charles and Peak Eleanora, protected within Peak Charles National Park, form granite islands in a sea of bush. See page 10.

The Swan River is a recreation area for humans and a home for migratory birds. See page 16.

A partnership between State and Commonwealth goverments, and a group of pastoralists is helping to fill the gaps in the conservation estate. See page 43.



Butterflies have a short life span, but they bring pleasure to many people who visit Rottnest Island. See page 23.

Many marine creatures have evolved ingenious survival methods. See page 49.

FEATURES

GRANITE ISLANDS IN A SEA OF BUSH
PENNY HUSSEY.....10

DISCOVERING THE SWAN
CAROLYN THOMSON-DANS, PETER DANS & ANN STORRIE.....16

BUTTERFLIES ON ROTTNEST ISLAND
ANDREW WILLIAMS & ROBERT POWELL.....23

CRUISING THE WANDJINA COAST
CHRIS DONE.....28

MANAGING A FIERY CHANGE
RICK SNEEUWJAGT & NIGEL HIGGS.....37

FILLING THE GAPS
KEIRAN MCNAMARA, TONY BRANDIS & ANGAS HOPKINS.....43

MARINE MIMICS – FIENDISH FISH
ANN STORRIE.....49

REGULARS

BUSH TELEGRAPH.....4

ENDANGERED
ELEGANT SPIDER ORCHID.....36

URBAN ANTICS
TREE TOP MICE.....54

COVER

Well-known Australian artist Ken Done captures the colour and turbulence of the horizontal waterfalls on the Kimberley's Wandjina Coast.

Painting by Ken Done
Racing Tide, Kimberley Coast, May 1999
(51 x 36 cm) oil crayon and gouache on paper.

Executive Editor: Ron Kawalilak
Managing Editor: Ray Bailey
Editor: David Gough
Story Editors: Caris Bailey, Verna Costello, Carolyn Thomson-Dans
Scientific/technical advice: Andrew Burbidge, Ian Abbott, Neil Burrows, Paul Jones and staff of CALMScience Division
Design and production: Tiffany Aberin, Maria Duthie
Illustration: Gooitzen van der Meer
Marketing: Estelle de San Miguel ☎ (08) 9334 0296 Fax: (08) 9334 0498
Subscription enquiries: ☎ (08) 9334 0481 or (08) 9334 0437
Colour Separation by Colourbox Digital
Printed in Western Australia by Lamb Print

Please do not send unsolicited material to *LANDSCOPE*, but feel free to telephone the Editor.

Visit *LANDSCOPE* online on our award-winning Internet site NatureBase at http://www.calm.wa.gov.au

Published by
Department of Conservation and Land Management,
Dick Perry Avenue, Kensington, Western Australia

THE NEXT BEST THING TO BEING THERE

Now most of us would rather be visiting and experiencing WA's special places in person. But sometimes, for those of us more confined to the city, raising our families and earning a living, that is just not possible. Luckily, and in the words of my colleague and marketing guru David Chandler, there's always LANDSCOPE.

In this issue we take you from some of the most isolated and beautiful spots in the Kimberley through to a little known but biologically rich area along the south coast. With many stops of interest in between.

Somewhat off the beaten track, is little known Peak Charles National Park. In 'Granite Islands in a Sea of Bush', Land for Wildlife Coordinator Penny Hussey examines the species richness to be found around the granite outcrops that tower over the dry sandplain heaths and salt lake systems south-west of Norseman.

Closer to home for many, and less than 20 minutes drive from central Perth, the Swan River and its foreshores provide habitats for a variety of plants and animals, including the migratory wading birds that travel there from as far afield as Siberia. In 'Discovering the Swan', Carolyn Thomson-Dans, Peter Dans and Ann Storrie explore the conservation significance and recreational attractions of the river, the Swan Estuary Marine Park and its adjacent nature reserves.

In 'Cruising the Wandjina Coast', CALM's Kimberley Regional Manager Chris Done joins a small group of tourists, including internationally-known artist Ken Done (see cover and pages 28-29 and 35), on a trip through some of the natural attractions that make the Kimberley so special.

And in 'Filling the Gaps', Keiran McNamara, Tony Brandis and Angas Hopkins describe the results to date in a multi-million dollar program to develop a conservation reserve system in the Gascoyne-Murchison area, to protect the region's unique ecosystems and their associated biota.

For those of you wanting to sleep under the stars and get your hands dirty in the name of conservation, there are LANDSCOPE *Expeditions. Whether your interest is in working in the grandeur and remoteness of the Gibson Desert with plants and animals that few people ever see, exploring the Zuytdorp Coast north of Kalbarri, or assisting in the reintroduction of endangered species within the Shark Bay World Heritage Area, there is a unique experience waiting for you. There's still time to book your place to take part this year in field-based study and research projects in the outback—an area named as one the 10 most significant wild places in the world by* National Geographic *magazine's list of millennium must-sees.*

For your free copy of the LANDSCOPE Expeditions 2000 *brochure, call (08) 9380 2433 or fax (08) 9380 1066, or download a copy from CALM's award-winning NatureBase website at www.calm.wa.gov.au .*

Go bush with us in the cause of conservation.

Executive Editor

ARGYLE DIAMONDS . . .

If the more than 450 wallabies stranded on two islands in Lake Argyle in March could talk, they would probably agree.

Argyle Diamond Mine—the benevolent rescuer—financed helicopter reconnaissance, a boat charter to the islands and food pellets that saved the agile wallaby (*Macropus agilis*) population from starvation.

CALM's Kimberley Regional Manager Chris Done said the stranding was caused by the sustained and heavier-than-usual seasonal rains, courtesy of Cyclone Steve, which impacted heavily on the Kimberley.

"Lake Argyle, WA's largest man-made reservoir, reached a record level, some two metres higher than the previous highest in 1982–83," Mr Done said. "The rains flooded the wallabies' usual range, trapping them on higher ground, which became isolated islands. The adjacent lush pastures of Grass Castle Plain (from Mary Durack's book *Kings in Grass Castles*) were covered by two to three metres of water.

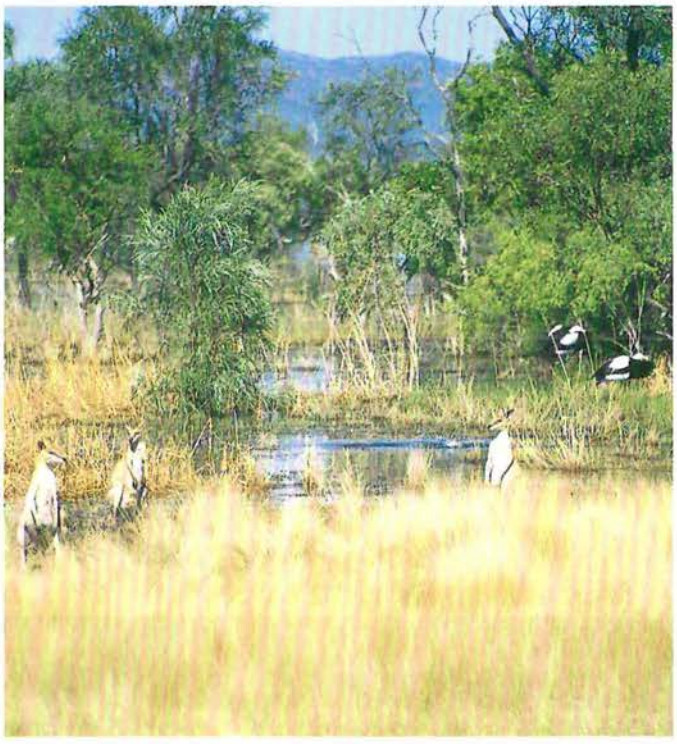
"Fortunately, there was plenty of roughage (mainly spinifex) on the newly created islands, and easterly winds had begun to blow ashore some ribbon-weed (an aquatic plant), which the wallabies seemed to find quite palatable.

"Although this was an animal welfare emergency, rather than a conservation issue, CALM picked up the challenge of organising food drops despite a lack of resources.

"It became obvious that a sponsor was required, so I approached the nearby Argyle Diamond Mine, which responded promptly

Below: *Agile wallabies and jabirus on Grass Castle Island.*

Photo – Chris Done/CALM



. . . ARE A WALLABY'S BEST FRIEND

by offering to fund the rescue."

Argyle environmental coordinator Jeff Waddington said the company was more than pleased to assist in the rescue.

"The big wet season had quite an effect on the Argyle mine, with a lot of road damage and the mine isolated for days at a time," Mr Waddington said. "We have a strong commitment to assisting the Kimberley community and the wallaby rescue was a great cause that complemented our ongoing environmental work."

Others involved in Argyle Diamond Mine's animal rescue were AGWEST (formerly Agriculture WA) District Veterinary Officer Tony Tully, who checked the nutritional value of the ribbon-weed, and provided advice on the wallabies' general condition.

Director of Lake Argyle Cruises, Steve Sharp, also kept a keen eye on the animals and continued providing information until their situation began to improve.

"Several food drops were made, but with the lake dropping about three to four centimetres a day, the islands began increasing in size, gradually revealing a small amount of new 'green pick', eagerly devoured by the animals," Mr Done said.

"Desperate circumstances can sometimes be alleviated by relatively simple actions. In this case, prompt action by Argyle Mines, AGWEST and CALM certainly made life much more comfortable for the Argyle agiles."

Above: *Euros stranded on a small island in the Pumpkin Islands group.*

Below left: *CALM's Brett Lewis (left) and Steve Sharp take a break from unloading 'roo pellets from the cruise boat* Silver Cobbler.

Photos – Chris Done/CALM

Below: *CALM's David Grosse (left) helps Chris Done rescue a euro.*

Photo – Gordon Graham/CALM

WALKING THE CAPES

Leeuwin-Naturaliste National Park is one of the most popular national parks outside the Perth metropolitan area, and is featured in a new book: *Walking the Capes: Twenty-One Walks in and around the Leeuwin-Naturaliste National Park*.

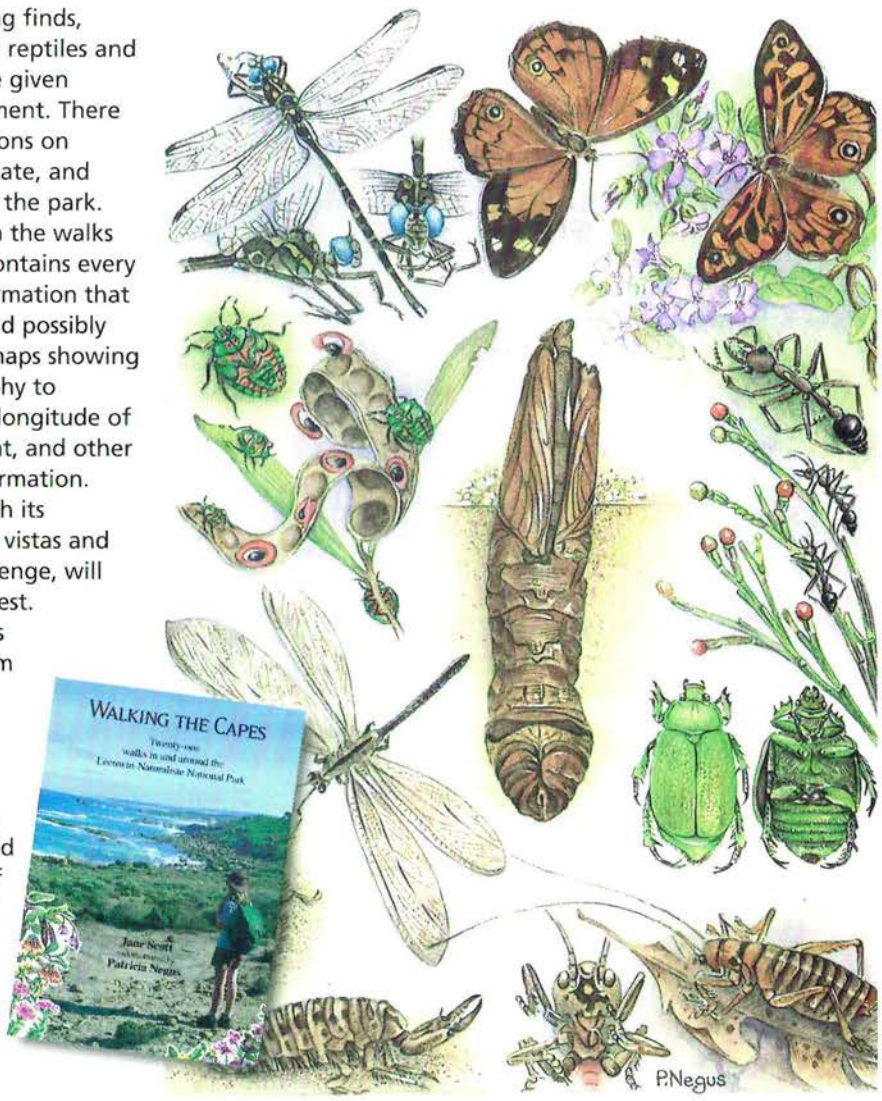
Walking the Capes has been written (and self-published) by Jane Scott, with illustrations by Patricia Negus. Colour photographs are by Jane Scott and the book also has brush and ink sketches by Lynne Tinley.

Despite its title, this book is very much more than just another walks book. It is extremely well researched and jam-packed with a huge amount of information on the plants, animals and natural features readers are likely to encounter. For instance, there are 31 pages with detailed notes and colour illustrations that can be used to identify most of the flora species that grow in the park, from beach colonisers to karri forest species.

Seaweeds, shells, beachcombing finds, insects, birds, reptiles and mammals are given similar treatment. There are also sections on geology, climate, and landforms of the park.

The text on the walks themselves contains every scrap of information that a walker could possibly want, from maps showing the topography to latitude and longitude of the start point, and other practical information. The park, with its breathtaking vistas and physical challenge, will provide the rest.

The book is available from CALM's *WA Naturally* information centre in Henry Street, Fremantle and a selection of camping and outdoor outlets.



CD HELPS NOISY SCRUB-BIRD RECOVERY PROGRAM

"There is sweet music here that softer falls Than petals from blown roses on the grass"

Alfred, Lord Tennyson's lines might well spring to mind when listening to

WA musician and composer Robert J Boyd's recently released CD *Australia—The South West—Images and Reflections*. It managed to relax this reviewer late in a day of solid concentration. By the end of the final track there was a feeling of being refreshed, even energised, rather than lulled into a dull-witted torpor.

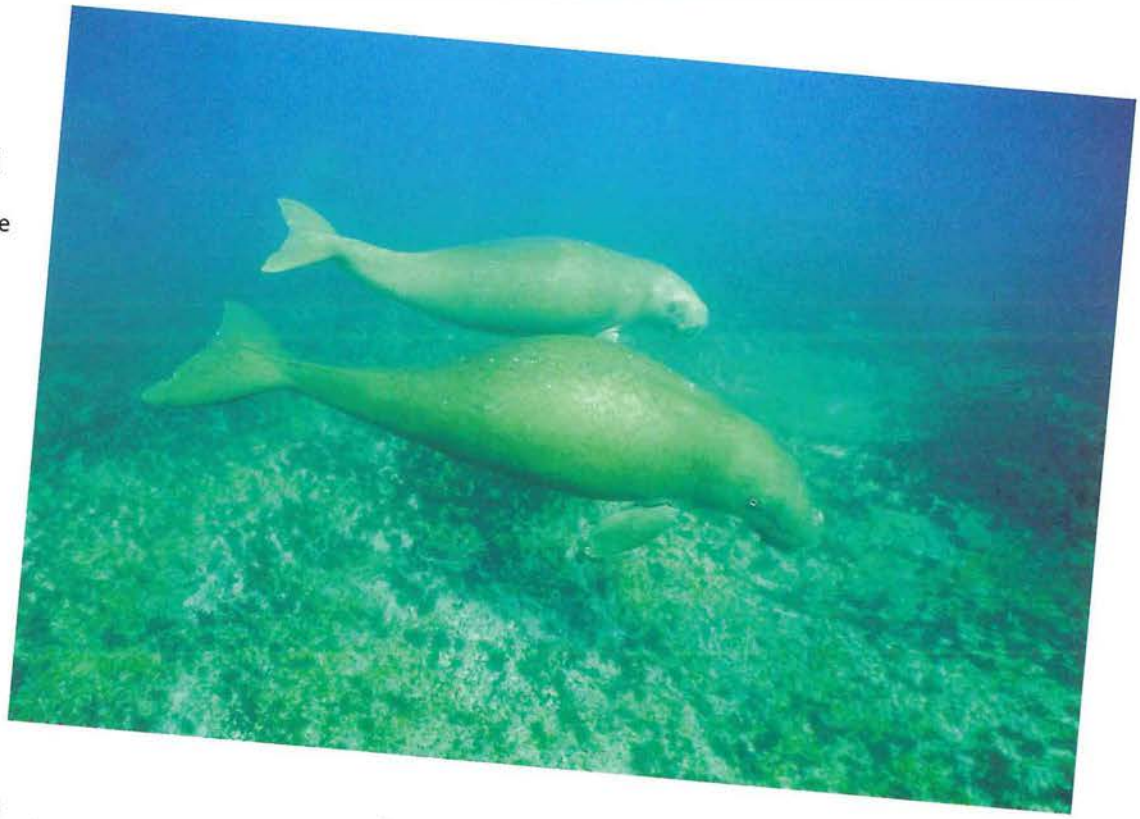
The secret seems to lie in the near-perfect balance between sounds of the bush and Robert's music, which (to quote from the booklet accompanying the CD)," is intuitively composed and recorded live".

The booklet also describes the sounds on each of the eight tracks. While birds feature strongly, they don't overwhelm, and other bush sounds accompany them. Wind, water (ocean waves and rushing river), rustling leaves, buzzing insects, croaking frogs are among them. And anyone wondering how the family dog sneaked into the CD player-equipped car can relax—it's probably the barking owl on track two!

The noisy scrub-bird features on track five, and is clearly a favourite of Robert, who kindly donates a proportion of the proceeds from sales of the CD towards CALM's Noisy Scrub-Bird Recovery Program.

The CD is available by phoning Robert's agent on (08) 9316 8122, or fax (08) 9321 8133 for information on outlets.

STUDYING DUGONG BEHAVIOUR AND HABITAT



Above: *Dugong mother with calf.*

Photo – Doug Perrine/Innerspace Visions

A special collaboration between CALM, the Yadgalah Aboriginal Corporation of Denham, Edith Cowan University and James Cook University has led to the first comprehensive study of the movement of dugongs in Western Australia.

In March this year, CALM Principal Marine Zoologist, Dr Nick Gales, led a pioneering project to track the movement of Shark Bay's unique dugongs, when ten satellite tags and dive dataloggers were deployed on the animals in the eastern part of Shark Bay.

"Dugongs are highly threatened throughout most of their range," Dr Gales said. "This includes east Africa, northern Indian Ocean, south-east Asia, south-west Pacific and parts of Australia. The Shark Bay population is an important stronghold for the species with more than 10,000 animals."

This shy, gentle marine herbivore, which features prominently in mythical sea legends, closely resembles a rotund dolphin or 'sea cow', and has been hunted in many parts of its range for thousands of years.

This, coupled with the depletion of sea grass meadows in some areas, and a low reproductive rate compared to most mammals, has led to a decline in the species over most of its range.

Dr Gales said that the innovative project arose from the need to understand dugong movements and identify their important habitats in order to ensure effective conservation management.

"Human activities such as tourism, aquaculture and exploration can then be better managed to ensure any impacts on dugongs are miminised," he said.

"Unlike previous surveys, this study includes the direct involvement and insights of the local Aboriginal group—a key factor in the project's success. Their involvement not only provides invaluable information and advice on the history of the species in the Shark Bay area, but also facilitates greater involvement by them in conservation management.

"We have learnt together how to safely capture and handle these unique creatures, and I believe we have developed a mutual respect for each other's contributions to this study. It is hoped that this will lead to greater Aboriginal involvement in marine conservation issues in Shark Bay."

Dr Gales said the study would involve a small team of scientists and researchers from CALM, ECU and JCU, as well as members of the Yadgalah Aboriginal Corporation.

"To track the dugongs successfully, the animals are first caught in shallow water from small boats," he said.

"A specially designed floating Geographic Positioning System (GPS) satellite tag is then attached to the dugong via a tether.

"The GPS tag records the position, water temperature and the dugong's diving activity, and stores these data until the tag is released from the dugong some time later (via a special VHF radio-activated electronic link), and retrieved.

"A pilot project for the study was successfully conducted in September 1999, during which the group learnt how to safely capture and handle these large animals. It also provided a means to test the new equipment and the release mechanisms, especially the satellite tags that were built specifically for this dugong study. The tracking has continued each day and has shown that, so far, the dugongs have stayed in the same general area, probably moving with the tides onto different feeding areas.

"We aim to retrieve the tags later in the year, when we'll be able to analyse all the location and diving information. The tags will then be used immediately on new animals to continue with the tracking study."

CHILDREN'S ART DECORATES MARINE POSTERS

Department of Conservation and Land Management Marine Conservation Branch Community Liaison Officers, Sue Osborne and Lauren Monks, have been developing educational material for two proposed marine conservation reserves in the Montebello-Barrow Islands region, and the Dampier Archipelago to Cape Preston region.

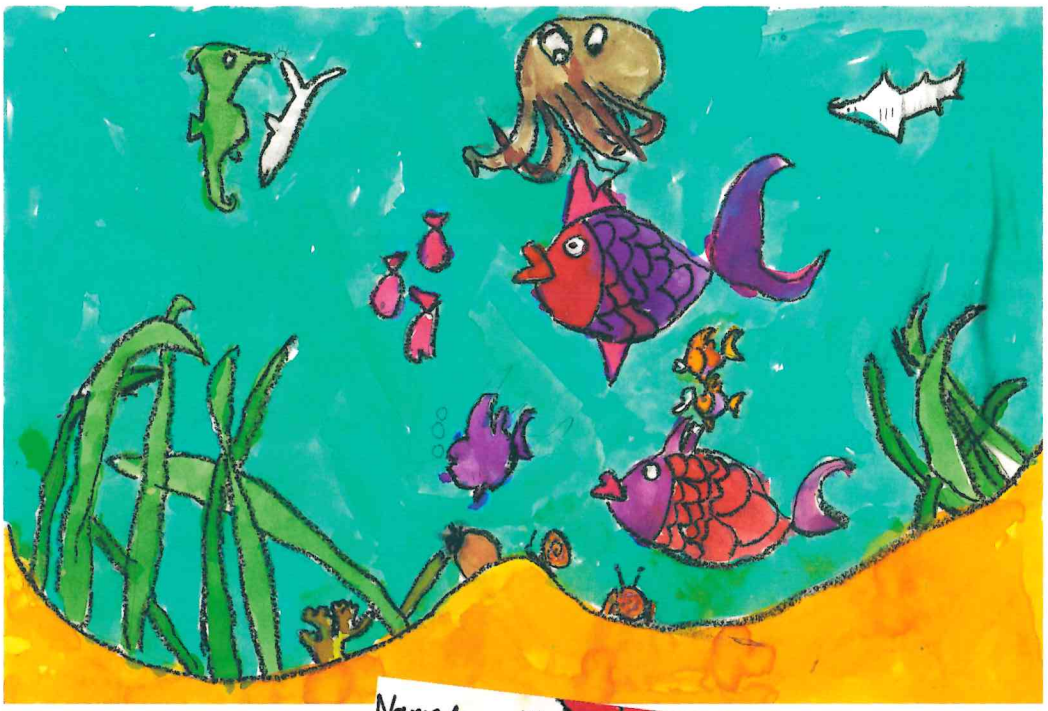
The educational material ranges from large booklets on the ecological, cultural and socio-economic setting of the regions, to brochures and posters on the study areas.

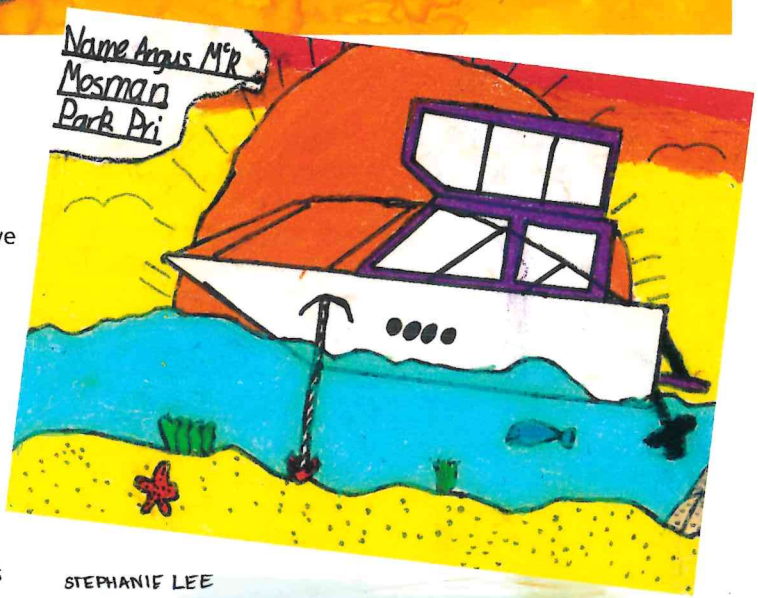
Using images and few words, posters can be an excellent educational tool. When they are bright and eye-catching, they arouse curiosity and can quickly pass on a great deal of information.

In a break with past practices, children's paintings are being used in a series of posters aimed at making people aware that the marine environment is used for many purposes, and that one use is seldom more important than any other.

The posters shown here are among the many designed to illustrate the different uses and attributes of the region, such as recreational and commercial uses, as well as cultural heritage, natural heritage and science and educational values. Most of these uses and values depend on the maintenance of a healthy marine environment.

The paintings have been contributed by years 1 to 7 pupils at Dampier, Roebourne, Mosman Park, Melville, North Beach and Roleystone Primary Schools.





STEPHANIE LEE

Each colourful painting depicts a child's wonderful perspective of the marine environment.

It is important when a marine conservation reserve is proposed, that the local community is encouraged to develop a sense of ownership and stewardship for the area. This is facilitated by that community becoming involved in the planning and development of the reserve, via community-based advisory committees such as public workshops and other avenues.

The use of children's art shows that some very important members of the community—the children—have also been involved in the process. They are this nation's future and it is vital that their interest in marine conservation is developed from an early age.

Some of the colourful art created by primary school students.

RARE TRIGGERPLANT FOUND IN RESERVE

A new population of one of the State's rare native plants has been found in a nature reserve near Wongan Hills.

The find is the sixth known population of the Wongan Hills triggerplant (*Stylidium coroniforme*), and is particularly significant as it is the first population to be recorded on a nature reserve.

Merredin District Manager Paul Roberts said that the discovery occurred during surveys in the Wongan Hills with volunteer members of the Toodyay Naturalists Club.

"The discovery of this new population of about 65 plants was verified by triggerplant expert Mr Allen Lowrie," Mr Roberts said.

Other populations are among remnant vegetation in a paddock next to the reserve and in a nearby gravel pit. Two populations have been recorded on railway and road reserves at Maya, 140 kilometres to the north.

The triggerplant is a small perennial herb with thumbnail-sized, cream 'butterfly' flowers. It is ranked as endangered under World Conservation Union (IUCN) guidelines, and declared as rare flora under Western Australia's Wildlife Conservation Act.

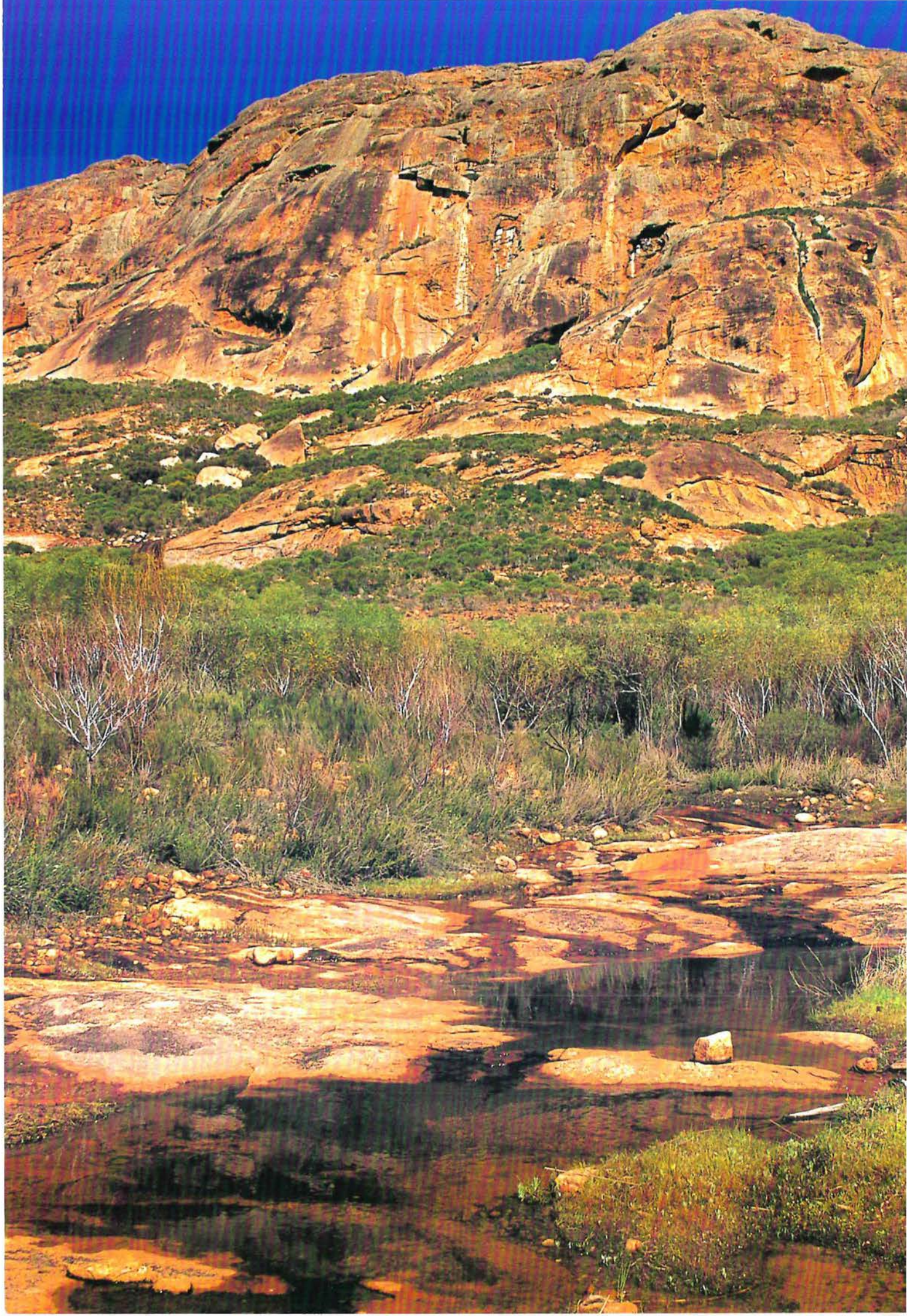
CALM's Merredin District has 23 native plant species listed as 'critically endangered', 17 listed as 'endangered' and a further 12 are listed as 'vulnerable'. A district threatened flora recovery program was begun in 1994 to help conserve these species.

Wongan Hills triggerplant.

Photo – Mike Fitzgerald/CALM

The Wongan Hills triggerplant faces a number of threats, including grazing by sheep, gravel extraction and roadworks. CALM staff, who have been working on a number of recovery actions over the past few years, wrote a recovery plan for the species. The recovery actions include helping landowners fence off populations, and collecting seed for storage in CALM's Threatened Flora Seed Centre.

CALM is integrating further strategies such as Land for Wildlife and projects under the Natural Heritage Trust's Endangered Species and Bushcare programs, which work with landowners and local community groups to conserve areas containing threatened flora and fauna species.



Granite Islands in a Sea of Bush

Peak Charles, an ancient peak, and its companion, Peak Eleanora, have weathered to various orange and brown hues, creating many unusual rock formations. Protected in Peak Charles National Park, they form granite islands in a sea of bush. A climb to the top of Peak Charles will reveal most of the features characteristic of Western Australian rock outcrops.

by Penny Hussey

Somewhat off the beaten track, about 100 kilometres south-west of Norseman, is the little known Peak Charles National Park. This park of about 40,000 hectares protects two interesting granite summits, Peak Charles and Peak Eleanora. Towering 500 metres above the surrounding plain, Peak Charles is visible for more than 50 kilometres in all directions. From the Peak Charles lookout, a two-kilometre climb, there are sweeping views over the surrounding dry sandplain heaths and salt lake systems, and the view from the top reinforces the feeling of being on an island.

Granite is the very stuff of which continents are made, and a huge and ancient chunk of granite, the Yilgarn Block, forms the basic underlying material of most of south-western Australia. Formed between two and three billion years ago, it has worn down over this almost unimaginable time into a gently undulating landscape. Granite tends to decompose quite deeply, so is often covered by a deep layer of weathered material, the topmost of which is soil. Sometimes, however, this material has been stripped away, or the rock is of a harder composition and so has not decomposed quite as fast as elsewhere, and the granite bedrock is visible at the land surface. These rock outcrops are a familiar feature of the south-west.

Previous page
Main: Peak Charles.
Photo – Chris Garnett
Inset: Ornate dragon (*Ctenophorus ornatus*).
Photo – Jiri Lochman

Below: Peak Charles viewed from the north.
Photo – Chris Garnett

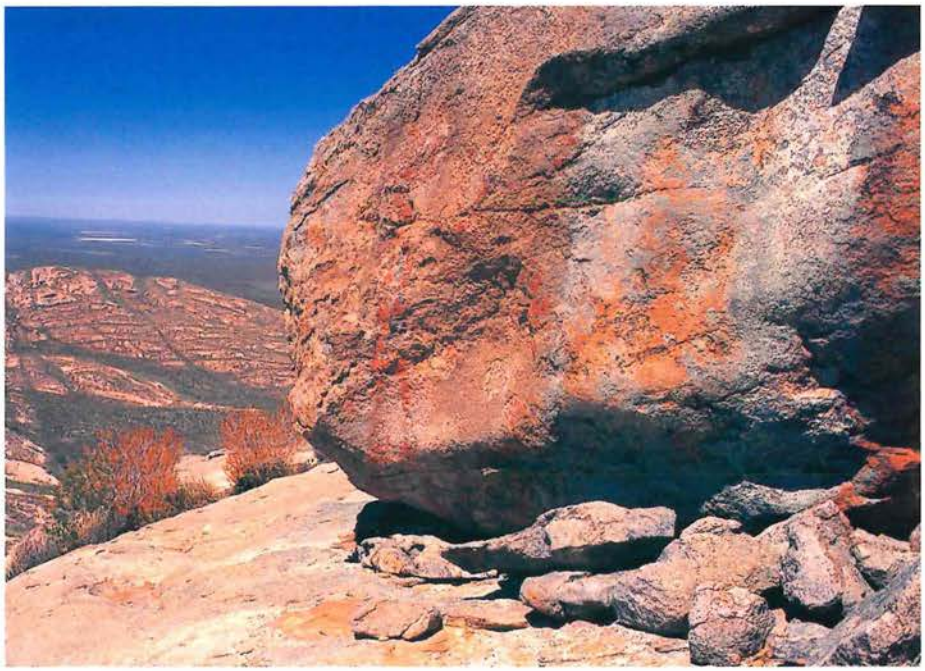
The shape and extent of the exposed rock varies. Sometimes only a flat sheet is visible, no higher than the surrounding soil. In other places, a mound of tumbled boulders marks the site. However, because of the rock's crystalline structure, most granite outcrops in Western Australia are basically dome-shaped. When these are large they are called inselbergs, and Peak Charles is an outstanding example. Just as mariners use islands to help them navigate, Peak Charles provides a guide for the traveller to steer by. And when you consider the plants and animals associated with them, granite outcrops have even greater analogies with islands, for they harbour living communities not found in the surrounding areas.

WATER COLLECTION

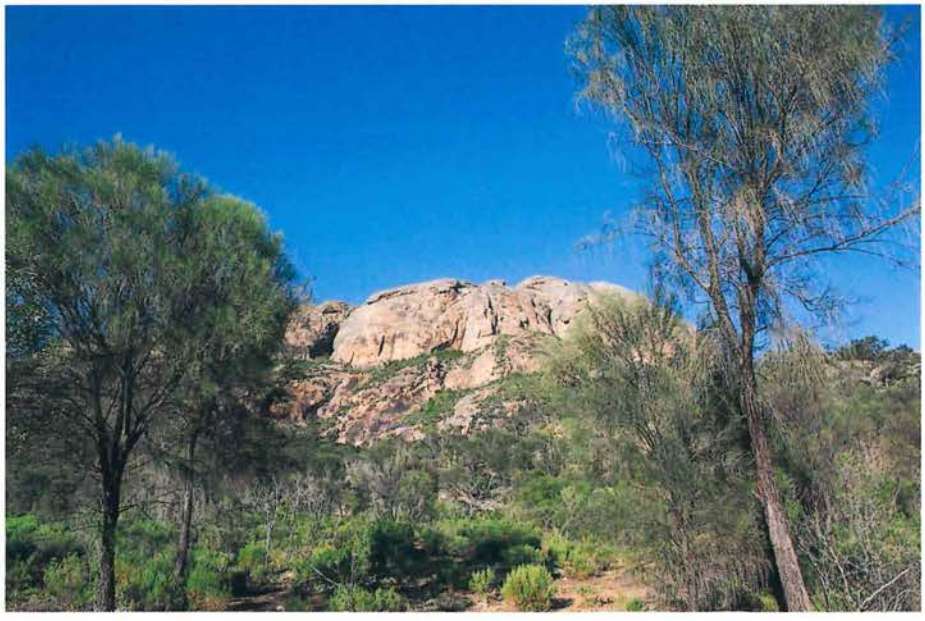
The most important characteristic of granite islands, in comparison with the bushland around them, is that they have water. In a dry land, this is of immense value. Water brings the rock to life. When rain falls on bare rock, it runs off, filling depressions to form pools, forming streams and eventually soaking into the surrounding soil. This concentration of water permits the survival of plants and animals that would not otherwise be able to live in the area.

The first evidence of the value of water is near the base of the rock, where an apron of brown, gritty soil has built up. Although shallow, it is well watered from run-off, and supports a dense community of trees and shrubs. These contain many of the same species as the surrounding plain, yet they grow more luxuriantly, produce more flowers and set more seed. Thus, with both food and shelter, the area provides good habitat for animals, especially small birds. This apron was a favourite feeding location for rock-wallabies which, unfortunately, no longer occur at Peak Charles, probably because of predation by foxes. The rock-wallabies browsed on tree and shrub seedlings, so the density of vegetation may have increased since their local extinction.

Right: Climbing Peak Charles with Peak Eleanora in the distance.
Photo – Graeme Rundle



Centre right: This granite feature on Peak Charles is known as painted rock.
Photo – Rob Olver



Below right: Rock sheoak (*Allocasuarina huegeliana*) and other dense vegetation grow around the base of the rock.
Photo – Marie Lochman

THE ROCK ITSELF

Once you start to climb onto the granite itself, the nature of the rock can be seen. The exposed surface is often ridged and uneven, because the various minerals of which it is made decompose at different rates. In places, the granite is seamed by veins of quartz-rich rock, which are harder than the surrounding matrix and so stand out as long ridges. Where the minerals are softer than their surrounds, they form furrows, often becoming channels for water to move across the surface. As the minerals decompose, they become the basis of soil, filling the crevices and hollows, accumulating under boulders and building up the soil apron.

As the rock surface heats by day and cools by night, it expands and contracts, eventually breaking up into sheets and slabs. Where the granite is well-jointed, it erodes into boulders with a rounded shape. Erosion at their base may lead to precarious-looking balancing rocks. Sometimes a catastrophic event will cause rapid erosion, and at Peak Charles there is abundant evidence of this. In the summer of 1991, a massive bushfire raged through the whole area, and where shrubs and debris at the junction of the rock and the apron burnt fiercely, the heat was sufficient to crack off huge sheets of rock, exploding them outwards.

These rock sheets and boulders form excellent habitat for animals, providing shelter from the extremes of weather and refuge from predators. On warm days, dragon lizards can often be seen on the bare rock, but if disturbed they race to safety under a slab. Smaller hollows shelter millipedes or spiders, and larger ones provide sites for creatures such as echidnas and carpet

pythons. In the past, stick-nest rats lived here, and the gooey black remains of their nests can still be found jammed under rock overhangs.

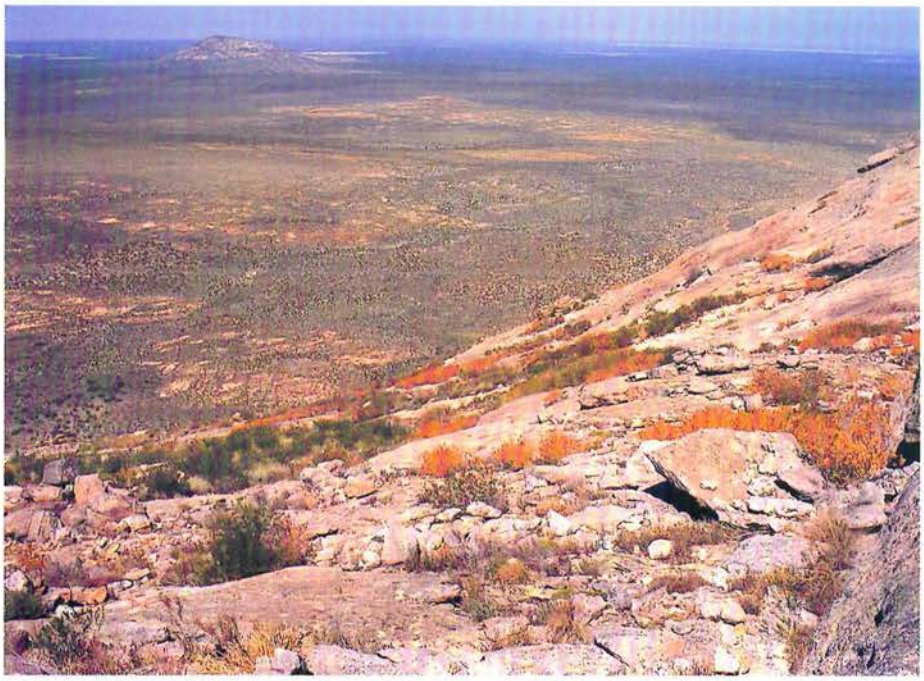
LIVING ROCKS

If you look closely, you will see that the apparently bare rock itself supports many species of lichens and algae, which give a black, grey, green or even orange colour to the surface. The acids they produce help to decompose the rock and, when they die, their tissues contribute humus, and especially nitrogen, to the soil. At Peak Charles there are several well-developed 'wave rock' features, where the granite has eroded into the shape of a breaking wave, accentuated by streaks of black algae.

Rock holes that fill with water after rain are called 'gnammas' by Aboriginal people, and were once vitally important to their nomadic lifestyle. These rock pools may be wide and shallow, or narrow and deep, and both may be seen at Peak Charles, although none is specifically marked. The wide, shallow pools dry out quickly, so the plants and animals found in them need to get through their life cycles very fast, and then be able to survive the hot baking temperatures of the long, dry summer. Deeper rock pools, as well as soaks dug out around the base of the rock, provided water for larger animals.

If these pools have a layer of gritty soil on the floor, they support specialised bog plants, including mudmats (*Glossostigma* species), whose tiny flowers may look like a lilac film across the drying surface of the mud at the start of summer. Quillwort (*Isoetes* species), a relative of the ferns, forms tiny, bright green, submerged tufts, and survives the summer as spores within the dry mud. Many small aquatic invertebrates also survive as drought-resistant eggs buried in the mud, and these 'water fleas' can be seen darting around the pools in cooler weather.

Where a depression allows soil and litter to accumulate, a moss sward develops. Such swards often appear to die in summer, but revive once rain falls. A large variety of tiny flowering plants lives in them, surviving the summer by dying back to tubers, such as orchids, or regenerating from seeds, like tiny triggerplants and daisies. The plants in flower in these swards change as the season advances. In winter, tiny sedges and the white-petalled early nancy (*Wurmbea dioica*) may be flowering, then come numerous small daisies and blue beard orchids, followed by pink triggerplants (*Stylidium* species) and native grasses. Swards with soil a few centimetres deep are often dominated by pincushions (*Borya* species), which are able to endure the dry summer because they can function with as little as two per cent water in their leaves. During this period they turn bright orange, greening up again with the rains, so they are sometimes called 'resurrection plants'.



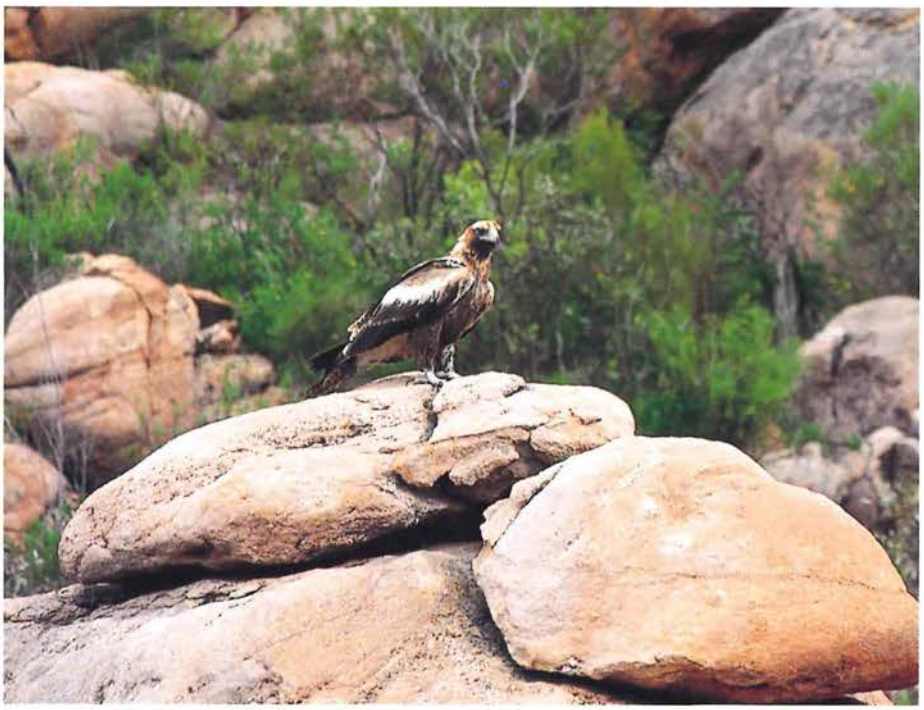
Top left: A fern and a parakeelya take advantage of a moist fissure.
Photo – Chris Garnett

Above left: The tuberous bottlebrush (*Calothamnus tuberosus*) grows in rock fissures on Peak Charles.
Photo – Penny Hussey/CALM

Left: Pincushions, or resurrection plants, turn bright orange in summer, but green up again with the rains.
Photo – Rob Olver

Right: The gnarled stems of natural bonsai that have formed at the summit of Peak Charles testify to their great age.

Below right: Wedge-tailed eagles are often seen at Peak Charles National Park, usually circling high in the sky.
Photos – Chris Garnett



Soil and water also collect in the fissures, and shrubs may grow there, their roots helping to prise the rock apart. Their gnarled, twisted stems testify to their slow growth and great age. This is a difficult habitat for plants, as they are exposed to all the extremes of drying wind and baking heat, so many have special features, such as needle-shaped leaves, to minimise water loss. The tuberous bottlebrush (*Calothamnus tuberosus*), which grows in such fissures at Peak Charles and a few other rock islands in the same general area, is most unusual in that it has fleshy, water-storing roots, a very uncommon feature among Australian flora. It flowers during spring and summer and, like other plants with red flowers, is pollinated by birds.

The combination of water and flowering plants brings numerous birds to these granite islands. Perhaps the most obvious are the raptors, using lift from the rock to spiral upwards and gain height. Often, several pairs of majestic wedge-tailed eagles can be observed, circling high in the sky. The thickets, woodlands and flowering scrub surrounding Peak Charles provide habitat for more than 40 species of small birds. An early morning walk around the apron, out onto the plain and back by the track, can be very rewarding. Wildflower enthusiasts should allow plenty of time to ramble among each different vegetation type along the track in. Have your camera at the ready!

Penny Hussey works for CALM as Coordinator of the Land for Wildlife program. She can be contacted on (08) 9334 0530.

Discovering the Swan

Perth's Swan River is a recreational playground, attracting walkers, divers, windsurfers, picnickers, fishers and boaters. A new pocket-sized, full-colour book, *Discovering the Swan River and the Swan Estuary Marine Park*, is an excellent guide to many of its attractions, while a new management plan provides a blueprint for the conservation of the marine park and its adjacent nature reserves for years to come.

BY CAROLYN THOMSON-DANS, PETER DANS AND ANN STORRIE

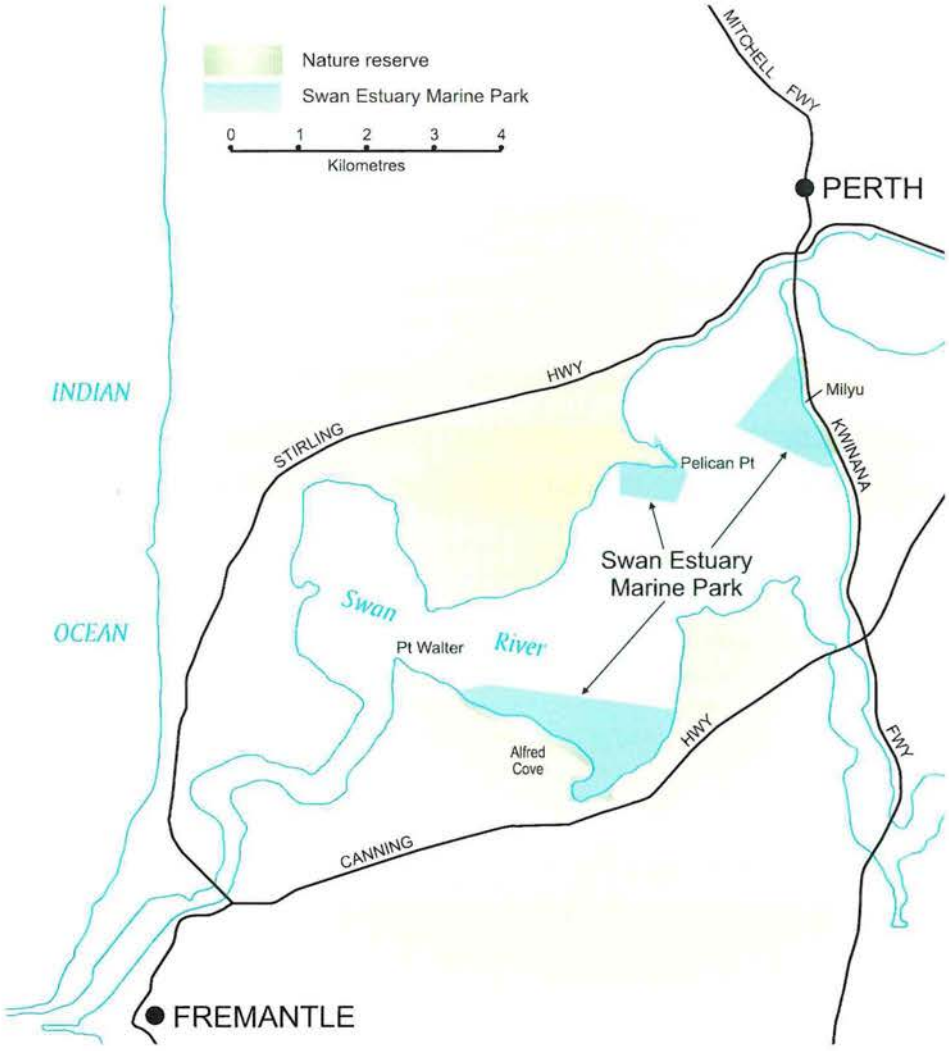
The Swan River and its foreshores provide habitats for a large variety of plants and animals. Today, the river is a highly altered environment with relatively little of its original fringing vegetation left. However, three important reserves collectively form the Swan Estuary Marine Park. The park is made up of 190 hectares at Alfred Cove, adjacent to Attadale and Applecross; a 40 hectare area at Pelican Point in Crawley; and 95 hectares at Milyu, adjacent to the Como foreshore and Kwinana Freeway. These areas remain a haven for wildlife, especially the migratory wading birds that travel there from as far afield as Siberia.

At Alfred Cove there are a number of vantage points for viewing more than 140 species of flying visitors and residents. The semi-enclosed waters hide shell deposits dating back 6,000 years, as well as living shellfish sought after by the 33 species of wading birds. The seagrass beds adjacent to the mudflats support many of the animals on which waders depend for food, and they are an important nursery area for fish and prawns. As well as the migratory waders, Alfred Cove is a happy hunting ground for ibises, egrets and other waterbirds.

At Pelican Point, you can see the birds and vegetation from an observation platform reached from Australia II Drive.

Milyu is the Aboriginal name for samphire, and the main physical feature of the reserve is a small peninsula vegetated with sedges and samphire. Despite its proximity to the freeway, this area provides excellent feeding and resting areas for waders and other waterbirds. They can be seen from the beach or from the foreshore path. You can almost always see Australian pelicans at this day roost site.

All three reserves lie within 20 minutes drive from central Perth. Depending on which area you are visiting, you can drive to the nearest car park and walk to the foreshore. Birdwatching is popular and there are heavily used dual use paths (for the shared use of pedestrians and cyclists) along the scenic river foreshore. There are also information panels at the Milyu Nature Reserve, which is cared for by children from South Perth Primary School.



MIGRATORY WADERS

Up to 10,000 migratory wading birds visit the Swan Estuary Marine Park each summer, coming from as far afield as Mongolia and Siberia.

Previous page
Main: Aboriginal people once camped, fished and hunted along the Swan River.
Photo – Rob Olver
Inset: The greenshank, one of 33 species of migratory wader protected under international treaties, uses the Swan Estuary Marine Park during the Australian summer.
Photo – Bill Belson/Lochman Transparencies

Above: Alfred Cove attracts the largest number of migratory waders of any site in the Swan River.
Photo – Jon Green/CALM

Thirty-three species of wader are protected under international treaties, which bind signatory nations to protect the birds and their habitat in all the countries through which they pass.

Most migratory waders congregate in flocks, jabbing their bills into shallow flats to obtain worms, snails, insects and minute crustaceans. The estuarine mudflats protected in the marine park contain high concentrations of food that replenish the energy of the exhausted birds after their long flight south. The birds move between the intertidal flats of the three areas in the marine park according to where feeding and roosting sites are available.

Different species arrive at varying times between August and November. Some of the birds sport their breeding plumage when they arrive. Others will moult to their breeding glory in February. Most waders will have left the Perth region by late March.

The red-necked stint (*Calidris ruficollis*) is one of the most abundant transequatorial waders. In some places elsewhere in Australia it arrives in tens of thousands. Despite its unprepossessing appearance, the red-necked stint is a remarkable bird. These tiny creatures, just 15 centimetres long and weighing only 30 to 40 grams, migrate from their breeding grounds in north-eastern Siberia and Alaska to spend summer in feeding grounds in Australia and south-east Asia. Their journey takes them through Mongolia, China and Japan. In March and April each year the majority will return to Siberia for the northern summer. The younger birds will often remain behind.

Other migratory waders that feed and roost in the Swan Estuary Marine Park include the bar-tailed godwit, whimbrel, grey plover, greenshank, common sandpiper, sharp-tailed sandpiper, red knot and curlew sandpiper.

Top: The tiny red-necked stint is the most common migratory wader seen in the Swan Estuary Marine Park.
Photo – Babs & Bert Wells/CALM

Above: You can almost always see Australian pelicans at Milyu (South Perth) in the Swan Estuary Marine Park.
Photo – Jiri Lochman

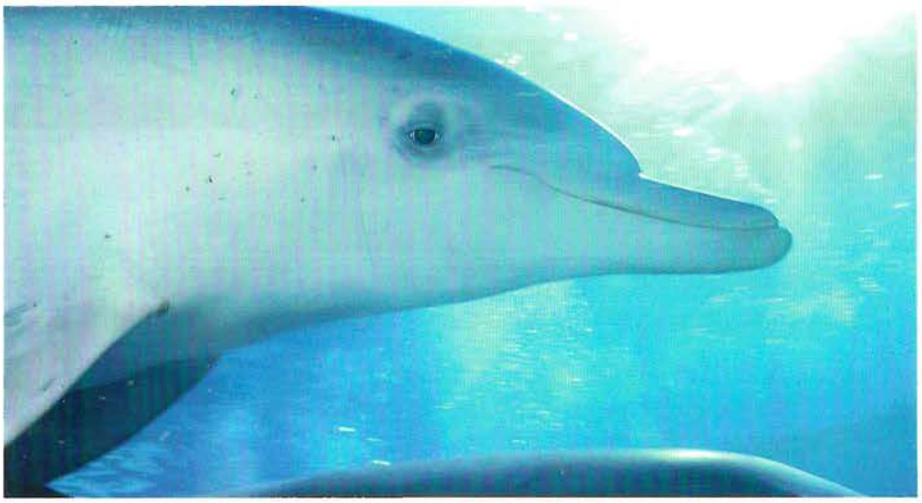
NEW MANAGEMENT PLAN

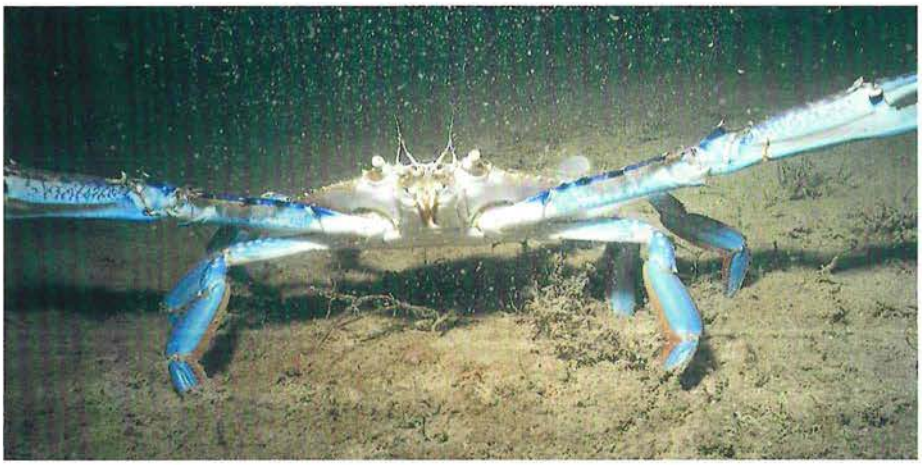
A management plan has just been released for the Swan Estuary Marine Park and its adjacent nature reserves. The plan was prepared by the Department of Conservation and Land Management (CALM), who are the park managers, on behalf of the National Parks and Nature Conservation Authority (NPNCA) and the Marine Parks and Reserves Authority (MRPA). It lays out a management strategy for the next 10 years.

The plan proposes the construction of a boardwalk for wildlife observation near Point Waylen looking back into Alfred Cove, with views of waterbird feeding and resting areas. The plan also advocates extending existing fencing to enclose Alfred Cove and Point Waylen and hence protect its wildlife from feral animals and indiscriminate use. A self-closing gate would allow access to the boardwalk.

In the past, the nature reserves adjacent to the three marine park localities have been greatly altered by weeds and excess landfill. The management plan puts forward a vision of restoring the original landscape and vegetation associations as much as possible, using historical photographs for inspiration. It is planned to re-establish native species, including flooded gum (*Eucalyptus rudis*) and salt sheoak (*Casuarina obesa*) in areas where they once occurred, while removing weeds, other introduced species and excess landfill.

The most significant threat to the values of the reserve system is disturbance of the waders and waterbirds. The plan proposes several strategies to address this issue and some have already been implemented. For instance, jet skis are now prohibited from the waters of the marine park and





CALM has sought the support of the Department of Transport to restrict the speeds of all powered vessels to eight knots. Additionally, powered and remote controlled vessels will not be permitted in the special purpose (wildlife conservation) zone of the marine park. These measures will dramatically reduce both vessel noise and wash, which are significant forms of disturbance.

Disturbance from pets has been recognised and new strategies are proposed for the whole reserve system. Creating an awareness of the impacts that uncontrolled pets can have on reserve values is paramount. Dogs are not permitted in nature reserves in Western Australia, however, this arrangement has not been well understood or enforced in the reserve system. Dogs exercising off leads can present significant disturbance to feeding waders and waterbirds. If feeding is disturbed to a large extent the birds may not be able to satisfy their energy requirements, which may contribute to a decline in numbers. The City of South Perth has implemented very workable local laws to minimise disturbance by dogs at Milyu, and CALM is currently working with the City of Melville to implement similar arrangements to minimise disturbance at Alfred Cove.

The management plan also highlights the need to fully explore the impacts that recreational prawning may have on reserve values. There is some evidence that the activity may trample and otherwise disturb the small crustaceans, worms and the like that are the main food source for waders. The plan proposes a research or monitoring program to fully investigate this possibility. One aspect of recreational prawning that can certainly impact on the birds is the dumping of by-catch at the water's edge. This smelly practice attracts feral cats and foxes. Public education is required to reduce the impact of these activities on the conservation values of the reserve system. For instance, returning the waste to the water (below the low water mark) and the use of bins will reduce the impact of prawning activities.

Fortunately, many other recreational uses of the Swan River have been found to have little, if any, impact on the environment. They include sailing, line fishing, walking along the foreshore, windsurfing and diving. It is these activities which are the main focus of CALM's new pocket-sized book, *Discovering the Swan River and the Swan Estuary Marine Park*.

UNDERWATER WORLD

Divers in Western Australia are lucky to be able to scuba dive in a river that runs through a capital city. Many rivers and estuaries elsewhere in the world are so badly polluted, and so overcrowded with boat traffic, that

Top: Bottlenose dolphins often thrill onlookers in the Swan River estuary, when they swim close to shore.

Above: Blue manna crabs are common in all estuaries of south-western Australia.

Left: The Western Australian seahorse is a diver's delight and is common in many areas of the Swan River.
Photos – Ann Storrie

scuba diving, snorkelling and swimming would not be considered. The Swan River, however, is still relatively clean, and the estuarine marine life is exceptional. Seagrasses, anemones, tubeworms, colourful nudibranchs, octopuses, blue manna crabs, decorator crabs, prawns, catfish, gobies and bottlenose dolphins are all common inhabitants of the river.

Many dive schools use sites in the river for teaching, not just beginners, but also students doing commercial dive courses. No matter what the weather conditions, there will be no swell or severe chop on the river foreshore. Sometimes if the tide is flowing, you may have to be careful of a current out from the bank. Check at the river's edge before swimming out too far. *Discovering the Swan River and the Swan Estuary Marine Park* has photographs and information that will help divers find and identify many plants and animals that live in the river, including the Western Australian seahorse. It also has maps and descriptions of excellent dive sites at The Coombs in Mosman Park and Harvey Beach in North Fremantle.

WINDSURFING

The Swan River provides boardsailors with varying styles and skill levels with a wide range of sailing opportunities. In effect, the whole river (limited only by water depth, boating traffic and clear wind) is available to boardsailors, however, you cannot launch directly into some areas and must sail your board to some locations to experience the conditions that they offer.

Above: The limestone cliffs at Blackwall Reach were spared from quarrying, unlike may other sites on the Swan River foreshore.
Photo – Rob Olver

Right: The Swan River has some interesting, protected dive sites, which provide subjects for macro underwater photography.
Photo – Ann Storrie

Melville Beach Road, on the foreshore at Applecross, is perhaps the best year round location for boardsailing on the river. There are extensive grassy rigging areas along almost the entire length of Melville Beach Road and easy launching into shallow near-shore waters. These shallow waters are ideal for learning high performance manoeuvres such as water starts and high speed gybes. Should sailors fall, they can usually stand on the bottom and reorientate themselves. The orientation of Melville Beach Road makes it suitable for high performance sailing in any winds between the north (through the west) to the south. Beginners will find the location ideal in any wind direction as long as the strength is less than ten knots.

Another popular summer spot for both advanced and beginner boardsailors is Pelican Point. The shallow near-shore waters of Pelican Point offer similar benefits to Melville Beach Road with the addition of onshore showers, toilets and a mobile snack facility.

WALKING

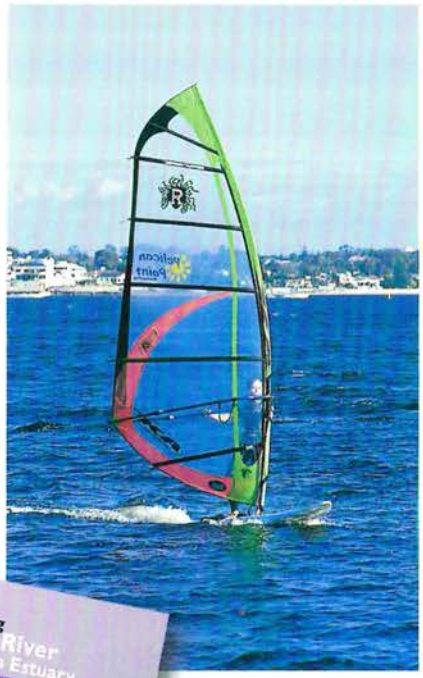
Undoubtedly the most popular recreational activity on the Swan River is walking along its shore. There are many places where you can see some of the original riverside landforms and vegetation. These include walks between Point Walter and Blackwall Reach and at Rocky Bay.

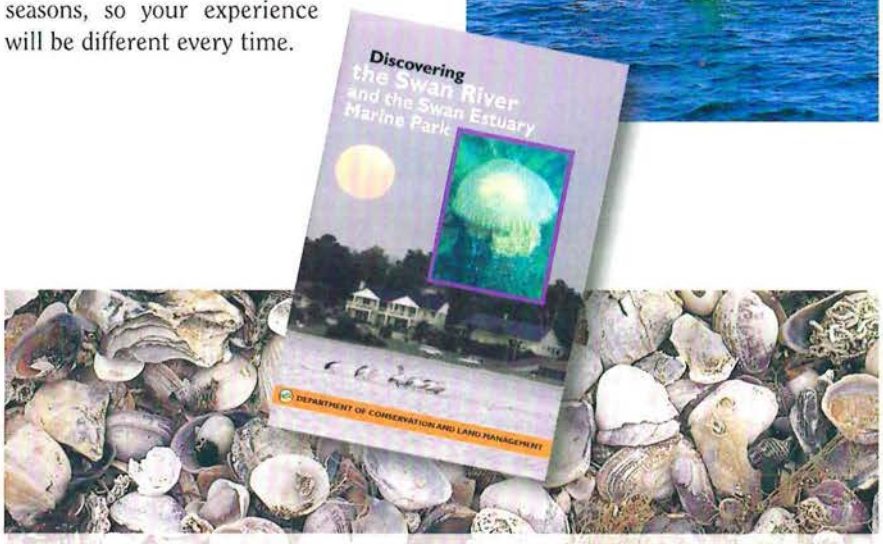
Discovering the Swan River and the Swan Estuary Marine Park has descriptions and maps of six wonderful walks along the river. Apart from the two walks mentioned above, the Freshwater Bay Walktrail, Pelican Point Walktrail, Between the Bridges Walk and the Claremont Foreshore Walktrail are also featured in the book.

So what are you waiting for? If you like boating, diving, fishing, walking, cycling, windsurfing or birdwatching the Swan River offers boundless opportunities for recreation, and it is always changing with the seasons, so your experience will be different every time.

Above: Cycling and walking along the foreshore are the most popular recreational activities based around the Swan River.

Right: Windsurfing is an extremely popular sport on the Swan River.
Photos – Ann Storrie



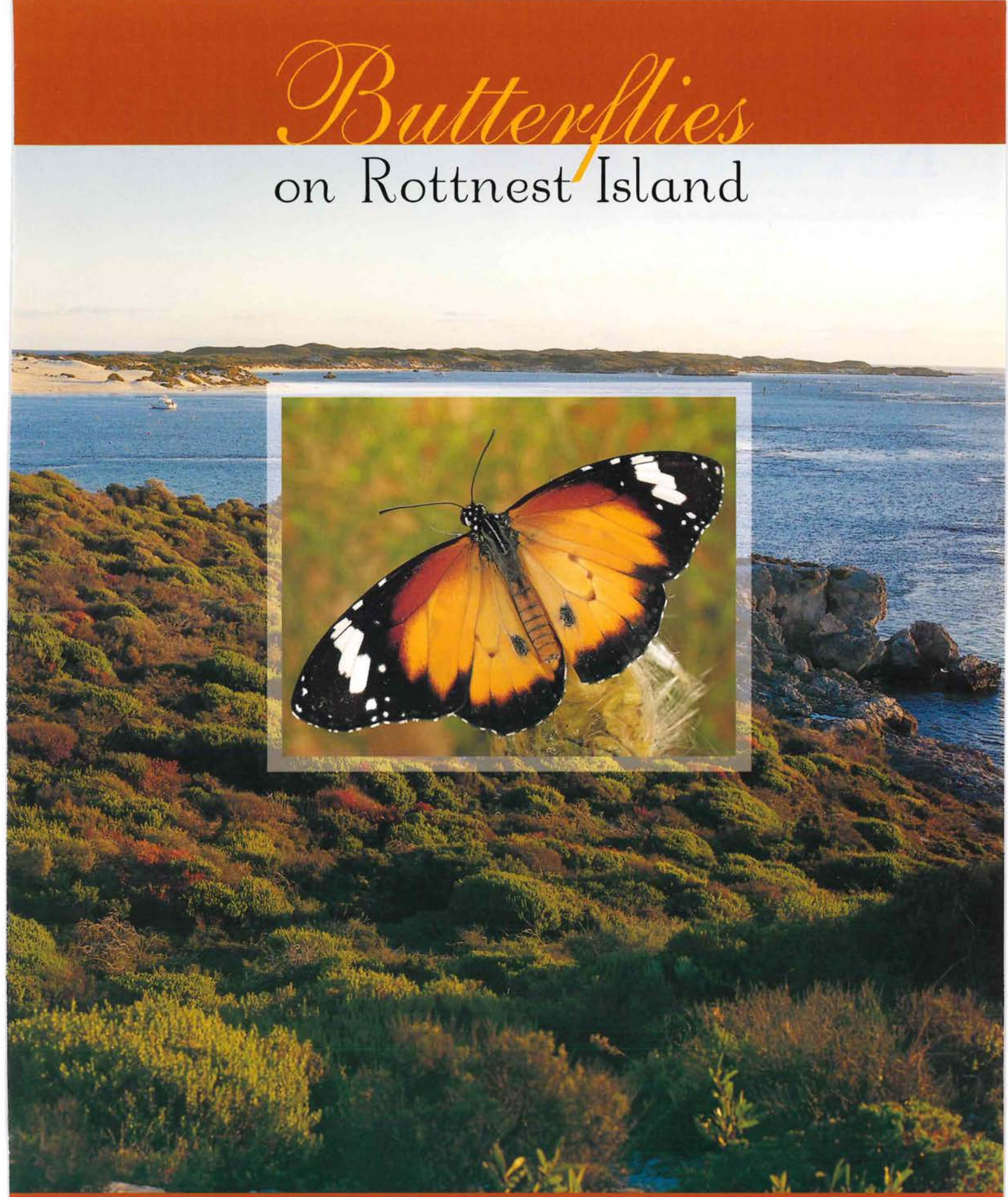


Carolyn Thomson-Dans is a special projects officer with CALM and has written and/or edited numerous CALM publications including *Discovering the Swan River and the Swan Estuary Marine Park*.

Peter Dans is the Manager of CALM's Marine and Coastal District, which is responsible for managing the Swan Estuary Marine Park.

Ann Storrie is a freelance writer and photographer. She co-wrote *Discovering the Swan River and the Swan Estuary Marine Park* and took most of the photographs in the book.

Butterflies on Rottnest Island

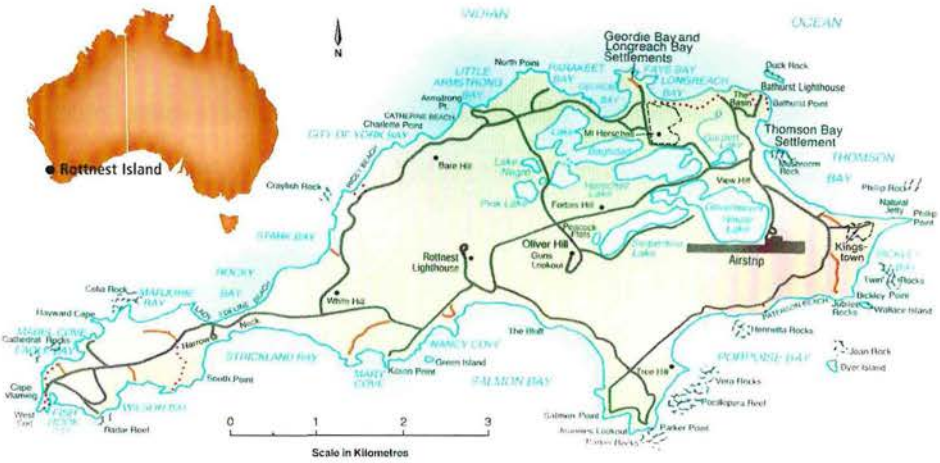


Although butterflies have a short life span, their appearance brings pleasure to many people. In this photo essay, Andrew Williams and Robert Powell describe some of the species that can be found on the idyllic island of Rottnest.

by Andrew A.E. Williams and Robert J. Powell

Rottnest Island lies 18 kilometres off the Western Australian mainland, almost due west of Perth. Irregular in shape and covering an area of some 1,900 hectares, its varied natural features and diverse habitats give it a special charm. Not surprisingly, it has become a favourite destination for Western Australian and other visitors.

By its very nature, Rottnest Island caters for a wide range of activities. For many, leisurely walks and bike rides around the island are the main attraction. Others go there to fish and swim, or scuba dive off nearby reefs. Some simply enjoy the scenery, exploring the isolated coves and picturesque salt lakes. Still others find great enjoyment in the wildlife, watching quokkas and the abundant birdlife. There are, however, other attractions for the keen observer, particularly in spring and early summer. These include an assortment of butterflies, and a little time is all you need to enjoy them.



Previous page
Main: Rottnest Island.
Photo – Marc Muller
Inset: Lesser wanderer.
Photo – Babs & Bert Wells/CALM

Below: Inland lakes from Lookout Hill, Rottnest Island.
Photo – Marie Lochman

Butterflies are insects that belong to the order Lepidoptera, a name of Greek origin that refers to the tiny scales that cover their wings. All butterflies start life as eggs, which hatch into small soft-bodied caterpillars. These caterpillars feed voraciously on their respective food plants, and grow through several stages until they are ready to pupate and form a chrysalis. In this immobile state they go through a miraculous transformation, finally emerging as perfect butterflies.

Butterflies are more robust than might be expected, and some have remarkable powers of flight. The Australian painted lady, for example, regularly flies across Bass Strait from the mainland, appearing in Tasmania. Butterflies also make the crossing to the Abrolhos islands, 60 to 80 kilometres off the Western Australian coast near Geraldton. It's not surprising, therefore, that some species also appear as vagrants on Rottnest, probably reaching the island with the aid of easterly winds.

Seventeen species of butterflies have so far been recorded on Rottnest. Some of these are residents, living and breeding on the island; others (like most of us) are transient visitors from the mainland.

Some of the species you might well encounter on your next visit are shown on the following pages.

Right: The monarch larva feeds on a toxic foodplant, narrowleaf cottonbush. This makes it unpalatable to predators.
Photo – Trevor Lundstrom

Far right: Monarch butterfly pupa that is close to emergence.
Photo – Peter Marsack/Lochman Transparencies

Below left: Silver-chequered ochre showing the distinctive silvery white markings on the underside of the hind wing.
Photo – Eric McCrum

Below centre: Salt-bush blue on its larval foodplant grey saltbush *Atriplex cinerea*.
Photo – Allan Wills/CALM

Below right: Two-spotted line-blue showing the characteristic spots on the trailing edge of the hind wing.
Photo – Trevor Lundstrom

SILVER-CHEQUERED OCHRE

(Trapezites argenteoornatus)

This small butterfly belongs to the skipper family; as the name suggests, it has a rapid skipping flight. It is common on the island, adults first appearing in early October, with numbers peaking in November. Occasional specimens may still be seen around Christmas. Silver-chequered ochres are especially prevalent in areas adjacent to the salt lakes, where the food-plant prickle lily (*Acanthocarpus preissii*) is abundant. The butterflies fly close to the ground, often landing on low shrubs or exposed rocks. A good place to observe them is at Vlamingh Lookout overlooking Garden Lake. Alongside the road between Garden Lake and Herschel Lake, flowering shrubs of thick-leaved fan flower (*Scaevola crassifolia*) attract many individuals, offering photographic opportunities to the enthusiast. The upperside of the butterfly's wing is brown with orange-yellow spots and blotches. Underneath, the hindwing has distinctive silvery white spots. These are very noticeable when the butterfly is at rest, and distinguish it from other species on the island.

SALT-BUSH BLUE

(Theclinesthes serpentata)

The salt-bush blue is a tiny butterfly, blue above with grey-brown and white chequered fringes to its wings. Underneath, its colouring is more cryptic, blotched with greys and browns. It is so named because its caterpillars feed on various types of salt-bush. On Rottnest Island it can often be seen flying around seaberry saltbush (*Rhagodia baccata*) and grey saltbush (*Atriplex cinerea*), which fringe many of the island's salt lakes. A particularly good place to find the butterflies is along the southern side of Garden Lake, not far from the main settlement. Salt-bush blues are most common in spring and summer, but may also be seen in autumn. The larvae are green and extraordinarily well camouflaged. They generally pupate in sheltered places on the stem or leaves of the food plant, the butterflies hatching within a few days. The species produces several generations a year, and so can be seen in any of the warmer months. At times when the butterflies are very abundant, welcome swallows can be seen swooping low over the salt bushes to catch them.

TWO-SPOTTED LINE-BLUE

(Nacaduba biocellata)

This tiny butterfly inhabits stands of summer-scented wattle (*Acacia rostellifera*), on which its caterpillars feed. It may also be seen in spring around flowering shrubs in the botanic golf course. Males are lilac above with blue basal areas, while females are blue with a broad border of brown. Underneath, both sexes are yellowish brown. Two small round spots on the trailing edge of the hind wing give the butterfly its name.

Left: Cabbage whites are most frequently seen around the settlement area on Rottnest Island.
Photo – Robert Powell/CALM

Far left: The yellow admiral has striking pale yellow patches on the forewing.
Photo – David Pike

Lower far left: Australian painted lady basking in early morning sunshine.
Photo – Robert Powell/CALM

Below: The monarch is the largest butterfly found on Rottnest Island.
Photo – Matt Willliams/CALM

YELLOW ADMIRAL
(Vanessa itea)

The pale yellow patches on the forewings give the yellow admiral its name, and immediately distinguish this medium-sized butterfly from all other species on the island. This species, also called the Australian admiral, is a powerful insect that can travel long distances; it is thought to be a seasonal visitor to the island, rather than a resident. It appears on the island in winter and spring each year, having apparently migrated from the mainland. It then breeds on two annual plant species that grow prolifically round the settlement at this time: native pellitory (*Parietaria debilis*) and the introduced stinging-nettle (*Urtica urens*). Both these food-plants die off in summer. The caterpillars conceal themselves in dome-like shelters, which will reveal their presence to the keen observer. The butterflies often fly fast round the treetops. They are, however, more easily seen when feeding at flowers or laying eggs on their food-plants. In the late afternoon, a good place to see them is Vlamingh Lookout, where the males establish territories to meet virgin females, a behaviour known as 'hilltopping'.

AUSTRALIAN PAINTED LADY
(Vanessa kershawi)

This medium-sized butterfly is one of our most recognised species, being commonly found throughout mainland Australia. On Rottnest Island it is mostly seen in spring and early summer, either flying, or basking on the ground with outstretched wings. It often feeds at the flowers of Rottnest Island daisies (*Trachymene coerulea*). There may well be a stable population of painted ladies on Rottnest, as one of its preferred food-plants, Cape weed (*Arctotheca calendula*), grows on the island. However, like the yellow admiral, it is a strong flyer and known migrant, well able to reach Rottnest from the mainland.

CABBAGE WHITE
(Pieris rapae)

This medium-sized species is not native to Australia, but was accidentally introduced to Victoria in 1937; it arrived in Perth more than fifty years ago. It is called the cabbage white because its larvae feed on cabbages and other plants in the cabbage family; it will also breed on garden nasturtiums. The cabbage white has only recently become established on Rottnest, where it is seen round the main settlement. Coming to Australia from temperate regions, it can fly in cool, cloudy weather, unlike many native species, which are active only when it is warm and sunny.

MONARCH
(Danaus plexippus)

This spectacular species, with a wing span of 9–10 centimetres, is by far the largest butterfly on Rottnest Island. In spring and summer, several may be seen at one time gliding effortlessly over the island. The monarch, also called the wanderer, originated in North America, but has now extended its range across the Pacific to Australia, first being recorded in Perth more than 100 years ago. On Rottnest Island, it is most often seen near the salt lakes, where the plant on which it breeds, narrowleaf cottonbush (*Gomphocarpus fruticosus*), has become established. Unfortunately, narrowleaf cottonbush is an introduced noxious weed, which needs control. If the plant can be maintained at low densities rather than eradicated, then this spectacular addition to Rottnest's lepidopteran fauna will continue to be enjoyed by its many visitors.

Right: Lesser wanderers are infrequent visitors to the island.
Photo – Eric McCrum

Lower right: The marbled xenica is very common on Rottnest. Cryptic colouration on the hind wing provides camouflage when the butterfly is settled on the ground.
Photo – Eric McCrum

Far right: Small grass-yellows have only recently been recorded on Rottnest.
Photo – Robert Powell/CALM

Lower far right: Common grass-blue.
Photo – Trevor Lundstrom

Below: Salt bush at Garden Lake, Rottnest Island.
Photo – Andrew Williams/CALM

LESSER WANDERER
(Danaus chrysippus)

This native species is a smaller relative of the monarch. As its name implies, it is very mobile. Its main area of occurrence is to the north of Perth, but influxes of the butterfly commonly occur in the south-west when favourable conditions prevail inland. At times, it is common on Garden Island, and was first recorded on Rottnest in April 1995.

MARBLED XENICA
(Geitoneura klugii)

The marbled xenica is abundant on Rottnest Island in spring and early summer. It is a medium-sized butterfly, yellow-brown above, with an irregular pattern of bold black markings. Underneath, it is coloured in varying shades of dark grey and brown, which enable the butterfly to blend into its surroundings when settled on the ground. Males first appear in October, females two to three weeks later. It can be seen wherever the food-plant tall speargrass (*Austrostipa flavescens*) grows.

SMALL GRASS-YELLOW
(Eurema smilax)

The yellow wings of this smallish species, brighter on the upper side, make it conspicuous and easily identified. It occurs widely in mainland Australia, but most abundantly in the north. Only occasionally do influxes occur in Perth. This species was recorded for the first time on Rottnest in September 1999.

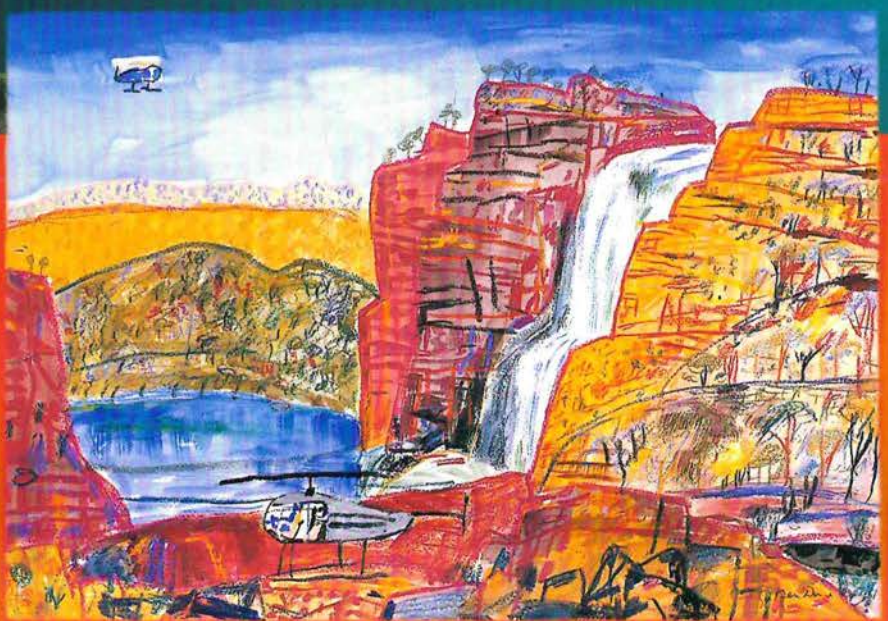
COMMON GRASS-BLUE
(Zizina labradus)

The common grass-blue is another small butterfly found on Rottnest Island. It is blue above, and pale grey below with indistinct markings. Individuals may be seen flying around grassed areas near the main settlement, where one of its food-plants, an introduced clover, has become established. The butterflies are also commonly seen in sheltered swales and hollows at the western end of the island.

Next time you plan a trip or holiday to Rottnest, consider travelling in spring or early summer and you just might experience another aspect of this island playground. For a brief few weeks, it comes alive with delicate splashes of colour as the butterflies emerge from their resting places to grace us with their transient beauty.

Andrew Williams is a Senior Technical Officer in CALMScience Division and is based at CALM's Wildlife Research Centre. He can be contacted on (08) 9405 5117 or email tandyw@calm.wa.gov.au.

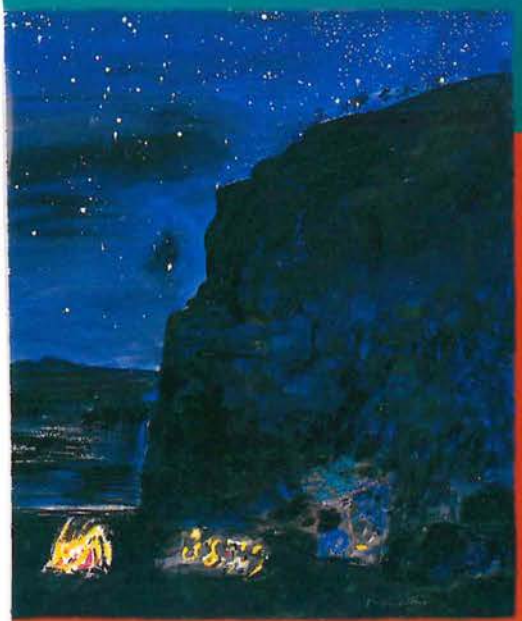
Robert Powell is the Land and Planning Officer at CALM's Planning and Visitor Services Branch, and is based at Kensington. He can be contacted on (08) 9334 0430 or email (robertp@calm.wa.gov.au).



Cruising the Wandjina Coast

By Chris Done

The stretch of coastline north of Broome is one of the world's most isolated and beautiful areas. Though most of this coast is accessible only by boat or helicopter, it is attracting small groups of environmentally aware tourists in increasing numbers. These visitors bring much needed revenue to the Kimberley region and provide locals with the impetus to conserve the area's beautiful, wild vistas. Chris Done, from the Department of Conservation and Land Management (CALM), accompanied one such group from Broome to Darwin aboard the Coral Princess.



Dawn found us sailing north from Broome along the Dampier Peninsula coast, one morning in May 1999. We passed the Lacepede Islands Nature Reserve, but strong easterly winds prevented us from landing there to see green turtle nesting areas and the huge colonies of brown boobies and least frigatebirds (the islands are breeding areas of world-scale significance for both species).

Arriving at Crocodile Creek, at the northern tip of Yampi Peninsula, we saw a whistling kite, white-bellied sea-eagles and both grey and white colour phases of the eastern reef egret. A pheasant coucal loudly protested the invasion of its territory as the more adventurous passengers climbed to the top of the waterfall, which tumbles year round into the tidal pool. Crocodile Creek was used as a 'weekend getaway' by miners from nearby Cockatoo Island. Along with Koolan Island, in the Buccaneer Archipelago, it was mined by BHP for high-grade iron-ore until the early 1990s. Small-scale mining still takes place on Cockatoo Island, while a resort has been developed using some of the accommodation and other facilities no longer required by the company.

Previous page
Mt Trafalgar and Mt Waterloo dominate the coastline of Prince Regent Nature Reserve.
Photo – Col Roberts/Lochman Transparencies
Inset paintings (from left):
Mitchell Falls; Beach Night, Kimberley Coast; Crocodile at Kings Cascades.
Paintings (all 36 x 51 cm in oil crayon and gouache on paper) – Ken Done

Striking landforms of ancient folded and eroded sedimentary rock lined the route of the *Coral Princess* to its overnight anchorage at Talbot Bay, in the lee of Slug Island.

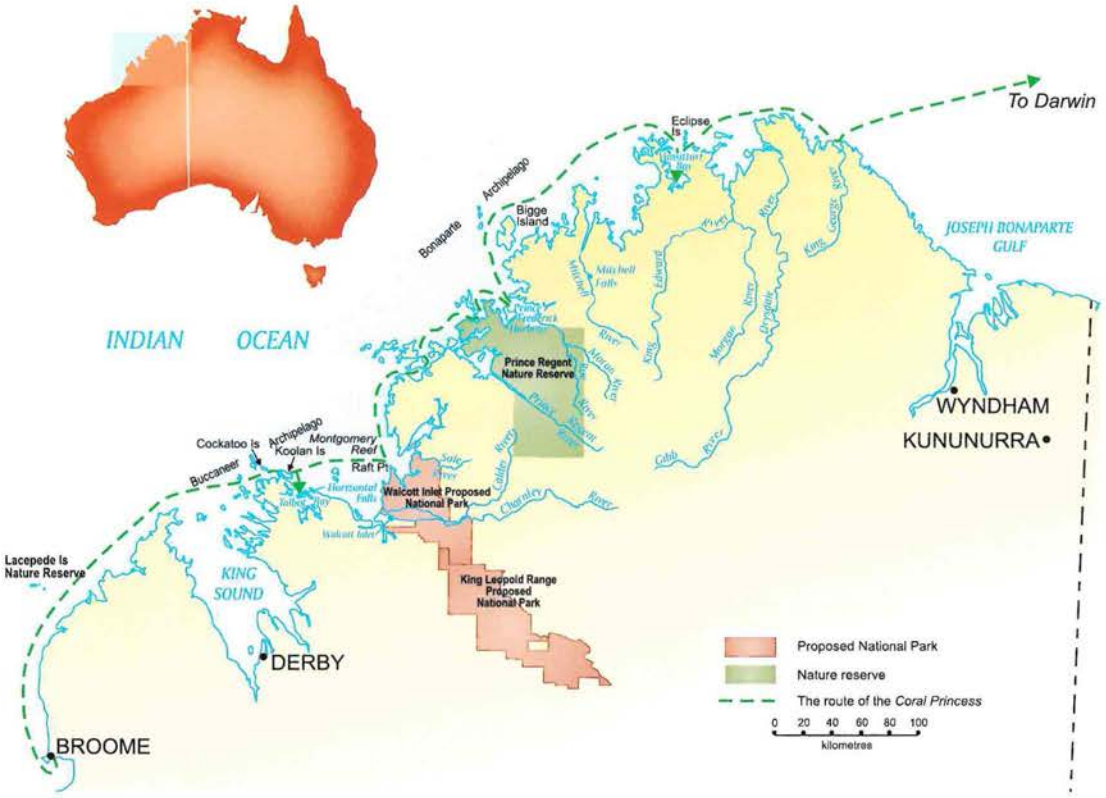
'HORIZONTAL' FALLS

Massive tides in this part of the coast have created the unusual spectacle of horizontal waterfalls in the Buccaneer Archipelago. The sea has breached sandstone escarpments through narrow gaps, and hollowed out large inlets in the softer siltstone rocks behind. At high tide, the inlets are filled by the sea, but when the tide turns the water has to drain out through the narrow gaps. The tide falls faster than the water can escape, producing 'horizontal' falls. By low tide the inlets have emptied, only to fill again with the turn of the tide, resulting in waterfalls in the reverse direction.

This dramatic natural phenomenon was in full outflow during our visit. An inflatable dinghy struggled to take groups of six through the narrow gap to look at the middle basin and the inner

Above: The *Coral Princess* off Raft Point.
Photo – Chris Done/CALM

Below: Secluded Crocodile Creek on Yampi Peninsula.
Photo – Bill Bachman



fall before it shot the rapid out to meet the *Explorer*—the *Coral Princess'* tender vessel.

The upper reaches of Talbot Creek were hemmed in by huge ramparts of folded rock strata. Despite the extreme slopes, they were well vegetated with cypress pine (*Callitris intratropica*), rock gum (*Eucalyptus rupestris*), spinifex and acacias.

At Raft Point, in the proposed Walcott Inlet National Park, we landed on a small rubble beach at the base of two huge bluffs, part of the 1,800-million-year-old Warton Sandstone. We could see a thick layer of darker volcanic rock intruded into the sandstone. The soil derived from the latter was much more fertile and supported lush woodland, through which we struggled up a steep slope to the top of the saddle between the two bluffs. As we regained our breath, our hearts started to race at the sight of a huge gallery of rock art above us. Staying well back from the gallery so that no impact of our visit was possible, we heard the story of the Wandjina figures, depicted here, and of their fish chase. In quiet reflection, we descended to the *Explorer* and returned to the *Coral Princess*.

The proposal to create a national park in this area also includes the waters of nearby Walcott Inlet and the surrounding lands. It would link to the proposed King Leopold Range National Park (currently a pastoral lease managed by CALM as if it already was a national park), creating a conservation area of unsurpassed grandeur, stretching from the tidal mud flats of the inlet to some of the highest mountains in the Kimberley.

IN THE WAKE OF KING

During Lieutenant Philip Parker King's epic voyages of hydrological survey and scientific discovery in 1818–21, he produced a body of knowledge so accurate that it formed the basis of modern navigation charts. He named many features along this coast. For example, 'Doctor' Montgomery on board the *Mermaid* had his name perpetuated at the small islands and the massive Montgomery Reef surrounding them.

It was, however, the spectacle of torrents of water cascading down the sides of the reef, exposed up to four metres at low water, that gripped our imagination. This massive reef system covers some 400 square kilometres. Sandy islands supporting mangroves, birds and crocodiles make up about 25 square kilometres; an internal lagoon that disappears at high tide covers more than 200 square kilometres; and the remainder is reef.

Turtles, fish and sharks fed in the white water below the cascades as we motored up a 'river' to the reef's interior. On the reef, eastern reef egrets, waders, Caspian terns, a white-bellied sea-eagle, an osprey, occasional beach stone-curlews and numerous other birds were feasting on the exposed bounty. Epaulette sharks, small octopuses and fish, giant clams, shellfish and crabs inhabit innumerable pools on the exposed reef. None of the delicate and fragile corals occurs here. The whole reef seemed to be made up of seaweeds, massive corals (*Porites* species) and rubble derived from these organisms.

Right: A colourful fiddler crab forages in the mangroves.
Photo – Pamela Butt

The reef and its surrounding waters have been proposed as a marine reserve. The islands are part of an Aboriginal reserve, as the area was used by intrepid Aboriginal groups who used rafts to transport themselves to and from the mainland.

We steamed back past Raft Point into Doubtful Bay, largely surrounded by the proposed Walcott Inlet National Park, and across to Red Cone Creek. A nine-foot crocodile escorted us for part of the way. Chestnut rails have been seen here before, but during our visit, the tide was high and these elusive birds were probably well back in the mangroves. However, we did see some of the crabs, small fish and mudskippers that inhabit the biologically important mangrove communities.

A difficult climb to the top of the waterfall opened up a whole new vista, with a small freshwater billabong that contained delicate, tiny waterlilies (*Nymphoides indica*). We joined several varieties of fish and the Kimberley freshwater crustacean, the cherrubin, for a swim in the pool. What looked like a bunch of flood debris on a paperbark sapling turned out to be the intricate nest of a pair of bar-breasted honeyeaters. The parents were busy feeding small grubs to the hungry brood.

The entry into St George Basin (another proposed marine park) was narrow, with whirlpools created by swiftly flowing tidal currents. Approaching St Andrew and St Patrick islands we could see the dramatic peaks of Mount Waterloo and Mount Trafalgar, named by a patriotic Philip Parker King.

RIVER FIT FOR A REGENT

After transferring to the *Explorer* again, we passed Wood Island and entered the mouth of Prince Regent River. King named it after the English ruler of the day, the hedonistic Prince Regent, who ruled for many years during his father's (King George III) incapacity. The river runs from south-east to north-west, following a line of weakness caused by the block jointing of the ancient King Leopold Sandstones. Several tributaries entered at right angles to the main stream. About 40 kilometres upstream, we entered one of the tributaries to be confronted by the beautiful King Cascade, which appeared just as King sketched it 180 years ago.

Camp Creek (another major tributary) provided a welcome opportunity to cool down in the shallow, fast-flowing, fresh water and to observe signs of animals such as the northern quoll, bungarra, dingo, euro and rock-wallaby. Black-faced cuckoo-shrike, little corella, white-quilled rock-pigeon, numerous rainbow bee-eaters, a whistling kite, great bowerbirds and an intermediate egret were observed. A shy fairy-wren called from the thick grass, but its identity remained a mystery.

The 630,000-hectare Prince Regent Nature Reserve was created to protect this area. Unlike most of the rest of mainland Australia, the reserve and much of the north-west Kimberley has an almost intact flora and fauna.

During the night we steamed past Careening Bay (also in the Prince Regent Nature Reserve), where King's cutter was repaired. A plaque on copper was attached to a kurrajong tree as a memento of their stay here.

Top left: Montgomery Reef, 1999. Painting (17 x 51 cm in oil crayon and gouache on paper) – Ken Done

Above left: Montgomery Reef as seen through the photographer's lens. Photo – Alex Steffe/Lochman Transparencies

Left: Talbot Bay, on Yampi Peninsula. Photo – Gerald Allen

Fortunately, the carpenter also carved the words 'HMC MERMAID 1820' deeply into a boab tree. The inscription is still clearly visible today, but the metal plate was gone when King returned only 12 months later in the *Bathurst*.

POWER OF NATURE

Prince Frederick Harbour, fringed by the Prince Regent Nature Reserve to the south (and itself a proposed marine park), is reputedly the most scenic part of the Kimberley coast. We could make our own assessment of this as we flew by helicopter to the nearby Mitchell Falls and in *Explorer* trips up Porosus Creek and the Hunter River. Few disputed the reputation.

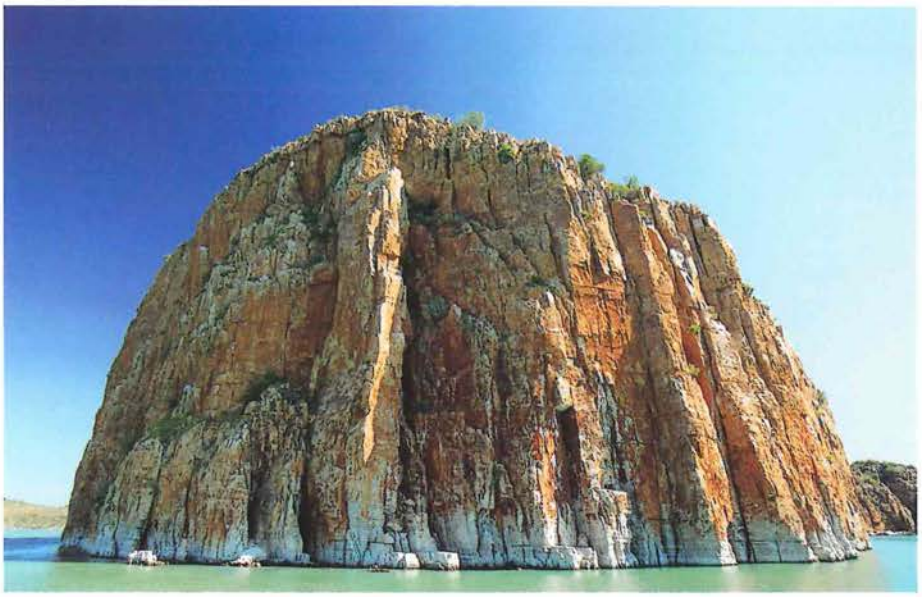
An impressive example of nature's power was obvious from the flight to the Mitchell Falls. During the 1998–99 wet season the north Kimberley was battered by two category-five cyclones. Thousands of large trees, including many woollybutt (*Eucalyptus miniata*), had been knocked over and lay towards the west-south-west. At the falls, acacias had been killed, apparently by the sheer strength of the wind separating the bark from the underlying cambium, even though most of these small trees had not been broken or blown over. Regeneration should replace both species quickly.

The falls were awe-inspiring, with their four separate cascades, and we had ample time to explore and swim in the calm waters above the falls. Other visitors had driven their four-wheel-drives to the terminus of the road and then walked another five kilometres to see the mighty falls in strong flow. Later in the year the falls slow to a trickle or cease.

Back in Prince Frederick Harbour the group sailed up Porosus Creek below the looming bulk of Mount Anderdon, with its massive terraces falling down to the sea. We were rewarded with a close-up view of a 'saltie' (*Crocodylus porosus*), after which the creek was named. A great-billed heron, an osprey, white-bellied sea-eagles, and sacred and azure kingfishers were a bonus. A barbecue on Naturalist Beach topped off the day. Cool air streaming from the rainforest pocket behind the beach cooled us down and made up for us not being able to swim in this 'crocodile country'.

TRACKS AND TRACES

A monjon (*Petrogale burbidgei*), the smallest species of rock-wallaby, welcomed us to rock-strewn Bigge Island



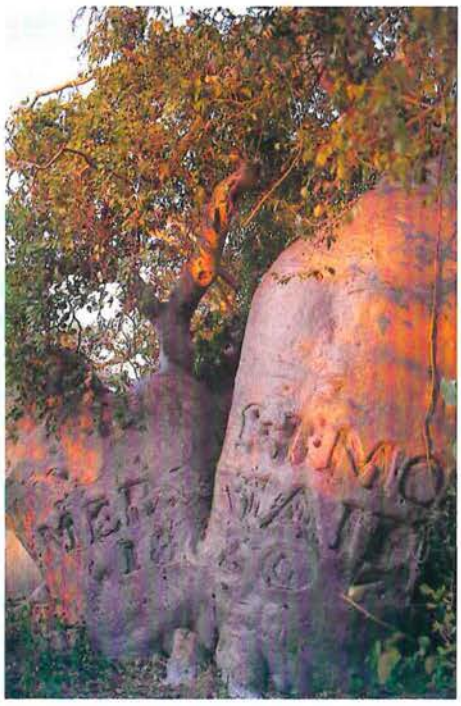
Above: St George Basin viewed from St Patrick Island.

Right: The aptly-named Steep Island in Doubtful Bay.
Photos – Steve Sadler

and several more were seen during our stay. Their tracks covered the beach and it was also exciting to see fresh tracks made by a couple of turtles that had come ashore to lay eggs overnight.

The Wandjina paintings here were of figures known as Kaiara. They were most impressive, and we treated the site with the greatest of respect. The representation of implements, sailing boats, rowboats, figures smoking pipes and so on gave rise to much lively discussion and speculation about their origin.

Jar Island, at the southern end of Vansittart Bay, was also named by King. Here, King and his men discovered shards of pottery, which they assumed had been left behind by Malay fishermen. However, the pottery was probably derived from the Maccassans, who visited the northern Australian coast to exploit the *bêche de mer* or sea cucumber. This animal was boiled and dried for sale as a delicacy back in Indonesia. The Maccassans left many artefacts, including rock hearths, in which they boiled their catch.



Above left: A pair of white-bellied sea-eagles.
Photo – Raoul Slater/Lochman Transparencies

Above right: At sunset, the moon glows over screw pine (*Pandanus spiralis*).
Photo – Pamela Butt

Left: The historic Mermaid boab tree at Careening Bay, Prince Regent Nature Reserve.
Photo – Alex Steffe/Lochman Transparencies

Both King and the Macassans were preceded to Jar Island by Aboriginal people, who left some delicate artwork, known as Bradshaw figures, on the rough sandstone. Other styles of art such as stencils of hands, also of great antiquity, adorned the walls. This site was difficult to approach through the prolific growth of spiny hibiscus-like *Gossypium* in full flower (a result of a previous dry season bushfire), but the effort was well worthwhile. Intriguing tracks in the sand could have been made by possums and further study to confirm this observation would be useful. A red-kneed dotterel was seen and an eagle ray repeatedly jumped clear of the water as we left the beach.

SWEEPING GRANDEUR

The sheer ruggedness of the terrain was evident as we motored up the King George River in the *Explorer*. Huge perpendicular cliffs of blocky sandstone formed a massive gorge, which had been eroded by the river over millions of years. Rising sea levels flooded the gorge, allowing small coastal vessels to enter and replenish water supplies while enjoying the scenic grandeur of the 100-metre-high King George Falls.

The 24-hour beat across the heavy

seas of the Joseph Bonaparte Gulf severely tested our sea legs. The sight of Darwin left us with mixed feelings as our trip along the Kimberley's spectacular 'Wandjina Coast' drew to a close, but we were pleased that we would soon be back on terra firma.

COASTAL MANAGEMENT

A relatively small proportion of the Kimberley coastline is protected as part of the conservation estate. Several island nature reserves including the Lacepedes, Swan, Low Rocks and Pelican islands, and the Prince Regent Nature Reserve, while extremely important in their own right, are not sufficient to adequately conserve the area's most important features in perpetuity.

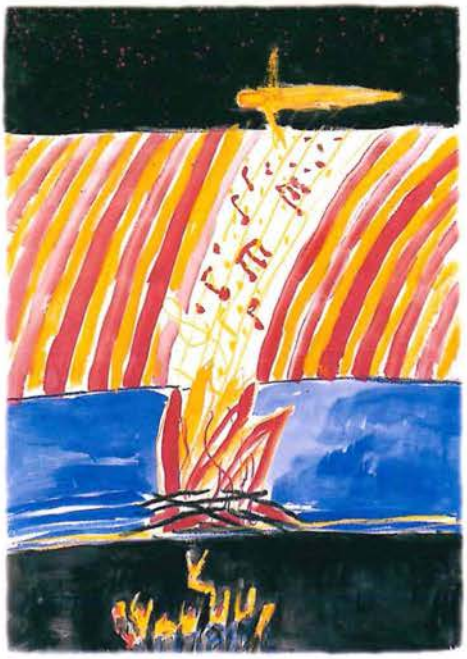
Several areas along the Kimberley coast were proposed as marine reserves in the 1994 'Wilson Report', a pioneering report on marine conservation for Western Australia. The report recommended that about 70 marine regions around the State be considered for declaration as marine reserves, so as to create a comprehensive system that would cater for conservation and other needs. Currently, the only Kimberley marine reserve is the Rowley Shoals Marine Park. A number of terrestrial reserves have also been proposed (see *Nature Conservation Reserves in the Kimberley,* published 1991).

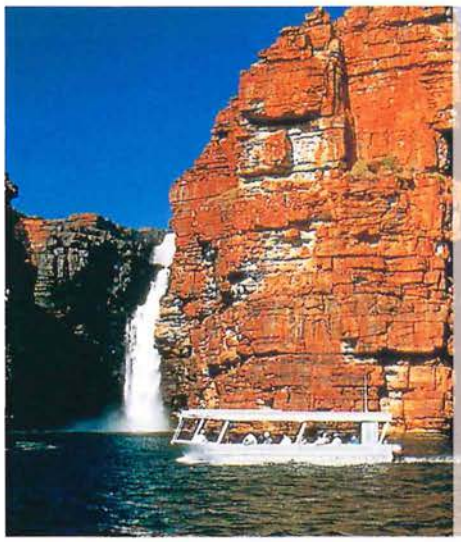
Remoteness and difficulty of access have resulted in limited human pressure on the Kimberley coast to date. However, the coast is increasingly important to traditional Aboriginal custodians, recreational and professional fishers and pearl farmers, and for recreational tourism, petroleum and other exploration and so on. CALM has been actively promoting a study of the area so that orderly planning and development can take place while preserving the natural attractions that make the Kimberley so special.

Above: An aerial view of Prince Frederick Harbour.
Photo – Alex Steffe/Lochman Transparencies

Right: Singing for the Spirit, 1999.
Painting (51 x 36 cm in oil crayon and gouache on paper) – Ken Done

Below: The *Explorer* at King George Falls.
Photo – Tim Willing





Chris Done is Kimberley Regional Manager for the Department of Conservation and Land Management. He has been involved in managing the region's conservation estate for 20 years. He has travelled the coast on many occasions and acted as a CALM volunteer on several cruise trips during his recreational leave. He can be contacted on (08) 9168 4200 or by email (chrisd@calm.wa.gov.au).

The author gratefully acknowledges the assistance of Tim Willing and Jenny Wilksch in writing the article and Ken Done for the use of his paintings, which add another dimension to the story.

ENDANGERED!

ELEGANT SPIDER ORCHID

Caladenia elegans ms, commonly known as elegant spider orchid, is one of Western Australia's rarest and most attractive orchids. Standing up to 30 centimetres high, it has a single hairy leaf to 12 centimetres long by five millimetres wide and has up to three large lemon-yellow flowers, each with a red-striped labellum (the lip or tongue of the flower). Plants grow in clumps of up to seven or more. Flowers appear between late July and late August.

The orchid closely resembles common white spider orchid, (*Caladenia vulgata*), with which it is often confused, but differs in having yellow rather than cream or white flowers, glossy calli and a preference for heavy clay-loam soils in winter-wet areas. *Caladenia vulgata* grows in well-drained soils further upslope. Hybrids occur in the narrow habitat boundary between populations of the two species.

Elegant spider orchid is found with another Critically Endangered orchid, Northampton midget greenhood (*Pterostylis* sp. Northampton). This orchid is even rarer than the elegant spider orchid and is known from just four very small populations. For information on this species see page 149 of *Western Australia's Threatened Flora*.

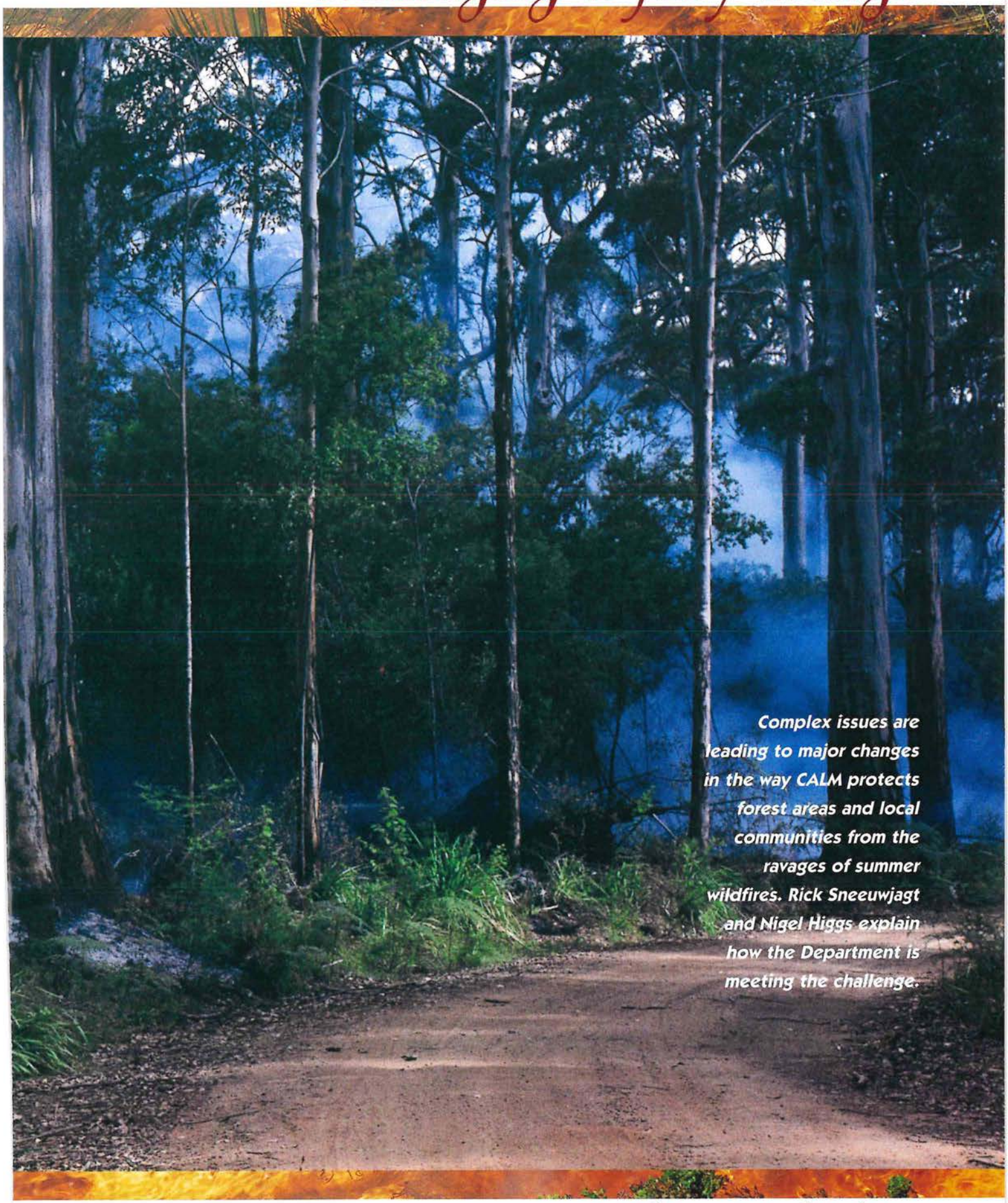
Habitat consists of broom bush (*Melaleuca uncinata*), djarnokmurd (*Hakea recurva*) and hopbush (*Dodonaea* sp.) over low heath consisting of pine grevillea (*Grevillea pinaster*) and rock thryptomene (*Thryptomene saxicola*). The elegant spider orchid was first collected in 1982 and since then just a few other populations have been found near Northampton. These are mainly confined to road reserves in areas where much of the natural bushland has been cleared for agriculture.

Elegant spider orchid was declared as Rare Flora in 1991 and ranked as Critically Endangered in 1995. An Interim Recovery Plan that outlines a number of essential recovery actions is being prepared by the Department of Conservation and Land Management (CALM) and is being progressively implemented. The Geraldton District Threatened Flora Recovery Team, which consists of representatives from CALM, community groups, pastoralists, local shires, and various government organisations, is overseeing the implementation of these actions. Actions include control of weeds, redirecting water flow, fencing populations to protect them from grazing, monitoring of feral pig activity, habitat rehabilitation, conducting further surveys, collection and storage of seed and researching the biology and ecology of elegant spider orchid.

Posters have been produced for both elegant spider orchid and Northampton midget greenhood. These are designed to aid CALM staff, shire employees and community members in identifying the species and to encourage them to look for further populations. The posters contain descriptive information, list threats and recovery actions and illustrate each species and their habitat. You can view them on CALM's NatureBase at http://www.calm.wa.gov.au/plants_animals/critical_flora.html.

By Andrew Brown and Val English

Managing a fiery change



Complex issues are leading to major changes in the way CALM protects forest areas and local communities from the ravages of summer wildfires. Rick Sneeuwjagt and Nigel Higgs explain how the Department is meeting the challenge.

By Rick Sneeuwjagt and Nigel Higgs

Each year, the south-west forests produce big quantities of leaf litter, bark and twigs that dry out and form potential fuel for summer wildfires. If build-up of these fuels is not regularly reduced, our hot, dry and windy summers will turn the forests into a vast arena ready for conflagration. This was shown in the horrendous fires in the summer of 1960–61 that destroyed Dwellingup, Karridale and other forest settlements.

The key to reducing this build-up of fuel is fire itself: low intensity, slow moving fires that create a mosaic of burned and unburned areas of forest. Burned buffers are used to protect towns, settlements, farms, plantations, camp sites, fire-vulnerable plants and habitats and fire-sensitive forest regeneration from wildfires. The aim is to maintain this system of protective buffers by regular fuel reduction burns, carried out to a prescription for the area.

To maintain adequate protection for life, property and other values in the south-west, between 220,000 and 240,000 hectares of forest needs to be 'prescribed burned' each year.

MANAGING SMOKE

The weather conditions that are normally suitable for safe fuel-reduction burning in the south-west forests are frequently the same that lead to smoke being blown by southerly winds into the Perth metropolitan area. This smoke can become trapped below a blanket of warmer air (known as an inversion) for several hours.

To help overcome smoke impacts, the Department of Conservation and Land Management (CALM), in consultation with other agencies, has developed and applied a decision support system that assists in forecasting the way in which smoke may impact on the metropolitan area. While it relies heavily on accurate weather forecasts—for up to four days ahead—the reliability and performance of these forecasts and the efficiency of the system have improved markedly in the past five years, largely as a result of on-going research into the factors that influence smoke transport and build-up.

The decision support system has reduced the number of incidents each year in which smoke from CALM burns has resulted in haze in the Perth metropolitan area. For example, in the past five years, the annual number of instances of reduced visibility has fallen from about eight to 10 incidents to just two or three.

An analysis of Department of Environment Protection data since November 1994 reveals that no smoke from CALM prescribed burns has exceeded the new National Environmental Protection Measure standard for fine particulates (PM10) at any of the air quality monitoring stations in Perth. The data show that the standard has been exceeded on several occasions in winter due to domestic wood stoves and in mid-summer as a result of wildfires and vehicle emissions. But the limits have not been exceeded in spring and autumn, when CALM's main

Previous page
Low intensity patchy fires protect valuable native forests from wildfires and have little impact on native animals.
Photo – Jiri Lochman

Left: Shredding bark contributes significantly to fuel build-up. It is a major source of fire spotting, which can occur several kilometres ahead of the main headfire.
Photo – Jay Sarson/Lochman Transparencies

planned burning in the south-west forests is undertaken.

Photochemical smog also impacts the Perth metropolitan area. It is a pollution cocktail caused by the reaction of nitrogen oxides (NO_X) and reactive organic compounds in the presence of heat and sunlight. Studies indicate that air temperatures higher than 30°C, and full sunlight are important ingredients to the generation of photochemical smog. Thus, this phenomenon tends to be a summer problem, and rarely occurs in spring and autumn when most planned burning is carried out. However, summer bushfire smoke can result in significant photochemical smog events, especially when the reactive organic compounds in bushfire smoke react with vehicle and industrial emissions on hot, sunny days.

As many of Perth's high photochemical events are triggered by smoke from summer bushfires, there is a real concern that these pollution events will increase because of bigger and more intense wildfires if the fuel build-up in the forest is not managed.

OPERATIONAL FACTORS

The mixed karri-jarrah-marri-tingle forests of the southern forest regions dry out at different rates and therefore burn at different times. So that these mixed forest areas are burnt at prescribed fire intensities and fire spread rates, they need several lightings. Each ignition is targeted to burn a mosaic of each major vegetation type as the fuel moisture dries out. Once such an area is lit on the first occasion, it is important for the security of the burn and the safety of the adjoining values that subsequent ignitions are undertaken as soon as each fuel type becomes available. If this is not done, there is a serious risk that the smouldering fires within the burn will become fierce, uncontrollable fires should severe fire weather occur before they are completed.

The risk of escapes from partially completed mixed-forest burns can increase dramatically from late November to early January when the sudden onset of severe weather conditions involving strong, hot and dry north-east and north-west winds can occur. Although this risk is best minimised by restricting the number of 'live' and incomplete burns, it also means that very few planned fires can be carried out if weather conditions are also unsuitable for safe, low intensity burns and smoke dispersion.

The requirement to apply multiple ignitions to ensure the safety of burns will often override smoke management constraints, and thus there may be a risk of haze in the Perth metropolitan area from these follow-up ignitions.

THE IMPACT

Smoke management constraints on planned burning have become more severe in recent years due to the increasing demands for 'zero smoke tolerance' in Perth. The impact of this is that CALM achieved only half its planned burn program in 1998–99, and only about 65 per cent in 1997–98. The backlog in overdue burns has reached its highest level in the northern forests, where smoke impacts on Perth are likely to be greatest.

As at the start of the current burning season, approximately 70 per cent (490,000 ha) of the northern forests were carrying heavy fuel loads that will burn intensely and uncontrollably, even under mild summer conditions. The potential now exists for large conflagrations similar to the 1960–61 Dwellingup fire (150,000 ha) and with even greater potential to destroy local communities and forest values. The situation is only slightly better in the central and southern forest areas where approximately 65 per cent of all forests, including fire-sensitive regrowth stands, are carrying heavy fuel loads. Significantly, the area subjected to planned burns in the past two years is now below the average area that was

PLANNED FIRES

CALM uses fire in a planned and specific way to protect community assets and to ensure that the State's forests, parks and reserves are managed sustainably.

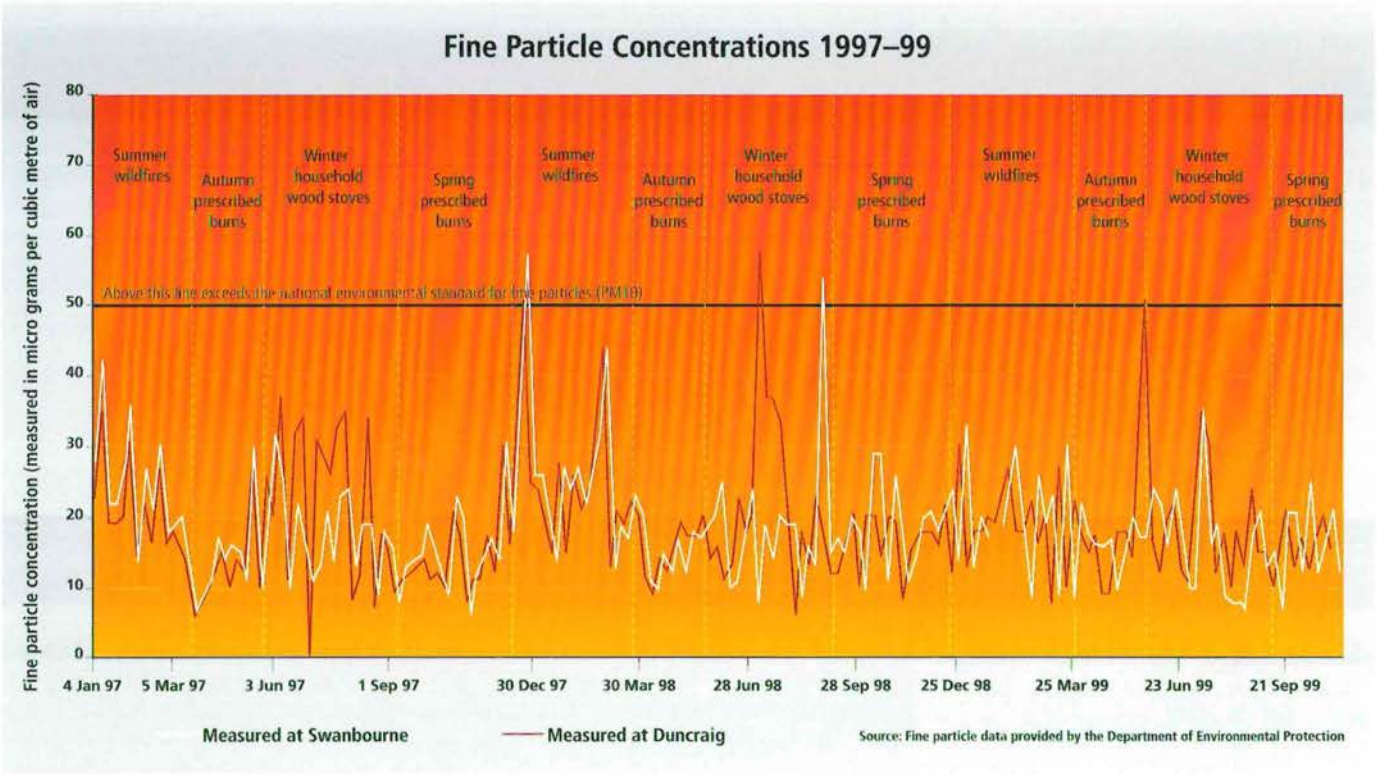
Fuel hazard reduction burns are located strategically within lands CALM manages and are aimed at protecting life, property, community assets and environmental values including fire-sensitive species. Forest fuels in these areas are reduced regularly so that wildfires can be readily suppressed on most summer days.

Ecological management burns use fire in a specific way that maintains and enhances the ecological processes on which native plants and animals depend. An example is using planned fires to regenerate thickets that grow along streamlines in the Perup Nature Reserve east of Manjimup. These thickets are valuable habitat for a range of native mammals, several of which are on the threatened species list.

Regeneration burns are used to create nutrient-rich ashbeds in the karri forest that enable seedlings to grow vigorously after harvesting. Similar burns are used in the jarrah forest to stimulate the regrowth of jarrah from underground lignotubers.

Young jarrah regrowth emerges through gaps in the forest canopy following carefully prescribed silvicultural burning.

Photo – Chris Garnett/CALM



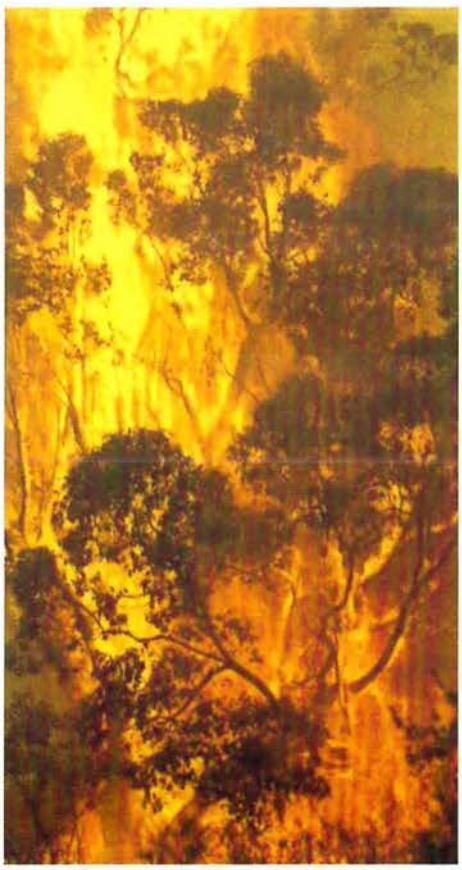
burnt by the Forests Department before the summer of 1960–61.

FIRE SAFETY

The intensity of a bushfire—its 'killing power'—is directly related to the amount of fuel available to burn. Fires burning in south-west forests become uncontrollable in summer whenever fuel loads are more than eight tonnes per hectare in jarrah forests or 18 tonnes per hectare in karri forests. This may occur between five and 12 years since the previous burn, depending on the forest type.

If fuel loads are maintained below these critical levels, there are relatively few days each summer when fire intensities exceed limits at which ground forces cannot suppress fires safely. On the other hand, if jarrah fuels accumulate to 15–20 tonnes per hectare, uncontrollable fires can occur on about 130 days each year.

Most importantly, fuel-reduced areas provide safer working conditions and refuges for firefighters. Without such low-fuel areas, the risk to the lives of firefighters increases dramatically. CALM has a proud record of fire fighter safety in the forest regions since the advent of broadscale planned burning. Unlike some other Eastern Australian States and USA experiences, there have been no CALM firefighters killed by bushfires in the past 40 years. Many of them have taken advantage of previously burned areas to ensure their safety in potentially dangerous situations.



Above: Australia has one of the strictest national standards for air quality. This graph shows the occasions on which the amount of smoke particles (commonly known as PM10) in the air exceeded the national standard. The readings were taken at the Department of Environment's monitoring stations in Swanbourne and Duncraig, two of Perth's coastal suburbs.

Left: Rapidly spreading fires are difficult to control, risk community assets and endanger the lives of fire fighters.
Photo – CALM

A SAFER COMMUNITY

Fuel reduction burning is a pivotal part of the overall strategy for minimising the damage that wildfires can inflict on townships, forest communities and the urban-rural interface. It is true that prevention measures such as house design, maintenance of clear areas and firebreaks around buildings, provision of sprinkler systems and fire equipment are important strategies for survival in fires in rural-urban areas. But only strategic fuel reduction burning in areas of heavy vegetation can prevent extensive, high intensity fires accompanied by burning embers, intense heat radiation and flames from assaulting local communities.

Alternatives to planned burning, which include mechanical and manual removal of fuels and vegetation, grazing and herbicide treatments, do not

provide for a sufficiently wide fuel break to prevent the spread of intense wildfires. The long-distance 'spotting' of wildfires—fireballs being blown great distances from a wildfire—means that low fuel zones need to be at least one kilometre wide. Mechanical fuel removal on such a scale is not only environmentally and ecologically unacceptable, but would be prohibitively expensive to maintain.

To help meet the challenges, CALM is developing and implementing a range of measures so that all suitable opportunities for safe and effective burning are used to achieve the planned burning target of around 220,000 hectares a year.

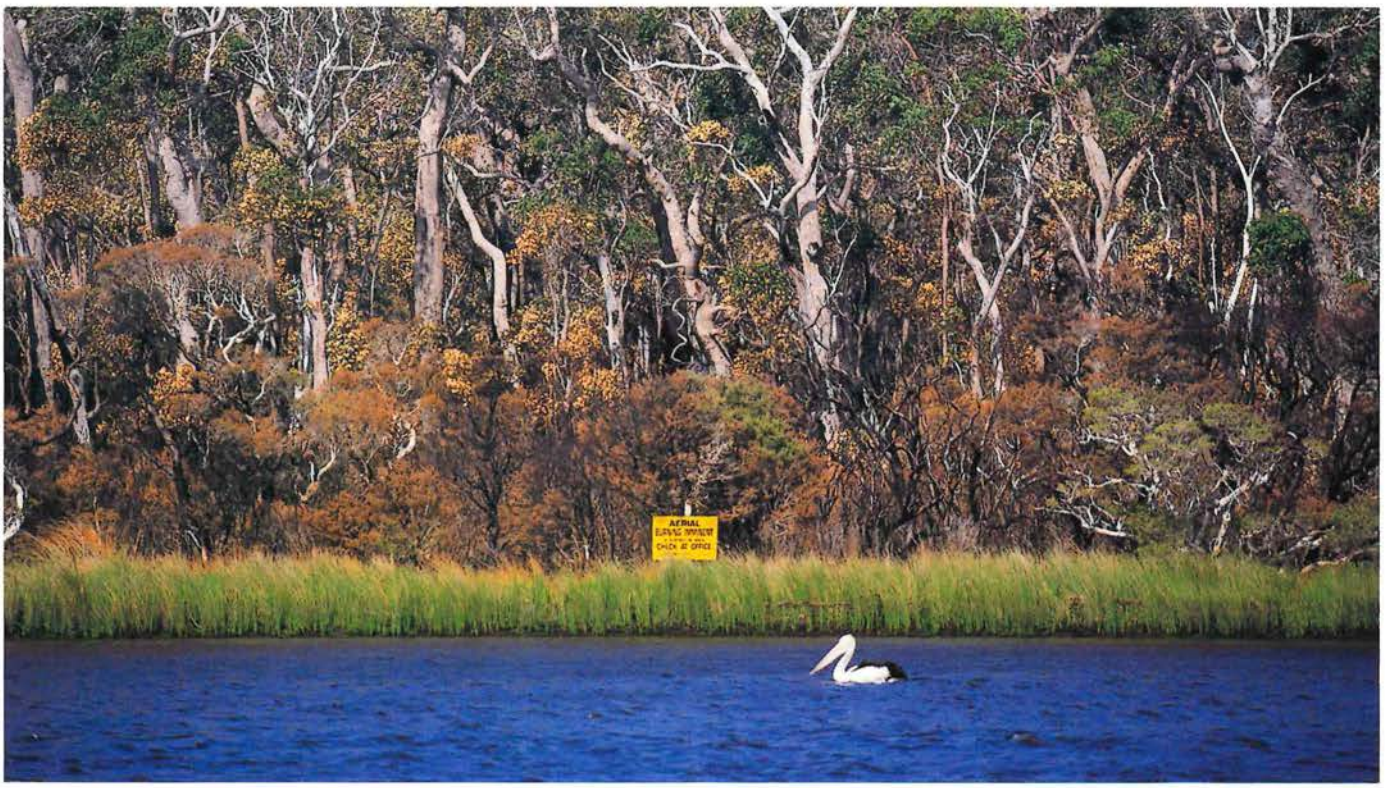
SMOKE AND WEATHER

Research into improved weather and smoke transport prediction systems has been among the priorities. CALM has funded a network of automatic weather stations in the south-west to enable the Bureau of Meteorology to base its weather forecasts on better data. CALM has also run smoke management workshops involving external agencies and Bureau research scientists. One such workshop, hosted by CALM and the Bureau last August, resulted in an agreed research program for the development of a Smoke Transport Prediction System, which will be coupled with a new weather prediction system developed by the Bureau. CALM and the Bureau have also participated in studies to better understand the nature of Perth's radiation inversions. These initiatives will be integrated into the Government's Air Quality and Management Plan for Perth and will provide CALM managers with improved tools for scheduling planned burns.

CALM is also helping coordinate this research at an Australia-wide level.

Right: CALM firefighters make safe live edges during planned burning.
Photo – Jiri Lochman

Below: Low instensity planned fire in the Blackwood River Estuary near Augusta safely removes ground fuels. Scorched lower shrub layers quickly re-establish from resprouting and seedling regeneration.
Photo – Bill Bachman



Left: Smoke from CALM planned burning near Pemberton is directed away from population centres by accurate forecasting and burn scheduling.
Photo – Dennis Sarson/Lochman Transparencies

Centre left: Low intensity planned burning in the jarrah forest consumes ground fuels and reduces the severity of subsequent wildfires.
Photo – Rick Sneeuwjagt/CALM

Below left: Native plants are well adapted to recover from wildfires. Here a banksia is respouting to replace its burnt canopy.
Photo – Bill Bachman

These efforts will help improve the current level of knowledge and understanding of complex weather processes that affect smoke transport and smoke accumulation.

CONCLUSION

These measures are being developed so that CALM and other fire authorities can maximise the few safe fuel hazard reduction opportunities that arise each burning season. However, it is inevitable that there will be occasions when there is short-term inconvenience caused by haze from prescribed burns. The real challenge is for the community and land managers to balance these occasions against the likelihood of more intense summer wildfires.

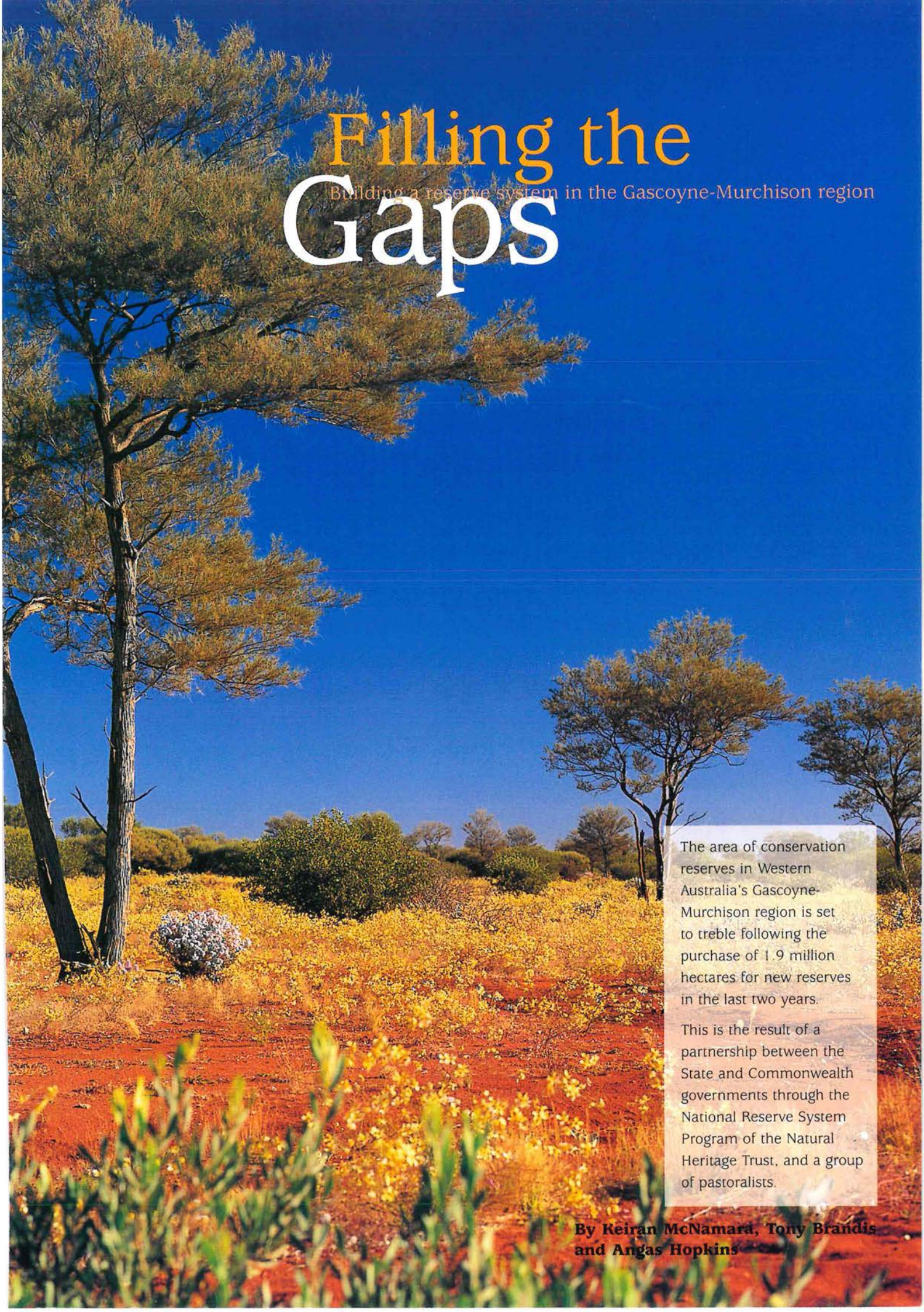
Rick Sneeuwjagt is Manager of CALMfire and internationally recognised for his work in prescribed burning and bush fire behaviour predictions. He can be contacted on (08) 9334 0375.

Nigel Higgs is CALM's Principal Media Liaison Officer and has been a volunteer fire fighter for 16 years. He can be contacted on (08) 9389 8644.

A special edition of *LANDSCOPE—Fire: the Force of Life*—features eight articles on fire previously published. It is available from CALM for $6.95.

Filling the Gaps

Building a reserve system in the Gascoyne-Murchison region



The area of conservation reserves in Western Australia's Gascoyne-Murchison region is set to treble following the purchase of 1.9 million hectares for new reserves in the last two years.

This is the result of a partnership between the State and Commonwealth governments through the National Reserve System Program of the Natural Heritage Trust, and a group of pastoralists.

By Keiran McNamara, Tony Brandis and Angas Hopkins

A multi-million dollar program is under way to fill the gaps in the conservation reserve system in the Gascoyne-Murchison region of Western Australia. This program will not only help protect the region's unique ecosystems and their associated biota, but will also bring economic benefits. These include cash injections for pastoralists who sell leases but remain on the land as contract managers or pursuing other interests, and earnings from a rapidly growing nature-based tourism industry.

Muggon Station, 216 kilometres north of Mullewa, is an example of the results already achieved. Isolated sections of Muggon were selected as leases in the 1870s and 1880s, and although development was slow because of poor water supplies, the station was running around 9,500 sheep by 1973. However, the 183,000-hectare station also supports 10 land systems, a chain of wetlands and 15 vegetation types. In 1999, the Department of Conservation and Land Management (CALM) purchased the lease and engaged the former lessee to stay on to manage the property. Later this year, the Department will run the first *LANDSCOPE* Expedition to Muggon. A team of expeditioners will pay to visit Muggon and help CALM scientists to gather botanical information. The Western Australian group of Birds Australia is also planning a bird survey of Muggon in September.

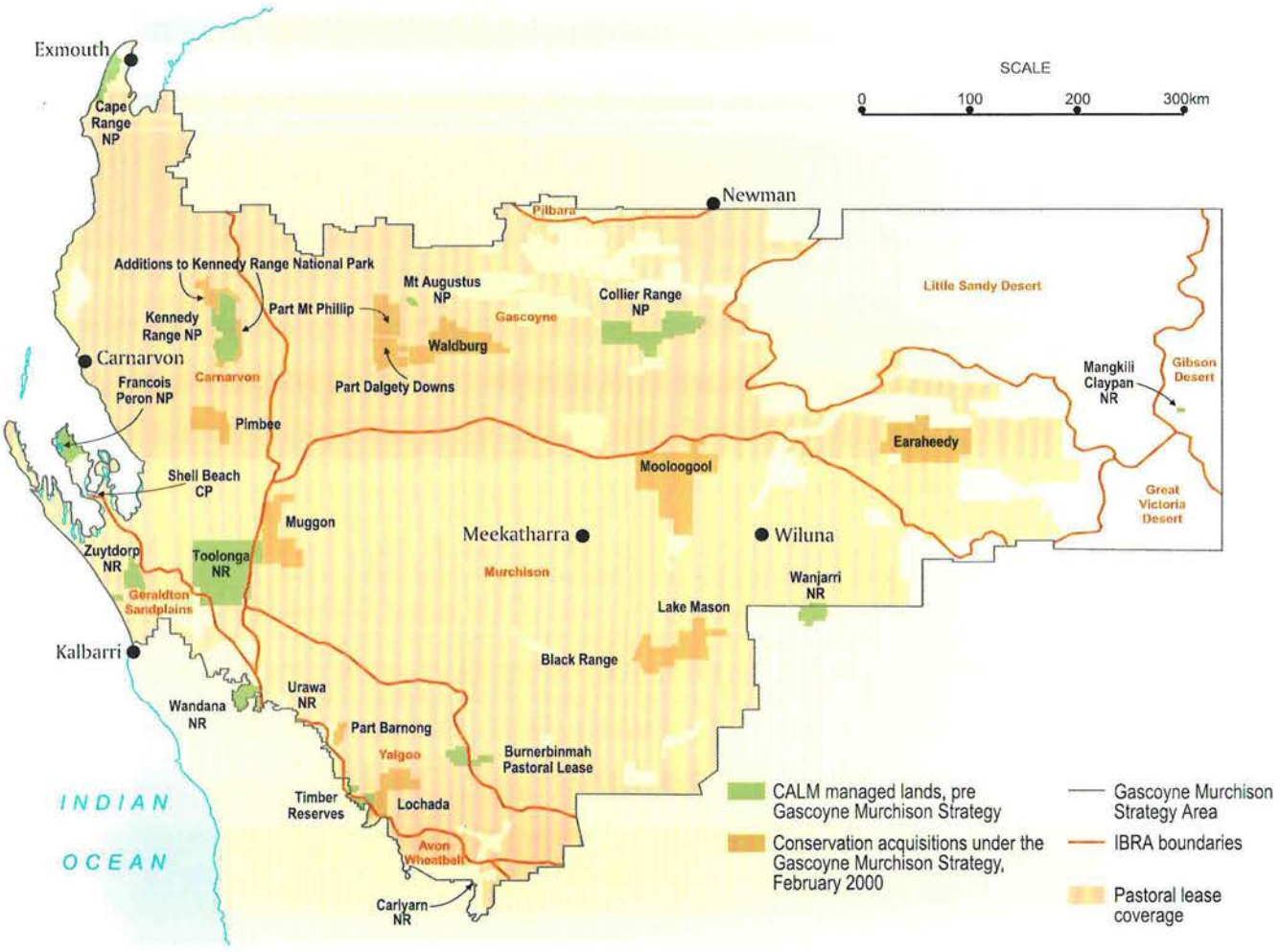
Ecotourism is already being promoted on other leases where accommodation and other services are provided, particularly on properties adjoining Kennedy Range National Park. The park is being extended through the land acquisition program.

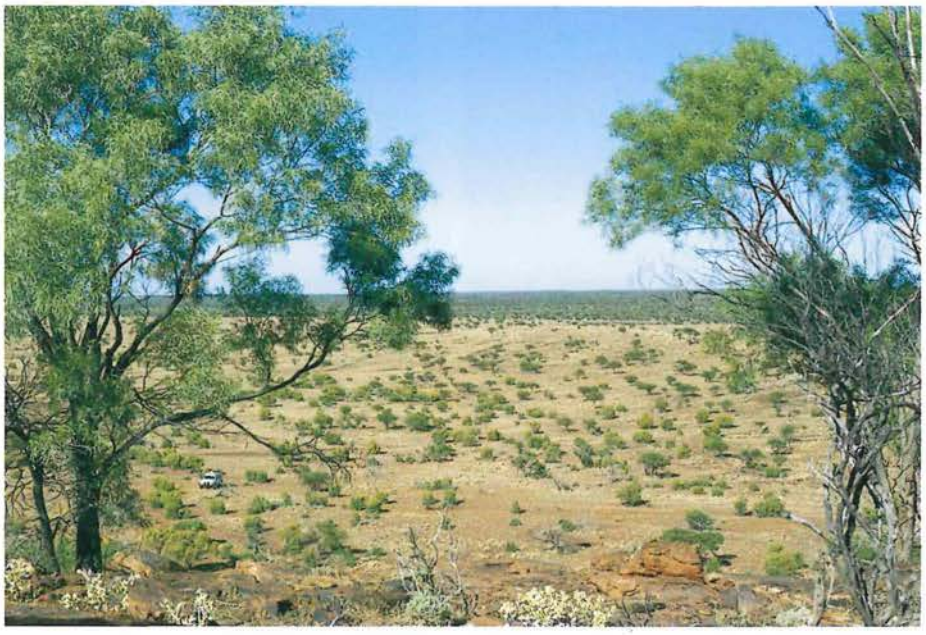
Previous page:
Typical colours of the Gascoyne-Murchison region in mulga scrub near Mt Augustus.
Photo – Bill Bachman

Below: The Gascoyne Murchison Strategy area stretches inland from the coast for a thousand kilometres. The map highlights the recent conservation acquisitions as well as land managed by CALM before 1998.

THE REGION

The Gascoyne-Murchison region covers an area of about 34 million hectares, which includes 253 pastoral leases and unallocated Crown land in the arid interior. The region covers some of the most arid land in Western Australia, but is known to have high biological diversity. A survey of the Southern Carnarvon Basin, for example, has recorded 144 species of indigenous reptiles, 500 species of aquatic invertebrates and more than 2,000 vascular plant species in an area covering only 15 per cent of the Gascoyne-





Right: Siltstone breakaway on Muggon station, one of the pastoral leases recently acquired.
Photo – Sue Patrick/CALM

Centre right: Billabong Mulga Well on Muggon is one of several wells established when the area was a working station. The billabong was flooded as a result of heavy rain earlier in the year.
Photo – Sue Patrick/CALM

Below right: The eastern cliffs of Kennedy Range—the national park in which the range is located is to be extended as a result of further acquisitions.
Photo – Marie Lochman

Murchison region. Research into the original mammal fauna of the survey area revealed that 59 species were present at the time of European settlement.

Despite the diversity of species and ecosystems known to occur there, only three per cent of the region was in conservation reserves when the Gascoyne-Murchison Rangeland Strategy was endorsed by the State Government in 1998. CALM also managed one pastoral lease in the region which it had purchased for reservation.

The Strategy was developed by the regional community and government agencies in response to the declining economic and environmental conditions facing the region's pastoral industry. It set out new approaches to land management to address both issues and ensure the long-term viability of the industry.

The Strategy recognised that some lessees might want to leave the industry, and the need to improve the reserve system through land acquisition. It was envisaged that some 10 to 15 per cent of the Gascoyne-Murchison region would be needed in the reserve system to meet national criteria.

Since December 1998, CALM has purchased eight leases and parts of nine other properties, a total of 1.9 million hectares. Further negotiations with pastoralists over land acquisition are continuing. As leases are acquired, information about each lease is added to a database so that further purchases do not unnecessarily duplicate vegetation units or land systems—each new acquisition will add different

ecosystems to the reserve system. The land acquired to date contains 37 vegetation types that were not previously within the reserve system, and many more vegetation types now have an improved level of representation.

At the same time as the conservation estate is growing, CALM is working with leaseholders to introduce voluntary arrangements to conserve and manage valuable areas on leases, to complement the reserve system. This can be done through formal arrangements under the Conservation and Land Management Act and memoranda of understanding, or through a variety of less formal voluntary arrangements (see 'Rescuing the Rangelands', *LANDSCOPE*, Spring 1997).

Western Australia's rangelands have undergone extensive changes as a result of more than 150 years of pastoral management combined with the introduction of feral animals and plants and altered fire regimes. There are now significant land conservation and range deterioration problems—in the Murchison region, for example, about 42 per cent of the vegetation is considered to be in poor or very poor condition.

CHOOSING NEW RESERVES

Western Australia has been a leader in establishing its conservation reserve system based on the results of detailed biological surveys (see 'Patterns in Nature', *LANDSCOPE*, Summer 1995–96). At the same time, however, there are regions of the State that have not yet been adequately surveyed, and most of these are seriously under-conserved. Most of the Gascoyne-Murchison region is in this category.

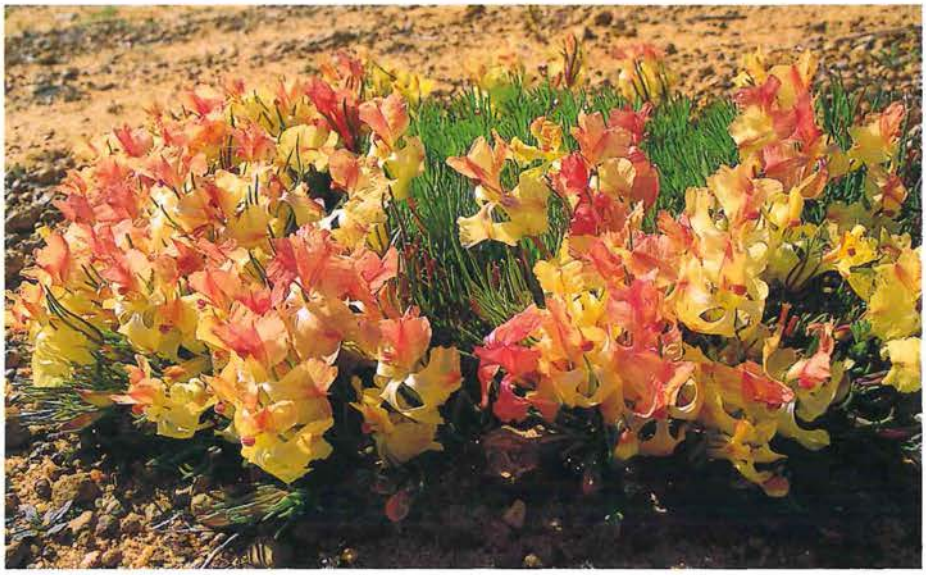
In 1996, a vegetation map database of Western Australia was developed and used to assess the State's conservation reserve system, under a joint project between CALM and Agriculture Western Australia, with financial assistance from the Commonwealth under the National Reserve System Program. The analysis showed the existing reserve system to be inadequate, and highlighted ecosystems and vegetation types that should have priority for acquisition for inclusion in the reserve system. For example, about 90 per cent of the vegetation types had less than 10 per cent of their original area in the reserve system, and about half were not represented at all. Vegetation mapping units are a valuable biodiversity planning tool as they most readily define ecosystems.

This database is being used to design the reserve system for the Gascoyne-Murchison region. The region contains 221 vegetation associations, or 25 per cent of all the associations recorded for the whole State.

Above left: When allowed to reach high population numbers, feral goats can remove virtually all palatable shrub foliage within their reach and suppress the regeneration of these plants.
Photo – Jiri Lochman

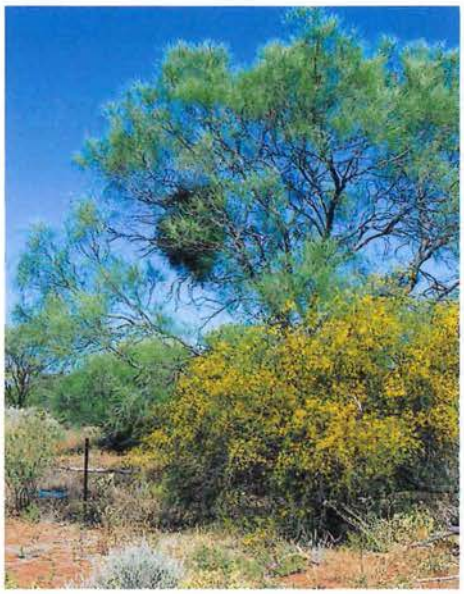
Above right: Botanists surveying a population of a poorly known plant on Muggon.
Photo – Daphne Edinger/CALM

Left: An undescribed wattle found recently on Muggon.
Photo – Sue Patrick/CALM



Right: Wreath lechenaultia (*Leschenaultia macrantha*) bears its flowers at the end of ground-hugging branches that radiate from the central rootstock.
Photo – Neville Passmore

Below right: Drummond's everlasting or pompom head (*Cephalipterum drummondii*).
Photo – Greg Harold



Below far right: Hunchbacked mistletoe (*Amyema gibberula* var. *gibberula*) growing at Muggon on the stems of a *Grevillea* species.
Photo – Sue Patrick/CALM

At the beginning of the acquisition program, fewer than half of these associations were in the region's reserve system and only 19 of those could be considered to be adequately reserved, having 15 per cent or more of their original area in conservation reserves.

Under the 1996 National Strategy for the Conservation of Australia's Biological Diversity and the National Reserve System Program of the Natural Heritage Trust, the Western Australian and Commonwealth Governments have committed themselves to working together to establish a comprehensive, adequate and representative (CAR) conservation reserve system.

The Interim Biogeographic Regionalisation of Australia (IBRA) study was completed to give a framework for establishing a national reserve system. The study identified and described 80 bioregions throughout Australia that help to plan the national reserve system and identify gaps in the existing reserve system. Twenty-six bioregions occur in Western Australia and 11 occur wholly or partially within the Gascoyne-Murchison region. The four main bioregions that make up the Gascoyne-Murchison region (namely Carnarvon, Gascoyne, Murchison and Yalgoo—see map) are all considered to be a high priority for increasing the reserve system.

The vegetation map database can be used to evaluate the comprehensiveness of the reserve system and elements of representativeness. For example, an additional 36 vegetation types have already been acquired for addition to the reserve system, and the number that will be reserved at the level of 15 per cent or more has grown to 29.

CRITERIA FOR A RESERVE SYSTEM

Conservation reserve systems are assessed in terms of meeting the attributes of comprehensiveness, adequacy and representativeness. These terms are defined in the Australian and New Zealand Environment and Conservation Council (ANZECC) 1999 Guidelines for Establishing the National Reserve System as:

- comprehensiveness—inclusion of the full range of ecosystems recognised at an appropriate scale within and across each bioregion;
- adequacy—the maintenance of the ecological viability and integrity of populations, species and communities; and
- representativeness—the principle that those areas that are selected for inclusion in reserves reasonably reflect the biotic diversity of the ecosystems from which they derive.

The terms comprehensive, adequate and representative together capture the desired concept of the ideal conservation reserve system.

In other words, the reserve system is well on the way towards meeting comprehensiveness criteria.

Work to identify high priority ecosystems and environments for acquisition or other types of conservation management continues. A biological survey of the southern Carnarvon bioregion and into the northern Geraldton Sandplains bioregion has just been completed. In addition, a conservation assessment

of the whole of the Gascoyne-Murchison region, drawing together information on geology, soils, topography, vegetation health, and existing biological data is under way. Biodiversity hotspots identified through the survey, and through the conservation assessment, will be targeted for acquisition or other conservation measures, and wetlands listed in *A Directory of Important Wetlands in Australia* will be acquired or managed to protect those special values.

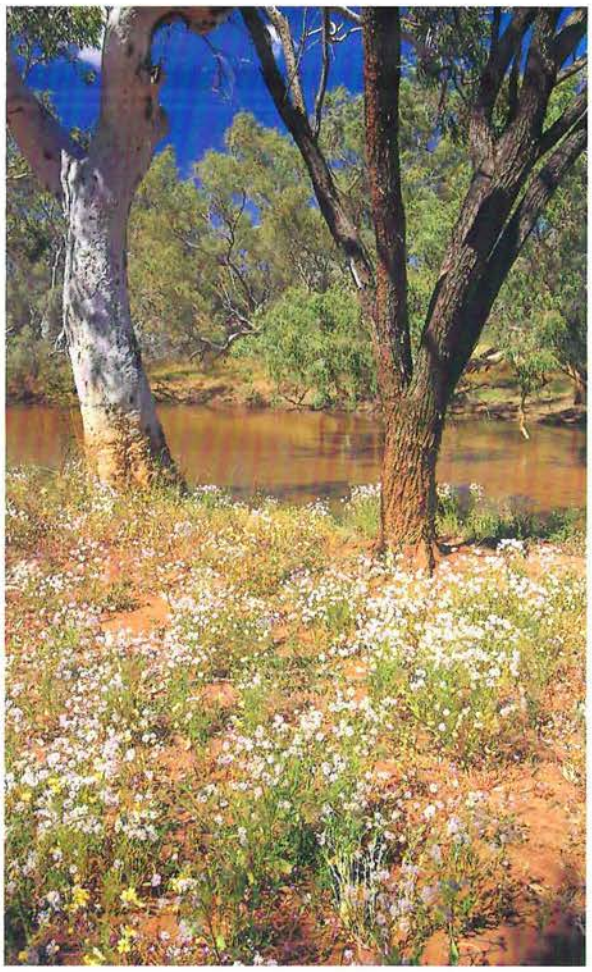
The acquisition program will continue to be implemented progressively over a number of years, with funds from the Commonwealth Government's National Reserve System Program under the Natural Heritage Trust, and from the State Government as part of the Gascoyne-Murchison Strategy.

FUTURE MANAGEMENT

Leases or parts of leases purchased for the reserve system will be managed for conservation, allowing the land to return to its natural state. Depending on previous impacts, some areas may take considerable time to recover. All domestic stock will be removed from acquired areas and stock from neighbouring properties kept from straying onto reserves. Feral animals, such as goats, camels, donkeys, foxes and cats, will be controlled through trapping, shooting or poisoning programs, which CALM will run in collaboration with lessees of neighbouring properties. Once habitats recover and feral animals are controlled, it should be possible to reintroduce locally extinct or rare native animals such as malleefowl, boodies, bilbies, stick-nest rats and hare wallabies.

Left: The wopilkara (or greater stick-nest rat *Leporillus conditor*) is one of the rare native animals that may be reintroduced to the Gascoyne-Murchison once habitats recover and feral animals are controlled.
Photo – Jiri Lochman

Below left: Wildflowers along the Gascoyne River.
Photo – Bill Bachman



Artificial water sources, such as bores and dams, have led to increased numbers of feral animals and kangaroos, which in turn have affected plant communities. Watering points will be closed down once all domestic stock has been removed, in a way that is sensitive to the animal populations that now rely on them for survival. During this adjustment period, it will be important to monitor numbers to ensure that unreasonable grazing pressure does not occur on adjoining leases.

CALM wants to retain people with an interest in conservation and nature-based tourism on the leases purchased. It is generally in the best interests of the community and CALM to have people stay on to maintain homesteads and surrounds, and to help manage the land and control feral animals. By keeping people in the rangelands it is anticipated that services such as telecommunications, roads and mail services will be maintained.

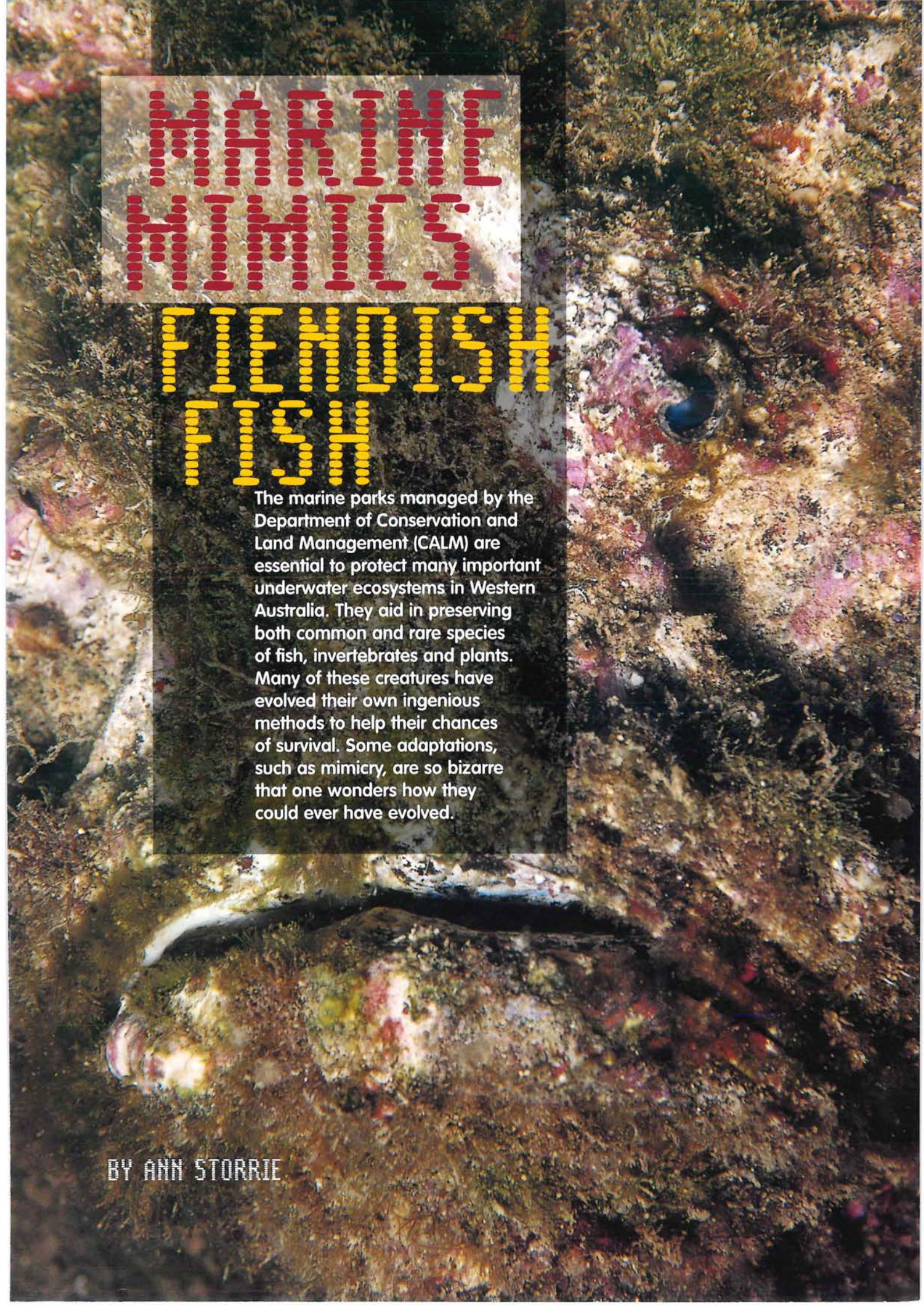
A key feature of CALM's approach will be to continue to consult with the wide range of stakeholders as areas are acquired, reserved and managed. These include pastoralists and their representative organisations, the Gascoyne-Murchison Strategy Board, the Pastoral Lands Board, Aboriginal groups, local government, conservation groups, the mining and tourism industries, and other government agencies.

The restoration of the natural ecosystems and reintroduction of native animals to their former habitats would mean the restoration of nature's balance. It may take a little time to achieve this, but we are already making a difference.

Keiran McNamara is CALM's Director of Nature Conservation and can be contacted on (08) 9442 0302.

Tony Brandis is the rangelands coordinator in CALM's Environmental Protection Branch and can be contacted on (08) 9729 1505.

Angas Hopkins is a principal research scientist in CALMScience Division and can be contacted on (08) 9405 5135.



MARINE MIMICS

FIENDISH FISH

The marine parks managed by the Department of Conservation and Land Management (CALM) are essential to protect many important underwater ecosystems in Western Australia. They aid in preserving both common and rare species of fish, invertebrates and plants. Many of these creatures have evolved their own ingenious methods to help their chances of survival. Some adaptations, such as mimicry, are so bizarre that one wonders how they could ever have evolved.

BY ANN STORRIE

To look like something you are not is one of the animal kingdom's greatest adaptations for survival. To be inconspicuous within one's surroundings, or to mimic another species that is harmful or unpalatable, is often the key to an animal's success, especially in the sea. Mimics may wish to hide from predators, or to render themselves invisible to the creatures on which they feed. Others are highly visible and encourage their prey to come to them.

Whether you dive in the Rowley Shoals Marine Park in the north, or in the Archipelago of the Recherche in the Southern Ocean, if you look carefully, you will find a mimic. Some fish have taken on the appearance and shape of another fish species that is very successful at surviving. One such species that is found from the Shark Bay Marine Park northwards is the false cleanerfish (*Aspidontus taeniatus*). This fish mimics the cleaner wrasse (*Labroides dimidiatus*). The real cleaner wrasse is a conspicuous, dainty little fish, which darts around the bodies and heads of large, predatory fish. With relative immunity, it can enter the mouths and gill chambers of these predators to gently pick off parasites, thus providing a cleaning service that is respected and sought after by many of the reef's inhabitants. The false cleanerfish, however, is not even a wrasse, but a blenny with enlarged fangs in its lower jaw. It resembles the cleaner wrasse almost perfectly in shape, size and colour. Even its juvenile stage displays the darker blue and broader black stripe of the young cleaner wrasse. The blenny's swimming motion also mimics the wrasse's jerky movements. Fish that approach the blenny expecting an enjoyable cleaning session will suddenly lose a chunk of skin, scales or fin!

A less aggressive marine mimic is the saddleback leatherjacket (*Paraluteres prionurus*). It looks like Valentin's pufferfish (*Canthigaster valentini*) which, like all pufferfish, contains a deadly toxin in its flesh. Predators recognise this fish by its bright, distinctive markings, and avoid eating it. By looking like the pufferfish, the leatherjacket is mistaken for the inedible species, and left alone. This tactic is also used by several species of fish that mimic the sabretooth blennies. As the name suggests, sabretooth blennies have large teeth in the lower jaw. They appear to be used mainly for defence. If you look like a sabretooth, predators are more likely to leave you alone.

Previous page
The venomous stonefish looks for all the world like a rock, especially as it remains remarkably still for long periods.

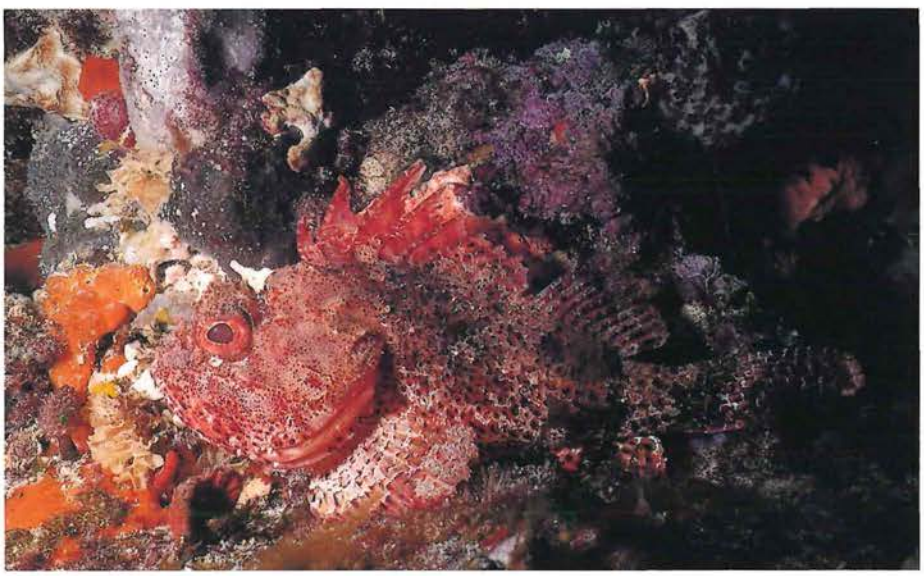
Above: The sea whip goby aligns itself flat against the sea whip. Often, its eyes are the only parts that give it away.

Left: Are these Valentin's pufferfish or saddleback leatherjackets pretending to be the inedible pufferfish?
The leatherjacket has a dorsal spine, but it is often difficult to see if it is laid flat on the back.
Photos – Ann Storrie

BLENDING IN

Unlike fish that copy other fish, most mimics use camouflage to blend into their surroundings. Many fish look similar to plant leaves, algae, corals, sponges or rocks. The estuarine stonefish (*Synanceja horrida*), with its venomous spines, occurs from the Shark Bay Marine Park northwards. It blends into the reef so well that it is rarely seen by divers, and unfortunately for the diver or wader, it is sometimes trodden on. These stonefish have a tough, warty skin that resembles rocks and rubble. Their skin secretes a sticky mucous to which sand, mud and silt adheres, thus enhancing its camouflage. In addition, the stonefish often partially buries itself, with only its head, mouth and the top of its body protruding above the sand. Its swivelling eyes sometimes reveal its presence to perceptive divers. The stonefish may remain buried and almost motionless for days at a time, and it can even skip breath when prey approaches. When it strikes, it does so with a remarkably swift, upwards movement that takes the prey totally by surprise.

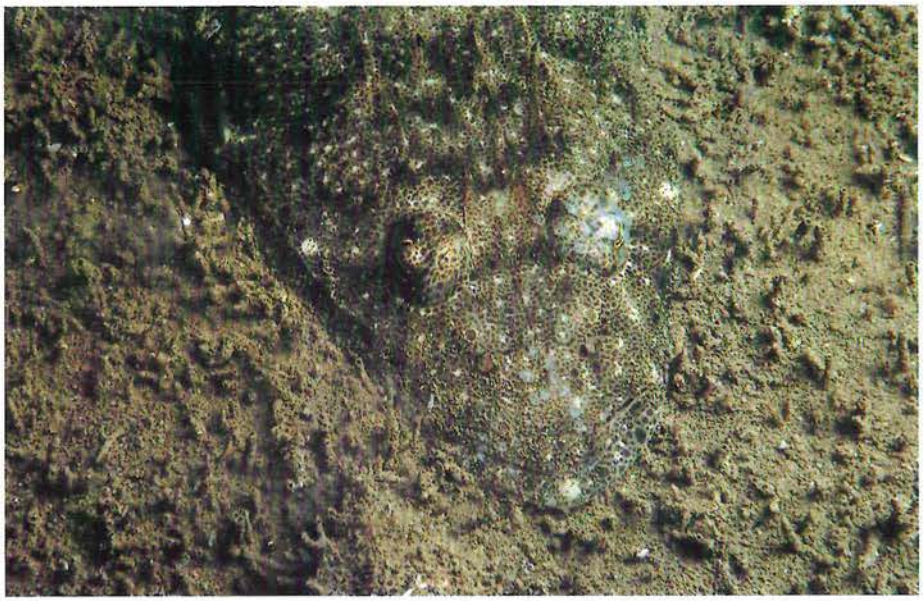
Like the stonefish, all members of the scorpionfish family blend into their surroundings. Many, however, are brightly coloured with what is often called disruptive coloration. The colours are designed to match the sponges, ascidians and algae of the reef. The mottled patterns also help to break up the fish's outline. Many scorpionfish possess fleshy extensions, or weed-like appendages on their body and fins. This gives them an irregular texture like the underwater surface on which they rest. Some are very common in the Marmion Marine Park and around Rottnest Island. The large western red scorpioncod



Above: This flounder can barely be distinguished from the sea floor.

Above right: Glauert's anglerfish is so similar to a sponge that divers have even poked it and not recognised it as a fish. Ironically, it can engulf prey faster than any other vertebrate on Earth.

Right: The western red scorpioncod is very common in local waters, but it is not always easily seen on the colourful reef.
Photos – Ann Storrie



(*Scorpaena sumptuosa*), for example, can perch on top of the reef, yet remain almost invisible to its prey and passing divers. It is always wise to watch where you place your hand if resting it on the reef.

Flatheads are bottom-dwelling fish that spend most of their time lying on the seabed, buried under a fine layer of sand or silt. Along with this protection, flatheads possess special pigment-laden cells called chromatophores. These are found in the skin and enable the fish to change colour to suit the underwater surface upon which they land. Flatheads also have a special membrane over their eyes. It is a mottled, web-like net that helps to camouflage the eyes, which protrude from the sand to watch for prey. This beautiful membrane is like a fingerprint in that it's pattern is unique to each fish.

Flounders have evolved a unique way to watch their prey while lying on their side. These fish bury themselves on their side, which is almost flat and easy to cover with sand. Most fish, of course, have eyes on either side of the head. So do the larvae of flounders and other flatfish. As the larva matures, however, one of the eyes gradually moves either around, or through, the head. The result is that both eyes end up on the same side of the body. Some species have eyes on their left sides, others on their right. When the flounder buries itself with the eyes' side up, its two tiny, beady eyes swivel in all directions to watch for both prey and predators.

SPONGE OR SILENT PREDATOR?

One of the most highly evolved examples of mimicry is seen in the anglerfish. Glauert's anglerfish is sometimes seen under the Busselton

Top left: Flatheads, like flounders, bury themselves in the sand and are a similar colour to their surroundings.

Centre left: Even when pipefish are in the open water, they are still quite difficult to see when close to the reef, as they are so thin.
Photos – Ann Storrie

Left: Unless you look carefully, the leafy seadragon looks like a piece of floating seaweed.
Photo – Peter & Margy Nicholas/Lochman Transparencies

Jetty. Its colour, texture, behaviour and structure so perfectly resemble a sponge that divers have been known to poke and prod it, and still not recognise it as a fish. The anglerfish can be bright orange, yellow, black or almost any colour to match the surrounding sponges. Its skin is pitted with large and small cavities like a sponge, and its modified fins resemble little feet and stabilise it on the reef. These fins are often covered with a growth of algae to aid camouflage.

As their name suggests, anglerfish attract their prey with a lure. The lure is an extension of the first spine of the dorsal fin, and it is like a tiny rod with a 'bait', known as the esca, on the end. Even the esca looks like something that it is not. In our local anglerfish, it resembles a piece of floating tissue, but other species have escas that mimic polychaete worms, shrimps or tiny fish. The anglerfish manipulates the esca to simulate the natural swimming motion of the creature that it mimics. When the prey approaches to take the lure, the anglerfish opens its enormous mouth and sucks the prey in. Most anglerfish can enlarge their mouth by a factor of 12, and can do so in about six milliseconds. The negative pressure created by the expansion of the mouth and gill cavity sucks water and prey in. This gives the anglerfish the distinction of being the fastest vertebrate predator on Earth!

BODY POSTURE

Body posture is used by some species to mimic their surroundings. The fish assumes a position that makes it less likely to be seen against its background. Pipefish are good examples. Some species swim in a vertical position, and this, together with their elongated shape, allows them to resemble the seagrass in which they live. Others curl around the reef to take advantage of their colours, which are similar to the surrounding invertebrates. Tiny 'sea whip' gobies always lie flat along the sea whip, or stem, of a gorgonian coral. If you come too close, they quickly whip around to the other side, blending in perfectly with the colour of the gorgonian.

Possibly the most successful marine mimic is the leafy seadragon (*Phycodurus eques*), also a member of the pipefish and seahorse family.

The sponge-like appearance of the anglerfish makes it easier to tempt prey with its dangling lure.
Photo – Ann Storrie

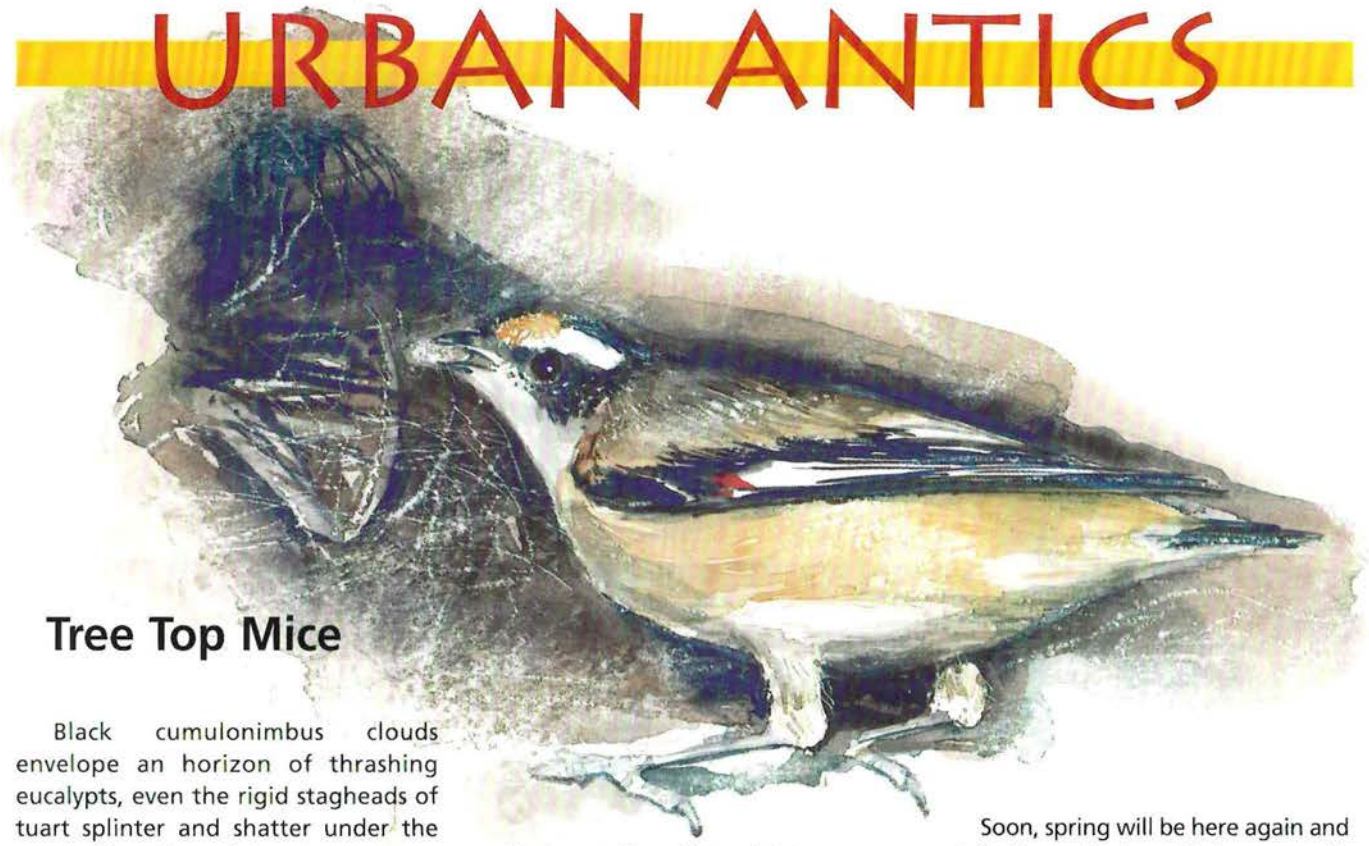
Seadragons are fish with tube-like snouts and bony plates, instead of scales, on their bodies. They have many leaf-like appendages that resemble seaweed. The leafy seadragon has evolved to such perfection that sometimes small fish will hide among them, mistaking them for weed. The dragons drift near real seaweed, gently floating back and forth in the current. Buoyancy control is thus very important, and these fish must fill their swim bladders with air from the surface when they first emerge from the egg.

Like all members of their family, seadragon males carry and incubate the eggs until they hatch. During mating, the female leafy seadragon lays between 100 and 250 eggs on the underside of her partner's tail. Here, they are fertilised and incubated in a 'brood pouch', which is a wrinkled area of cup-like indentations under the tail. The young hatch as well-developed miniatures of their parents, except that their leafy appendages take a few weeks to develop.

Leafy seadragons are totally protected in Western Australia. They are found only in southern Australian waters, from Lancelin in Western Australia to Wilsons Promontory in Victoria. If you find one, please don't disturb it, or take it to the surface to show your friends. Its swim bladder may rupture. Of course, if you do find one, you are among very few lucky divers who have seen one in the wild. Take the time to marvel at its shape, form and movement. Watch as its tiny snout darts forward to catch small shrimps and other planktonic animals. But if you take your eyes off it for a second, it will vanish in the weed. The leafy seadragon is a masterpiece of mimicry in the sea.

Ann Storrie is a freelance writer and underwater photographer. She has co-authored two full-colour books (*The Marine Life of Ningaloo Marine Park and Coral Bay* and *Wonders of Western Waters: the Marine Life of South-Western Australia*), which also feature many of her photographs. Both books are published by CALM. Ann can be contacted on (08) 9385 9355.

URBAN ANTICS



Tree Top Mice

Black cumulonimbus clouds envelope an horizon of thrashing eucalypts, even the rigid stagheads of tuart splinter and shatter under the onset of another winter storm.

In the valleys of the coastal districts, very large, long-dead trees containing invaluable nesting hollows, nooks and crannies, finally succumb to the forces of nature and thunder to the Earth, eventually to become the fodder of termites.

Among the voluminous canopies of marri, tuart and garden trees, passerines (or perching birds), drenched in the torrent of wind and rain, tighten their vice-like grip on bark and branch and prepare for a seasonal ride of violence.

One of the smallest passerines currently enduring the metropolitan winter is the spotted pardalote (*Pardalotus punctatus*). This tiny, dark-coloured, white-spotted bird about 10 centimetres long usually frequents the southern cooler eucalypt forests, but is now in its seasonal visit around Perth.

Also to be seen is the slightly bigger striated pardalote (*Pardalotus striatus*), which is more common around Perth during spring and summer, but shifts to open woodlands in the north and inland areas in winter. Its appearance is quite different to the spotted species by having a black crown usually streaked with white, a very stubby black tail, black wings with a white stripe and a bright yellow stripe above the eye.

Four species of pardalotes occur throughout Australia. The spotted and striated pardalotes contain several subspecies and, where subspecies overlap breeding ranges, there may be some resultant hybridisation within each species.

The migratory wandering of all pardalotes is attributed to the availability of favourite food types. As foliage-gleaning birds that feed almost exclusively in eucalypts, they have long legs and hop, run and creep though high foliage like mice. They are rarely seen as they fly bullet-like, and usually at least twice the height of the tallest trees, as they migrate.

During the warm placid days of spring and summer, the incessant sounds of *'chip-chip, chip-chip'* by striated pardalotes have resulted in the occasional name, 'headache bird'. In preparation for nesting, they have been observed to climb house walls and enter open kitchen windows in search of spider webs, while the occupants sit to lunch.

In the precinct of CALM's Wildlife Research Centre at Woodvale, a striated pardalote nested in a branch hollow some three metres above the ground. To the delight of staff, chicks were heard. However, a week later, a black-tailed monitor lizard (*Varanus tristis*) was observed protruding from the now silent hole. Such is life.

Soon, spring will be here again and while the spotted pardalotes presently clutch for dear life among the storm-tossed tree-tops, the coming of sunny days and spring will herald their departure to the south and the arrival of their striated cousins.

Keep your eyes peeled and follow the *chip-chip*. Eventually, you'll spot the 'tree-top mice'.

BY JOHN HUNTER

DID YOU KNOW?

- *Pardalotes have scoop-shaped bills and use them to prise sugary lerps—the white scaly coating of psyllid insects—from leaves and to pick up other small insects and grubs from twigs.*
- *Spotted pardalotes generally prefer to nest in ground burrows, while striateds prefer a high trunk hollow.*
- *While pardalotes are keen to attack others that encroach their nest sites, they are in turn often chased by aggressive honeyeaters. Watch your garden for the 'David and Goliath' show.*

A treasure trove of *LANDSCOPE!*

Back Issues of Western Australia's premier conservation quarterly!

VOLUME 5


Spring 1989
(Summer 1989–90 and Autumn 1990 out of stock)


Winter 1990

VOLUME 6


Spring 1990


Summer 1990–1991


Autumn 1991


Winter 1991

VOLUME 7


Spring 1991


Summer 1991–1992


Autumn 1992


Winter 1992

VOLUME 8


Spring 1992
(Summer 1992–93 out of stock)


Autumn 1993


Winter 1993

VOLUME 9


Spring 1993


Summer 1993–1994


Autumn 1994


Winter 1994

VOLUME 10

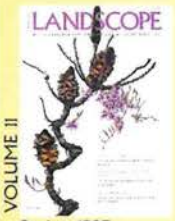

Spring 1994


Summer 1994–1995


Autumn 1995


Winter 1995

VOLUME 11


Spring 1995
(Winter 1996 out of stock)


Summer 1995–1996


Autumn 1996

VOLUME 12


Spring 1996


Summer 1996–1997


Autumn 1997


Winter 1997

VOLUME 13


Spring 1997


Summer 1997–1998


Autumn 1998


Winter 1998

VOLUME 14


Spring 1998


Summer 1998–1999


Autumn 1999


Winter 1999

VOLUME 15


Spring 1999


Summer 1999–2000


Autumn 2000


Winter 2000

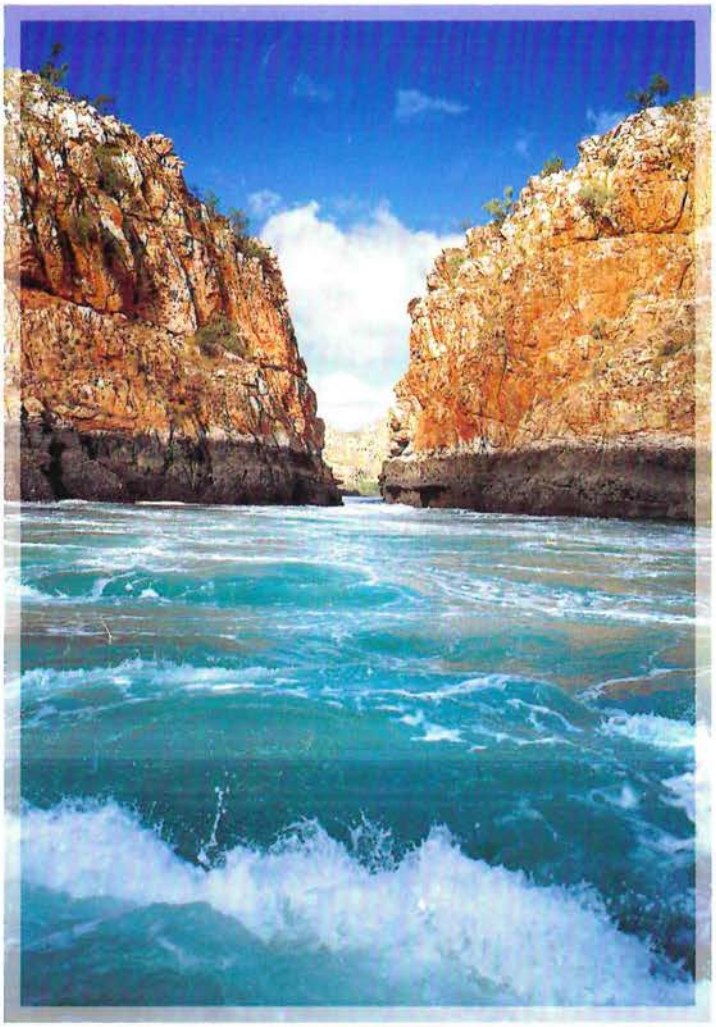
VOLUME 1: June 1985, December 1985 *(September 1985 and March 1986 out of stock)*
VOLUME 2: June 1986–Winter 1987 *(Summer 1986–87 out of stock)*
VOLUME 3: Spring 1987–Winter 1988 *(Summer 1987–88 and Autumn 1988 out of stock)*
VOLUME 4: Spring 1988–Winter 1989 *(Spring 1988 out of stock)*

Attractive *LANDSCOPE* binders (store 8 issues per binder)

Complete the order form inserted in this issue of *LANDSCOPE* and send it to us.
Issue prices listed on order form.
Postage: 1–2 issues $2.50, 3–4 issues $5.00, 5+ issues $7.00.

Phone (08) 9334 0481 to check availability.
We accept VISA, MASTERCARD, BANKCARD and *LANDSCOPE* Conservation Card for payment.

CALM Publications
DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Locked Bag 29, Bentley Delivery Centre, WA 6983.
Tel: (08) 9334 0333. Fax: (08) 9334 0498. TTY (hearing impaired) facility available (08) 9334 0546. Order online at http://www.calm.wa.gov.au



Horizontal waterfalls.
See the same scene depicted in Ken Done's painting on the front cover.

Photo – Col Roberts/Lochman Transparencies

ISSN 0815-4465
9 770815 446041

PRINT POST APPROVED PP665002/00004