WA's conservation, parks and wildlife magazine

LANDSCOPE

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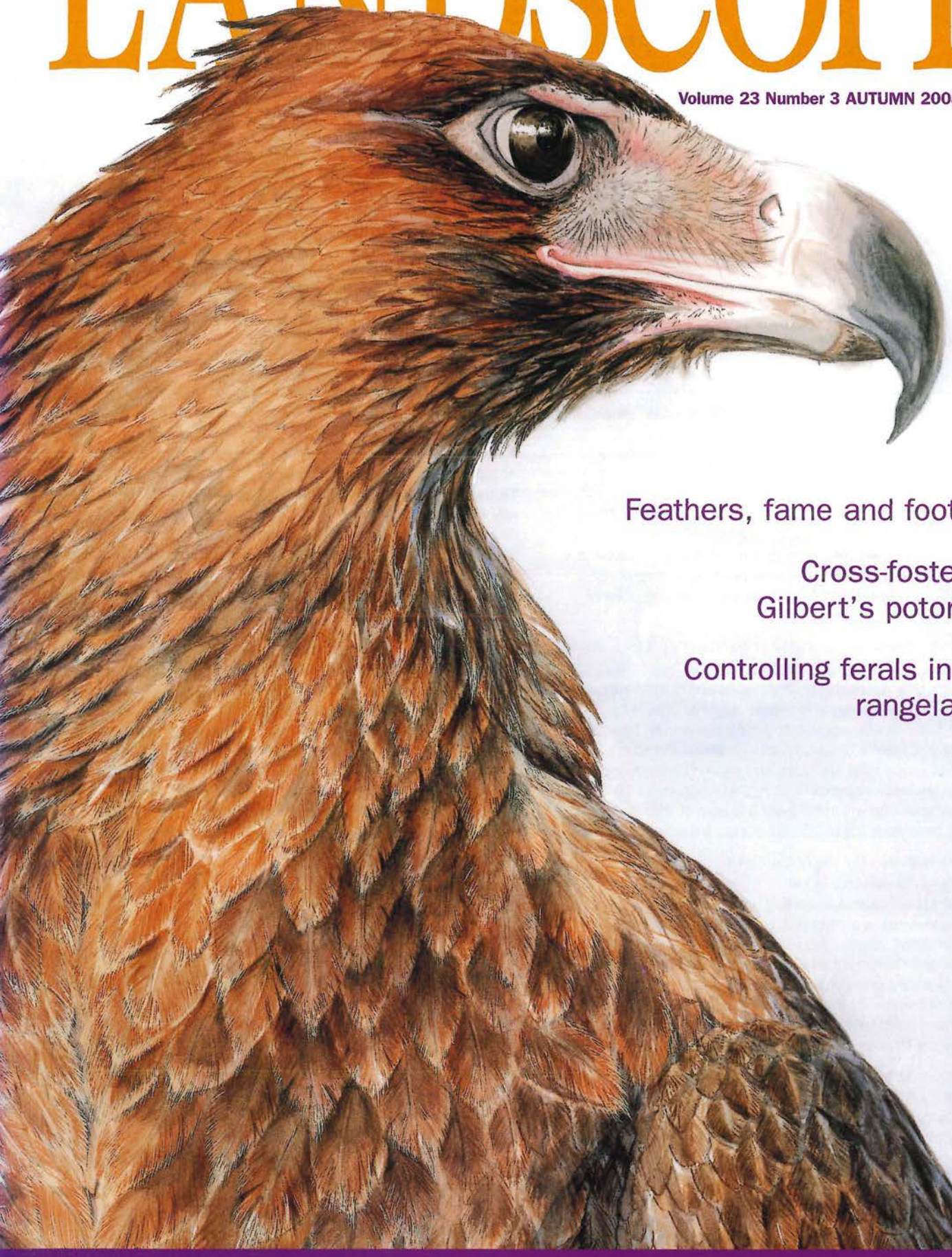


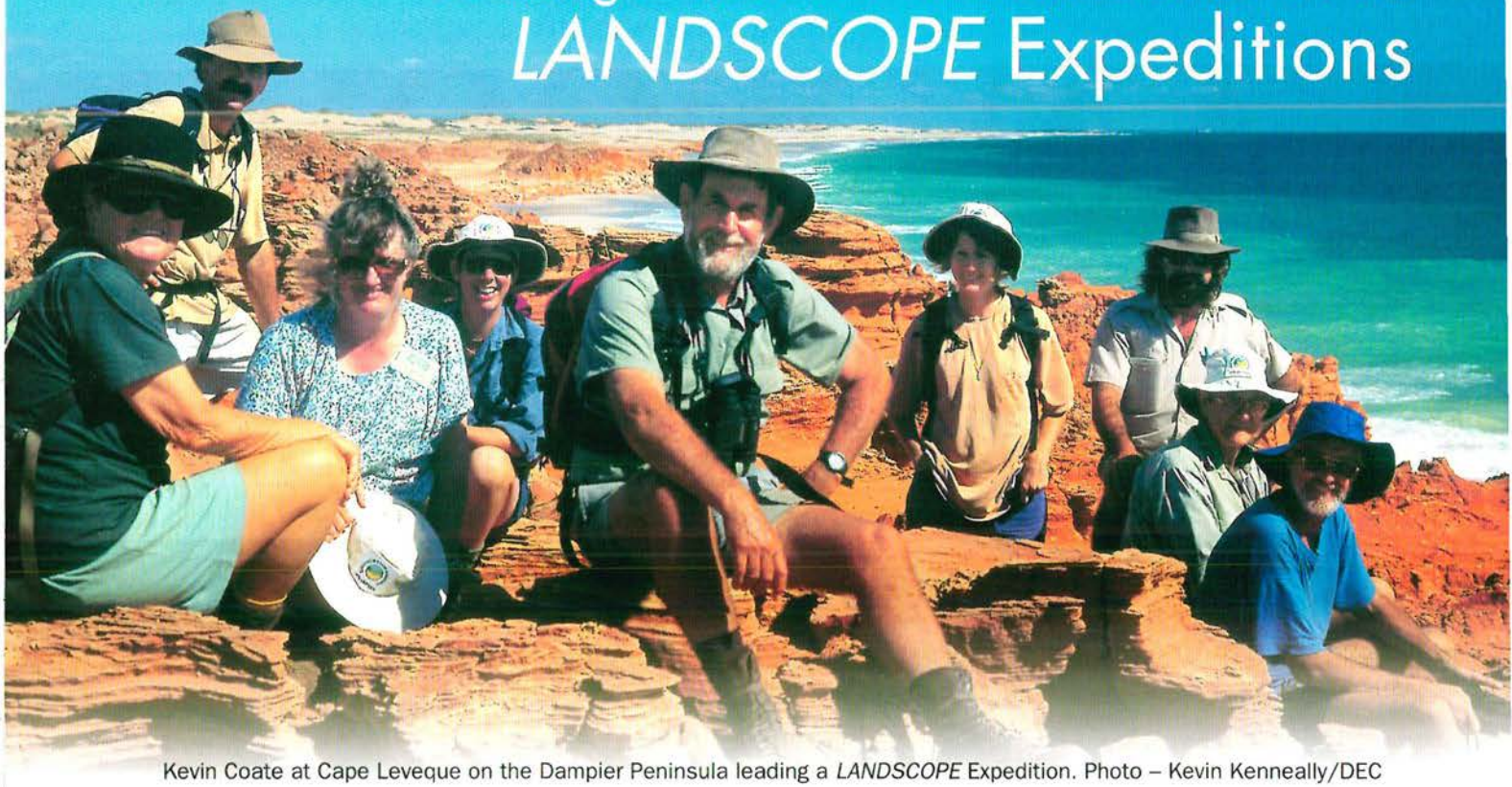
Feathers, fame and football

Cross-fostering Gilbert's potoroos

Controlling ferals in the rangelands

Wungong Regional Park **Eighty Mile Beach** Hammer orchids

Making a world of difference since 1992
LANDSCOPE Expeditions



Kevin Coate at Cape Leveque on the Dampier Peninsula leading a *LANDSCOPE* Expedition. Photo – Kevin Kenneally/DEC

Birds of the Tanami Desert - Ornithological investigations at Paruku (Lake Gregory)

Paruku (Lake Gregory) 29 June–7 July 2008

Paruku (Lake Gregory), in the Tanami Desert, is home to 73 species of waterbird and is an important stopover for 16 migrant shorebirds. Join Kevin Coate, one of Western Australia's foremost naturalists, in this expedition to observe migrating waterbirds and to determine major waterbird breeding activity areas. Tag-alongs are welcome.

Desert Tracks - Animals and plants of the Canning Stock Route

Canning Stock Route 10–22 August 2008

Experience the true Australian outback while conducting important research into desert ecology and biodiversity. For scientists, the Canning Stock Route represents a long biodiversity transect through several different biogeographical regions. Discover local fauna and flora, map fire scars and search for evidence of introduced predators while experiencing the magnificent Australian desert. This expedition will investigate the area of the Canning Stock Route from wells 23 to 35. Tag-alongs are welcome.

A Brush with Nature - The art of the flower hunters

Thundelarra 8–17 September 2008

Discover the art of botanical painting with botanical artist Katrina Syme at Thundelarra, a former pastoral lease being managed for its conservation values. You will also assist Department of Environment and Conservation (DEC) scientists establish flora monitoring quadrats and compile a field herbarium for the area. This is a rare opportunity to combine scientific research and botanical observations with the tradition of botanical illustration in an area world famous for its wildflowers.

In the Tracks of Len Beadell - The plants and animals of the Neale Junction Nature Reserve

Great Victoria Desert 28 September–11 October 2008

Len Beadell explored and opened up more than 2.5 million square kilometres of rugged Australian outback. This project seeks to improve our understanding of the geographic distributions of the biota that inhabits the Great Victoria Desert. We will be surveying the plants and animals in the Neale Junction Nature Reserve, which lies where two of Len Beadell's tracks meet. Tag-alongs are welcome.

Researching the Recherché - Wildlife of Southern Ocean islands

Middle Island, Recherché Archipelago 20–27 October 2008

From Esperance to Israelite Bay on the south coast of WA there are more than 100 islands and 1,500 islets that make up the Recherché Archipelago. The largest of these is Middle Island, where this expedition will be based. This expedition will conduct searches for rare flora and observe and record small mammals, reptiles, seabirds, seals and sea lions. Join DEC scientists on a journey to undertake research into the wildlife of these remote and relatively untouched islands.

Sanctuaries of the Sea - Wildlife of the Montebello Islands

Montebello Islands 5–12 October 2009

The Montebello Islands are home to many native animals severely affected by introduced predators, which arrived at the turn of the century. DEC has removed these threats to enable the recovery of native species. Join scientists in searching for boodies, mala, golden bandicoots and Shark Bay mice and discover the history of this magnificent marine sanctuary.

Request your copy of the *LANDSCOPE* Expeditions 2008 Program:

call – (08) 6488 2433
fax – (08) 6488 1066
email – extension@uwa.edu.au

or write to *LANDSCOPE* Expeditions
The University of Western Australia
35 Stirling Highway,
Crawley, Western Australia 6009

or visit DEC's website at
www.naturebase.net

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contributors

Judy Davidson is a Marine Conservation Planner with the Department of Environment and Conservation's (DEC's) Marine Policy and Planning Branch in Fremantle. Since starting work with DEC in 2000, Judy has held various roles in marine conservation research, policy and planning. She now coordinates the planning of marine parks and reserves in the Pilbara and Eighty Mile Beach regions. In 2005–2006, Judy took a 12-month volunteer position with the Mekong River Commission in Vietnam. She worked with Vietnamese Government staff and local fish farmers' organisations on co-management of water resources. This valuable experience has given Judy an appreciation for Western Australia's biodiversity and a keen interest in building partnerships with local communities on marine conservation issues.

Shannon Armstrong has been a Research Scientist with DEC's Marine Science Program in Kensington since mid-2006. In 2005, she completed first class honours at Southern Cross University, NSW. Shannon is currently working on the design and implementation of long-term marine monitoring programs for the proposed Dampier Archipelago Marine Park, the Ningaloo Marine Park and the metropolitan marine parks. Shannon's research interests include coral reef ecology and the design of long-term marine monitoring programs.

Ian Radford is DEC's Kimberley Region Fire Ecologist. His research interests range from invasive plant biology to fire and community ecology and, in the Kimberley, include the decline of small and medium-sized mammals, and the relationship between this decline and severe fire regimes. He has also worked in New South Whales, north Queensland and the South Island of New Zealand.

Gooitzen van der Meer has been a Senior Graphic Designer with DEC's *LANDSCOPE* team for the past 12 years. He is particularly passionate about designing and illustrating *LANDSCOPE*'s regular 'Urban Antics' feature (see page 62). Gooitzen has designed the books *North West Bound*, *Urban Antics* and many titles in the popular BushBook series. He says working in the DEC graphics team offers plenty of variety and challenges.

editor's letter

Passion and intrigue, deception and disappointment. They are words more likely to be associated with the spiel on the back of the latest fiction best seller than the introduction to a magazine about Western Australia's conservation, parks and wildlife. But, they can be applied just as easily to much of what occurs every day in nature and feature in so many of the reports from people involved in projects to conserve our natural environment.

Every edition of *LANDSCOPE* unearths more of these fascinating stories with nature providing some extraordinary twists and turns in complex plots. They are found in the earliest reports from the State's first explorers to the findings of the latest scientific research. And, these intricate tales come to us with the backing of carefully checked and evaluated scientific research.

Look no further than nature for an example of true enticement and deceit. A feature in this edition, 'Hammer orchids with a waspish attraction', is an article on WA's hammer orchids, one of 400 orchid species found in WA. While even the story of their discovery and history since the 1800s has been one of dispute and confusion, recent research has shown the orchids to be masters of the art of deception in the way they entice male wasps to aid their pollination. The poor male wasps are deceived not only by the looks of the orchid, but are initially drawn to it by a scent the orchid gives off that mimics the sexually attracting odour of the female wasps.

The research highlights the reliance of different parts of nature on each other—the conservation of the wasp is important to the conservation of the orchids. It's a theme also highlighted in the article 'Fire in the Kimberley', which looks at fire management in the north-west of Australia. Global research suggests that, without fire, tropical savannas throughout medium and high rainfall areas would convert to forest. However, there is a concern that too many fires in the wrong season may be the leading cause for the decline of many Kimberley mammals.

Other articles in this edition include a look at some of the wonderful marine treasures in the Dampier Archipelago, where a scientific monitoring program has started before the area is declared a marine park. Another report takes us to the Pilbara and Eighty Mile Beach regions and looks at the many features that make the need for more integrated marine planning and management in the area so vital.

Not so remote, but still offering wonderful opportunities to see a variety of landscapes and some unique plants and animals, is the Wungong Regional Park at the edge of the Darling Scarp near Perth. The park has much to offer visitors and locals alike, from intriguing stories of bushrangers and their hideouts in the hills to rare plants and animals.

And, for those with a passion for football at this time of the year, turn to the article on the rehabilitation and protection work being done at Whiteman Park. Auzzie, the wedge-tailed eagle famed for entertaining visitors at the park and its association with the West Coast Eagles Football Club, is one of the star features at the park's Western Australian Birds of Prey Centre.

Kaye Verboon
Executive Editor

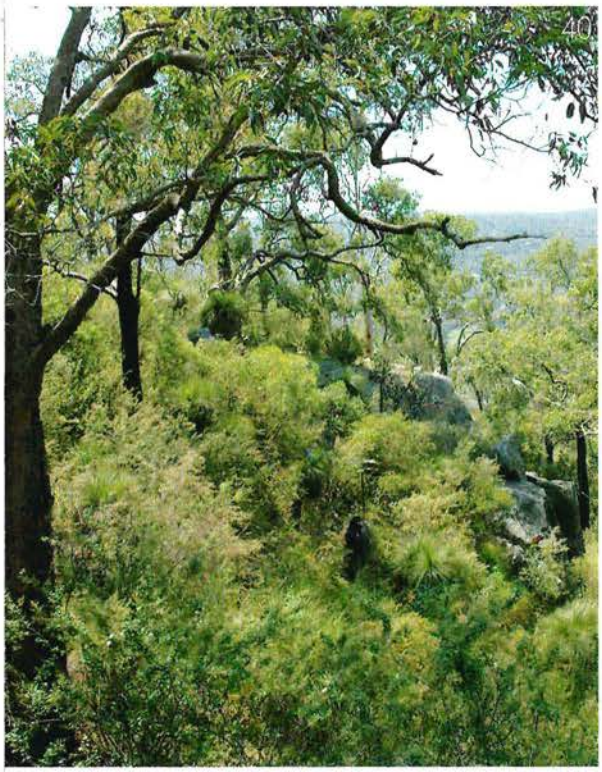
also contributing....

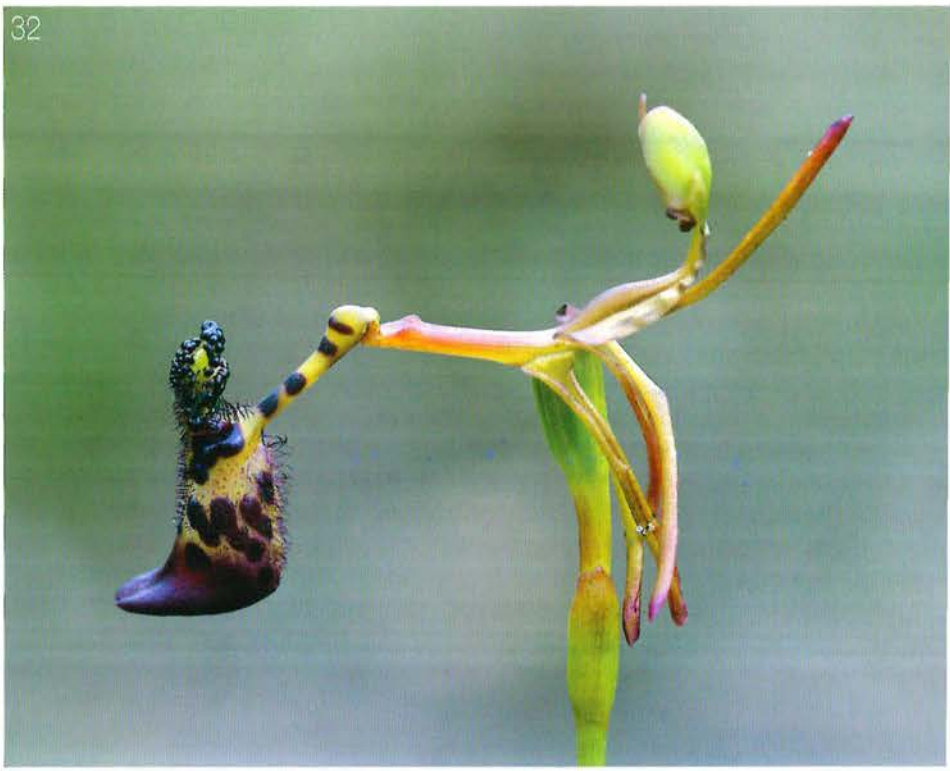
Kevin White, Paul Burns, Jacqui Richards, Dave Algar, Anne Cochrane, Andrew Brown, Stephen Hopper, Elise Carr, Samille Mitchell, Carolyn Thomson-Dans, Rebecca Hayes, John Hunter, Joanna Moore and Tony Friend.

Cover illustration by Philippa Nikulinsky
Wedge-tailed eagles (*Aquila audax*) are renowned for their huge wing span of up to 2.5 metres. These magnificent birds hunt by high-soaring flight, circling on the thermals and sailing across the skies before swooping upon prey such as small mammals, birds or reptiles. Wedge-tailed eagles conduct acrobatic aerial displays during the breeding season, the male diving upon the female. Both sexes tend to their giant stick nests, which the male lines daily with fresh leaves while the female is incubating and breeding. Wedge-tailed eagles occur across most of Australia.

Back cover photo by Dennis Sarson/ Lochman Transparencies
Wungong Regional Park.

Features





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Department of Environment and Conservation
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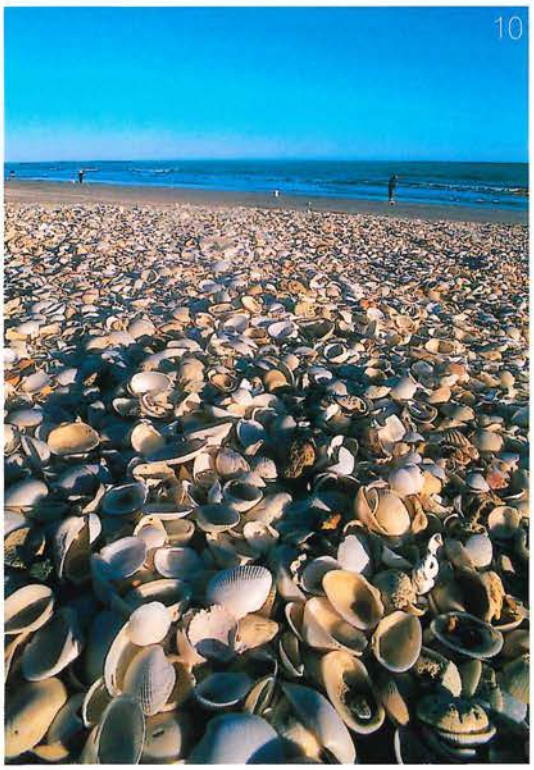


Above Female Gilbert's potoroo with a juvenile.
Photo – Jiri Lochman

Opposite page
Top right Gilbert's potoroo pouch young still attached to its mother's teat.
Above right The teat of a long-nosed potoroo foster mother is inserted into the mouth of a juvenile Gilbert's potoroo.
Right A successfully reared Gilbert's potoroo after exiting its long-nosed potoroo foster mother's pouch.
Photos – Tony Friend/DEC

In late 1994, the exciting news of the rediscovery of Gilbert's potoroo (*Potorous gilbertii*), a small rat-kangaroo thought to be extinct by the early 1900s, hit the headlines. This one-kilogram animal, which had only been known from a few specimens collected on the south coast of Western Australia, had clung to life in a tiny population on the slopes of Mount Gardner, in Two Peoples Bay Nature Reserve east of Albany.

Immediately, a captive Gilbert's potoroo colony was established at Two Peoples Bay Nature Reserve to insure these precious mammals against a large wildfire in the habitat—just a single lightning strike and consequent wildfire could have wiped them out. The captive colony would also enable the potoroos to be bred for translocation to new sites and thus increase their chances of long-term survival.

Staff from the then Department of Conservation and Land Management (now Department of Environment and Conservation) also started a program of searches for potoroos along the south coast. The team was later complemented by a community project instigated by the Denmark Environment Centre and funded by the WWF Threatened Species Network. These searches employed hair-arches—plastic tunnels with double-sided sticky tape inside to catch hairs for identification—and concentrated on long-unburnt, dense heathland along the south coast both east and west of Two Peoples Bay.

Despite searches over 10 years, no other populations have been discovered. Meanwhile, intensive trapping of the Mount Gardner population has shown there are only 30 to 40 animals there. Females produce pouch young continuously, and new independent young animals are found regularly, but population numbers are stable and the available habitat is fully occupied. Excess young are being produced but there is no room for them all to survive in this restricted habitat. Due to the low numbers and the vulnerability of its single population to extinction, Gilbert's potoroo is ranked under State, national and international criteria as Critically Endangered, the most threatened category available for wild populations.

Cross-fostering Gilbert's potoroo

One of Australia's most critically endangered mammals, the Gilbert's potoroo, has new hope for life with exciting new successes in transferring pouch young to a foster mother of a different species.

by Tony Friend

The captive colony, founded from six adult potoroos brought in from the wild, along with three young in pouches of females, produced young during the first few years, with eight born between 1995 and 2001, but then the colony began to decline. Some adult animals died from old age and various health disorders and no more young were born. Husbandry conditions were varied, including how individuals were grouped or separated and changes in diet. Nutritional analysis of the fungi that Gilbert's potoroos eat in the wild is being used to improve the diet, but there has been no more breeding as yet. Drastic action was required to save these fascinating mammals.

Fostering pouch young

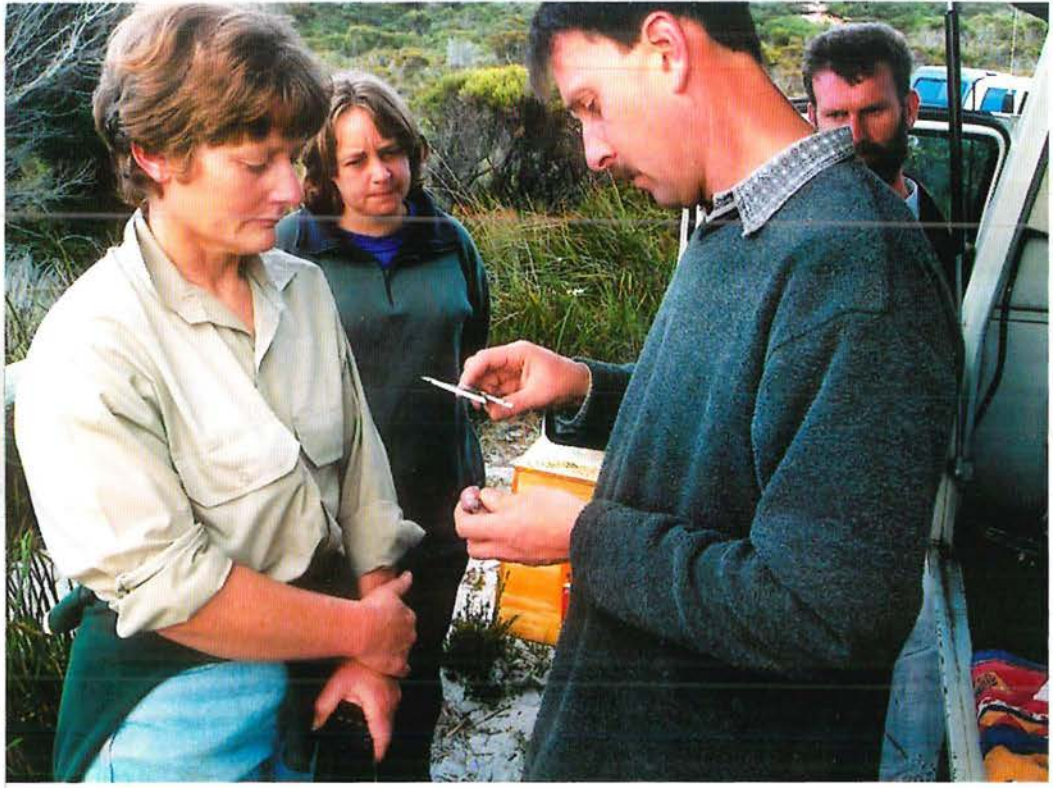
Since the 1960s, it has been known that pouch young of kangaroos and wallabies can be taken from their mother's pouch and substituted for the young of another kangaroo or wallaby species. Under the right conditions, these transferred joeys adapt to the foster-mother's milk and develop to the fully furred stage, to be weaned and become independent, just as if they had been reared by their own mothers.

The significant point here is that female kangaroos and their relatives (including potoroos) often hold an undeveloped embryo inside them, and the removal of the suckling joey triggers the embryo's development, resulting in the birth of another joey within three to four weeks. The birth rate of the donor mother can therefore be increased. When the surrogate mother belongs to a different species to the donor mother, this technique is known as cross-fostering. When an endangered species is the donor, it can result in a large increase in production of the endangered species, while a more common or easily bred species can rear the endangered species' young to independence.

In collaboration with the Gilbert's Potoroo Recovery Team, the Royal Zoological Society of South Australia's David Taggart, a research scientist and leader in cross-fostering, carried out a research project to develop specific cross-fostering protocols for use with potoroos. He is using the technique to increase numbers of the critically endangered Victorian brush-tailed rock-wallaby, South Australia's endangered black-footed rock-wallaby and the mainland subspecies of the tammar wallaby, with Kangaroo Island tammar wallabies and yellow-footed rock-wallabies acting as foster mothers.

David's initial work on long-nosed potoroos, woylies and boodies in South Australia showed that using long-nosed potoroo foster mothers resulted in the highest survival rate of cross-fostered young. He recommended that this species, native to south-eastern Australia, be used in a Gilbert's potoroo cross-fostering program.

For efficient cross-fostering, the transfer time between pouches must be as short as possible. A captive colony of long-nosed potoroos was needed as close as possible to Two Peoples Bay, but not on the nature reserve as the animals are not native to the area.



Above left Royal Zoological Society of South Australia's David Taggart measuring potoroo young.

Above Checking the progress of a Gilbert's potoroo in an incubator. *Photos – Tony Friend/DEC*

Left A Gilbert's potooro joey in a portable incubator awaiting cross-fostering to a long-nosed potoroo surrogate mother.

Below Long-nosed potoroos successfully fostered Gilbert's potoroo young. *Photos – David Taggart*

Through the generosity of a landowner in the Albany area who provided the land as well as financial support, a cross-fostering facility was built. This housed a colony of long-nosed potoroos, sourced from Warrawong Sanctuary in Adelaide, quarantined at Perth Zoo and temporarily held at Caversham Wildlife Park while the facility was being completed. Financial support from the Natural Heritage Trust through South Coast Natural Resource Management and another private donor saw the facility finished by June 2006 and the long-nosed potoroos moved in.

Cross-fostering in WA

To date, four Gilbert's potoroo pouch young have been transferred from wild mothers to long-nosed potoroo foster mothers at the cross-fostering centre. Unfortunately the long-nosed potoroo young which the Gilbert's potoroos replaced were too young for hand rearing and had to be euthanased. From these transfers two Gilbert's potoroos survived to independence and were moved to the Gilbert's potoroo captive colony at Two Peoples Bay. One of the other two did not survive and the other was still in her foster mother's pouch at the time of publication. The transfer that did not succeed involved the biggest size difference between the existing long-nosed pouch young and the Gilbert's potoroo joey being substituted, emphasising the need to match these young closely.

The cross-fostering trial so far indicates that there is promise in this technique for Gilbert's potoroo. Other strategies to increase Gilbert's potoroo numbers are also being trialled, including the very successful transfer of young independent potoroos from Mount Gardner to Bald Island, and the introduction of non-breeding captive potoroos into an extensive enclosure containing native vegetation. The recovery strategy may include cross-fostering from females in this enclosure or the use of the enclosure to 'harden up' cross-fostered young after weaning to help in their socialisation. With luck, and further cross-fostering, prospects for Gilbert's potoroo's long-term future may brighten.

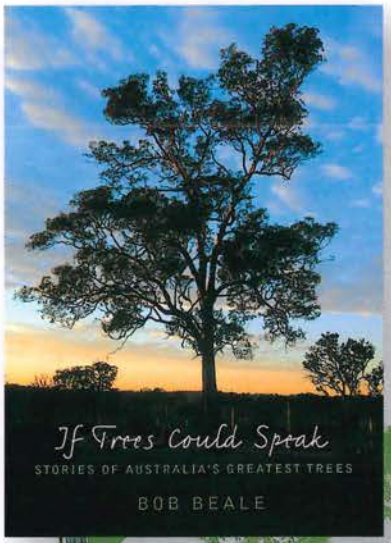
Tony Friend is a Principal Research Scientist in the Department of Environment and Conservation's Science Division and is based in Albany. He can be contacted on (08) 9842 4523 or by email (tony.friend@dec.wa.gov.au).

bookmarks by Samille Mitchell

If Trees Could Speak: Stories of Australia's Greatest Trees

Author: Bob Beale
Publisher: Allen and Unwin
245 pages, soft cover, full colour
ISBN: 978 1 74114 276 1
RRP: $39.95

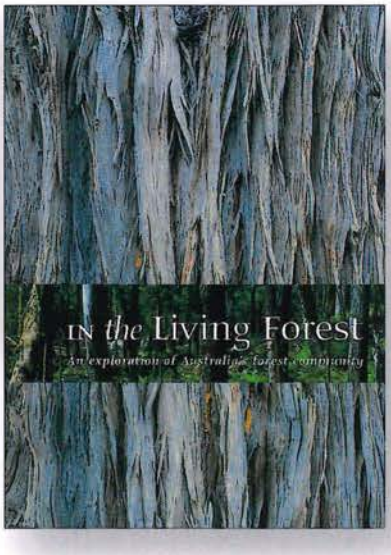
This beautifully written book is a story of Australia and its people told through a celebration of the country's finest trees. It weaves mystical Aboriginal tales about trees together with stories of trees which have played important historical roles. It includes the story of the Gloucester Tree near Pemberton, Walpole's Valley of the Giants Tree Top Walk and eastern states' trees like the Burke and Wills Dig Tree in Queensland or the Separation Tree in the Royal Botanical Gardens in Melbourne.



Wild Land: A Photographic Tour of Western Australia

Photos: Damon Annison
Publisher: Damon Annison
120 pages, soft cover, full colour
ISBN: 978 0 9802969 0 7
RRP: $30

This stunning photographic book presents the work of photographer Damon Annison. He has travelled to the more remote regions of Western Australia, capturing some of the State's most remarkable landscapes with an artistic eye. The result is a collection of evocative images, ranging from tranquil coastal scenes and placid inlets to sweeping landscapes and rugged gorges—images as diverse as the State itself.



In the Living Forest: An exploration of Australia's forest community

Editor: John Keeny
Publisher: ETN Communications
191 pages, hard cover, full colour
ISBN: 0 9580 207 7 9
RRP: $39.95

In the Living Forest explores the importance and contributions of forests and forestry to Australian society. It looks at their role in rural and Indigenous communities, ecosystems, economics, social change and more. By doing so, the book encourages the reader to view forests from a range of different perspectives.

It was compiled from articles submitted by nearly 50 writers and is complemented by full colour photography throughout.

PILBARA and Eighty Mile Beach:

The human 'footprint' in the Pilbara and lower west Kimberley is growing and there is a need for more integrated marine planning and management so our marine environment remains in pristine condition. The State Government is therefore planning to expand the marine parks and reserves system in the Pilbara and Eighty Mile Beach regions.

by Judy Davidson and Carolyn Thomson-Dans

multiple objectives, one marine planning process

In December 2006 the State Government approved the Department of Environment and Conservation (DEC) leading a whole-of-government effort to expand the marine parks and reserves system in the Pilbara and Eighty Mile Beach regions. Six study areas have been identified, within which marine parks and reserves will be proposed.

The Pilbara and Eighty Mile Beach coast supports significant marine biodiversity values such as mangroves, coral reefs, sponge gardens, seagrass beds, seaweed meadows and coastal formations such as barrier and offshore islands, protected lagoons, deltas, rocky shores and sandy beaches. These diverse habitats are home to marine turtles, dugongs, whales, dolphins, seabirds, fish and many colourful invertebrate species.

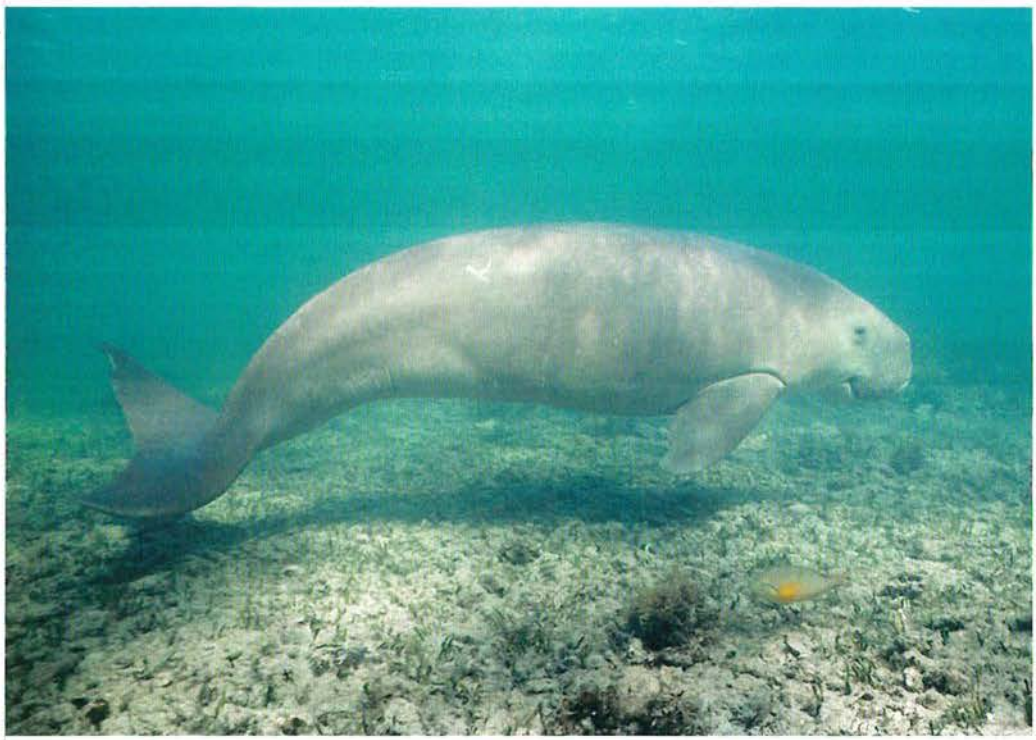
The area is extremely important for flatback turtles (*Natator depressus*), which nest on sheltered mainland beaches with intertidal mudflats and turbid waters in the Kimberley and Pilbara and on several islands in the Pilbara. Flatback turtles are a threatened species and only nest in Australia, making each and every rookery important. Other species of turtle recorded in the region include green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*).

The long mud

The scenic Eighty Mile Beach, south of Broome, is the longest uninterrupted beach in Western Australia, stretching for about 220 kilometres between Cape Missiessy and Cape Keraudren. Its tidal mudflats are exceptionally wide, extending for several kilometres out to sea in many places. They support rich communities of invertebrates, including colourful sponges and soft corals that are sometimes exposed at very low tide, as well as millions of crustaceans, molluscs and worms that live in the muddy sediments.

Tiny but amazing feathered visitors fly all the way from the northern hemisphere each year to feed on the wealth of marine invertebrates that live in the mudflats of Eighty Mile Beach. Some of the birds may have flown stretches of more than 8,000 kilometres without stopping. On arriving from the northern hemisphere in about September, these migratory birds spread out to feed over the exposed sand and mudflats of the beach at low tide. At high tide they congregate in immense flocks on the narrow beach slopes and exposed sand shoals—an incredible spectacle. Without areas so rich in resources on which to feed, these important shorebirds would not survive their long migration back to their breeding areas in the tundra of the northern hemisphere, which are covered in snow and ice for most of the year.

Eighty Mile Beach is one of only a dozen or so areas in the world with huge intertidal flats rich in shorebirds and, as such, has been designated as a wetland of international importance. About 90 per cent of the birds are concentrated in the northern section of the beach between Cape Missiessy and Wallal. Peak counts of well over half a million shorebirds have been made along Eighty Mile Beach and numerous species of these shorebirds occur there in internationally significant numbers. For example, about half of the world's great knots use Eighty Mile Beach during their annual migration. The area is also believed to be used by the entire population of distinct subspecies of red knots and bar-tailed godwits. On 7 February 2004, an estimated 2.88 million oriental pratincoles were recorded at Eighty Mile Beach, a



Previous page
Main Sandpipers and other shorebirds congregate in the shallow waters along Eighty Mile Beach.
Photo – Jiri Lochman

Above Sponges exposed at low tide near Cape Keraudren.
Photo – Steve Bunce

Left Dugongs feed in the seagrass of the Pilbara and Eighty Mile Beach regions.
Photo – Geoff Taylor/Lochman Transparencies

Above The wide fringing mudflats of Eighty Mile Beach make it one of the world's most important areas for migratory wading birds.
Photo – David Bettini

Left The threatened flatback turtle has several rookeries in the Pilbara and Eighty Mile Beach area.
Photo – Jiri Lochman

surprise to scientists as the previous estimated population for the whole East Asian-Australasian flyway had been just 75,000.

Large areas of Eighty Mile Beach are inaccessible, although there is a well-patronised caravan park at Wallal. The most popular activities are beachcombing and enjoying the spectacle of the long beach, particularly at sunset. If the tides are right, fishing and four-wheel driving are also popular.

Cape Keraudren, De Grey River and Turtle islands

At the southern end of Eighty Mile Beach is Cape Keraudren, which has a scenic landscape dominated by limestone formations (headlands, offshore reef platforms and inland outcrops), tidal flats, mangroves, sandplains, sand dunes and sandy beaches. The area has a unique geology and geomorphology, extremely diverse and rich ecosystems and a long history of use by Aboriginal people that continues to the present day. A 4,800-hectare reserve at Cape Keraudren is managed by the Shire of East Pilbara and has a resident ranger. About 4,500 campers visit Cape Keraudren every year, many of them retired travellers, who stay for about a week at the Cape.

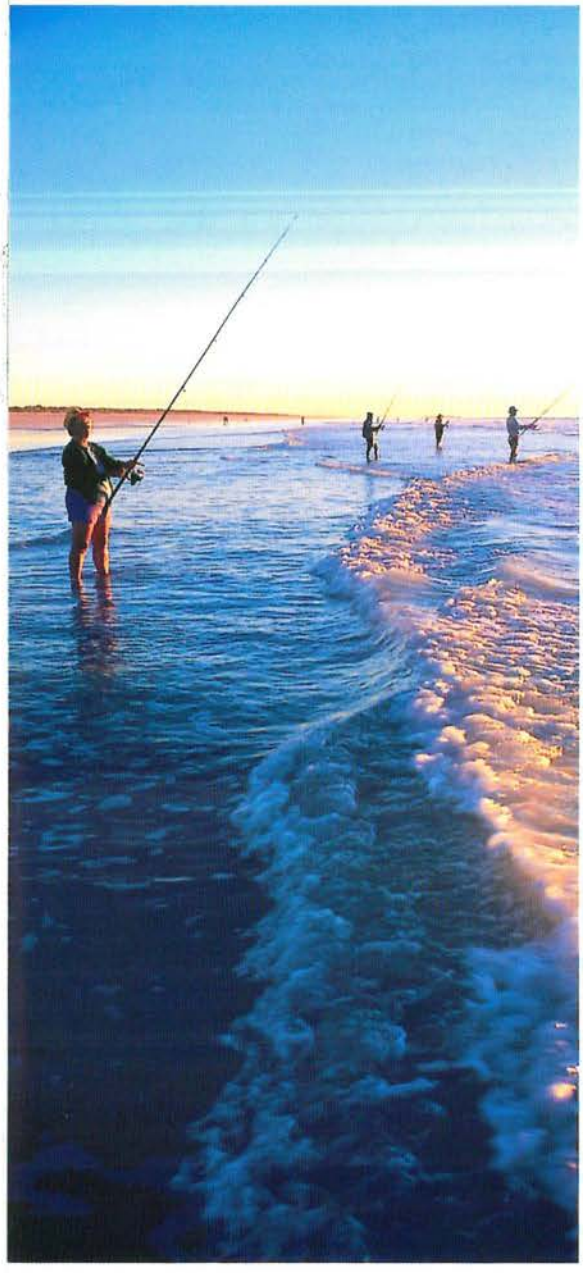
To the west of Cape Keraudren, the De Grey River enters the sea at Breaker Inlet between Poissonnier Point and Larrey Point. The river mouth has a delta of extensive mud and sand banks. Here, white mangroves (*Avicennia marina*) are low and sparse, and frequently interrupted by bare mudflats. A few stunted red mangroves (*Rhizophora stylosa*) grow at the river mouth.

North Turtle Island and Little Turtle Island lie about 20 kilometres off the coast north-west and west of Larrey Point. Bedout Island is a small mid-shelf island about 40 kilometres north of Poissonier Point. These islands are fringed by coral reefs and are important marine turtle and seabird nesting areas.

Cowrie Beach, Depuch Island and Sherlock Bay

The coast between Cape Thouin and Cape Lambert is complex, consisting mainly of mangroves interspersed with several low rocky headlands and sections of beach.

Cowrie Beach, south-west of Cape Thouin and about 140 kilometres east of Karratha, is one of the largest nesting areas for the threatened flatback turtle in WA, with several hundred females laying their eggs on the beach each year. DEC is undertaking long-term



turtle tagging and a fox baiting program in cooperation with the owners of the adjacent Mundabullangana Station.

There are many small near-shore islands scattered along this coast—remnants of an eroded shoreline collectively known as the Forestier Archipelago after Baron Forestier, a distinguished general who fought with Napoleon. At their centre is the rocky Depuch Island, which features an interesting history. Earlier this century nearby Balla Balla Harbour was an important port for the copper mines of the Whim Creek district. A large, iron sailing ship, the *Crown of England*, was wrecked on Depuch Island and the *Concordia* was driven ashore nearby during a cyclone on 22 March 1912 that claimed the lives of at least 15 people. Depuch Island is rich in Aboriginal rock art and a deep water port that was planned there in the 1960s was abandoned at the behest of the Western Australian Museum because of the extensive art and cultural values. With increasing industrial pressure on the Pilbara coast as a result of the resources boom, the world's biggest bulk port is proposed for nearby Ronsard Island in the Forestier group.

Further west, Cossack, 12 kilometres from Roebourne and once the major port of the Pilbara region and the site of the first pearling industry in WA, has special interest for natural historians. All seven species of mangrove found in the Pilbara can be seen growing together along the shores of Butchers Inlet, within easy walking distance of Cossack.

Robe River and Great Sandy Island Nature Reserve

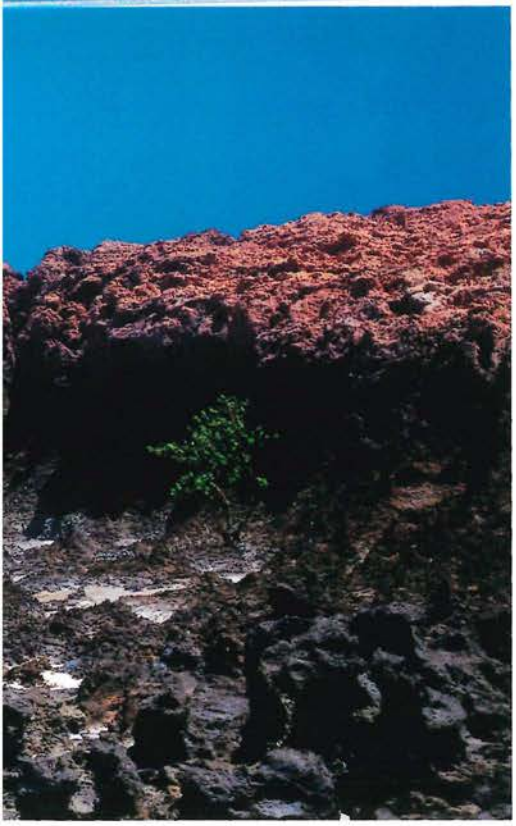
Another section of coast that will be considered during the planning process stretches from the mouth of the Fortescue River to that of the Cane River, and includes the waters surrounding the Great Sandy Island Nature Reserve and the Mary Anne group of islands. This area is relatively remote and untouched. The Robe and Fortescue rivers have inactive deltas, a distinctive coastal landform that is not otherwise seen in the Pilbara.

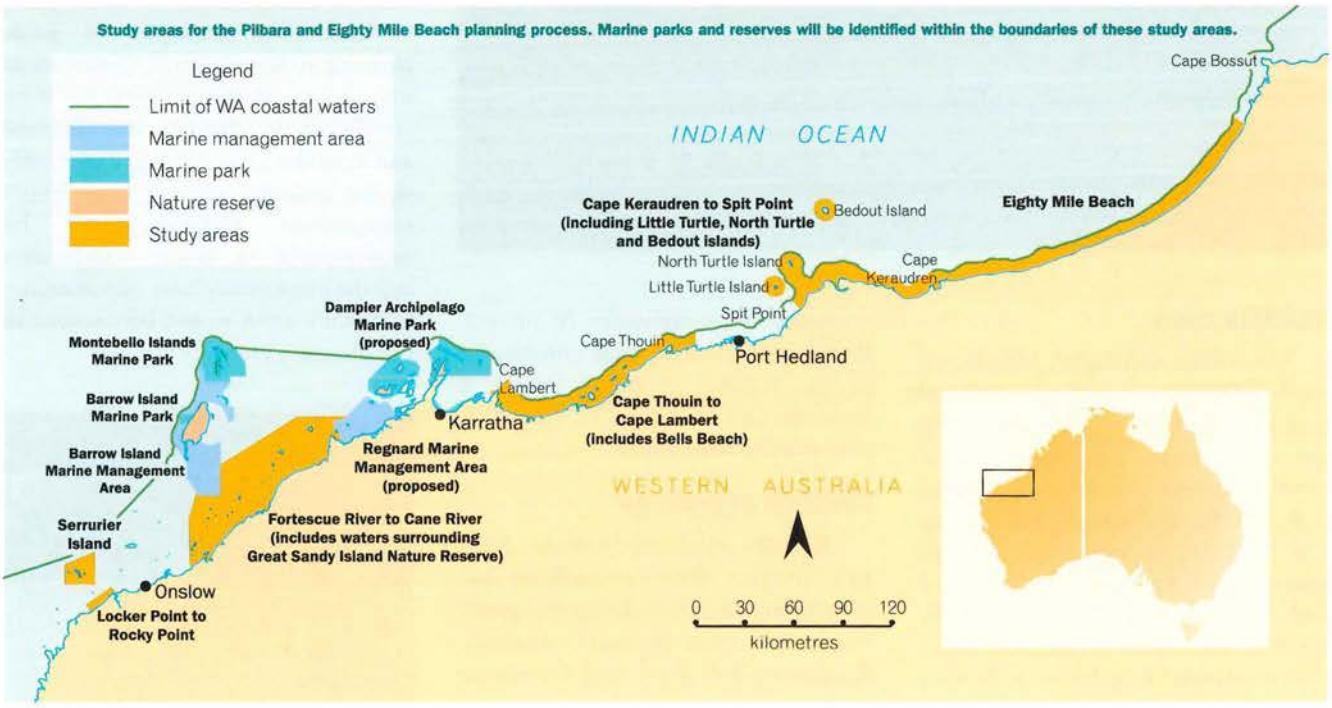
A 75-kilometre plus stretch of coastline lying on either side of the Robe River contains the most diverse mangrove forests found on the Pilbara coast. Seaward of the mangroves, there are many small, low barrier islands close to the shore which frequently

Above Cape Keraudren is popular with campers.
Photo – David Bettini

Left Fishing at Eighty Mile Beach.
Photo – Dennis Sarson/Lochman Transparencies

Opposite page
Above right Mangroves protect shorelines from erosion and provide habitat for fish, birds and other animals.
Photo – Marie Lochman





have fringing mangroves around them. Intertidal mudflats, rock pavements and their associated mangroves as well as coral reefs are particularly well developed around the Mary Anne group of islands. Mangroves are an important source of nutrients for adjacent marine ecosystems and provide excellent nursery areas for many fish species. Turtles, particularly young ones, use these areas for shelter and food. The mudflats are rich in burrowing invertebrates and are important feeding areas for migratory wading birds. A little offshore, dugongs and various species of turtles feed on extensive beds of seaweed and seagrass. Corals grow wherever they can find a foothold forming reefs and bommies and creating lagoons around the offshore islands. Many of the islands provide nesting places for green, flatback and hawksbill turtles.

Serrurier Island

A group of offshore islands and emergent rocks in the western Pilbara includes Serrurier, Flat and Bessieres islands. They form a fringing reef system growing on Pleistocene rock platforms in the middle of the continental shelf. These islands are remote and surrounded by clear water, and are therefore among the most attractive in the Pilbara. They have extensive fringing coral reefs and luxuriant corals on the slopes of rock platforms that offer attractive underwater scenery. There is a high diversity of coral reef fish and invertebrates and well-developed seagrass beds in the shallows.

Ospreys, white-breasted sea-eagles, Caspian terns and crested terns nest on the islands and the wedge-tailed shearwater rookery on Serrurier Island Nature Reserve is one of the largest in the Pilbara. Serrurier Island is also an important nesting area for green and loggerhead turtles and possibly for other turtle species.

Left Aerial view of the Pilbara coast near Weld Island.
Photo – Richard Woldendorp

Below Shells on Eighty Mile Beach.
Photo – Kate Fitzgerald

Multiple uses

The Pilbara and Eighty Mile Beach region supports a growing mining and petroleum industry, commercial fishing and many recreational uses such as nature appreciation, boating, fishing, scuba diving and four-wheel driving. The area is an important cultural landscape for Aboriginal people, from both historical and contemporary perspectives, and contains some extensive rock art galleries and other significant sites.

Marine and coastal activities are undertaken by many of the region's residents who live in the towns of Onslow, Roebourne, Dampier, Karratha, Wickham, Point Samson, Port Hedland, South Hedland, Pannawonica, Newman, Paraburdoo, Tom Price and Broome, and on pastoral stations and other remote communities along the coast.

The region's economy is fuelled mainly by the mining and petroleum industries and much of the State's mineral and petroleum production is from the Pilbara region. Several major commercial fisheries and the pastoral industry also contribute to the economy and community. At present, tourism is a relatively small contributor to the region's economy but it is growing and is likely to be more important in the future.

Multiple objectives

Western Australian marine parks and reserves have a multiple-use management framework that recognises a range of human uses and community aspirations while protecting the marine environment.

The project to expand the marine parks and reserves system in the Pilbara and Eighty Mile Beach regions aims to better protect marine biodiversity, threatened marine animals, habitats of special significance and unique areas. The design and location of the marine parks and reserves will draw on comprehensive, adequate and representative reserve design criteria and information collected during the planning process. This will help the State Government maximise biodiversity conservation outcomes while minimising impacts on cultural values and commercial and recreational users. Planners overseeing the process will also aim to develop opportunities and linkages for the local community (such as future management arrangements with Aboriginal people and benefits for local businesses, industries and tourism ventures).

To help ensure scientific rigour in identifying appropriate marine park and reserve boundaries and to allow a thorough analysis of options, DEC will use a systematic reserve planning approach and may seek advice from an independent scientific panel in developing principles to guide planning in the region. A Government Interagency Working Group has been established to develop the proposal and consider cross-agency issues early in the planning process. Community engagement programs will be implemented to ensure stakeholders and the community have opportunities to provide input to and be involved in the planning process.

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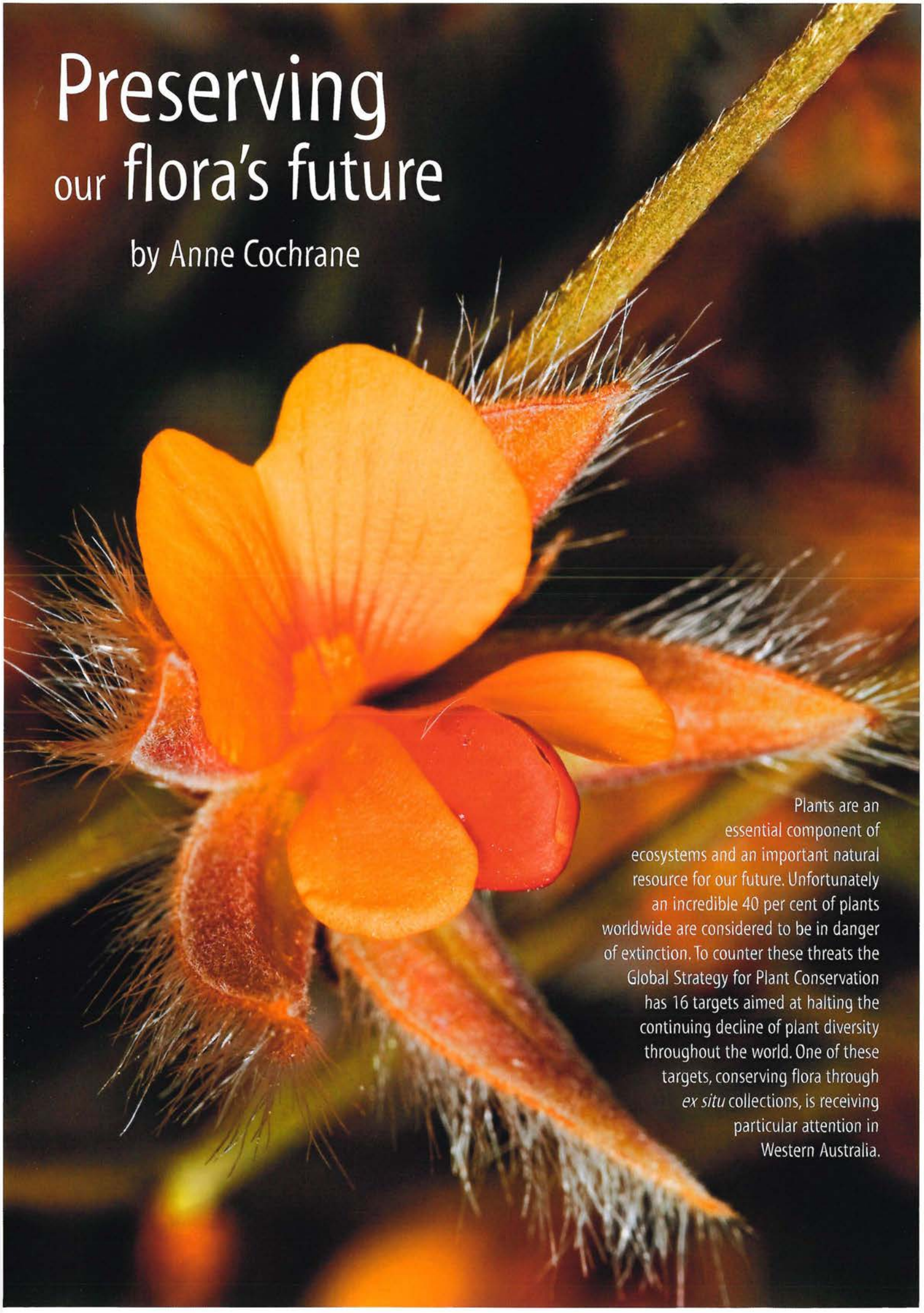
For more information please contact DEC's Marine Policy and Planning Branch on (08) 9336 0100, DEC's Pilbara Regional office on (08) 9182 2000, DEC's West Kimberley District office on (08) 9195 5500 or visit www.naturebase.net/pilbara80mile.

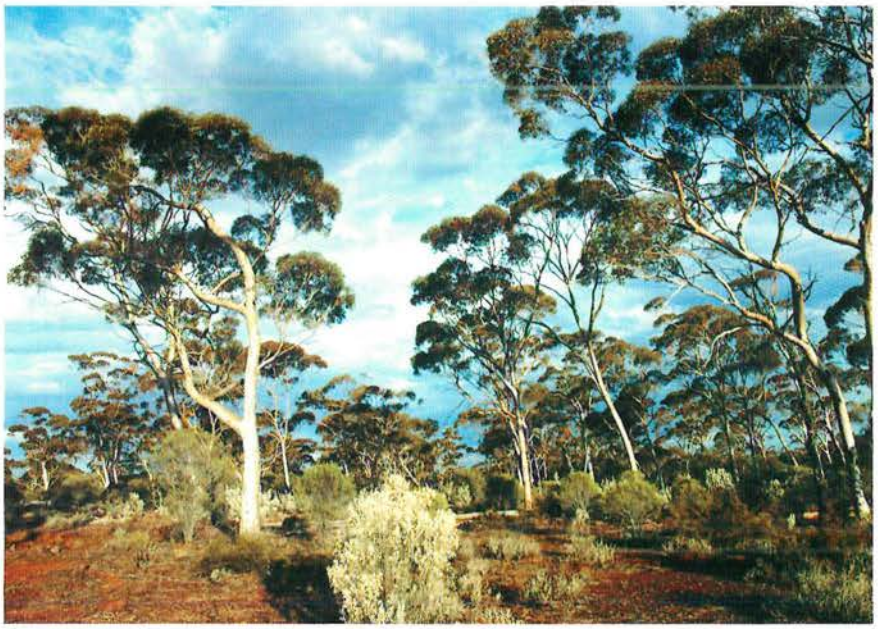
Preserving our flora's future

by Anne Cochrane



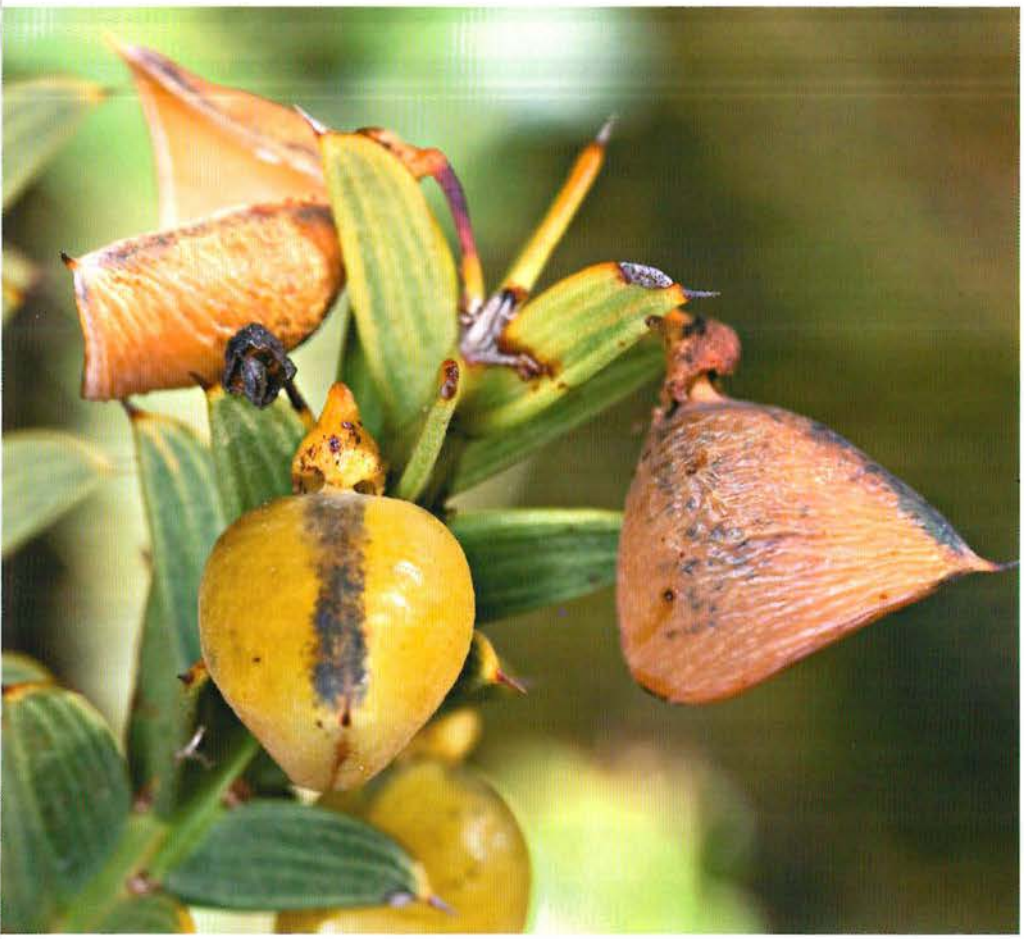
Plants are an essential component of ecosystems and an important natural resource for our future. Unfortunately an incredible 40 per cent of plants worldwide are considered to be in danger of extinction. To counter these threats the Global Strategy for Plant Conservation has 16 targets aimed at halting the continuing decline of plant diversity throughout the world. One of these targets, conserving flora through *ex situ* collections, is receiving particular attention in Western Australia.

In 2002 the Convention on Biological Diversity adopted a framework for plant conservation actions at global, national, regional and local levels—the Global Strategy for Plant Conservation (GSPC). The strategy has 16 targets that aim to promote the understanding, documentation and conservation of plant diversity and the sustainable use of plants while encouraging education, awareness and building capacity for conservation. The strategy's primary approach to plant conservation is through *in situ* (on site) measures, complemented by *ex situ* (off site) conservation. This is the first time that quantitative global plant conservation targets have been set with a deadline for their attainment. That deadline of 2010 is fast approaching.



Meeting targets in Western Australia

Western Australia is blessed with a highly diverse flora which displays high levels of endemism, meaning that many of these plants are found nowhere else in the world. This vast array of stunningly beautiful plants draws visitors from across the world, particularly during spring. But this flora is threatened by current environmental problems such as habitat fragmentation, changed hydrology and invasion by exotic pests and diseases. With projected future climate change, plants will be facing a whole new series of threats including drought and more frequent fires. Although not precisely known, it appears that there may be more than 13,000 plant species and subspecies in WA, of which about 20 per cent are considered to be of conservation significance. This combination of high floral diversity and threat has resulted in the south-west of WA being listed as one of the world's 34 biodiversity hotspots—the only such hotspot in the country. For these reasons it is vital that plant conservation targets are adequately addressed.



Storing seeds for the future

One of the vitally important goals as stated in target eight of the GSPC is the conservation of "... 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programs".

Previous page
Main The rare *Jacksonia pungens*. The Threatened Flora Seed Centre holds many thousands of seeds of this species in secure long-term storage as an insurance against loss in the wild. *Photo – Andrew Crawford/DEC*

Above Goldfields woodlands. *Photo – Anne Cochrane/DEC*

Left Fruit of the priority-listed *Daviesia chapmanii* from the flora-rich northern sandplains. *Photo – Andrew Crawford/DEC*

Above Colourful flowers of the conservation-listed *Verticordia rutilastra* from the northern sandplains.

Left The little known and geographically restricted *Stylidium pendens*.
Photos – Andrew Crawford/DEC

Within WA this goal is being addressed by the Department of Environment and Conservation's (DEC's) Threatened Flora Seed Centre, which was established in 1992 as part of a risk-management strategy for the State's threatened plant species. The seed bank is responsible for collecting and storing seeds from the State's conservation-listed flora and flora associated with threatened ecological communities and biodiversity hotspots. During its 15 years of operation, the seed bank has provided protective custody, through *ex situ* seed conservation, for hundreds of threatened flora facing extinction. Seeds are held in the seed bank from some populations of species that no longer exist in the wild. Not only is seed conservation providing 'insurance' for threatened species diversity, it is also providing material for research and recovery. Seeds and seedlings have been provided for a number of different research studies ranging from assessing temperature limits for recruitment in restricted endemic plant species in the Stirling Range to provision of material for *Phytophthora* dieback susceptibility trials. However, the ultimate purpose of the seed bank is to provide genetic material for the recovery of threatened species.

In 2001 the Threatened Flora Seed Centre joined a global seed conservation partnership initiated by the Royal Botanic Gardens, Kew, in the United Kingdom that includes more than 50 partner countries around the world (see 'Our frozen future', *LANDSCOPE*, Winter 2001). This 10-year partnership—the Millennium Seed Bank Project—has enabled WA to increase its capacity to deliver seed conservation goals for its unique flora.

Currently the DEC seed bank has 30 per cent of the 2,618 Declared Rare and Priority Flora of WA in storage. This includes 70 per cent of the 372 extant taxa listed as being Threatened (Declared Rare Flora) under the International Union for

Global Strategy for Plant Conservation targets

1. Creating widely accessible working lists of known plant species.
2. Assessing the conservation status of known plant species.
3. Developing models with protocols for plant conservation and sustainable use, based on research and practical experience.
4. Effectively conserving at least 10 per cent of each of the world's ecological regions.
5. Assuring protection of 50 per cent of the most important areas for plant diversity.
6. Ensuring that management is consistent with the conservation of plant diversity in at least 30 per cent of production lands.
7. Conserving threatened plant species through conservation reserves.
8. Storing 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programs.
9. Conserving 70 per cent of the genetic diversity of crops and other major socioeconomically valuable plant species and maintaining associated Indigenous and local knowledge.
10. Establishing management plans for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems.
11. Ensuring no species of wild flora is endangered by international trade.
12. Ensuring 30 per cent of plant-based products are derived from sustainably managed sources.
13. Halting the decline of environmental resources, including Indigenous and local knowledge, innovations and practices that support sustainable livelihoods, local food security and health care.
14. Conducting community education programs on flora.
15. Ensuring skilled staff and facilities are available to achieve global plant conservation targets.
16. Forming local, regional, national and international partnerships.

Above Robin Probert from the Royal Botanic Gardens Millennium Seed Bank Project collecting seeds of the priority-listed *Banksia tricuspis* in Mount Lesueur National Park.
Photo – Andrew Crawford

the Conservation of Nature criteria. More than 1,000 collections represent these 259 Threatened taxa. Seeds have been collected and conserved from multiple populations to ensure a broad range of genetic variation has been captured. More than half of all the collections have been made since the start of DEC's partnership with the Millennium Seed Bank Project, the remainder having been collected with funding from State and Federal sources (e.g. Commonwealth Government Natural Heritage Trust funding through the South Coast Natural Resource Management).

Plant reintroduction

The collections support an active species recovery program, an important component of which is reintroduction of threatened species back into the wild (see 'Restoring diversity, restoring hope', *LANDSCOPE*, Spring 1999). Although one of the major challenges associated with target eight of the GSPC is considered to be species reintroduction, DEC has implemented reintroductions for 48 of the State's Threatened plants, 33 of which have used seed from the seed conservation program. DEC's responsibility for all aspects of flora conservation includes an active and integrated strategy combining both *in situ* and *ex situ* conservation programs. The flora reintroductions have had a major impact on the threatened wild populations, sometimes doubling or trebling plant numbers as a result. For example, the numbers of plants of the spiral-fruited wattle (*Acacia cochlocarpa* subspecies *cochlocarpa*), rose from 132 plants in the wild in 1998 to 540 (plus the original 132) plants after one single reintroduction in 2006. These increases in plant numbers help to ensure that Threatened species known from single small populations are less vulnerable to extinction. Many of the reintroductions are still only a few years old and their success is not guaranteed until the new reintroduced populations become self sustaining, meaning the new plants survive, flower and reproduce successfully, adding progeny to the population. All the reintroductions are routinely monitored and documented and provide valuable information on plant performance. This information helps DEC staff in the development of management strategies for wild populations and enhances our understanding of rare plants and their ecological interactions. These data also help determine the amounts of seeds required for future reintroduction programs. This is a very important feedback mechanism for the seed conservation program. If only 10 per cent of the seeds germinated in the laboratory actually grow and survive to maturity in the new populations, then we know how many seeds we require for the next reintroduction to attain a certain number of reproducing plants in the ground.

Above Flora diversity in the Stirling Range requires protection from threats such as *Phytophthora* dieback. *Photo – Rob Olver*

Below right Laboratory of the Threatened Flora Seed Centre in Perth. *Photo – DEC*

Achieving target eight of the GSPC before the 2010 deadline clearly demonstrates the progress that DEC's seed conservation program has made towards implementing the global biodiversity targets for flora. We are lucky to be part of a global network of seed banking facilities supported both financially and technologically by the Millennium Seed Bank. We are also privileged to be able to draw on expertise from around Australia and the world, knowing that we are not alone in our endeavours to conserve our portion of the world's flora. We are also very fortunate to have much of the infrastructure and skills required to undertake the enormous task of conserving our most endangered plants species as seeds. It has been a major achievement to reach this goal but many of the existing conservation collections are still not adequately representative of the genetic diversity of the species. In many cases the collections only contain small amounts of seeds and are not big enough to meet the demands for recovery. To obtain enough seeds to meet conservation goals without impacting on wild populations is an on-going challenge. For seed conservation to be truly effective, it is necessary to be able to collect seeds before population size and genetic diversity decline. Therefore early identification of threatened species status is essential.

Flora for the future

Seed conservation is only one means to help maintain biodiversity and ensure that our unique flora is not lost to future generations. *Ex situ* collections are reserve collections that can be drawn on when required and it is important that seed stocks are readily available in case of drastic environmental change, such as may be expected with future climate change. In the short term, DEC's seed conservation program aims to address as a priority the collection and conservation of critically threatened plant species, with a goal of 90 per cent in seed banks by 2010. Over the next 10 years it will be concentrating on saving more plant resources for the future and directing its efforts towards sampling throughout a species range. It will also work to ensure the collection and conservation of enough genetically representative material to support efforts to recover species to a point where they are no longer considered threatened.

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Fire in the Kimberley

natural phenomenon or natural disaster?

Fire is a natural part of tropical savannas worldwide, but are too many fires in the wrong season killing our tropical wildlife? by Ian Radford and Kevin White

Recent global studies suggest if it were not for fire, tropical savannas throughout medium and high rainfall areas would convert to forest. Rangeland fire is an essential and natural process that has helped shape the rangelands for thousands of years. It creates and maintains a wide variety of habitat niches that enable a diverse range of plants and animals to flourish in the tropics. It reduces the accumulation of vegetation that can inhibit the establishment of some plant species and creates fresh grazing for many ground-feeding fauna. Periodic fire also stimulates growth and reproduction of plants. What's more, Aboriginal people have applied fire in these landscapes for many thousands of years to provide themselves with food and other resources.

While fire is integral to the maintenance of savanna landscapes, evidence indicates that the contemporary fire pattern of frequent, large-scale, high-intensity and late dry season fires may be the leading cause of decline for many northern Australian mammal species. Why?

Fire's role in mammal declines

There is now considerable evidence that small to medium mammals between 35 grams and five kilograms are particularly susceptible to the current, severe fire regimes in north-west Australian savannas. The most dramatic mammal declines have occurred in relatively recent times, from the 1980s to now, which coincides with unprecedented fire frequency, high fire intensity and extensive areas burnt, compared with previous times. Most fires now occur in the highly flammable mid-to-late dry season and burn for months at a time. Previously, traditional Aboriginal fire regimes involved small-scale fires ignited throughout the year or naturally occurring fires during wetter periods caused by lightning strikes. These fire regimes were much less severe than those occurring in north-west Australia today, where many modern-day fires are unauthorised or accidental and occur late in the dry season.

The other evidence suggesting that too severe fire regimes, may be driving small mammal declines is provided by scientific studies. One study, the Kapalga fire experiment conducted in Kakadu in the 1990s, clearly showed that mammal numbers were most dramatically reduced under the most severe fire regimes while mammals were most common in plots which had not been recently burnt and therefore contained a variety of habitat structures. Other ecological studies show that habitat structure, which is affected by fire, is also a strong determinant of mammal species' success. Protecting small mammals from these severe fire regimes is a major challenge for land management agencies in the north and west of Australia.

Mitchell River fire research

In the 2007 dry season, the Department of Environment and Conservation (DEC) and CSIRO Sustainable Ecosystems conducted an extensive mammal trapping study in the Mitchell River National Park and

Previous page
Main Fire amongst boab trees in the Kimberley.
Photo – Brett Dennis/Lochman Transparencies
Inset Delicate mouse feeding on grevillea.
Photo – Lochman Transparencies

Above Fire in a remote Kimberley gorge.
Photo – Jiri Lochman

Left Wet season burning in spinifex at Mitchell River Natonal Park.
Photo – Ian Radford

Above Bushfire in King Leopold Range Conservation Park.
Photo – Jiri Lochman

Right Bushfire smoke covering the Roe River area of Mitchell River National Park.
Photo – Marie Lochman

on adjacent unallocated Crown land on the Mitchell Plateau. The research was funded by *Saving our Species*, the State Government's two-year, $15 million biodiversity conservation initiative. The work was set up to see if, firstly, Kimberley mammals have the same negative responses to inappropriate fire patterns that were found during other studies conducted in northern Australia (mainly in the Northern Territory). Secondly, assuming there was a response, DEC hoped to determine how long it took for mammals to re-establish themselves in healthy populations after fire, thus providing information to help with prescribed burning programs. DEC staff selected trapping sites in sandstone and laterite-basalt landscapes in which the occurrence of the last fire varied. Large grids of Elliott traps were established and species and numbers of animals recorded. Grids were then measured for habitat characteristics that might be related to mammal numbers. These factors included soil, invertebrate communities and vegetation and other physical features that act as ground habitat, which might be affected by fire.

The study found a direct relationship between the time since fire and small mammal numbers, especially for native rodents which include the common rock rat (*Zyzomys argurus*) and the western chestnut mouse (*Pseudomys nanus*). A fire effect was found both in sandstone and laterite-basalt environments. The more recent the fire, the fewer the animals.

Even two years after a fire, mammal numbers were still recovering and, at the laterite sites, mammals were still often absent after two years' recovery time.

This suggests the small mammals need at least two years, and preferably three, for a successful breeding cycle, particularly in areas with no natural refuges from predators, such as open country without rocks. This highlights the importance of achieving longer periods between fires, or retaining older fuel patches within the landscape to enable mammal populations to function at their best. In northern Australia, modern fire frequencies can be as high as one or two a year in some areas, leaving few such older fuel areas in the modern landscape.

Explanations for fire effects

What is the explanation for this fire-related effect when fire is apparently 'natural' in these areas? The answer seems to concern the amount of ground cover, such as grass cover and

Above Pale field rat.

Left Bushfire in rugged terrain in the Kimberley.
Photos – Jiri Lochman

shrubs. Mammal numbers were highest in areas where ground cover had not been burnt for at least 18 months. This suggests that habitat structure and shelter is important in protecting Kimberley mammals. Ground cover burnt by fire leaves many Kimberley mammals vulnerable to predation by feral cats and other predators. It may be that predators, particularly the introduced cat, are the chief agents of small mammal declines in conjunction with severe fire regimes. So, while fire itself is not responsible for mammal decline, frequent, large-scale removal of suitable shelter leaves many animals vulnerable to attack.

Food scarcity after fire could also play a role in reduced mammal numbers, but food availability is unlikely to be affected by the time between fire. Further research in the Mitchell River National Park and adjoining regions will investigate the relative importance of predators versus food resources in determining mammal numbers.

Study similarities

Results of the Mitchell study are clearly mirrored in other Kimberley studies, which also reveal a relationship between fire, ground cover and mammal numbers. Thalie Partridge, a PhD student from Macquarie University in Sydney, doing research in Purnululu National Park (the Bungle Bungle Range) found that while some species like the Kimberley pebble-mound mouse (*P. laborifex*) and the delicate mouse (*P. delicatulus*) occurred in recently burnt habitats, the desert mouse (*P. desertor*) and the western chestnut mouse were restricted to areas with spinifex cover of more than 60 per cent. Such areas were only found at least five years after a fire.

Similarly, Sarah Legge from the Australian Wildlife Conservancy at Mornington Station in the Central Kimberley found that two of the three mammal species—the pale field rat (*Rattus tunneyi*) and western chestnut mouse—were restricted to older fuel patches within burnt areas. Both sets of results, plus those collected last year in the Mitchell study, emphasise the importance of patches of post-fire ground cover for the persistence and abundance of small mammals.

DEC fire strategy in the Kimberley

So what do these results mean in terms of DEC's fire management in the Kimberley Region? They indicate that fire regimes which maximise the number of older fuel patches within burnt country will promote a more rapid re-establishment of mammals by providing suitable shelter from predators

Right Burnt landscape near Kununurra.
Photo – David Bettini

Below right Aerial ignition of fuel reduction buffers in King Leopold Range National Park.
Photo – Kevin White and Ed Hatherley

within open, recently burnt country. These patches will be most effective as mammal refuges by experiencing at least three years without fire. However, achievement of such an interval is no mean feat in northern Australia.

DEC's fire strategy is designed to protect areas of high conservation value as well as enhance diversity in the fuel-age structure within the region's conservation estate. The program also has a strong focus on providing safe access to, and protection of, camping areas within the many national parks located in remote areas across the Kimberley.

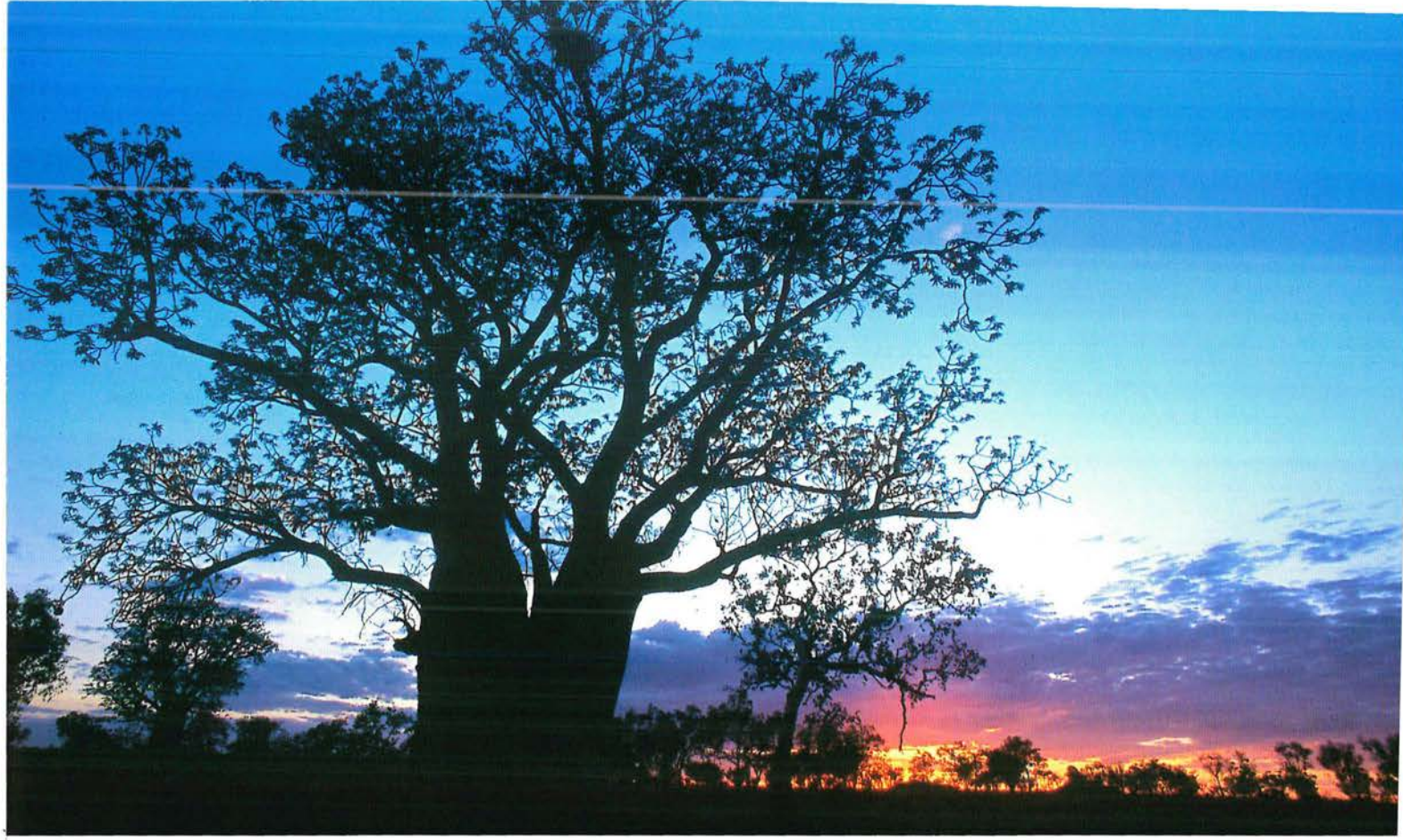
DEC has deliberately developed a flexible strategy to mitigate the impact of wildfires and to enhance biodiversity conservation. The strategy is aimed at developing large management 'cells' surrounded by burnt buffers that protect the cells from large, dry season wildfire entering from outside. Such a strategy also reduces the risk of wildfires that start inside the cells from impacting on neighbouring cells. The strategic buffers are burnt early in the dry season in an attempt to break up the country into management compartments. Wet season (December to March) ground and aerial mosaic burning aims to establish and maintain the habitat mosaic within the cells to enhance biodiversity within the landscape. This wet season mosaic burning also seeks to reduce the impact of late dry season wildfires within the cells.

The early, dry season burn program is implemented while the annual grass growth is only partially cured and the cool weather conditions and moist soil profile ensure mild fire behaviour that will readily extinguish overnight or along natural barriers like grass species change or riparian zone fringes.

DEC has conducted six years of operational experimentation in the Kimberley to develop the current annual fire management practices. This experience has significantly contributed to the knowledge and understanding of fire ecology in these complex land systems. During the six years there has been only one year without a reduction in the areas lost to wildfire on DEC estate. In 2006 the total area burnt by all fire activity on DEC estate was less than 20 per cent compared with 35 per cent of area lost in the first year of operation. However, DEC only has direct management responsibility for about 2.8 million hectares of parks and reserves in the Kimberley. The vast majority of naturally vegetated land in the Kimberley is managed by pastoral or Aboriginal interests. The area lost to wildfire outside the conservation estate in the same period has continued to increase in most years.

Improving the northern fire situation

DEC is endeavouring to improve on this performance. Due to the vast, inaccessible nature of the Kimberley and limited information on local fuel and weather conditions during the wet season, there may well be burning opportunities that are being missed. Advances in remote sensing to monitor and predict the condition of fuels, more reliable local weather information and advances in aerial ignition technologies may provide opportunities to further improve prescribed burning



Above Boab tree in the Kimberley.
Photo – Bill Belson/Lochman Transparencies

Left Desert mouse.
Photo – Jiri Lochman

performance to more rapidly achieve stable, ecologically based fire regimes on the Kimberley conservation estate.

In northern Australia there is similarity in the approaches being deployed to reduce the impact of unplanned wildfire. Land and fire management agencies across the tropical north of Australia share their research findings and experiences, and frequently exchange information. There is also increasing collaboration in training, resource sharing and information management systems. Land managers in the Northern Territory use broad landscape-scale burning with external buffers to protect the conservation estate and pastoral values. In WA, DEC uses wet and early dry season mosaics supported by a buffer system. Pastoralists often use prescribed fire on their boundaries to protect themselves from wildfires and use fire on their leases to manage pasture values. And Northern Territory and Queensland land managers have undertaken collaborative fire management projects with Indigenous communities that have allowed a localised mosaic to be established in some areas and bought about a reduction in late dry season fires.

Despite such efforts, there are three major challenges to sustainable fire management and biodiversity conservation in the tropical savannah. Firstly, collaboration and partnerships need to be further strengthened between government land managers, fire management agencies, local governments, traditional owners and pastoralists. Secondly, the fire ecology knowledge that underlies sound fire management is incomplete. Fire ecology knowledge needs to be expanded to enable more confident decisions on fire management to be made for the wide variety of ecosystems in the Kimberley. And finally, the quantum of resources required to apply pro-active fire management in a vast, sparsely populated landscape such as the Kimberley needs careful consideration. Advances in aviation technology and the involvement of resident Aboriginal communities are opportunities that need to be explored and developed.

Despite such challenges and the fact that contemporary fire patterns in the Kimberley are strongly suspected of having a significant detrimental effect on the Kimberley's unique natural heritage, it is not too late to do something about it. DEC, in partnership with other stakeholders, can reduce the 'bad' fire and increase the 'good' fire. It will take hard work, a lot of good will and the focused application of resources. But it can be done.

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Kevin White was DEC's Regional Fire Coordinator, based in Broome.

endangered

by Andrew Brown and Rebecca Hayes

Woolly foxglove

The genus *Pityrodia* was named by Robert Brown in 1810 from a collection made in Queensland in 1802. It is a common, widespread Australian member of the Lamiaceae family, which includes the well-known genera *Hemiandra* and *Prostanthera*. Some 56 species have been described, 27 of which are found in Western Australia. All are commonly known as native foxgloves due to the resemblance of their flowers to those of that genus. The Greek name *Pityrodia* refers to the scale-like leaves of the type species.

Native foxgloves are evergreen perennial shrubs that range in size from 15 centimetres to more than three metres high. Many species are disturbance opportunists. That is, they germinate from soil-stored seed following fire or other disturbance, quickly mature, flower profusely and slowly age.

Woolly foxglove is a small shrub to 30 centimetres high with its stems and leaves covered in dense, white, woolly hairs. The wrinkled, egg-shaped leaves are usually two to four centimetres long and one to 1.5 centimetres wide. Attractive deep red to pinkish-yellow flowers appear between late September and November. These are either solitary or arranged in clusters of three to five along a main stem. Each flower has five petals with wavy to tooth-like edges and four stamens that extend beyond the flower tube with the style extending further beyond them.

Woolly foxglove was first collected by John Septimus Roe in the nineteenth century and was described as a species of *Dasymalla* by Stephan Endlicher in 1839. In 1917 the species was placed in *Pityrodia* by George Druce. Native foxglove is currently known from a handful of locations over a range of 58 kilometres between Caron and Buntine in WA's northern wheatbelt, growing in areas of yellow sandplain with sheoak, bottlebrush, wattle and featherflower species.

Due to restricted habitat and threats associated with low population sizes, land clearing, road maintenance, weed intrusion and lack of suitable disturbance, the species is declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* and ranked as Critically Endangered. The species is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

With funding provided through the State Government's two-year, $15 million *Saving our Species* initiative, woolly foxglove will be the subject of a five-year interim recovery plan. Recommended recovery actions include promoting awareness of the species, surveying, monitoring, mapping of critical habitat, obtaining biological and ecological information, weed control, seed collection, and disturbance trials to stimulate germination of soil-stored seed.

If you think you have found native foxglove in the Dalwallinu–Perenjori area, please advise the Department of Environment and Conservaton.

Photos by Catherine Page and Rebecca Hayes

by Samille Mitchell

Cape Le Grand National Park

White beaches and rugged peaks characterise Cape Le Grand National Park.

Cape Le Grand National Park near Esperance is treasured for its wildly spectacular coast. Here giant granite boulders tower high above the earth, massive stretches of beach sweep across the coast and oceans dazzle with intense hues of blue.

In the distance, island peaks mark the necklace of islands of the Recherché Archipelago. And inland, sandplain heath harbours spring wildflowers which erupt annually from the austere growth in lashings of brilliant colour. The raw, rugged beauty means the 32,000-hectare park exudes a remote, almost desolate feel, yet it is just a 30-minute drive from the town of Esperance.

Exploring the park

You can explore Cape Le Grand National Park's wild reaches on the 15-kilometre Le Grand Coastal Trail, which links many of the park's most spectacular coastal sections. Alternatively, break the trail into four shorter sections.

Le Grand Beach marks the trail starting point and is also the site of one of the park's two camp grounds. These camp grounds are complete with septic toilets, solar hot water showers and camp kitchen facilities. Each bay is tucked away by itself, affording you privacy. The camp ground is perched on the edge of a wide stretch of beach overlooking island peaks in the distance.

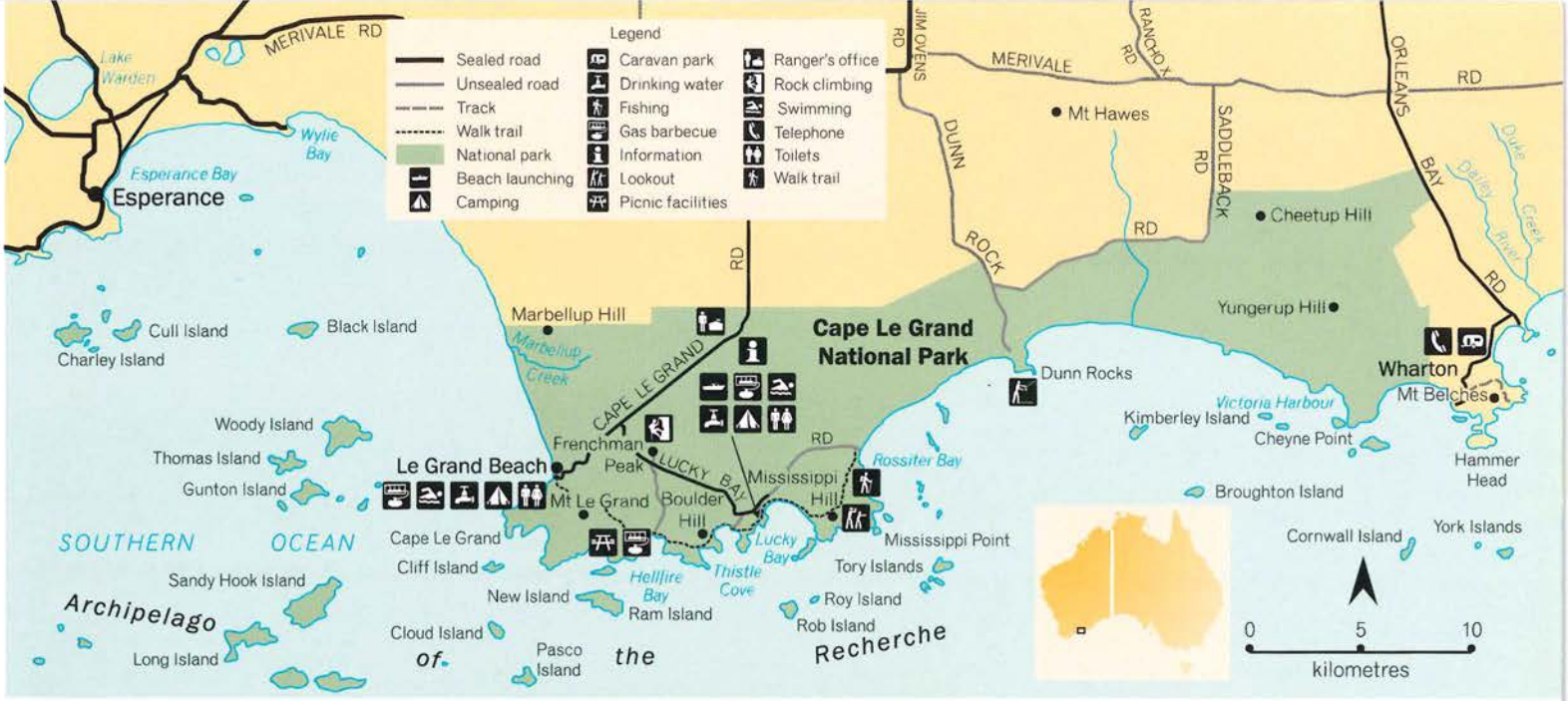
The walking trail connects Le Grand Beach with the spectacular sweep of beach at Hellfire Bay. Here, like most of the park's beaches, the sand is so clean it squeaks as you walk across it.

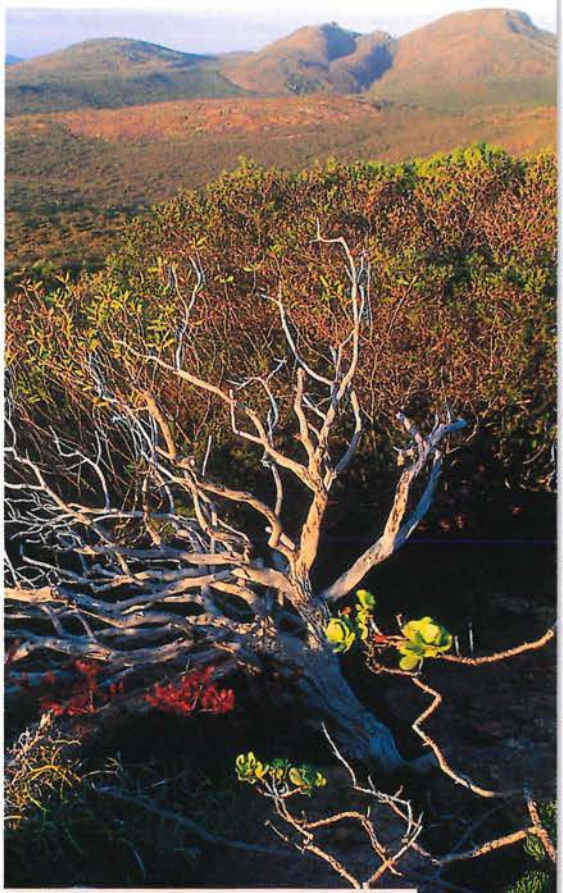
Walk another two hours from Hellfire Bay and you'll arrive at the picture-perfect Thistle Cove. Here a seasonal freshwater stream spills from the hills, carves its way through the sand and trickles into the ocean. A white ribbon of beach curves towards a soaring granite peak in the distance, and giant boulders are strewn across the land and into the sea.

Next stop on the walk is the ever-popular Lucky Bay, named by Matthew

Above Mount Le Grand.
Photo – Gordon Roberts/DEC

Opposite page
Top Le Grand Coastal Trail.
Photo – Andrew Davoll/Lochman Transparencies
Right Honey possum on a pincushion hakea (*Hakea laurina*).
Photo – Ian Solomon
Far right Mount Le Grand at sunset.
Photo – Dennis Sarson/Lochman Transparencies





Flinders in 1802 after he took shelter here from a storm. Lucky Bay is famed as being declared by scientists as officially having the whitest beaches in the country. It is also the site of the second of the park's camp grounds and is the best place in the park to launch a boat.

Walk another two to three hours and you'll reach Rossiter Bay. Explorer John Eyre named the bay after the captain of the ship *Mississippi*, which he encountered here after completing his epic and gruelling journey across the Nullarbor in 1841.

Away from the coast, you can also hike up Frenchman Peak—a two-hour journey which can be very steep in places. Frenchman Peak soars 262 metres above its surrounds while Mount Le Grand is 345 metres high and Mississippi Hill is 180 metres.

These massive granite outcrops were formed over the past 600 million years as erosion and movements in the Earth's crust shaped them to their present form.

Then, some 40 million years ago when sea levels were about 300 metres higher than today, the currents, waves and eddies further sculpted the peaks, carving out tunnels and caves.

Plants and animals

Cape Le Grand National Park's inland sandplains are particularly beautiful in spring when seasonal wildflowers adorn the landscape with colour.

The lashings of colour of the red kangaroo paw are particularly stunning, splashed across the undulating heath-covered sandplain. A variety of banksias also occur here, providing nectar and insects for the tiny and impossibly cute honey possum. Other mammals like the quenda or southern brown bandicoot and the ubiquitous kangaroo also live within the park's reaches.

park facts

Where is it? 30 kilometres south-east of Esperance, 50 kilometres by bitumen road.

Total area 32,000 hectares.

What to do Walking, camping, boating, picnicking, sightseeing, nature study, swimming, photography, fishing.

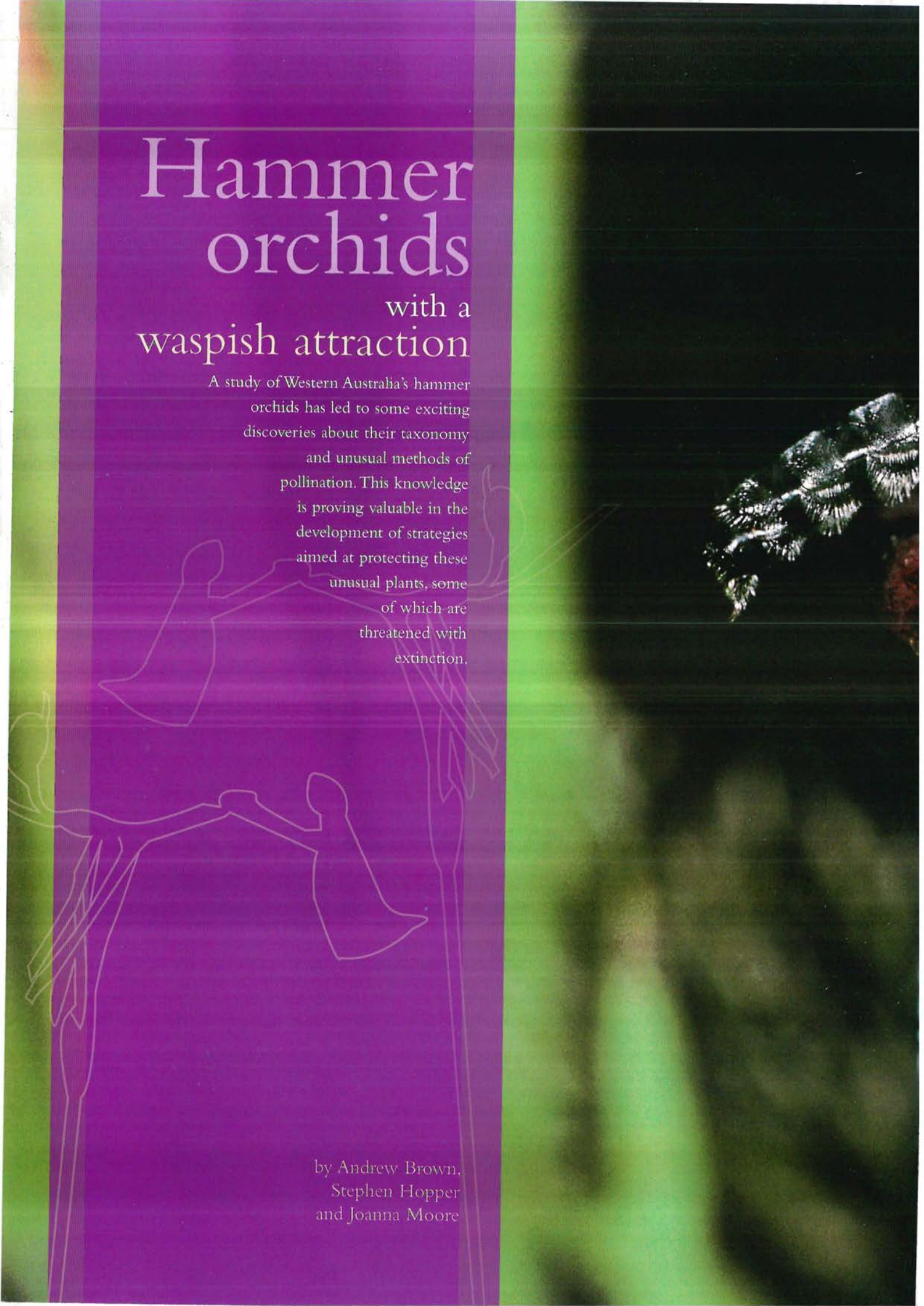
Facilities Barbecues, tables, toilets, camp sites, picnic areas, shade shelters, camp kitchens, water, information bay, walk trails.

Nearest DEC office Esperance District, 92 Dempster Street, Esperance. Phone (08) 9083 2100.

Hammer orchids

with a waspish attraction

A study of Western Australia's hammer orchids has led to some exciting discoveries about their taxonomy and unusual methods of pollination. This knowledge is proving valuable in the development of strategies aimed at protecting these unusual plants, some of which are threatened with extinction.



by Andrew Brown, Stephen Hopper and Joanna Moore

Well known for being spectacular or unusual, orchids are one of the largest of all plant families, making up about 10 per cent of the world's plant species. They are varied, complex and engage the eye of many bushwalking wildflower enthusiasts.

Although a myriad of floral forms are known among the orchids, without a doubt the orchid genus that exhibits one of the most bizarre adaptations is the Western Australian genus *Drakaea*—the hammer orchids.

The hammer orchids

Named from the type species *Drakaea elastica* by John Lindley in 1839 in honour of the accomplished botanical artist Sarah Anne Drake, *Drakaea* is a genus of 10 species characterised by small, fleshy, heart-shaped leaves, thin wiry stems and solitary flowers, each with a hinged insect-like labellum (lip). This latter feature leads to their common name, with the lip imagined as the head of the hammer and the arm the handle.

Hammer orchids are among some 400 orchid species found in Western Australia and, like the majority, are endemic to the south-west between Kalbarri and Israelite Bay. Most species are found in deep sandy soils and all favour open areas, meaning they are often seen along old tracks and around the margins of sand pits. A keen eye is required to observe hammer orchids because, while they are sometimes locally common, they are small and have dull colouration. Hammer orchids can be found in flower between August and November with the majority of species flowering between September and October.

Confused taxonomic history

The taxonomic history of the hammer orchids has been one of dispute and confusion from the time the genus was first named in the nineteenth century. When first described, just one species, *Drakaea elastica*, was recognised by English botanist John Lindley. James Drummond, a botanist and plant collector with a special interest in orchids and who collected the type specimens of *D. elastica*, was surprised by this, as two species were plainly evident around Perth and he had sent them separately bundled to Lindley's herbarium. However, the two species had been mistakenly pasted together on the same sheet. When he realised the mistake, Drummond named them *D. livida* and *D. lucida*. So for more than a century, the name *D. elastica* was applied to the wrong species—the common warty hammer orchid now known as Drummond's *D. livida*.

A long and complicated series of contributions to the genus followed, involving the discovery of new species, numerous new descriptions, misnamings and renamings. By the 1980s four species had been named—the glossy-leafed hammer orchid (*D. elastica*), warty hammer orchid (*D. livida*), king-in-his-carriage orchid (*D. glyptodon*) and narrow-lipped hammer orchid (*D. thynniphila*).

First modern-day study

The most recent chapter in the hammer orchid story—a taxonomic review of the genus carried out over 25 years—is a particularly exciting one. The study is the first based on modern collections and field data and recognises 10 species within the *Drakaea* genus, including the description of six new species. Official naming of the new hammer orchids took place in 2007 in a paper written by Stephen Hopper and Andrew Brown published in *Australian Systematic Botany*. It bases its taxonomy in part on the perceptions of wasps!

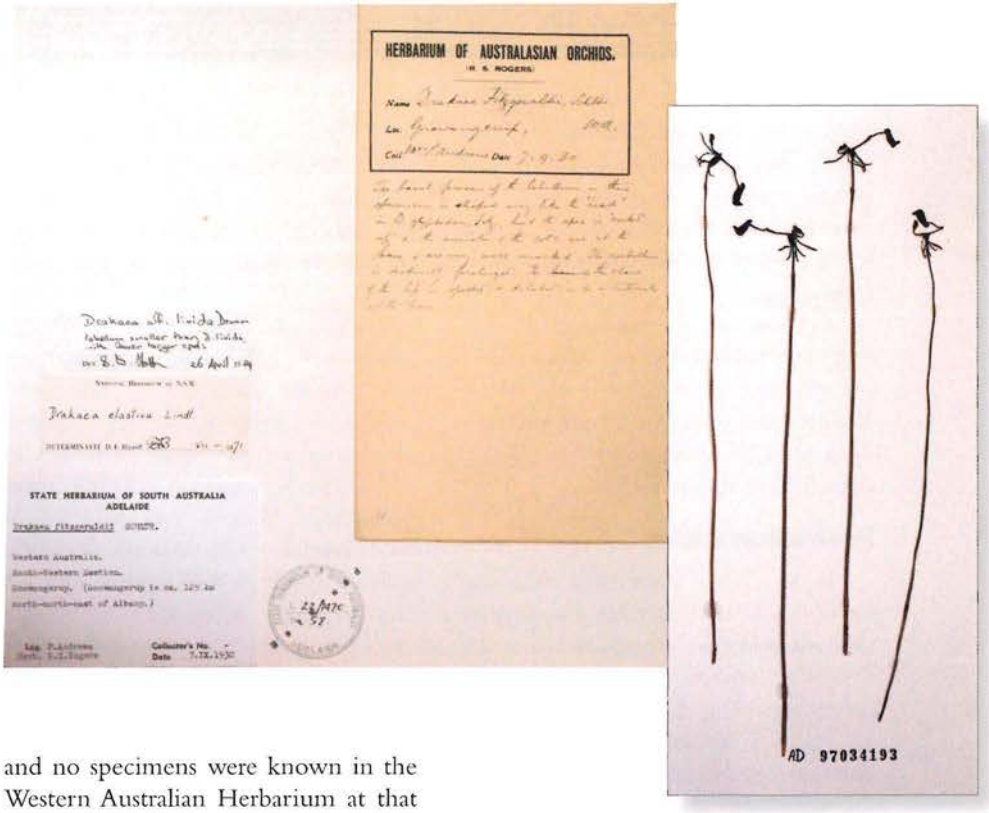
Previous page
Main Wasp with warty hammer orchid.
Photo – Babs and Bert Wells/DEC

Left Kneeling hammer orchid.
Photo – Andrew Brown/DEC

The review began following a mapping program undertaken in the early 1980s by Stephen Hopper when at the former Department of Fisheries and Wildlife, the precursor to the Department of Conservation and Land Management, now the Department of Environment and Conservation (DEC), in collaboration with knowledgeable locals. The program was aimed at determining the taxonomic and conservation status of orchids. Through the program and follow-up research it became evident that despite the great amount of interest shown by numerous botanists and orchid enthusiasts over many years, undescribed taxa of *Drakaea* still existed. Six new species were subsequently recognised.

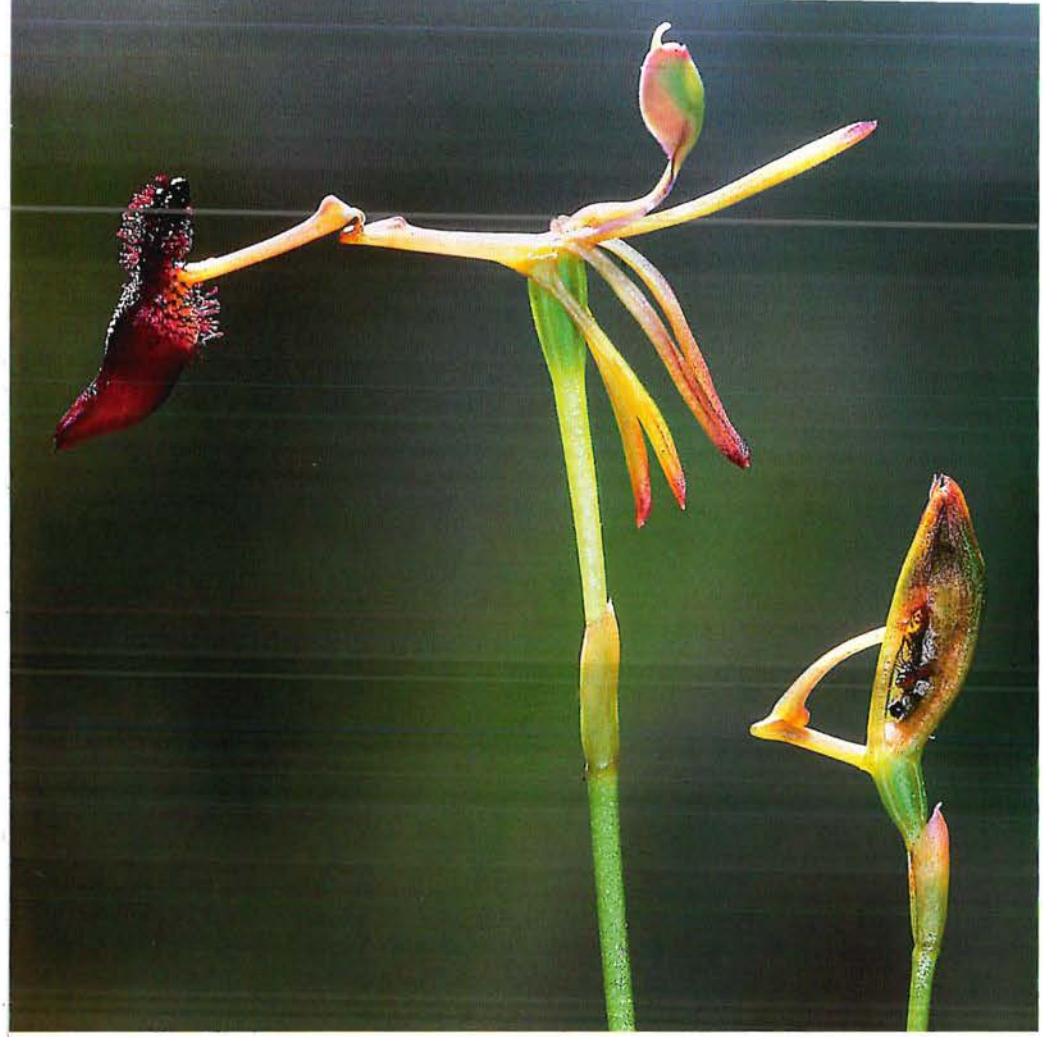
By 1992, five of the six new species had been identified. These were the kneeling hammer orchid (*D. concolor*), late hammer orchid (*D. confluens*), slender hammer orchid (*D. gracilis*), lonely hammer orchid (*D. isolata*) and dwarf hammer orchid (*D. micrantha*).

The sixth new species—the lost hammer orchid (*D. andrewsiae*)—was recognised only as the taxonomic review of the genus was finalised. Although photographs of the lost hammer orchid were taken in the early 1980s, no plants had been located and no specimens were known in the Western Australian Herbarium at that time. However, in 2004 a collection was discovered at the Adelaide Herbarium that had been made by Mrs P. Andrews from Gnowangerup in September 1930, and this was able to be used as the type collection. Subsequently, the prominent Western Australian orchidologist Garry Brockman took a photo of the species in September



Top The only known recent photograph of the lost hammer orchid.
Photo – Garry Brockman

Above and above right Type sheet and specimens of the lost hammer orchid collected by Mrs P. Andrews in 1930.
Photos – Bill Barker/State Herbarium of South Australia



Above Warty hammer orchid.

Left Late hammer orchid.
Photos – Babs and Bert Wells/DEC

2004 when he found two plants in a weedy area of remnant bushland east of Gnowangerup. Searches since then have failed to find the species, but it is hoped that it still exists in bushland somewhere.

As part of the revision of the hammer orchid genus, many field surveys were conducted and these explored the interaction between male wasps and the wasp-mimicking lower petal (lip) of the orchids.

Pollination tricks

It has been discovered that the lip of many orchids takes on physical similarities to female wasps to enable the orchids to attract male wasps for cross pollination. This biologically complex adaptation is repeated in several Western Australian orchid genera but nowhere to the remarkable degree as in the hammer orchids where the significantly enlarged and highly modified lip or labellum actually resembles an insect more than it does a petal.

Although the function of the insect-like lip of hammer orchids drew speculative comment as early as 1951, a full understanding of its role in attracting pollinating insects did not begin until male thynnid wasps were seen visiting flowers of the common warty hammer orchid in the Darling Scarp east of the Perth suburb of Kelmscott in the early 1970s.

American pollination ecologist Professor Warren Stoutamire was visiting Australia at the time, conducting fieldwork on the function of unusual or rare floral characters in orchid species aimed at enticing insect pollinators. Warren was told about the thynnid wasps visiting common warty hammer orchid flowers. This led him to study other hammer orchid species and resulted in his publication of illustrations and descriptions of the mechanisms used by the hammer orchids for pollination.

Understanding the mating behaviour of thynnid wasps is integral to understanding how hammer orchid flowers are pollinated. The female thynnid wasp is flightless so when it is ready to mate, it climbs up low vegetation and releases a pheromone (a sexually attracting odour). The stingless winged male thynnid wasp detects the pheromone and zigzags upwind to find its source.

Once the male wasp locates the much smaller female it picks the female up and they mate in flight. The male immediately flies to a source of nectar so they can share a nuptial dinner before decoupling. The female thynnid wasp then drops to the ground and burrows below to find beetle larvae, which it renders immobile with its sting before laying eggs on the victim.

Sexual confusion

It has been established that hammer orchid flowers emit an aerially transported chemical that mimics the pheromone of the female thynnid wasps. The male thynnid wasp, when picking up the orchid's deceptive scent, behaves as if it had located a receptive female wasp—it heads towards the source.

The hammer orchid's wasp-like lip sits at the end of an intricately constructed hinged attachment. When the male thynnid wasp finds what it perceives to be a pheromone-releasing female wasp, it grasps the female and tries to fly away to mate. But instead, the male and the lip arc forwards with the wasp's momentum—made possible by the hinged attachment—until its

Above A thynnid wasp flies up to a slender hammer orchid flower, attracted by its appearance and scent.

Right The wasp grasps the female wasp-mimicking lip, hoping to mate.

Below right It then arcs forward, colliding with the orchid's column.
Photos – Babs and Bert Wells/DEC

back collides with the orchid's column (a structure within the orchid flower).

During this process—and as the baffled wasp probably tries to work out what has gone wrong—the male's upper thorax (the middle section of its body) comes into contact with the stigma and anther (the top part of the orchid's column). This is what the orchid needs for pollination to occur. The wasp may pick up some pollinia (pollen packets) on its thorax or, if it already has some on it from a previous visit to another hammer orchid, some may rub against the stigma.

A specific attraction

Building on the work of previous researchers, a study was conducted into which thynnid wasps were attracted to which hammer orchids. To do this, sets of different species of hammer orchid flowers were set up in vials of water in areas of bushland where male thynnid wasps were known to be active. The wasps could then be watched to see how they interacted with the flower baits.

Above Eight of the 10 known species of hammer orchid.
Photo – Stephen Hopper

Right Leaves of the dwarf hammer orchid.

Far right Searching for rare hammer orchids.
Photos – Andrew Brown/DEC

The study established that the thynnid wasps that pollinate hammer orchids display species-specificity. This means when given a choice, each species of wasp is selective in which species of hammer orchid it attempts to mate with. The conservation of the thynnid wasps is therefore important to the conservation of the orchids.

The actions of the wasps provided evidence that the subtle floral differences between the hammer orchids warranted naming several new species. This explains the assertion that the new hammer orchid taxonomy is based in part on the perceptions of the wasps.

Fungal association

Even if the pollination process goes smoothly and the orchid's pollen grains grow down into the plant's ovary where they develop into a mature seed, seed germination is not guaranteed. Orchid seeds are among the smallest plant seeds and this means they are unable to germinate and grow on their own, as they lack the necessary nutrient store.

Most terrestrial orchids require certain mycorrhizal fungi for seed germination and hammer orchids are no exception. The fungus also supplies the mature orchid plant with water and nutrients during its seasonal growing cycle. In the absence of this association the orchid would not be able to survive for long due to its poor photosynthetic capabilities and its lack of a normal root system. So the survival of hammer orchids not only relies on the wasp-assisted pollination process but also on a guarantee that the appropriate mycorrhizal fungus is present in the soil.

Naturally rare

Hammer orchids are among the most endangered Western Australian orchids with six of the species now extremely rare in their natural habitat. The lost hammer orchid is not known to have any extant populations in the wild while the glossy-leafed hammer orchid is now confined to just a few areas of remnant bushland along the Swan Coastal Plain. Other rare species are the kneeling hammer orchid, late hammer orchid, lonely hammer orchid and dwarf hammer orchid.

While the Threatened status of the rare hammer orchids is largely due to past land clearance and ongoing threats such as rising saline water tables, weeds, inappropriate fire regimes and changes in hydrology, several hammer orchids appear to be naturally rare. The reasons are largely unknown and research is under way to determine the specific causes of rarity.

Taking a closer look

Ryan Phillips, a PhD student at The University of Western Australia and the Botanic Gardens and Parks Authority, is undertaking research to better understand factors affecting the evolution and conservation of rare hammer orchid species. This research

Right Habitat of glossy-leafed hammer orchid.
Photo – Andrew Brown

Below right Wasp with narrow-lipped hammer orchid.
Photo – Babs and Bert Wells/DEC

will increase our knowledge of the orchids' biological and ecological requirements, including habitat requirements, fungal associations and the sexually deceived wasps that pollinate them. The research will yield important insights which will help in the future conservation of hammer orchids.

Ryan's research is currently focusing on the factors influencing rarity and the formation of new species in hammer orchids. By combining experimental baiting for pollinators (using flowers picked under a scientific collecting permit from DEC) and for mycorrhiza (using orchid seed baits), he hopes to determine the causes of rarity in all of the endangered hammer orchids.

A key early discovery is that there is considerable variation in the causes of rarity between different species of hammer orchid. For example, the dwarf hammer orchid has a widespread mycorrhizal fungus but its pollinator is extremely limited. At the other extreme, the kneeling hammer orchid has a widespread pollinator but is restricted by its own specific habitat requirements. An unexpected result is that all species enjoy a very high pollination rate—a sign of the effectiveness of sexual deception. It is hoped that this will enable a high survivorship of current populations.

Conserving for the future

The conservation of the hammer orchids is an enduring concern and, in order to protect them, five of the 10 species are legally protected under the *Wildlife Conservation Act 1950* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. This highlights the ongoing need for active research and management to ensure the conservation of this unique part of Australia's orchid heritage.

In particular, surveys for the lost hammer orchid are urgently needed to establish its conservation status. So far, it has been recorded only three times from the Gnowangerup–Tunney district about 350 kilometres south-east of Perth and it has not been found in recent searches.

DEC staff have written interim recovery plans for the late and lonely hammer orchids and are updating a previously published plan for the glossy-leafed hammer orchid. These recovery plans outline the actions that are needed to urgently address the threatening processes most affecting the survival of these species and begin the recovery process. Many of the recovery actions have been implemented and with ongoing action it is hoped that the future of the rare hammer orchids is ensured.

Hopefully the bizarre flowers and behaviours of hammer orchids will continue to captivate us so we are inspired to keep learning about and protecting them well into the future.

Andrew Brown is the Threatened Flora Coordinator with the Department of Environment and Conservation (DEC). He is the honorary Curator of the Orchidaceae and Myoporaceae at the Western Australian Herbarium, a life member of the Western Australian Native Orchid Study and Conservation Group and has conducted more than 30 year's research into Western Australian orchids, including their biology, ecology, taxonomy and genetics. Andrew has collaborated in the description of 131 new Western Australian orchid taxa, including the six new hammer orchids included in this article.

Stephen Hopper became Director of the Royal Botanic Gardens at Kew in October 2006. He is an internationally recognised plant conservation biologist who collaborated in the discovery, classification and description of 300 new plant taxa and led the delivery of improvements to programs and infrastructure at WA's Kings Park to world-class standards. He is Visiting Professor at The University of Western Australia and the University of Reading, and is a Fellow of the Linnean Society.

Joanna Moore is a DEC Communications Officer.
She can be contacted on (08) 9389 8644 or by email (joanna.moore@dec.wa.gov.au).

Wungong Regional Park

by Paul Burns

The national and regional parks of the Darling Range east of Perth are precious for their scenic beauty and provide valuable habitat for native wildlife. They are also ideal locations for recreational activities such as walking, picnicking, horseriding, abseiling and rock climbing. Wungong Regional Park—one of four regional parks in the area—is an outer-city haven for native animals and humans alike.

The *Forest Management Plan 2004–2013* instigated the separation of the Darling Range Regional Park into four separate regional parks in Chidlow, Kalamunda, Kelmscott-Martin and Wungong. The four regional parks are currently named after their locality, but the Department of Environment and Conservation (DEC) is in consultation with Aboriginal groups to rename the parks with Indigenous titles.

The regional park in Wungong is an area of 4,103 hectares, directly east of the town of Byford. It is made up of a number of separate blocks, the biggest of which are the Wungong Valley, nearest to Byford, and Churchmans Brook, which is adjacent to the Canning River. These areas cover a variety of landscapes and accommodate a range of plants and animals.

Wungong Valley

Wungong Valley lies among the rugged hills at the edge of the Darling Scarp, where the terrain is rough and access is by a single dirt track. The red, rocky soil supports towering stands of marri (*Corymbia calophylla*) and jarrah (*Eucalyptus marginata*) trees. Under the canopy lies a thick carpet of low-lying heath and tangled undergrowth that provides perfect cover for the valley's native marsupials.

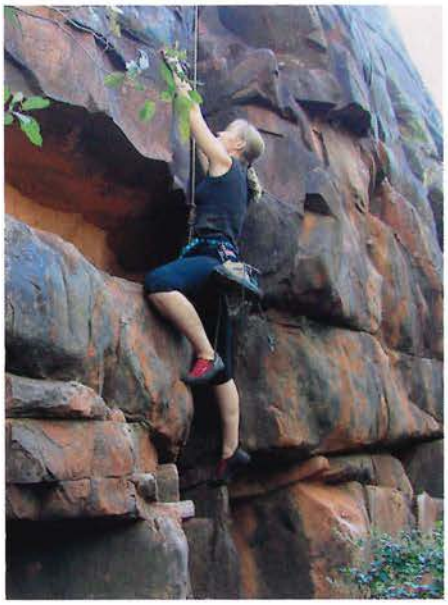
Over thousands of years, wind and rain have scrubbed away patches of topsoil from some of the valley's steep slopes, exposing the granite bedrock beneath. These bare outcrops form spectacular features against a backdrop of woodland greenery. Over time, further erosion has cut deep slices in the rock and polished some sections so that they gleam in the sun, creating an odd contrast of smooth and rough. Along the cracks and crevices in the rock, patches of native grass and the occasional sheoak (*Allocasuarina fraseriana*) retain a tenuous grip on the sheer hillside.

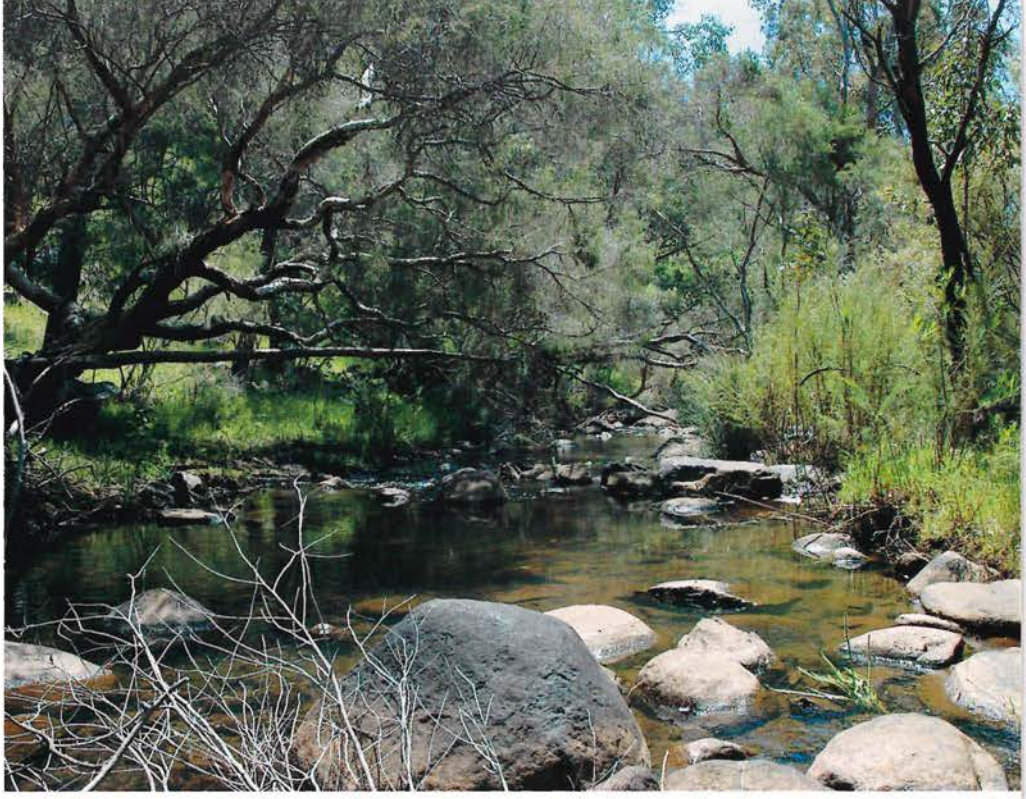
Throughout the Wungong Valley there are continual reminders of nature's life cycle. A solitary, long-dead jarrah tree sits atop a steep hill, bleached white by the sunlight and hollowed out by rot and decay. The tree has probably been dead for decades, but still provides habitat for native species such as possums and

Previous page
Main Forest understorey.
Photo – Sallyanne Cousans
Insets from left Bushtail possum.
Photo – Jiri Lochman
Firewood banksia.
Photo – Rob Olver
Scarlet robin.
Photo – Jiri Lochman

Left Western grey kangaroo.
Photo – Jay Sarson/Lochman Transparencies

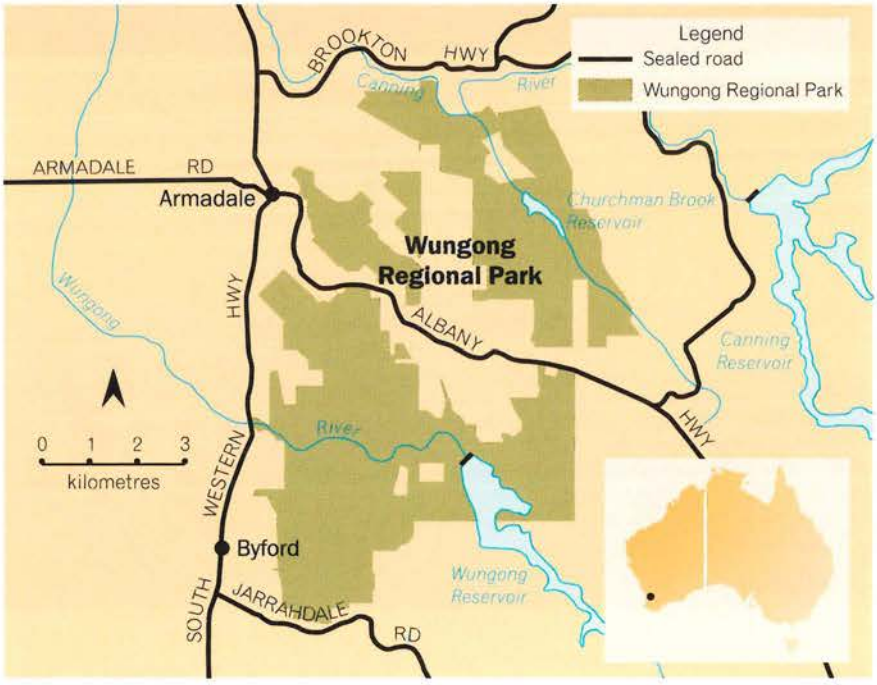
Below Sweeping vistas in Wungong Regional Park.
Photo – Paul Burns/DEC





Above Rock climbing at Churchmans Brook.
Photo – Phillip Calais

Above right Tranquil scenes in Wungong Regional Park.
Photo – Paul Burns/DEC



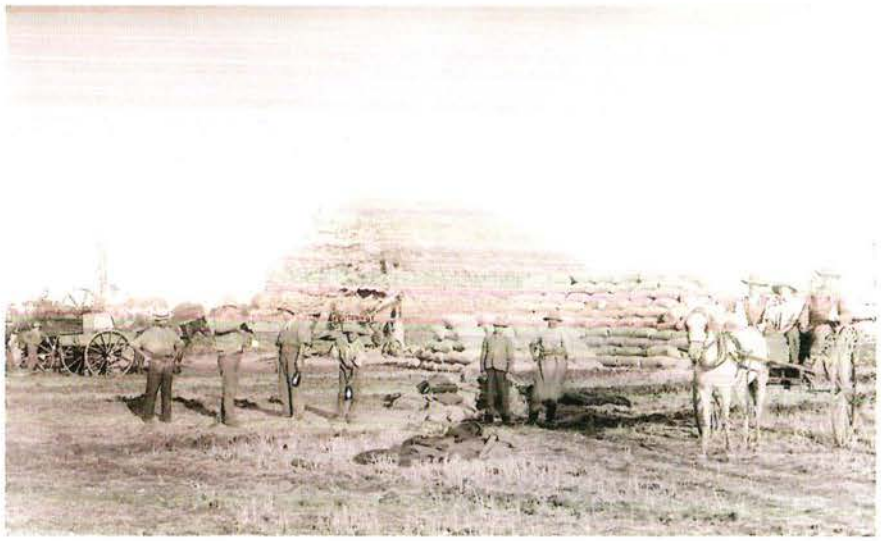
parrots. Some trees and bushes still bear black scorch marks from the last bushfire. Fires can threaten animals, destroy plants and remove much of the ground cover that is used as habitat. However, it also plays an important role in regeneration and clears space for new shoots to push up through the soil without having to compete with larger plants for sunlight. The heat of a bushfire also enables the seed pods of the firewood banksia (*Banksia menziesii*) to open and, after a fire, kangaroos and quenda are provided with a feast of tender, green shoots.

Churchmans Brook

Churchmans Brook is a smaller section of the regional park that lies east of Armadale, overlooking Roleystone Valley. The vegetation of Churchmans Brook differs greatly from Wungong Valley. Water-loving paperbarks (*Melaleuca acacioides*) thrive along the banks of the Canning River, together with thick groves of flooded gums (*Eucalyptus rudis*). Because the area has been subjected to grazing, there is very little undergrowth. In its place, weeds like watsonia, blackberry and Paterson's curse have sprung up to choke out the scrub, seriously affecting the area's biodiversity. Fortunately, volunteer groups such as the Churchmans Bushland Association have weeded broad areas along the Canning River and successfully revegetated the banks with indigenous bushes and reeds. Further from the river, there is evidence of the native bush fighting back, as a field of Paterson's curse succumbs to a grove of marri saplings. As the saplings grow and spread their branches, the prolific weeds are shaded out, enabling more marri trees to establish themselves. Over decades, generations of trees have crept down the field to form a cascading wave across the clearing.

A steep cliff face within Churchmans Brook is one of Perth's most popular climbing locations and offers climbs with a range of difficulty levels that cater to the beginner to the 'hardman'. The breathtaking panorama from the top of the cliff, which enables you to see deep into the Roleystone Valley and along the Darling Scarp, is well worth the effort of making it to the top. A few metres up the cliff face lies a narrow alcove and although moisture permeates through the back wall of the cave, it is well protected from wind and rain. It is believed the infamous bushranger Moondyne Joe used the cave as one of his many hide outs along the Darling Range.

Left Short-beaked echidna.
Photo – Jiri Lochman



Below left Wungong was one of the first established farming districts in WA.
Photo – Courtesy Battye Library (012796d)

History

The Nyoongar Aboriginal people have inhabited the south-west of Western Australia for thousands of years, including the Perth hills where Wungong Valley is located.

However, it wasn't until the mid-1800s that Europeans began to settle in the area. History records hostile meetings between the Aboriginal people and the new European settlers. However, in other instances Aboriginal people are said to have helped their European counterparts with such tasks as finding water, and relatively friendly relations ensued.

Wungong was one of the first established farming districts in WA. Thomas Saw first bought into the area near Admiral Road, downstream from what is now Wungong Dam, in 1865 with his brother-in-law, William Lacey Gibbs. Gibbs' share in the land was acquired by William Butcher senior the following year.

The Butcher family was to have a significant influence on the future of the area, their impact extending from Armadale–Kelmscott through to Serpentine–Jarrahdale. William Butcher senior was said to have arrived in Perth at the age of 12. The boy had a note pinned to his coat asking for "a good Christian family to take him in and care for him". He worked around the Gingin area for some years, before marrying Marian Horton in 1853. They moved to the Kelmscott district, where William began carting sandalwood along the road from Fremantle to Albany. It was through this business that he discovered the potential of the Wungong Valley.

After buying Gibbs' land, Butcher built a cottage close to the brook—the first of four dwellings built in the area by the Butcher family. The cottage no longer exists and all that remains of the Butcher homestead is a cement slab and a couple of gnarled mulberry trees. Further up the Wungong River lie the remnants of a water mill, which was adapted to churn butter, cut timber and grind wheat. In 1900, the Butcher family's presence in the area was consolidated, when Saw sold some of his land to Robert Batt, who had married Sarah Ann Butcher in 1886.

Churchmans Brook derives its name from Captain Charles Blissett Churchman, who arrived at the Swan River Colony in 1830 with an ambition to farm the land, and by 1831 was assigned 5,666 acres in the district now known as Roleystone. Churchman arrived at a difficult time in the Swan River Colony's history. Money and labour were in short supply, and food was scarce to the point of starvation. Like many other settlers unaccustomed to their new surroundings, Churchman struggled against the unyielding land and harsh climate, without success. The strain eventually took its toll and in 1833, at the age of 43 years, he died of 'apoplexy or paralysis'.

Churchman died without leaving a will, and many years passed before his estate was reallocated. His land was left to return to its natural state, undisturbed until the middle of the nineteenth century.

Managing the park

DEC faces a number of challenges in managing the regional park in

Right Wungong Regional Park is popular for bushwalking through jarrah forest. *Photo – Dennis Sarson/Lochman Transparencies*

Below right Bushranger Moondyne Joe is believed to have used a cave in Wungong Regional Park as a hideout. *Photo – Paul Burns/DEC*

Wungong. Because most of the land had been used for agriculture, weeds pose a major problem to the maintenance of biodiversity and the provision of habitat for native wildlife. It requires ongoing effort to manage existing weed infestations and control new ones. The area is also at high risk of bushfires. The steep hills make access for firefighting vehicles difficult, while also increasing the volatility of a spreading fire. The fire risk makes the creation and maintenance of firebreaks essential. However, choosing a good alignment is important, as the tracks are susceptible to erosion from rain washing down the hilly slopes of the valley. Introduced animals such as foxes, rabbits and pigs do significant damage to native species through habitat destruction, competition for green feed and preying on native mammals. Apart from being environmentally destructive, feral pigs can pose a serious danger to people, so DEC runs a seasonal trapping program to keep pig numbers in check.

The Wungong Valley provides habitat for a number of native mammals, including western grey kangaroos (*Macropus fuliginosus*), western brush wallabies (*M. irma*), brushtail possums (*Trichosurus vulpecula*) and echidnas (*Tachyglossus aculeatus*). The quenda or southern brown bandicoot (*Isoodon obesulus*) is making something of a comeback in the area, as the low scrub provides the small marsupial with shelter and a place to hide from its main threat, the fox. However, despite its recent recovery, the quenda's future in Wungong remains uncertain, due to the pressure of feral animals and nearby development.

The valley is also home to an array of bird species, and is a popular site for birdwatchers. A variety of honeyeaters occupy the regional park, such as the New Holland, brown and white-naped honeyeaters. The area features white-breasted and western yellow robins, as well as splendid and red-winged fairy-wrens. The distinctive call that gives the golden whistler its name can be heard throughout the valley, as well as the rising chirps of grey fantails. A number of colourful parrot species also occupy the area, including western rosellas, red-capped parrots and elegant parrots. In recent times the valley has become home to a family of wedge-tailed eagles, and the occasional emu has been spotted roaming through the bush.

Churchmans Brook, along with the Wungong Valley and other sections of the regional park, have been allowed to re-vegetate and recover. Many of the marks of human occupation have been erased as the native bush reclaims cleared land. Now people can enjoy and use the land in a way that doesn't adversely affect the natural surroundings.

Paul Burns was a final-year, creative writing student at Curtin University when he undertook a work experience placement with *LANDSCOPE* and wrote this article.

Thanks to the Department of Environment and Conservation's Planning Officer Jacinta Overman, Parks and Visitor Services Division Acting Manager Brendan Dooley and Operations Officer Tony Eddleston for their input into the article.

Science in the sea

by Carolyn Thomson-Dans and Shannon Armstrong

When celebrated navigator and buccaneer William Dampier visited the archipelago now named in his honour during the seventeenth century, the astute observations and intriguing sketches in his journal brought the area's natural history to the attention of the world. It is fitting then that, with the imminent declaration of the Dampier Archipelago Marine Park, a long-term scientific monitoring program has now been established for its very special suite of marine plants and animals.

The Dampier Archipelago—42 islands, islets and rocks, all lying within a 45-kilometre radius of Dampier—is the richest area of marine biodiversity known in Western Australia, comparable to that of the Great Barrier Reef (see 'Dampier Down Under', *LANDSCOPE*, Summer 2003–2004). The archipelago's waters will soon be protected by two important marine conservation reserves.

The proposed Dampier Archipelago Marine Park will cover about 122,000 hectares and protect the waters around most of the islands in the archipelago. The diversity of fish and corals in the Dampier Archipelago is comparable to other parts of the Indo-Pacific and many of the species are common to several areas. However, peculiarities in the structure of the islands mean these coral reefs are unique. More than 215 species of corals, many of which occur both inshore and offshore, have been recorded. In inshore waters, corals grow prolifically on rocky slopes but generally do not form reefs. Most of the coral reefs in the archipelago are fringing reefs.

The proposed Regnard Marine Management Area will straddle the mainland coast west of Dampier and cover an area of approximately 62,000 hectares (see 'Marvellous mangroves and mud', *LANDSCOPE*, Spring 2007). It will extend from Eaglehawk and West Intercourse islands eastwards to South West Regnard Island.

The Dampier Archipelago has exceptional natural beauty and high conservation values. Several of the beaches are important nesting sites for hawksbill, flatback and green turtles, with Rosemary Island having the largest hawksbill turtle rookery in the Indian Ocean. More than 40 species of shorebirds and migratory waders use the saltmarshes, mangroves, extensive mudflats and intertidal reefs, and some of the small, outer islands and rocks support large seabird colonies. The proposed Dampier Archipelago Marine Park is also an important area for migratory humpback whales and dugongs graze on the seagrass meadows.

Zoning in on conservation

Like most other marine parks and reserves in WA, the proposed Dampier Archipelago Marine Park will be a multiple-use reserve that caters for a wide range of activities. Multiple-use reserves reflect a balanced approach to conserving the natural environment and providing opportunities for people to enjoy and appreciate it.

Previous page
Main *Pavona decussata* corals are commonly found in turbid waters of the proposed Dampier Archipelago Marine Park.
Photo – Suzanne Long/DEC
Inset Recording the abundance and length of fish along a monitoring transect using underwater stereo video equipment.
Photo – Alicia Edwards/DEC

Below Much of Searipple Passage is likely to be a sanctuary zone when the proposed marine park is declared.
Photo – David Bettini

Zoning is an important part of the management framework in multiple-use marine parks and reserves. The establishment of sanctuary zones (or their equivalent) is an integral element of 'best practice' multiple-use marine parks and reserve systems worldwide. Sanctuary zones prohibit all forms of extractive activities, including fishing, so the establishment of sanctuary zones is often the most contentious part of the planning process. Sanctuary zones provide natural refuges for the conservation of marine biodiversity, form reference areas for research and monitoring to help scientists measure the impact of human activity on the environment and are important areas for passive recreation, nature appreciation, tourism and public education.

Sanctuary zones only comprise about seven per cent of the proposed Dampier Archipelago Marine Park. While this percentage is below emerging benchmarks for sanctuary zones in tropical multiple-use marine parks and reserves, it represents the achievable outcome of a protracted community planning process. These processes attempt to balance the best conservation outcomes possible, in terms of marine park and reserve design, while minimising impacts on existing recreational and other uses and hence retaining local community support for the park or reserve to be established. Once the proposed marine park and marine management area have been established, the results of the local research and monitoring studies and public marine education programs will be used to better inform and demonstrate to the local community the numerous benefits of sanctuary zones.

The proposed Dampier Archipelago Marine Park is popular for a wide range of recreational activities including scuba diving, snorkelling, fishing and boating. The best diving is on the outer islands, such as Delambre, Legendre, Kendrew, Rosemary and Enderby islands, and the reefs that lie between them.

The Dampier Archipelago provides recreational fishing opportunities that are greatly valued by local communities. In fact, the nearby population has the highest level of boat ownership in WA.

Top Diverse coral community near Conzinc Island.

Above Hawksbill turtle in a mangrove creek in the proposed Enderby Island sanctuary zone.
Photos – Shannon Armstrong/DEC

Once the marine park is declared, fishing will still be permitted in most of the park and there will be no restrictions for divers, snorkellers, wildlife watchers and other low-impact users.

Long-term monitoring

Once the marine reserves are established, the only way to tell if the new zoning and management strategies are working successfully is through rigorous and regular scientific monitoring. For this reason the Department of Environment and Conservation's (DEC's) Marine Science Program carried out its first two-week monitoring survey in the Dampier Archipelago area in September 2007.

A previous study in the Dampier Archipelago by Barry Hutchins of the Western Australian Museum had revealed that most recreationally targeted fish species within the archipelago were strongly associated with coral reefs, so DEC's marine scientists decided that the first survey would focus on coral reef habitat (future surveys will target different fish habitats). Survey sites with similar coral cover and coral species were selected to minimise the effects of habitat variability on changes to fish assemblages.

DEC's marine survey team, led by Research Scientist Shannon Armstrong, recorded coral reef communities and their associated reef fish, both within and outside proposed sanctuary zones. Six 50-metre-long transects were surveyed at each of six sites at both Legendre Island and Sailfish Reef. A subsequent survey in mid-2008 will establish sites at Delambre Island, Hamersley Shoals and Kendrew Island to provide baseline data before the creation of the marine park.

These areas were chosen for several reasons. They included areas within proposed sanctuary zones; they offered

Top The proposed Dampier Archipelago Marine Park will protect the richest area of marine biodiversity known in WA.
Photo – Shannon Armstrong/DEC

Above left DEC Research Scientist Shannon Armstrong records the condition of corals using underwater video.
Photo – Alicia Edwards/DEC

Above Edible red jellyfish (*Crambione mastigophora*).
Photo – Suzanne Long/DEC

good stretches of coral reef on which to locate transects; and they will also enable scientists to make comparisons with historic data because past surveys of fish and coral reef communities have been undertaken at several of the sites.

Divers worked in groups of three. The first diver swam along the transect recording the abundance and length of fish using an underwater stereo-video, closely followed by a second diver who recorded transect length. The third diver recorded the cover of corals and other plants and animals attached to the sea floor along the transect again using an underwater video.

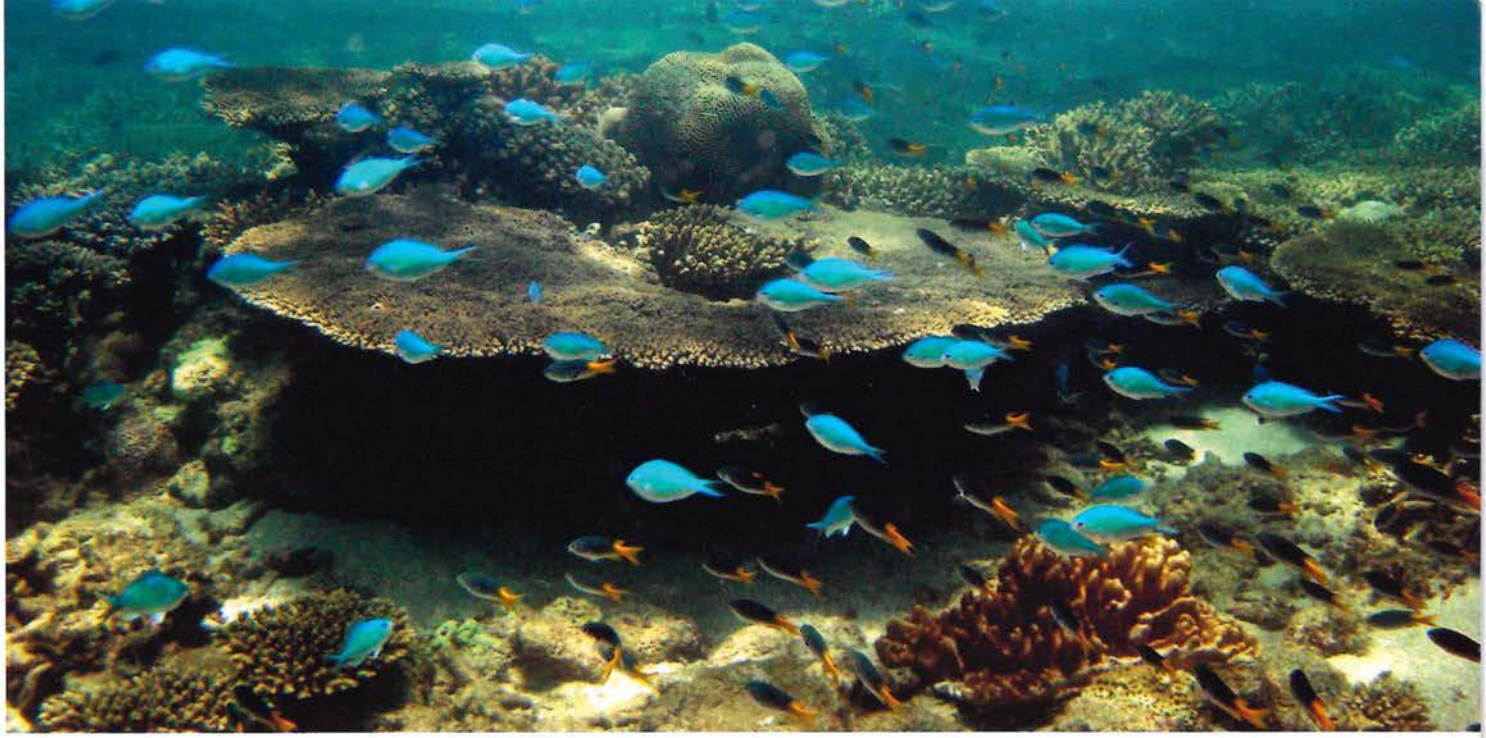
Although the scientists undertaking the September 2007 survey were astonished at the large variety of marine habitats, they did not see a lot of large recreationally targeted, site-attached fish species such as coral trout, which indicated that areas within the proposed marine park may be significantly depleted of these species. Given these observations, it will be interesting to see if the general abundance and size of such fish species increase over time within sanctuary zones.

When it becomes available, the information gained from the survey will give invaluable insights into the current health of marine communities of the proposed Dampier Archipelago Marine Park and provide a basis on which to compare the results of future surveys in the area.

Future surveys

Some larger fish species targeted by recreational fishers may avoid scuba divers but are likely to be successfully sampled using baited remote stereo-video. This technique involves lowering baited video cameras to the seafloor to record the size and numbers of fish during set time intervals. A second survey will be conducted in mid-2008 to collect data on fish abundance and length using this method. The combination of the two different survey techniques will provide more comprehensive information on changes to the abundance and assemblages of fish species in the Dampier Archipelago over time.

The baited remote stereo-video survey will target additional fish habitats to the first survey. Researchers may also establish sites aimed at determining



Above Luxuriant corals at Nelson Rocks in the proposed Dampier Archipelago Marine Park.

Right DEC will monitor crown of thorns sea stars as part of its long-term monitoring program.
Photos – Shannon Armstrong/DEC

whether benthic protection zones within the proposed marine park are effective at protecting bottom-dwelling fish species over time.

Future surveys will also include estimating the size and density of recreationally targeted tropical rock lobsters inside and outside proposed sanctuary zones. DEC researchers will also be keeping a watching brief on the densities of crown of thorns sea stars and drupella snails—which predate on corals and can sometimes reach plague proportions and damage large areas of reef (see 'Snail threat to Ningaloo Reef?', *LANDSCOPE*, Summer 2007-2008).

To better understand seasonal variations in fish abundance and length and rock lobster size and density at the Dampier Archipelago, surveys will be repeated during different seasons over the next two years. The data will provide an estimate of the size of such differences against which we can compare the differences between fished and unfished areas.

These surveys will form part of a long-term monitoring program. Monitoring of other key marine ecosystems, such as mangrove communities, which are good indicators of whether marine park management strategies are effective, will be worked into the program at a later date. The baseline data collected during these surveys will serve a critical management function by allowing scientists to determine trends in the condition of these areas over time following the establishment of the park and its zoning scheme.

Future management direction

Information gained from this long term marine research will improve marine management, planning and policy for the proposed Dampier Archipelago Marine Park. Monitoring the condition of the marine environment over time will enable DEC to assess the effectiveness of different management regimes for the proposed marine park.

Monitoring human impacts—manifested in changes in the marine environment over time—will facilitate the best possible management of this important area.

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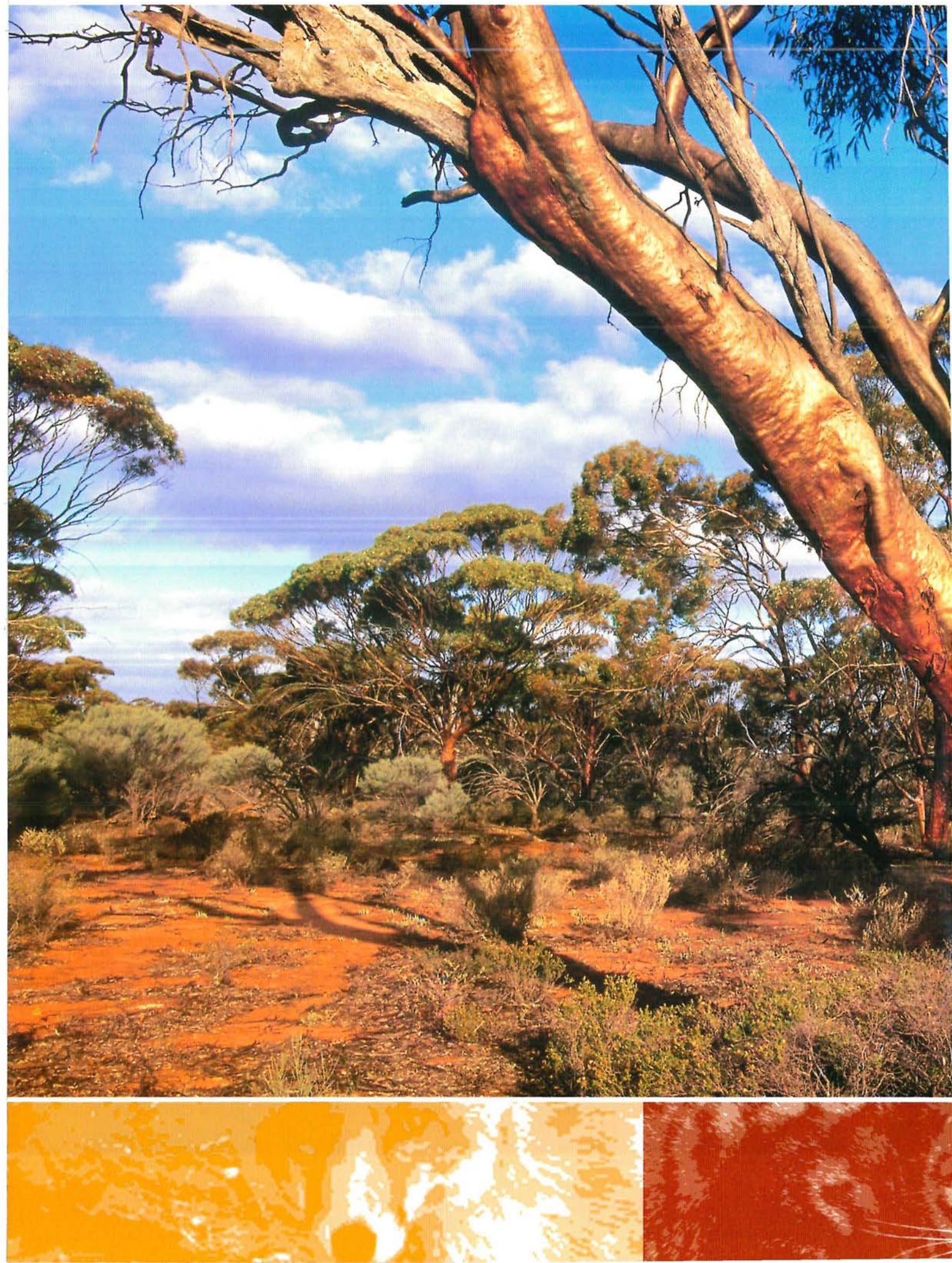
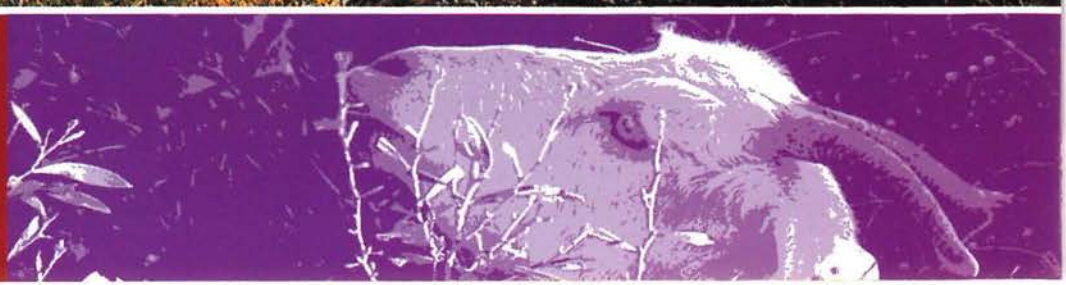


Controlling feral animals in the rangelands

New baiting techniques are having success in controlling feral cats, foxes and wild dogs and thus protecting threatened species in the Western Australian rangelands.

by Jacqui Richards and Dave Algar



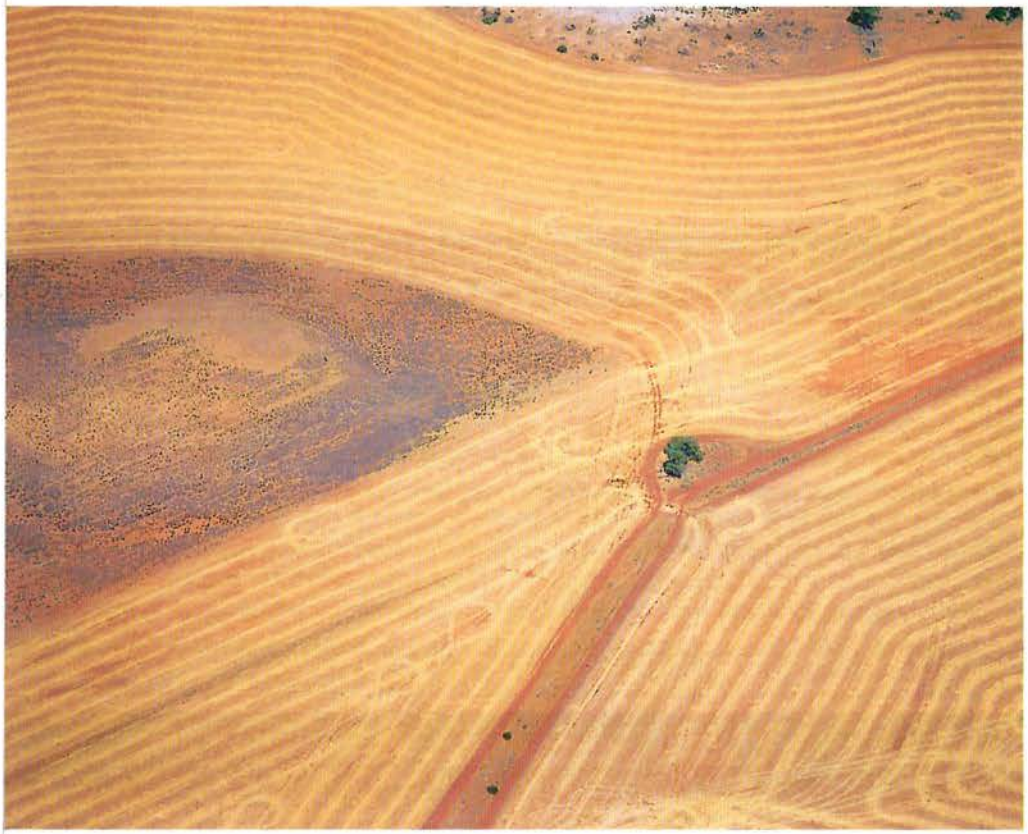
Much of the wheatbelt region of Western Australia has a bleak history of broadscale clearing for agriculture, resulting in rising water tables, salinisation of creeklines and the loss of flora and fauna that once inhabited these ecosystems. However, in the north of the region on the edge of the rangelands lies a parcel of formerly common habitat.

Immediately north of the agricultural zone past Dalwallinu and Wubin lies a vast tract of sandplain and woodlands that has been grazed by sheep and goats, inhabited by feral cats, foxes and wild dogs, and suffered the effects of an increase in wildfires, but has not been cleared. It is a transitional environment incorporating flora typical of the South-West Botanical Province, which was formerly dominated by vast tracts of *Eucalyptus* woodlands and flora from the drier Eremean Botanical Province, dominated by mulga (*Acacia aneura*) shrublands and known locally as the 'mulga-eucalypt line'.

Changing land use patterns

The southern rangelands are characterised by pastoral leases, with a spattering of conservation reserves and an array of mining tenements with interests in iron ore, gold and gypsum. Among these very obvious primary industries, the business of conservation is also increasing, championed by a diverse range of organisations.

Within close proximity to one another lie the Australian Wildlife Conservancy's (AWC's) Mount Gibson Wildlife Sanctuary and the Department of Environment and Conservation's (DEC's) Karara and Lochada stations—pastoral leases on which stock numbers have been reduced or removed in a bid to return them to a more natural state. Bush Heritage Australia's Charles Darwin Reserve and Ninghan Station's Indigenous Protected Area managed by the Pindiddy Aboriginal Corporation, link the properties, adding strength to a regional focus on conservation.



Integrated predator control

DEC, AWC and the Invasive Animals Cooperative Research Centre (IA CRC) started a project in early 2006 on the 'integrated control of introduced predators' in the southern rangelands in an attempt to control feral cats, foxes and wild dogs using a single baiting strategy.

Karara–Lochada was chosen as the 'control' site, where introduced predators were not baited. With a similar suite of habitat types, Mount Gibson was chosen as the 'treatment' site, where introduced predators were controlled with an annual aerial baiting of the entire 130,500-hectare pastoral lease. Instead of the standard dried meat baits injected with 1080 poison that have been used in DEC's *Western Shield* initiative for many years, 70,000 'Eradicat' sausage baits, developed by Dave Algar and his team from DEC, were used in an effort to target feral cats, with the added bonus of also controlling foxes and wild dogs.

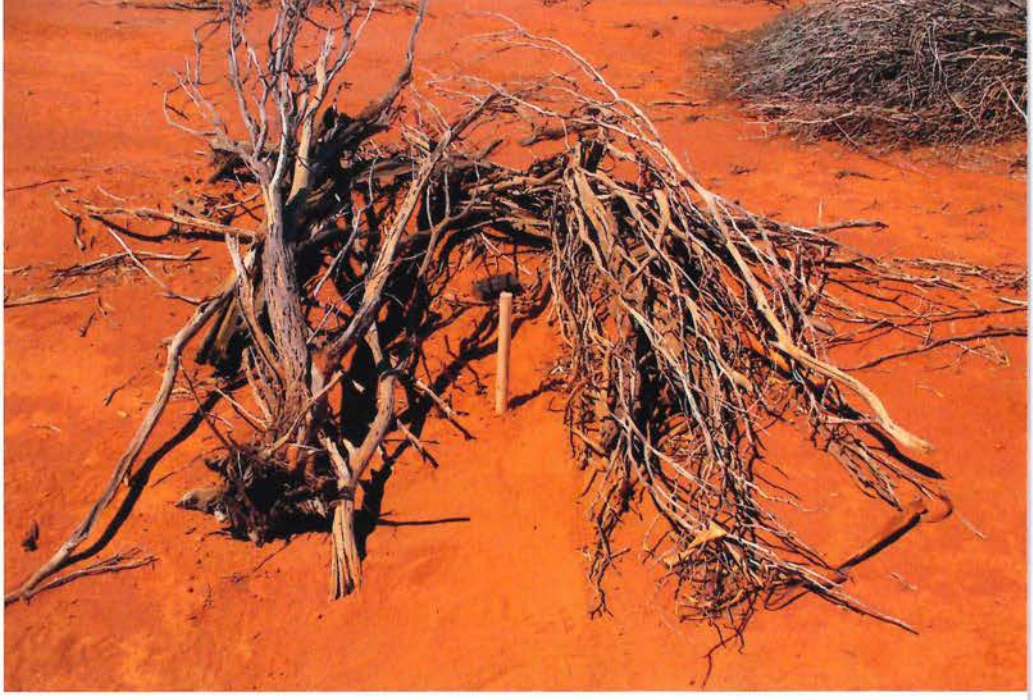
The problem with cats

Feral cats are recognised as contributing to the decline of native fauna in Australia (see 'Controversial Cats', *LANDSCOPE*, Summer 2007–2008). Cats were thought to have been introduced to Australia in the 1820s, if not earlier, and had spread throughout the continent by 1890, inhabiting almost every habitat. They were even able to populate the hot, dry deserts of inland Australia, where the fox is absent due to the unpredictable nature of food and water resources.

Historically, baiting programs for feral cats have been ineffective, principally because cats do not readily consume the standard dried meat baits used for introduced predators. Development of the Eradicat bait

Previous page
Main Woodlands.
Photo – Marie Lochman
Insets Spinifex hopping mouse, feral fox, cat and goat.
Photos – Lochman Transparencies

Left The northern wheatbelt is mostly characterised by agricultural land.
Photo – Marie Lochman



Above New baiting techniques target feral foxes.
Photo – Alison Dugand

Above right Sand plots helped determine predator abundance.
Photo – Steffie Hilmer

Right Fox tracks.
Photo – Alison Dugand

Far right A 'hair snag' used to trap DNA and enable species identification.
Photo – Neil Hamilton

has provided an effective method in both experimental and operational baiting campaigns for reducing feral cat numbers across broadscale areas. Cats find the fresher sausage-style bait more palatable and foxes and dogs will consume either.

In semi-arid and arid zones the best time to conduct these baiting programs to maximise their effectiveness is under the cool, dry conditions of late autumn and winter. At this time, rainfall, which will cause degradation of feral cat baits, is less likely to occur than during the summer months and the abundance and activity of all prey types, in particular predator-vulnerable young mammalian prey and reptiles, is at its lowest. Feral cats are therefore more likely to be hungry and more willing to take alternatives to live prey.

Taking the bait

As part of this monitoring regime eight permanent track survey transects were established at both Karara–Lochada and Mount Gibson, providing a broad coverage of both sites. Ten permanently marked sand plots, positioned at the edge of the tracks and located at one-kilometre intervals along each 10-kilometre transect, were used to survey introduced predator abundance. Each sand plot was positioned within a small clearing in a bush or manufactured with brush and fallen trees to create a one-way or 'blind' sand plot with a single entrance. Sand was placed in the entrance channel to permit detection of any animals entering the plot, and also one metre from the entrance to enable detection of any animals that passed the plot without actually entering it.

Each plot contained three lures: a FAP or Feline Attracting Phonic (audio cat call), Pongo (a delightfully smelly blend of cat faeces and urine), and a non-toxic Eradicat bait. This combination of lures was designed to attract the three introduced predator species to the sand plot and it also provided a reward system to encourage further visits. Each sand plot was then monitored for the presence or absence of tracks for four consecutive days during each survey period. The sand plots were swept each day to clear evidence of any previous animal activity and, at each plot, a record was made of a species' 'visit' or 'pass' and whether the Eradicat bait was removed.

Introduced predator activity along the transects was measured before and after baiting (in July and August) and at approximately three-monthly intervals (October, December and April) to provide information on the rate and extent of re-invasion into the baited site. Use of these sand plots has also enabled seasonal bait uptake to be assessed.

This 'index of relative abundance' has provided a comparison of predator abundance over time but has provided no information on the actual number or 'absolute abundance' of the cats, foxes and wild dogs of Karara–Lochada and Mount Gibson. New methods, using DNA analysis to determine the real number of introduced predators, are currently being trialled. A 'hair snag'

Top left Lochada Station.
Photo – Steffie Hilmer

Top Setting drift fences and pitfall traps.
Photo – John Angus/DEC

Above left Carpets of wildflowers adorn Mount Gibson.
Photo – Jacqui Richards

Above 'Eradicat' bait.
Photo – Rob Brazell/DEC

(a central post with double-sided tape) was located at the entrance of each of the sand plots so that animals were forced to brush past it as they entered the plot. Collected hair can then be used for DNA analysis to identify individuals and thus provide estimates of the absolute population size of feral cats, foxes and wild dogs.

Results

At the Karara–Lochada control site, fox abundance was quite high from the outset. Plot occupancy results for foxes ranged from 35 per cent to 81 per cent of all sand plots visited. By comparison, at the baited Mount Gibson site, over the same period, plot occupancy rates started at 12 per cent in July 2006 just before the first aerial baiting. An immediate reduction to zero per cent fox abundance was demonstrated after the July 2006 baiting. This absence of foxes continued right through until December 2006. At this time foxes began to reappear (four per cent plot occupancy), but did not re-invade Mount Gibson until March 2007 when plot occupancy rates increased to 18 per cent and continued to climb to 30 per cent just before the second aerial baiting in August 2007.

Cat plot occupancy results mirrored those of foxes at both locations, ranging from 25 to 53 per cent at Karara–Lochada, while at Mount Gibson rates dropped from 23 per cent initially to one per cent immediately after the first baiting and remained at zero per cent through to March 2007. A gradual increase to 10 per cent just before the second aerial baiting in August 2007 meant that cat abundance a year after the baiting was less than half of the initial level, a good indication of the overall effectiveness of the baiting strategy for feral cats. The success of the first baiting program was demonstrated again last year with complete removal of both foxes and cats following the winter baiting.

Introduced predator abundance was lower at Mount Gibson than Karara–Lochada before the start of the program due at least in part to AWC's past baiting for foxes and dogs using 1080 dried meat baits and ongoing wild dog control programs within the region, supported by the Department of Agriculture and Food

Right Kultarr.
Photo – Jiri Lochman

Below right Reticulated dragon (*Ctenophorus reticulatus*).
Photo – Katrin Koch

WA (DAFWA), DEC, AWC and Bush Heritage Australia. Wild dog track counts remained relatively low at both sites in the first couple of years, possibly as a result of DAFWA's wild dog initiative within the pastoral zone whereby pastoral lessees bait regularly in order to control predation of livestock by wild dogs.

Hope for vulnerable prey?

The more intriguing but longer-term part of the predator–prey equation is whether the reduction of introduced predators will benefit prey populations—those small mammals, reptiles, birds and invertebrates that are predated by cats, foxes and dogs.

Pitfall and Elliott trapping were conducted at 12 sites within four habitat or landsystem types characteristic of both Karara–Lochada and Mount Gibson: *Acacia* shrublands on yellow sandplain; *Eucalyptus* woodlands on red loamy sandplain; *Acacia* shrublands on granitic breakaways; and saline flats. The fauna surveys were conducted twice each year—firstly in winter, just before the baiting to assess prey abundance at its lowest, followed by a second survey in spring, when reptiles were active and small mammal and bird populations had received an influx of new recruits after breeding.

Small mammal and reptile populations were certainly higher at Mount Gibson than Karara–Lochada. A greater abundance of introduced predators at Karara–Lochada may be reducing these prey populations. However, it is possible that habitat or rainfall differences between the two sites may also be affecting fauna abundance. The next couple of years will help tease out some of the relationships between predator and prey species.

In the meantime, the fauna surveys at both sites have turned up an array of new species that had not previously been captured in the area. For example, the ranges of the southern ningaui (*Ningaui yvonneae*) and the kultarr (*Antechinomys laniger*) have been extended westwards with captures at Mount Gibson and Karara–Lochada respectively in spring 2007. At Mount Gibson an additional gecko, *Lucasium squarrosus*, the southern shovel-nosed snake (*Brachyurophis semifasciata*) and the spinifex hopping-mouse (*Notomys alexis*) were trapped also for the first time in spring 2007. None had been trapped during the previous three trapping sessions since the start of the collaborative IA CRC project, nor during a range of fauna surveys conducted by AWC or during mining company surveys in the area conducted since 2000.

Research continues

The results for the first two years of the project have certainly provided encouraging signs. They have shown that introduced predators can be controlled for many months after the winter baiting. However their numbers, particularly foxes, gradually increase over the summer and autumn to a level that is likely to inhibit native fauna recovery. To address this fox re-invasion, additional baiting using fox baits will be conducted at Mount Gibson in March–April 2009 to supplement the July 2008 aerial Eradicat baiting. In doing so, we aim to suppress fox numbers until the subsequent aerial Eradicat baiting in July 2009. The ongoing intensive monitoring of predator and prey distribution and abundance, as well as the influence of environmental conditions, will again enable us to determine whether this additional control method yields even better results in reducing predator abundance, and perhaps ultimately, an increase in prey abundance.

At Karara–Lochada a predator control program will start in mid-2008, replicating that of Mount Gibson. The

Left Fat-tailed dunnart (*Sminthopsis crassicaudata*) at the base of a pit trap. *Photo – Katrin Koch*

Below left A wheatbelt stone gecko (*Diplodactylus granariensis*). *Photo – Steffie Hilmer*

addition of another baited area, while removing the control site, will enable us to determine whether the baiting strategy trialled at Mount Gibson is also effective at Karara–Lochada where introduced predator numbers are high. The baseline data gathered in the first two years of the project at Mount Gibson and Karara–Lochada will then be used to assess future changes in predator and prey abundance as the project heads towards completion in another two years' time.

Student involvement

In conjunction with the baiting program, several students have taken part in a range of sub-projects. Danielle Oliver from The University of Western Australia recently conducted a study examining the fauna assemblages at the control and baited sites, determining the relative abundance of prey species available to introduced predators and describing any differences between the sites. Katrin Koch from the Johann Wolfgang Goethe University in Frankfurt, Germany, has been examining the stomach contents of foxes and cats to describe their diet and determine whether niche separation in diet occurs between feral cats and foxes.

Steffi Hilmer, also from the Johann Wolfgang Goethe University, is halfway through a four-year PhD study into the physiology of feral cats. She has been measuring energy consumption and thermoregulation of feral cats from a range of Australian mainland and island habitats, looking for physiological differences that may have evolved since their colonisation of the continent. Her work will provide an understanding of the feral cats' successful colonisation of the Australian continent and place this predator in an ecological framework, together with native Australian wildlife, that may in turn provide a novel approach for further projects focusing on the control of feral cats.

Fauna reconstruction

AWC plans to re-introduce a suite of threatened mammal species such as the numbat (*Myrmecobius fasciatus*), red-tailed phascogale (*Phascogale calura*), bilby (*Macrotis lagotis*) and banded and rufous hare-wallabies (*Lagostrophus fasciatus* and *Lagorchestes hirsutus*), which formerly occurred in the region. Initially, animals will be housed in a large fenced enclosure free of introduced predators in a similar fashion to AWC's Scotia Wildlife Sanctuary in western New South Wales, where seven threatened mammals have been successfully reintroduced into a 4,000-hectare enclosure.

A longer term vision of AWC is to one day re-introduce those same species back to the greater unfenced part of Mount Gibson and surrounding areas, to recreate the former mammal community on a regional scale. Similarly, DEC will be able to continue reintroductions of threatened fauna in WA, particularly in the semi-arid and arid zones where feral cats remain a factor inhibiting the success of translocations. The techniques developed by DEC, AWC and the IA CRC at Mount Gibson Wildlife Sanctuary and Karara–Lochada stations will hopefully make this vision a reality within the next few years.

Jacqui Richards is a Regional Ecologist for the Australian Wildlife Conservancy (AWC), based in Perth. She has been involved in the conservation of threatened mammals and predator control in Western Australia for more than a decade. She can be contacted on (08) 9380 9633 or by email (jacqui@australianwildlife.org). AWC's website (www.australianwildlife.org) provides more information about the organisation.

Dave Algar is a Senior Research Scientist at the Department of Environment and Conservation's (DEC's) Science Division at Woodvale. He has worked throughout WA conducting research on feral cat control for the past 15 years. He can be contacted by email (dave.algar@dec.wa.gov.au).

The Invasive Animals Cooperative Research Centre (IA CRC) aims to counteract the impact of invasive animals in Australia through the development and application of new technologies and by integrating approaches across agencies and jurisdictions. Its website (www.invasiveanimals.com) provides information about IA CRC programs.

The authors wish to thank the many staff from DEC and AWC and the volunteers who have been involved in the project during the past two years, particularly Neil Hamilton, Craig Stephens, Jim Rolfe, Steffie Hilmer, John Angus, Trish Gardner, Phil Boglio and Mike Onus.

Feathers, fame and football

by Elise Carr

Whiteman Park and the Western Australian Birds of Prey Centre share a vision for the rehabilitation and protection of native animals.

Whiteman Park, located in the Swan Valley, provides a valuable habitat for a range of plants and animals by acting as an important refuge within 25 kilometres of Perth. The park is also home to the Western Australian Birds of Prey Centre, which is devoted to the care and management of native birds of prey. The centre features an outdoor arena for interactive and educational displays which offer visitors to the park the exhilarating opportunity to see eagles, falcons, kites and owls up close or soaring through the sky.

Within its 4,200 hectares of bush and wetland, Whiteman Park also provides desirable nesting grounds for a vast array of wild bird species. More than 100 species of birds inhabit the park, including a pair of nesting wedge-tailed eagles which have made the park home for more than eight years. Last year the pair produced two chicks in the breeding season.

Feathered football star

The most well known of the Western Australian Bird of Prey Centre's inhabitants is Auzzie the wedge-tailed eagle, famed not only for entertaining visitors to Whiteman Park but also for its association with the West Coast Eagles Football Club.

With the cooperation of the Department of Environment and Conservation (DEC), Auzzie highlighted the importance of bird rehabilitation and protection, and raised the profile of the Western Australian Birds of Prey Centre by making game appearances during the 2007 AFL season. Auzzie flew around the grounds of Subiaco Oval before West Coast Eagles home games impressing audiences with its grace and two-metre wingspan. The appearance of Auzzie at Subiaco, as well as on television shows and at exhibitions, is a positive platform for providing educational information about the preservation of these amazing animals.

Rise to stardom

Taken from its nest in Alice Springs, Auzzie was kept illegally as a pet until authorities rescued and placed it in a temporary home with a Northern Territory wildlife carer. Once Auzzie's condition was assessed and an export licence obtained, the Birds of Prey Centre was authorised to start rehabilitation and provide it with a new home in the west.

After transporting Auzzie from the Northern Territory to Perth, an assessment was carried out to determine the level of 'human imprinting' by watching Auzzie's behaviour and response to various environments. The assessment deemed Auzzie non-releasable as a result of human interference that had rendered it unable to survive in the wild. The assessment also resulted in approval for the centre to include Auzzie on its education licence, which allows fauna to be displayed for educational purposes. Socialisation and ensuring familiarity to a broader variety of environments was necessary to adapt Auzzie to life as an ambassador for the centre and all birds of prey. If not for the commitment, time and expertise of the centre, Auzzie would have been euthanased.

Bird rehabilitation

The rehabilitation of Auzzie, as with any wedge-tailed eagle or bird of prey, was very involved. Treatment

Previous page
Main Auzzie the wedge-tailed eagle. *Photo – Dennis Sarson/Lochman Transparencies*

Above left Juvenile wedge-tailed eagle. *Photo – Whiteman Park*

Left Wedge-tailed eagles have long entertained visitors at Whiteman Park. *Photo – Ann Storrie*

Left Auzzie at a West Coast Eagles football game at Subiaco Oval.
Photo – William Crabb Photography

Above The Western Australian Birds of Prey Centre rehabilitates a number of species, including the brown falcon.
Photo – Whiteman Park

Below Whiteman Park flag.
Photo – Dennis Sarson/Lochman Transparencies

and recovery, with the purpose of preparing the animal to return to the wild, requires a great commitment of time, constant training, husbandry and regular assessment by a knowledgeable, specialised carer. The importance of custom-made aviaries, transport logistics and diet are paramount in ensuring the condition and survival of the bird.

There are three stages of rehabilitation and protection when treating birds of prey. The first stage involves animal collection, initial hospitalisation and intensive veterinary monitoring. Issues of confinement for injuries such as a broken wing or leg, as well as necessary medication are addressed. The second stage is a less intensive transition phase, which focuses on rehabilitation and constant care to regularly assess the progress and wellbeing of the bird. The final stage specialises in flying training before release, if the bird is deemed suitable to return to life in the wild. This involves providing stimulus so the bird can think for itself, scavenge or search for food and regain the ability and confidence to survive independently. It is imperative for the carer to determine a bird's fitness level and establish the best exercise programs to ensure it can fly and therefore enjoy a successful release.

The Western Australian Birds of Prey Centre receives several calls each week from people asking for advice or assistance with injured or malnourished birds and babies that have fallen out of nests. Birds are cared for on an individual basis, with their own rehabilitation program and regular personal assessments. It can take a couple of weeks to 12 months to rehabilitate a bird, with the average time being three to six months.

The centre is run by Yvonne Sitko, and employs eight other staff who are assisted by volunteers. The centre is funded by donations and money raised from educational demonstrations, such as flying displays and talks for school and corporate groups. All of the displays and talks use birds that are unable to be returned to the wild. Many organisations, including DEC, rely on the centre to rescue, rehabilitate and care for sick, injured and orphaned birds.

Flying into the future

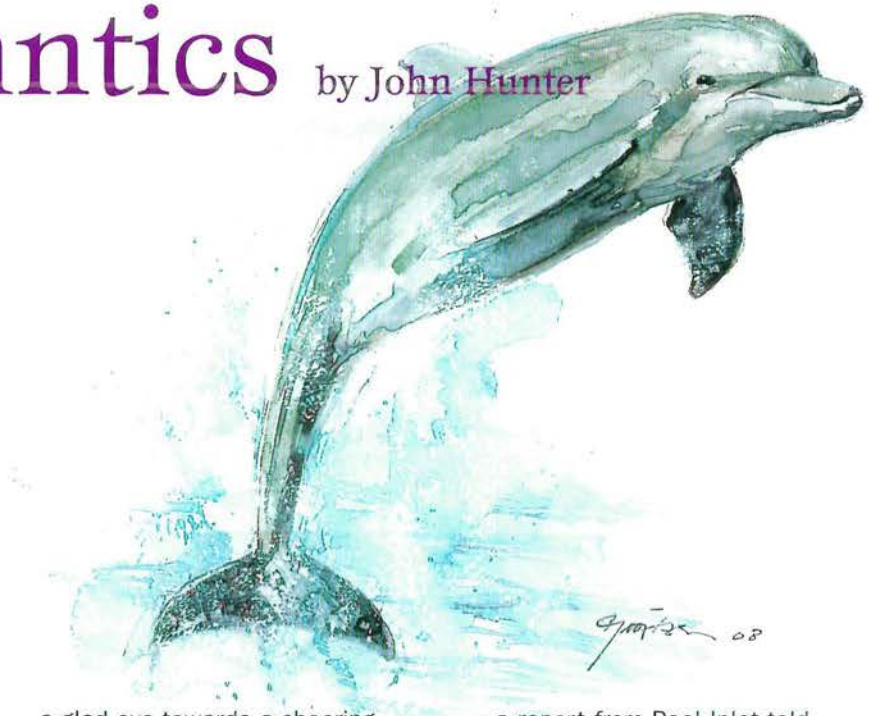
The relationship between Whiteman Park and the Western Australian Birds of Prey Centre will continue to support the protection and educational awareness of these birds of prey through the park's school and holiday education programs and park flying displays. By doing so they will help to ensure these magnificent birds survive well into the future.

Elise Carr worked with Whiteman Park in environmental communications and as the Volunteer and Education Coordinator. Whiteman Park can be contacted on (08) 9209 6000.
Anyone who finds a sick, injured or orphaned bird or animal can call the Department of Environment and Conservation's 24-hour, seven-day-a-week WILDCARE helpline on (08) 9474 9055 for help and advice.

urban antics

by John Hunter

Karma



The salt spray always stung my cracked skin and froze my small thin frame, but mum said the ocean was good for me and that there was something out there to warm the cockles of my heart. Therapy or not, mum was always right.

As children we play along an ocean's edge searching for a crab, a starfish or a broken shell—believing always, as we look, we will find something new, or perhaps something very old.

We now know that our ancestors came from the sea and that in our collective imagination we may think the beloved dolphin is a distant cousin. There is no doubt, however, that this mammal always warms the cockles of our hearts.

The urban areas of many towns and cities in the south-west of the State have ocean or marine estuary environments that surround, entwine or abut them. It is entirely possible that most of the population, thereabouts, have had a dolphin experience.

The bottlenose dolphin (*Tursiops truncatus*) regularly visits our shorelines and even stays within large estuaries for long periods, where it interacts with people. My first contacts were some 60 years ago when I spent many family holidays swimming, fishing and crabbing in the then backwoods of Coogee, Yunderup and Mandurah.

Times have changed but not so the enthralling contacts with dolphins. Even now, two small groups often plunder shoals of mullet some 50 metres from my office in Matilda Bay, Crawley. Here excited staff get a regular, recharge of life as the dolphins' power dashes and aerial leaps in the shallows create white-water mayhem. Now and then, the tiny short nose and melon head of a young animal entertains as it breaks the surface and casts a glad eye towards a cheering audience.

Bottlenose dolphins have a fascinating social structure. While they have a defined home range, members do change from time to time. They assist each other in fish herding, calf rearing and even mating, as males cooperate to herd a female in reproductive condition then take turns to mate with her. It is thought that this herding technique prevents rival groups from having access to her. Hmm... very considerate and protective.

Unfortunately the bottlenose dolphin, like its relative the whale, often strands, either singularly or in small groups. While there is much conjecture whether sonar and other human interference is at times responsible, natural events such as viral sickness, injury from fighting or tidal stranding resulting in severe sunburn are more the norm. Recently, a report from Peel Inlet told of a boating family who were thoroughly entertained by an animal with the number 20 on its dorsal fin. Department of Environment and Conservation records indicated that 'Twenty' was one of four dolphins that stranded when the tide changed in Lake Goegrup north of Mandurah on the Serpentine River in March 1997. All four were rescued and transported to deep water in their Peel Inlet home range. Officers freeze-branded (a painless process) the animals and listed their vital statistics before release. Such rescues and records are proving to be scientifically and thoroughly worthwhile.

Was this encounter a thank you, or just fate? Who knows, but female 'Twenty' at 2.03 metres long and a tad sunburned in 1997 was still going strong and from all accounts was very happy to see us again.

DID YOU KNOW?

- Bottlenose dolphins talk to each other using groans, grunts, whistles and squeaks.
- They find their favourite food—fish, squid and octopus—by making a series of clicks called echolocation.
- Each individual seems to have its own signature whistle, but it's the sounds we can't hear that may be the most important.

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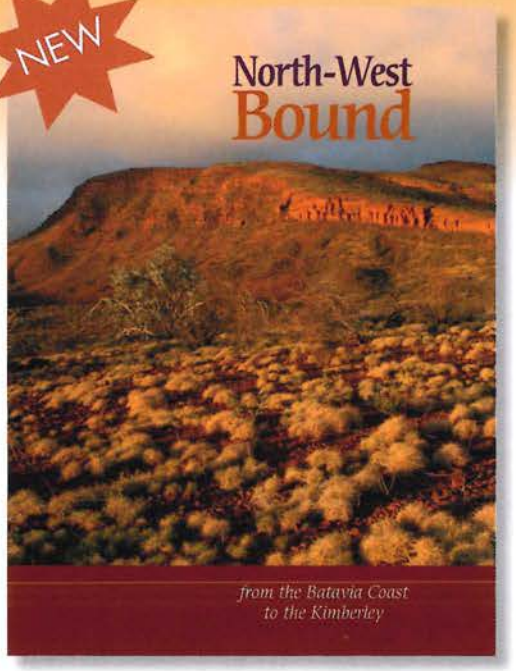

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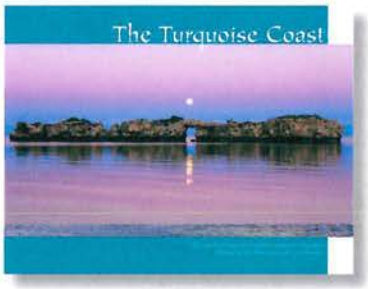

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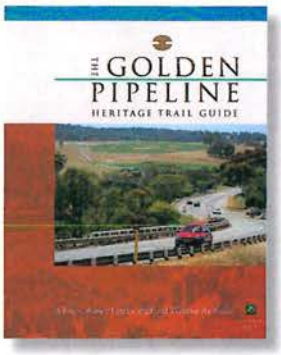

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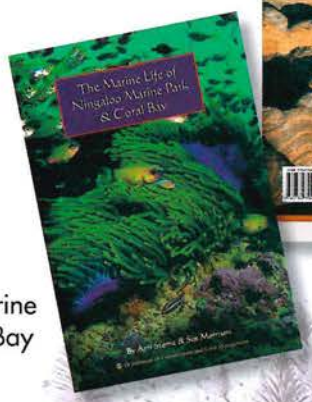

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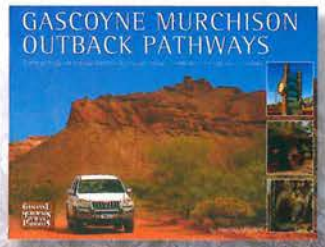

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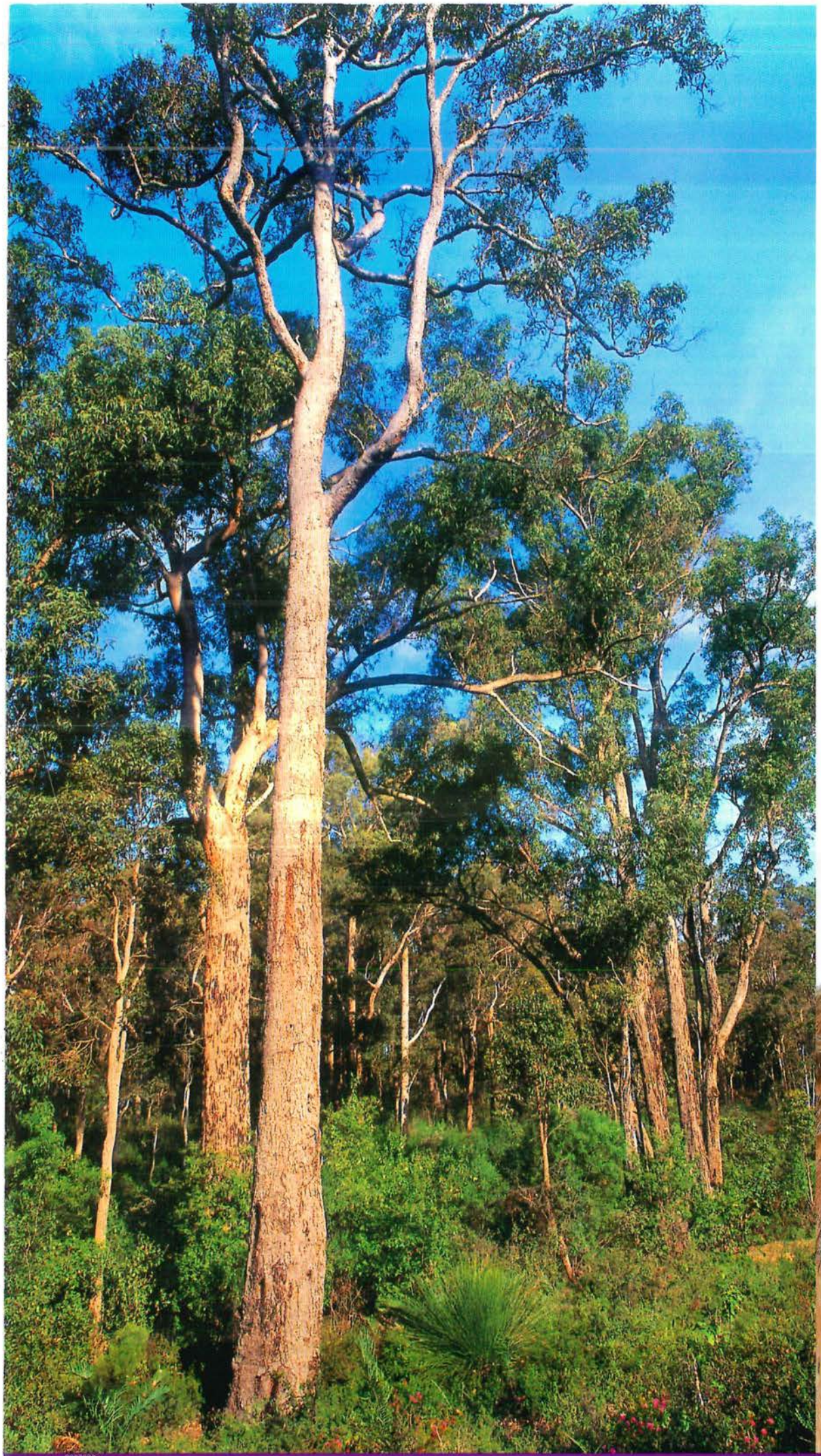

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