The background of the cover is a painting of a humpback whale and its calf swimming in blue water. The whale is the central focus, with its characteristic white ribs and dark skin. The calf is smaller and positioned below the adult whale. The water is depicted with various shades of blue and green, suggesting depth and movement.

WA's conservation, parks and wildlife magazine

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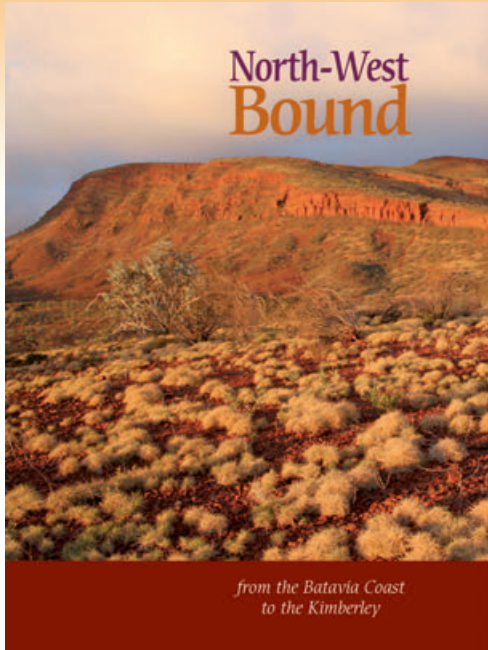
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Pinnacles Desert

Captivating Kalbarri

The ant, the butterfly
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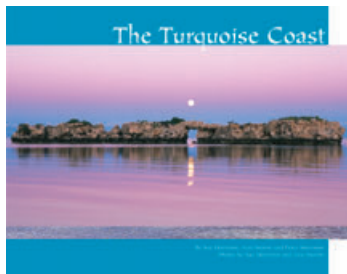
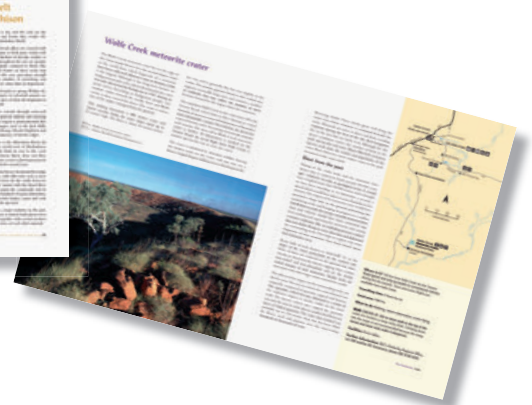
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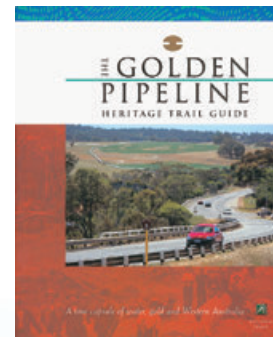


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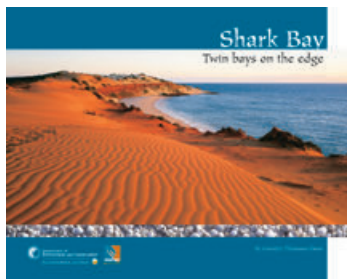
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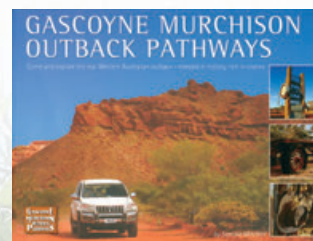
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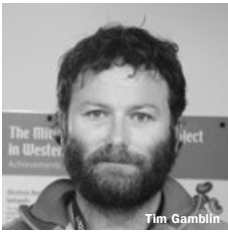
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Department of
Environment and Conservation





Tim Gamblin



Mia Podesta

contributors

Tim Gamblin has been involved in numerous projects as an employee and a volunteer with the Department of Environment and Conservation (DEC) since 1991. Now based at Walpole, he has been a technical officer for DEC's Science Division since 2006. His work has included marine turtle research off

the North-West Cape, fauna surveys in the Pilbara, threatened butterfly and moth research, breeding programs in zoos and, most recently, baselining data from the Avon Catchment. He is currently working on the graceful sun-moth (*Synemon gratiosa*) project on the Swan Coastal Plain.

Mia Podesta started work with DEC through the graduate development program. Since 2006, she has worked as an ecologist on the Threatened Ecological Communities Database in the department's Species and Communities Branch. Mia also worked on a South West Catchment Council-funded position to monitor and evaluate wetlands in the south-west in 2007. Her current role with DEC is as executive officer of the Roadside Conservation Committee, a position she shares with Cressida Lehmann.

Dave Algar is a senior research scientist with DEC's Science Division, based at the Wildlife Research Centre in Woodvale. Dave has extensive experience and expertise in the field of feral cat ecology and control strategies. His current research program is focussed on the design and development of feral cat baits and baiting strategies to be used in baiting programs to provide effective control over broadscale areas. Dave is also involved in the development and implementation of feral cat control on a number of offshore islands including Cocos (Keeling) Island, the Guadalupe and Espiritu Santo islands in Mexico and Floreana Island in the Galapagos.

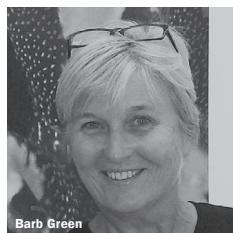
Barb Green is the senior marine conservation policy officer for DEC's Marine Policy and Planning Branch. She is preparing the indicative management plan for the marine park in the Camden Sound area and is coordinating policy development on behalf of the Marine Parks and Reserves Authority. She has worked in the coastal and marine planning and management field for more than 15 years and has a long-held personal interest in promoting community-based projects in the Shoalwater Islands Marine Park and Lancelin Island Lagoon Fish Habitat Protection Area.

also contributing . . .

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Dave Algar



Barb Green

editor's letter

I can still picture the moment in 2000, the year we took our two small children on an epic camping trip 'up north'. We were homeward bound after a long journey and we had decided to make an unplanned side trip, turning off the North West Coastal Highway for one last sojourn in the bush before the final haul to the city. It was late in the spring, the weather had turned hot, and as we bumped along a dusty unsealed side-road we were all beginning to feel like we had had enough. Tempers were fraying, verbal skirmishes were breaking out in the back seat and every utterance had the edge of a tired whine—low-level grizzling that got louder and more plaintive as we coaxed, threatened and dragged the kids out of the car and along the pathway to the lookout.

And then, all of a sudden, silence.

We had come to the viewpoint over 'The Loop' of the Murchison gorge. Dramatic sand and russet-coloured cliffs stretched to the horizon in every direction. Far below, along the ancient river-course that had carved this spectacle, limpid pools gazed back up at the sky with an all-pervading stillness, a complacent silence that seemed to carry a sense of entitlement of having been there for eons. The whole vista was breathtaking in its timelessness, and almost eerily peaceful. To intrude on this scene with any kind of noise seemed somehow disrespectful.

This was, of course, awe; by definition a rare experience—certainly more than enough to stop tired children in their tracks mid-whinge, instantly causing them to forget anything they might have had to complain about. We still talk about this moment, one of so many rich memories from Kalbarri National Park. In this issue of *LANDSCOPE*, 'Captivating Kalbarri' offers a picturesque word-sketch of this very special part of the world, and gives a tantalising sample of the delights of DEC's new book, *Kalbarri*.

Meanwhile, as the logo below indicates, 2010 is the International Year of Biodiversity, and as usual *LANDSCOPE* is full of examples of projects that are working to understand and protect this phenomenon. For example, Tony Friend updates us on the parlous return of WA's faunal emblem from the brink of extinction ('The numbat: back by popular appeal'). A classic example of biodiversity is recounted with the discovery in the wheatbelt of a remarkable three-way symbiosis between ant, butterfly and leafhopper—a story with a happy ending as many partners come together in recognising the importance of protecting this relationship ('The ant, the butterfly, the leafhopper and the bulldozer'). And of course this issue's cover story—a proposed marine park in Camden Sound to conserve humpback whale breeding habitat—strikes at the very heart of the human relationship with nature, our profound fascination with the mysterious mammals of the deep, manifest in literary tradition from *Moby Dick* to *Whale Rider*.

By the way—it's great to be back at *LANDSCOPE*, some 10 years after my last contribution as a freelance story editor. This has to be one of the most satisfying publications to work on, anywhere, and it's an honour to come back as a permanent part of the team.

Madeleine Clews
Executive Editor





Cover illustration by Ian Dickinson

Each year, humpback whales (*Megaptera novaeangliae*) migrate along the Western Australian coast from their Antarctic feeding grounds to northern breeding grounds. One such area, Camden Sound, in the remote north of Western Australia, has long been a refuge for humpback whales. Between June and November, humpback cows use the Camden Sound area to rest and nurse their calves to quickly build up their young's protective blubber layer before their long migration south to colder waters.

Back cover photo by Col Roberts/Lochman Transparencies

The south-west end of Camden Sound.

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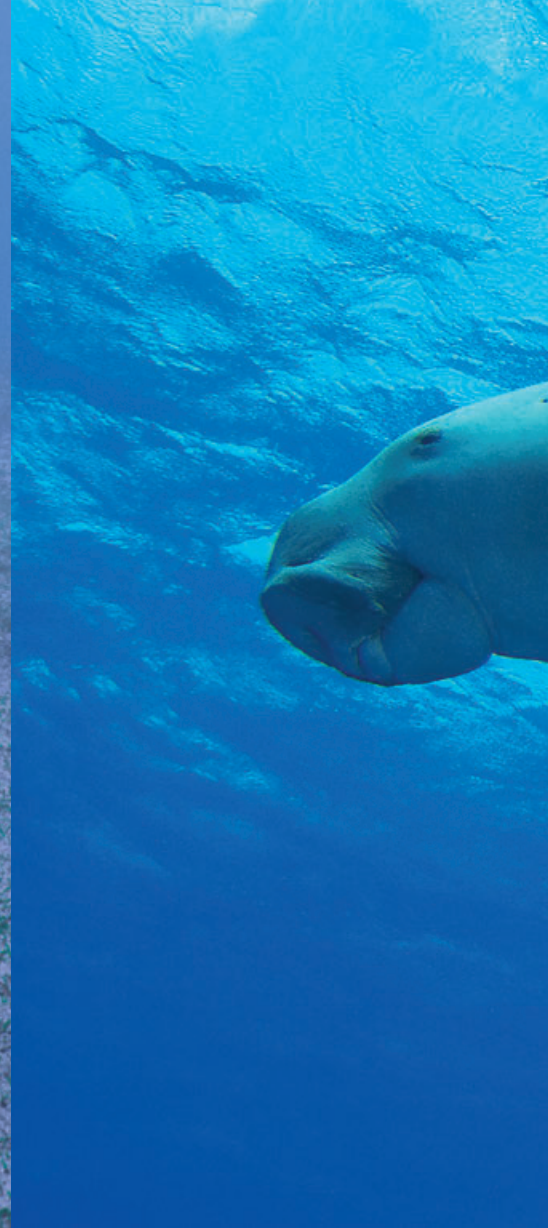
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46



A project to conserve dugongs in the Kimberley combines traditional knowledge and emerging technology.

by **Dave Holley and Richard Meister**

Although the dugong (*Dugong dugon*) is rarely seen, research has shown it is one of the most abundant marine mammals in the coastal waters of northern Australia. The notoriously shy mammal is seldom observed because it feeds almost exclusively on seagrasses, spending little time at the surface. Its grey-brown colouring also enables it to easily camouflage against the sandy ocean floor.

The dugong can be found in Western Australia's Shark Bay, across the coastal waters of the Kimberley, into the Northern Territory and Queensland. The Kimberley is thought to be home to a large population of dugongs but there is little scientific knowledge of the mammal or information on population sizes, distribution patterns and migratory corridors. A satellite tagging project in the waters off the



Dampier Peninsula aims to unlock some of the secrets of this elusive animal.

The Department of Environment and Conservation (DEC) and the Bardi Jawi Rangers from the Dampier Peninsula are working together on the satellite tagging project. The partnership combines thousands of years of traditional knowledge with

conventional science and emerging technology. The Kimberley dugong tagging project was born out of the success of previous satellite research work with DEC and the traditional owners of Shark Bay, the Yadgalah Corporation (see 'Tracking dugongs', *LANDSCOPE*, Spring 2002).

Improved technology

Studying the movements and behaviour of marine mammals such as the dugong can be a difficult task. However, advances in technology in the past decade have led to significant improvements in information collection and accuracy. Technology is constantly evolving and since the last major round of dugong tagging in Shark Bay, satellite tracking devices have been improved.

The new satellite trackers can more accurately record a dugong's position,



Working together for dugong conservation

diving patterns and time spent in waters deeper than five metres when moving around. This level of accuracy is critical for understanding which areas dugongs are feeding in and their travelling routes between areas. Improvements in technology have also played a significant role in conducting successful research in the Kimberley where water depth is generally greater than around Shark Bay and where animals travel longer distances because of seasonal influences such as monsoonal conditions.

Pilot project provides confidence

A pilot research project was started in the Kimberley in 2007 to learn more about the dugong's travel and feeding patterns and to see if it was indeed possible to catch dugongs in deeper waters. The first round of tagging was

a success with two dugongs caught and fitted with older-style transmitting devices, which were used to capture useful data on dugong distribution. This achievement led to a grant being awarded by the Australian Marine Mammal Centre in 2008 with financial support from oil and gas company Woodside.

In July 2009, the Bardi Jawi Rangers expanded the project south to Beagle Bay on the Dampier Peninsula, with assistance from the neighbouring Nyul Nyul traditional owners. This time, four animals were tagged with the new satellite devices and the results revealed more about travel patterns of the dugong. Three of the animals remained near Beagle Bay while the fourth ventured south towards Port Hedland, a journey of more than 500 kilometres.

Above Dugong with batfish.
Photo – Karen Willshaw/Oceanwide Images

Opposite page
Inset Dugong with calf.
Photo – Bob Halstead/Oceanwide Images
Left Grazing tracks in a seagrass bed.
Photo – Kelvin Aitken/Marine Themes

Indigenous knowledge

Using new technology, although important, forms only one component of dugong conservation research. The knowledge of the Bardi Jawi people provides another important element in the quest for information, as they have a strong cultural and traditional connection to the dugong as well as marine turtle species, such as the green turtle (*Chelonia mydas*).



Above Dugong grazing.
Photo – Kelvin Aitken/Marine Themes

The Bardi Jawi Rangers are a local ranger group with the Kimberley Land Council (KLC). The KLC works as part of the North Australian Indigenous Land and Sea Management Alliance (NAISMA), with the support of the

Australian Government's *Working on Country* program, on projects which focus on practical Indigenous land and sea management to care for country. Expertise brought to the overarching NAISMA Dugong and Marine Turtle Project by the Bardi Jawi Rangers has been vital to its success.

Centre left Dugongs often carry scars from boat strikes or shark attacks.
Photo – Karen Willshaw/Oceanwide Images

Bottom Left Seagrass meadows near the Dampier Peninsula.
Photo – Glen Cowans



Data collected from ongoing research into the movements and behavioural patterns of dugongs and turtles will be used to establish management plans to ensure the long-term survival of these marine species. With good management and planning the rangers hope it will be possible to achieve a balance between sustaining dugong and turtle populations and meeting the cultural needs of their people.

The success of the collaborative partnership between the Bardi Jawi Rangers, KLC and DEC means

the future of the dugong looks promising. The collection of data and improved understanding about this marine mammal will be used in the establishment of local community management practices as well as providing the knowledge necessary for ongoing conservation of this elusive species.



Dave Holley is the Department of Environment and Conservation's marine park coordinator at Shark Bay. Dave has been researching marine mammal movements through satellite tracking for more than 10 years. He can be contacted on (08) 9948 1208 or by email (david.holley@dec.wa.gov.au).

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For more information see Always part of us: The socioeconomics of Indigenous customary use and management of dugong and marine turtles—a view from Bardi and Jawi sea country, Western Australia.



Camden Sound:

a refuge for recovery

A new marine park proposed at Camden Sound off the remote central Kimberley coast will protect what has been identified as the most important humpback whale breeding and calving nursery in Western Australia.

by Barb Green, Carolyn Thomson-Dans and Alena Kessell

Camden Sound is a marine embayment located within a remote and isolated part of the central Kimberley region approximately 400 kilometres north of Broome in Western Australia. The sound is encompassed by the Kimberley mainland to its east, Augustus Island (the largest island in the Kimberley) to its north, an elaborate arrangement of islands and reefs to its north-west and west, and a complex of shoals, rock platforms and soft sediments to its south.

Phillip Parker King named Camden Sound while charting the Kimberley coast in 1821. He named the sound after the first Marquess of Camden, John Jeffery Pratt, an English nobleman and politician who was a generous patron of the New South Wales colony in the early 1800s.

Humpback whale refuge

During the 1800s and 1900s humpback whales (*Megaptera novaeangliae*) were hunted extensively throughout the world's oceans, resulting in elimination of an estimated 95 per cent of the world population. In Australia, it is estimated that humpback whales were reduced to

less than five per cent of pre-whaling abundance. As such, humpback whales are listed as threatened under the State's *Wildlife Conservation Act 1950*, the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* and the International Union for the Conservation of Nature's 'Red List' of threatened animals.

Camden Sound has long remained an unintended refuge for humpback whales in the remote north of WA. Whales using the area were protected from whaling vessels operating off WA by some of the most treacherous waters known to mariners. While the area was charted by Phillip Parker King in 1821, his charts did not become available until the mid 1800s. This limited the ability of whalers to navigate safely in the inner waters of the Kimberley

resulting in them targeting other more accessible parts of the WA coast where humpback whales were common, such as the Exmouth Gulf.

Each year, humpback whales migrate along the WA coast from Antarctic feeding grounds to northern breeding grounds. Camden Sound continues to play a critical role in the recovery of the WA humpback whale population, which is now estimated to number between 22,000 and 25,000.

Camden Sound is a warm water nursery area for newborn humpback whales where water temperatures can reach 28°C during the calving season. Newborn calves are only four to five metres long at birth and are almost completely lacking in insulating blubber. Between June and November each year, humpback cows use Camden Sound to rest and nurse their young to quickly build up their calves' protective blubber layer. This layer of natural insulation ensures that the metabolic strain endured by the warm-blooded mammal is minimal during its first few critical weeks of life.

The complex shoreline and bathymetry of Camden Sound provides ample hiding places and enables cows to protect their calves from predators and even aggressive bull humpback whales intent on mating. The combination of warm water and complex shoreline makes Camden Sound an ideal calving and nursery area for the protected species.

Minke whales (*Balaenoptera acutorostrata*) and false killer whales (*Pseudorca crassidens*) have also been seen in Camden Sound, indicating that the area provides habitat for both baleen and toothed whales.

Previous page

Main A humpback whale in Camden Sound.

Photo – Micheline Jenner

Left A humpback whale 'spy hopping'—raising its head and eyes above the water to look around.

Photos – Hans and Judy Beste/Lochman Transparencies





Above Humpback whale.
 Photo – Hans and Judy Beste/Lochman
 Transparencies



Above right Sea eagle.
 Photo – Ann Storrie

Right Manta ray.
 Photo – Geoff Taylor/Lochman
 Transparencies



More than just whales

The distribution of marine life in Camden Sound, and the Kimberley as a whole, is influenced by the Indonesian ‘throughflow’, a warm, nutrient-deficient, low-salinity current that originates in the Pacific Ocean. Cyclones and storms also have a major influence on the area. Tidal movement can exceed nine metres in amplitude, and rainwater run-off from rivers and gullies affects water clarity, nutrient levels, ecological function and bathymetry in the sound. The complexity of these influences is such that Camden Sound is likely to have unique features in comparison to other areas of the Kimberley coast.

Geologically, Camden Sound is a drowned valley of the western section of Macdonald Range. The surrounding islands are the only remaining emergent features of this ancient formation, with subtidal features presenting a complex arrangement of habitat throughout the area.

The ‘valleys’ of the Camden Sound seabed are dominated by mud sediment and rocky substrate. Mud sediment is the primary habitat of bottom-feeding species such as rays and crabs. Adult male humpback whales are known to cake themselves in the sticky mud of Camden Sound, possibly to assist in healing wounds sustained during mating battles. Rocky substrate is a dominant feature in the south of the sound, and consists of a submerged platform extending from the mainland.

Many coral inhabited reefs exist throughout Camden Sound, although they vary greatly in size and depth. A large reef platform between Jungulu and Augustus islands has similar characteristics to the Montgomery Island reef system located further south.

This reef platform is likely to be influenced by hydrological and tidal processes unique to the adjacent Saint George Basin and Prince Regent River system. Although this reef platform is yet to be surveyed in detail, it is likely to be highly diverse and provide significant habitat and feeding value for reef-associating marine plants and animals.

A locally distinct fringing coral reef system occurs at the Champagne Island group at the western edge of Camden Sound. This fringing coral reef occurs across a variable depth range, and is located both on the seaward and landward sides of the island group. Marine biological surveys in the Kimberley have so far identified 280 species of coral across 55 genera,



and marine scientists are only just starting to discover what are thought to be globally significant coral reefs in the region. Camden Sound is expected to host a significant number of coral species, some of which may be new to science.

In the southern area of Camden Sound, and approximately 500 metres off Wilson Point, are the Slate Islands. In 2008, these islands were examined by the Australian Institute of Marine Science using underwater video. The research revealed that reefs in the area are dominated by a mix of seaweeds and reef-building corals along reef edges, and sponges and gorgonian and whip corals in the channels between the mainland and islands. This preliminary assessment indicates that many sponges in the area may also be new to science.

The shoreline of Camden Sound, including its islands and inlets, has fringing mangrove forests that are nursery areas for many marine and estuarine species including barramundi (*Lates calcarifer*), threadfin salmon (*Polydactylus macrochir* and *Eleutheronema tetradactylum*) and prawns. Mangrove-lined inlets are known feeding areas of the newly identified Australian snubfin dolphin (*Orcaella heinsohnii*), which is endemic to northern Australia, as well as for Indo-Pacific humpback (*Sousa chinensis*) and bottlenose (*Tursiops* sp.) dolphins. A study of inshore dolphins conducted by an independent dolphin researcher has shown that Deception Bay and the inlets of Augustus Island are particularly important to these species in the Camden Sound area.

Mangroves and their associated invertebrate-rich mudflats are important habitats for migratory



Top left Slate Islands near Wilson Point, in the heart of Camden Sound.

Photo - Ann Storrie

Centre left Black-necked stork.

Photo - Hans and Judy Beste/Lochman
Transparencies



Left Intertidal mangroves.

Photo - Marie Lochman



Above Hammerhead shark.
 Photo – Clay Bryce/Lochman
 Transparencies



Left Striated heron.
 Photo – Hans and Judy Beste/Lochman
 Transparencies

small Australian population of olive ridley turtles is distinct from those of India and Malaysia in the Indian Ocean and from those of Mexico and Costa Rica in the Pacific Ocean. Thus, although the species is more abundant in some other parts of the world, Australia is the custodian of an endemic stock and WA retains some of the best populations of turtles in the world.

Saltwater crocodiles (*Crocodylus porosus*), once hunted to near extinction for their skin and as a food source, are abundant in the nearby Saint George Basin and Prince Regent River and are likely to be intermittent visitors to the muddy mangrove-lined shores and waters of Camden Sound to rest and ambush prey.

Dugongs (*Dugong dugon*) are believed to occur in low numbers in Camden Sound in areas where seagrass occurs. Studies have found that in areas where tidal change is great, dugong feeding activity is largely determined by tides and weather.

shorebirds from the northern hemisphere, such as common sandpipers and whimbrels, which are protected by international agreements. Bird species that are mostly confined to the mangroves include mangrove grey fantails, broad-billed flycatchers, dusky gerygones, yellow white-eyes, red-headed honeyeaters and white-breasted whistlers. Striated herons, black-necked storks and brahminy kites nest in the dense mangrove foliage. Stilt rooted mangroves are also important roosting areas for black flying-foxes (*Pteropus alecto*) and other bat species.

Sharks and rays are common in Camden Sound including the largest of all rays, the manta ray (*Manta birostris*). A total of 94 shark species, representing approximately 19 per cent of the world's known shark species, have been recorded in northern

Australia and a high proportion of these are likely to be found in the Camden Sound area. Species such as the hammerhead shark (*Sphyrna* spp.), pigeye shark (*Carcharhinus amboinensis*), sandbar shark (*Carcharhinus plumbeus*), tiger shark (*Galeocerdo cuvier*), blacktip sharks (*Carcharhinus* spp.) and lemon shark (*Negaprion acutidens*) are most likely common there.

Turtles, including loggerhead (*Caretta caretta*), flatback (*Natator depressus*), olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*), are all believed to occur in Camden Sound among coral reefs and near mangroves. All four species are listed as threatened and the State's marine turtle populations are extremely important in a world context. Flatback turtles breed only in Australia and genetic research has shown that the



Above Humpback whales are important to tourism.

*Photo – Geoff Taylor/Lochman
Transparencies*

Above right Barramundi.

*Photo – Gunther Schmida/Lochman
Transparencies*



offered by cruise companies include fishing for barramundi and oysters and an appreciation of colonial settlement and exploration sites, pearl farms and the outstanding scenic coastline. Most of the whale watching and recreational fishing in Camden Sound occurs as part of these cruises.

Traditional connections

All lands, including islands, adjacent to Camden Sound are Aboriginal reserves. The entire area is culturally significant to the Dambimangari people, with whales being strongly represented in their spiritual beliefs. While traditional owners no longer live on these lands year round, they maintain ongoing cultural and spiritual connections with their land and sea country.

In October 2009, the State Government, as part of its Kimberley

Science and Conservation Strategy, announced its intention to establish a marine park to protect Western Australia's most significant nursery ground for the threatened humpback whale. The area also contains marine habitats representative of the Kimberley marine bioregion, which are not currently included in the State's marine park and reserve system. The proposed marine park in the Camden Sound area will promote greater public awareness of the scenic and near-pristine marine waters of the Kimberley, together with their high scientific and conservation value, which is already attracting growing numbers of visitors. Along with other outcomes of the Kimberley Science and Conservation Strategy, such a marine park will help to protect the region's natural and cultural values as the Kimberley fulfils its economic potential.

Cruising Camden Sound

The Kimberley coast expedition cruise industry consists of more than 30 vessels operating multi-day cruises along the coast between Broome and Wyndham. The industry has grown significantly during the past 10 years. Camden Sound is an important destination for the Kimberley expedition cruise industry, as it is a place where passengers on the cruise vessels are able to view hundreds of whales in their natural habitat at certain times of year.

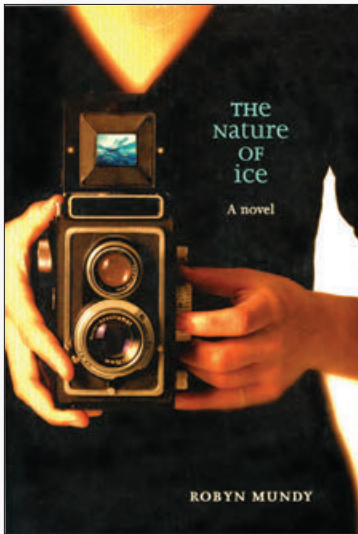
Most Kimberley cruises visit Montgomery Islands reef before moving north to Camden Sound to anchor and land in Camden Harbour, where stone ruins, graves and a shipwreck site can still be seen—remnants of an ill-fated attempt to farm sheep there in 1864–65. The settlement at Camden Harbour was abandoned after only 10 months due to the harsh conditions experienced by settlers. Features

Barb Green is the senior marine conservation officer at the Department of Environment and Conservation's (DEC's) Marine Policy and Planning Branch. She is facilitating the preparation of the indicative management plan for the proposed marine park in the Camden Sound area. She can be contacted on (08) 9336 0103 or by email (barb.green@dec.wa.gov.au).

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bookmarks by Joanna Moore



The Nature of Ice

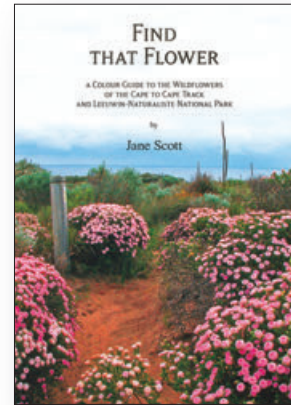
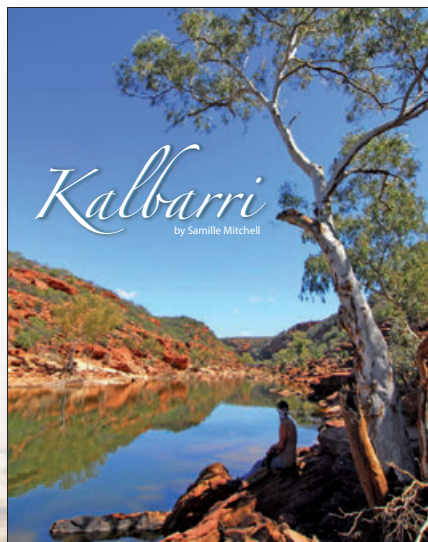
Author: Robyn Mundy
Publisher: Allen and Unwin
www.allenandunwin.com
374 pages, paperback, fiction
ISBN: 978 1 7417 5576 3
RRP: \$26.99

Our cultural fascination with the frozen continent Antarctica and the history of its discovery is explored in this novel by Western Australian author Robyn Mundy. Her protagonist, a young photographer facing the breakdown of her marriage, joins a summer expedition to Antarctica to create a photographic tribute to Frank Hurley's iconic Antarctic photographs. As she explores the icescapes, her world begins to change in many ways.

Kalbarri

Author/photographer: Samille Mitchell
Publisher: Department of Environment and Conservation
www.dec.wa.gov.au/shop
135 pages, paperback, full colour
ISBN: 978 0 7307 5599 9
RRP: \$29.95

Page after page of beautiful photographs are accompanied by easy-to-read, engaging information about the Midwest town of Kalbarri and its nature-rich surrounds. Find out about the rich heritage of the region—from Dreamtime stories, to shipwreck and mutiny, and the emergence of tourism and fishing industries. Discover the geology of the ancient landscapes, their brilliant wildflower displays and native fauna species, and the many ways to enjoy Kalbarri's natural spaces. An essential companion for any visitor to Kalbarri National Park, or the armchair traveller.



Find that Flower: a colour guide to the wildflowers of the Cape to Cape Track and Leeuwin-Naturaliste National Park

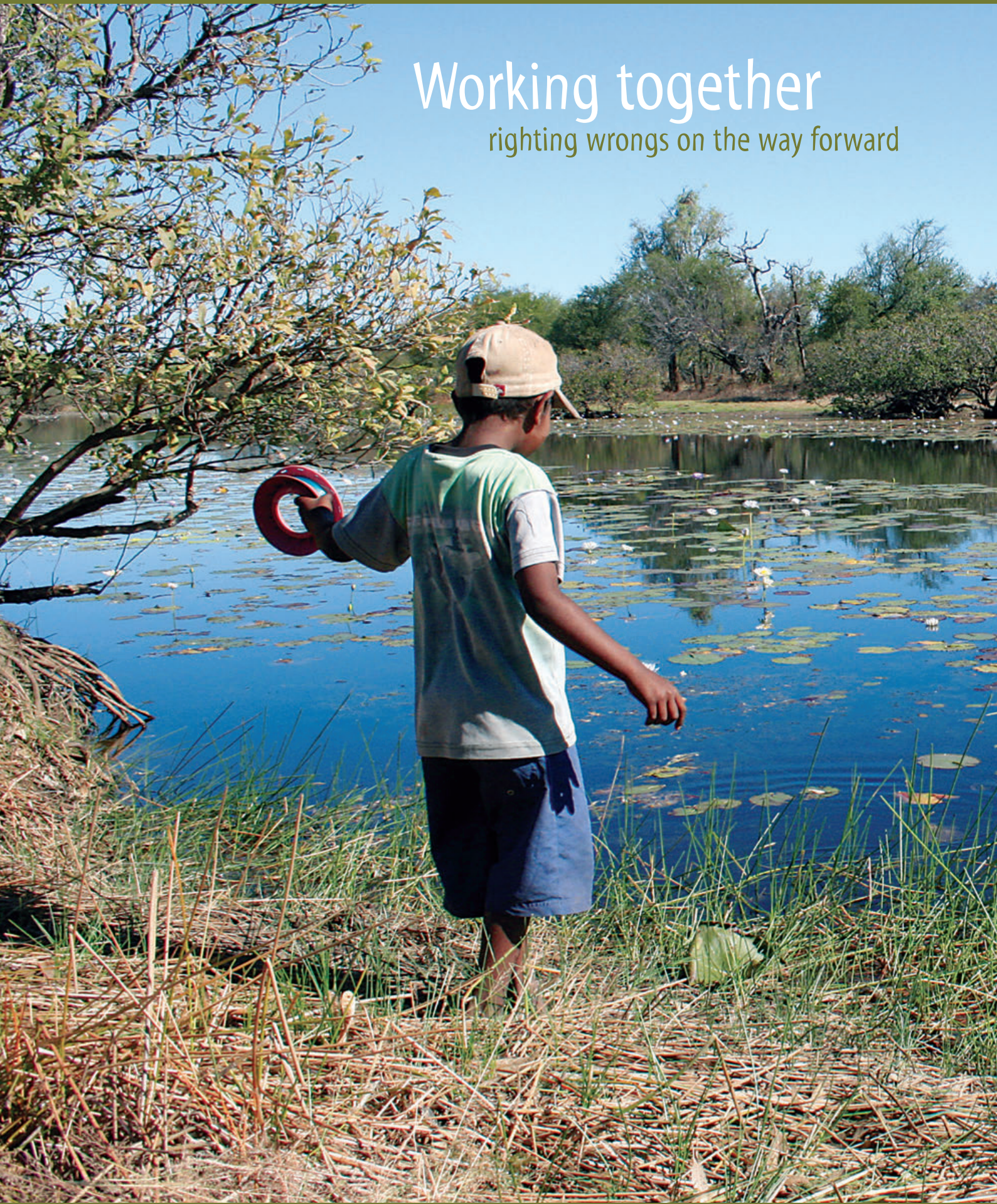
Author/photographer: Jane Scott
Publisher: Cape to Cape Publishing
www.capetocape.8m.com
104 pages, paperback, full colour
ISBN: 978 0 9803 3372 5
RRP: \$19.95

This great guide is both comprehensive and small enough to pack in with you on a hike. It identifies 280 plant species with colour photos and concise descriptions, including hints on locations and flowering times. Lovely close-up photos, an index and the arrangement of the species according to flower colour make this reference book a useful, enjoyable read.



Working together

righting wrongs on the way forward





In a Western Australian first, the Department of Environment and Conservation, the Conservation Commission of Western Australian and the Yawoorroong Miriuwung Gajerrong Yirrgeb Moong Dawang Aboriginal Corporation have forged a meaningful partnership to manage six new conservation parks developed under the Ord Final Agreement. The partnership is going from strength to strength in managing the land and is providing economic and social benefits to local communities. It is also working to right some of the wrongs of the past.

by Rhianna King, Des Hill, Rosemary Hill and Scott Goodson

In the 1960s and early 1970s the Western Australian Government embarked on an ambitious irrigation project in the East Kimberley region known as 'Ord Stage One'. The project was designed to transform the area into a food bowl for the nation through the creation of 13,000 hectares of irrigated farmland. It also led to the creation of lakes Argyle and Kununurra.

However, the project had significant negative ramifications for the local Miriuwung and Gajerrong peoples. Much of their traditional land was either flooded or allocated for agriculture and resulted in dispossession and cultural and socioeconomic damage.

In the early 1990s, the State Government developed a proposal to extend the Ord River Irrigation Area by 65,000 hectares as part of an 'Ord Stage Two' project. In response, the Miriuwung and Gajerrong peoples sought native title claim over 8,000 square kilometres with the National Native Title Tribunal. The case, known as the 'Ward case', was referred to the Federal Court in 1995 where Justice Lee determined the Miriuwung and Gajerrong peoples held native title of the area. Then, in 2000, the Full

Bench of the Federal Court partially overturned Lee's decision, resulting in a major reduction in the area of recognised native title. In 2002, the High Court re-examined the nature of native title and referred aspects of the case back to the Federal Court. However, in an attempt to resolve the issue through negotiation rather than litigation, the State Government and the Miriuwung and Gajerrong peoples sought an adjournment. The next three years were filled with complex negotiations while the parties sought to determine suitable compensation for Ord Stage One, compensation for the 65,000 hectares of land necessary for Ord Stage Two and compensation for the abolishment of native title in the region. The result of these negotiations: the Ord Final Agreement.

Moving forward, together

The Ord Final Agreement recognises the injustices of the past and sets out a range of measures that form the basis for future partnerships between the Miriuwung and Gajerrong peoples, the State Government, industry bodies and developers to lead the area, and its people, into the future.



A crucial part of this was the establishment of the Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation (MG Corporation), which will receive and manage the settlements of the agreement. The corporation was established in 2006 and is governed by a structure made up of one representative from each of the 16 dawang, or traditional land areas, which make up the Miriuwung and Gajerrong lands. The corporation aims to improve the social, cultural and economic wellbeing of the Miriuwung and Gajerrong peoples.

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Main Gilbert Riley fishing at Niligem in Barrbem Park.

Photo – Rosemary Hill

Inset top Skeleton Creek, Ngamoowalem Park—one of the six new conservation parks.

Inset bottom DEC Miriuwung Gajerrong Rangers Andy Reid and Jerrimiah Hester with Miriuwung elder (Garrayilng) Button Jones together as part of a men's 'back to country' trip.

Left Looking north-east at Barrbem Park—one of the six new conservation parks.

Photos – Scott Goodson





Above Lake Kununurra, created as part of Ord Stage One.

Photo – Bill Belson/Lochman Transparencies

Right Carol Hapke, Matthew Ningamara, Nancy Dilyai, DEC's Scott Goodson and Janelle Ningamarra in front of Garn-Garnbe (Barbecue Hill) near Yirralalem community bordering Darram Park.

Photo – Rosemary Hill



The agreement also led to the creation of six new conservation parks in the East Kimberley (see 'New conservation parks' on page 23). The parks were created to be held under freehold title by the traditional owners, the Miriuwung and Gajerrong peoples, and leased to the State for joint management between the Miriuwung and Gajerrong peoples and the Department of Environment and Conservation (DEC). They will be the first Aboriginal-owned jointly managed conservation parks in WA and will be managed through the Yoorrooyang Dawang Regional Park Council (YDRPC), which is made up of representatives from DEC and the MG Corporation. The park council will be guided by individual park

management plans due to be released in 2010 and an overall management plan which will be developed through a three-stage planning process.

Cultural planning

The Miriuwung and Gajerrong peoples' approach to park planning is based on culture and customary law and they believe that keeping culture alive and strong is central to conservation management. In the words of Miriuwung elder Ben Ward,

who was instrumental in the Ward case (2004):

"The law comes from the country and controls the Miriuwung tribe. The law comes from Ngarranggarni, the Dreaming. Ngarranggarni comes from the country. Ngarranggarni provides the reasons and rules, the law, for how we look after country. The law is taught by the old people to the young people and is passed on through generations. People can't have country unless they have the law, because the law teaches us about the country and how to protect and manage

Miriuwung and Gajerrong Dreaming

Our ancestors created Miriuwung and Gajerrong country in the Ngarranggarni, the Dreaming. At the dawn of time, our land was covered by the waters of an enormous flood. The waters eventually receded, placing some of the Dreamings, the ancestral beings, on the landscape. Other Dreamings roamed the land, creating creeks, billabongs, hills and escarpments on tracks through our country. They created the different soils, plants and animals, and all the seasons of our country—yin-geng (the wet season), gerloong (big storm), barndinyirry (dry season) and wan-gang (cold weather). During these sagas of journey and creation, our ancestral beings, who were simultaneously human and animal, also established the all-encompassing moral and practical rules by which succeeding generations of Aboriginal people have lived for thousands of years—our Law, languages and ceremonies.

Our Dreamings became different features of our landscape, and are still present in our country today. Every part of our country has a song. Our Dreaming makes connections between our people, plants, animals and parts of our country like water holes, creeks, hills, mountains and tracks through our country. Yarndungarll (dingo), lemoogeng (blue-tongue lizard), diwanang and jalareng (wedge-tailed eagle and egret), bilbiljing (grass-hopper, goorrgoorjring (tawny frog-mouth owl) and gerdan (frill-necked lizard) are some of the Dreaming stories and places on our country.

Taken from the *Miriuwung Gajerrong Cultural Planning Framework*

it. When old people say you have to know about country, it means you have to have law for that country.”

The Miriuwung and Gajerrong peoples feared their traditional laws and customs would not get adequate recognition if the standard management planning process employed by the State was followed for the six new

conservation areas. Therefore, DEC, the MG Corporation and the Conservation Commission agreed to work together, with research support from CSIRO, on an innovative approach to develop the management plan through a three-staged process.

The first stage involved developing the Miriuwung Gajerrong Cultural

Background left Original artwork.
Painting – Nancy Dilyai

Below Ngamoowalem Park.
Photo – Rosemary Hill

Planning Framework. Released in November 2008, the framework documents the Miriuwung and Gajerrong peoples’ approaches to land management and outlines how the Western Australian Government Planning Guidelines could incorporate these approaches. It also sets out protocols for the partnership.

The second stage focuses on the development of the Yoorrooyang Dawang Joint Planning Guidelines—a joint planning framework between the MG Corporation, DEC and the Conservation Commission that brings the two approaches together, taking into account management principles set out in the Ord Final Agreement. These guidelines were endorsed by YDRPC in September 2009.

Finally, stage three will use the Yoorrooyang Dawang Joint Planning Guidelines to guide the development of the management plan and the sub-plans.





Above Helen Gerrard with her grandson Tremayne together as part of an 'on-country' trip to Wawoolem Creek. Photo – Rosemary Hill

This staged approach paves the way for a successful partnership for the joint management arrangement that will see Miriuwung and Gajerrong peoples and DEC working side by side, each sharing and taking equal responsibility for managing the conservation areas. After all, both share the same vision for the country and have an obligation to protect it—one group through legislation and the other through traditional law and culture. In time, it is hoped this will lead to the Miriuwung Gajerrong people assuming sole responsibility for managing the land.

So how's it going?

Progress so far

To date, the partnership has made significant progress on a number of projects with stages one and two complete. The third stage will see much of the planning being implemented on the ground in the new conservation parks.

A significant highlight has been the progress of the Miriuwung Gajerrong Ranger Program which is involving up to 10 rangers who are being trained in certificates II and III in Conservation and Land Management. The rangers are also taking part in a culture and language course, which has been specifically



developed to cover the needs of the program and to prepare the rangers for working on country in the new conservation areas. In addition, two of the rangers have received specialised training in law enforcement and now have powers under the *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950*.

As well as learning practical skills, the program has given the rangers the opportunity to take part in projects and programs that have increased their

standing in their broader community. They have gained positive reputations for the quality and timeliness of their work. These results are pleasing indications that a key objective of the program is being fulfilled—that it's not just about managing parks and providing employment, but improving the standing of Miriuwung and Gajerrong individuals in their community and assisting them to make meaningful and significant contributions to the conservation of their traditional lands.



Left Ngamoowalem Park.

Below left DEC Miriuwung Gajerrong Rangers Jerrimiah Hester and Andy Reid talking with pastoralist Jeff Warnier about park planning and management.
Photos - Scott Goodson

As well as the significant cultural and social benefits, on-ground work has been successfully implemented in the conservation areas. A works maintenance and capital works program has been developed for each park and it is hoped that site plans will be developed in 2010 for the Ngamoowalem and Goomig parks that will include infrastructure such as interpretive signage and walk trails. Work to scope and plan for potential tourism developments will also be carried out.

In addition, the rangers have helped conduct fauna surveys in five of the six new parks. The information gleaned from these surveys will provide benchmark information on species diversity, ahead of the arrival of cane toads. These surveys have been conducted in partnership with the relevant Dawawang (people of the area) as part of on-country trips and have facilitated the sharing of traditional and contemporary knowledge. A number of on-country trips have been conducted and more are planned for later in the year.

Rangers have also been involved in a number of activities with the local community, including taking part in agricultural shows and national forums and working with school students as part of in-school visits and talks, and DEC's Bush Rangers WA program. They have also taken part in special projects such as providing assistance to the Australian Quarantine Inspection Service to protect against exotic plants, insects and avian influenza, and in a study into potential tourism economic development in the six new conservation areas.

Moving on

The landmark project is achieving important results for one of the most beautiful and remote parts of the world



New conservation parks

Goomig Park (Pincombe and Cave Springs Ranges)

Goomig Park incorporates the Sorby Hills and spectacular Pincombe Range which are vegetated by sparse eucalypt woodlands over spinifex. Cave Springs is the only permanent fresh water body in the park and is surrounded by ferns, palms and rainforest plants. The cave is home to bats and provides an important habitat for as many as 134 bird species as well as 16 mammal, 25 reptile and 11 frog species. Martin's Bluff hills to the south of Martin's Gap have many paintings in them and three sites in the park, which include mythological places, ceremonial sites, paintings, grinding patches and engravings, are registered with the Department of Indigenous Affairs.

Barrbem Park (Zimmerman Range)

The eastern side of the 14,328-hectare Barrbem Park borders Keep River National Park, and the Northern Territory border, as well as the Goorrboome (Kumburumba) living area to the north. Biological surveys have identified the park as having significant biological values including the presence of the endangered Gouldian finch and a diverse range of flora. The park's vegetation ranges from open woodlands on flat areas to rainforest thickets and palm groves. The park incorporates Mount Zimmerman, Mount Septimus and Burt Range. The ranges are thought to be up to 350 million years old. To the Miriuwung and Gajerrong peoples, the park is an important story place for sugar-bag and lemoogeng (blue-tongue lizard) Dreaming.

Darram Park (Packsaddle Swamp)

The smallest of the parks, the 896-hectare Darram Park is bordered by the Ord River, private property and the proposed Wawoolem Conservation Reserve. It forms part of the 117,495-hectare Lake Argyle and Lake Kununurra Ramsar site and is an important habitat and breeding area for waterbirds such as swampheens and magpie geese. The Miriuwung and Gajerrong peoples hope to establish the area as a bird-watching destination. It also contains a number of

sites that have cultural significance to the Miriuwung and Gajerrong peoples and a number of Dreamings. The area also was used as a refuge by people hiding from the police and as a safe haven during World War II when Wyndham was bombed.

Ngamoowalem Park (Livistona Range)

The largest of the six new conservation reserves, the 70,310-hectare Ngamoowalem Park adjoins Parry Lagoons Nature Reserve to the west. It has a diverse range of flora, including populations of cycads and Livistona fan palms (*Livistona lorophylla*) and riparian plant communities that grow around the seasonal waterfalls and permanent freshwater pools. It also contains a number of culturally significant sites and is rich in bush tucker.

Mijing Park (Ningbing Range)

The Ningbing community living area is located in the southern part of Mijing Park. The park's defining landscape feature is the Ningbing Range, consisting of limestone that was formed as part of an ancient (Devonian) barrier reef system which contains vast deposits of marine fossils. The park supports eucalypt woodlands and palm groves of Livistona fan palms and its permanent freshwater pools provide vital habitat for many bird species. It is also home to *Georissa obesa*—land snails known to occur only in the Ningbing Range.

Jemandi-Winingim Park (Weaber Range)

Jemandi-Winingim Park extends about 63 kilometres to the Northern Territory border and borders Point Spring Nature Reserve along its southern border. The Miriuwung and Gajerrong peoples would like Mijing and Jemandi-Winingim parks to be connected to reflect that their ancestors used to walk between the parks. Eucalypt woodlands over spinifex grasses cover much of Jemandi-Winingim and patches of rainforest are found in sheltered valleys and under cliff lines. Seasonal swamps, characterised by sedges and paperbarks, cater to the many birds that can be found in the area.

Above background Original artwork.
Painting – Nancy Dilyai

Right Niligem in Barrbem Park.
Photo – Rosemary Hill

and the people who live there. By developing a sound framework from which to build lasting partnerships, provide employment and potential prosperity for the Miriuwung and Gajerrong peoples and achieve tangible environmental benefits, the project is setting a strong example for other areas—both within WA and around Australia. Importantly, it is also working to repair some of the damage done to an ancient and proud people who still carry scars from the past.

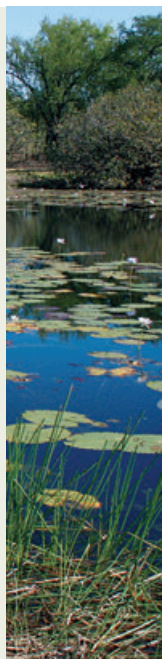
Rhianna King is the Department of Environment and Conservation's (DEC's) Publications Manager and *LANDSCOPE* co-editor. She can be contacted on (08) 9389 4009 or by email (rhianna.king@dec.wa.gov.au).

Scott Goodson is DEC's Miriuwung Gajerrong Joint Management Coordinator and has collaborated with the Miriuwung and Gajerrong peoples since joining the department in 2007. He can be contacted on (08) 9168 4236 or by email (scott.goodson@dec.wa.gov.au).

Des Hill is the Yawoorroong Miriuwung Gajerrong Yirrgab Noong Dawang Aboriginal Corporation's Ord Final Agreement Projects Implementation Officer and a Miriuwung traditional owner from the Ord Valley region.

Dr Rosemary Hill is an environmental planner with CSIRO Sustainable Ecosystems based in Cairns. Her research interests include natural and cultural heritage conservation and management, and collaborative environmental planning, policy and governance, with a strong focus on Indigenous peoples' approaches to the environment.

Rosemary, Scott and Des wrote the Miriuwung Gajerrong Cultural Planning Framework and also prepared the Yoorrooyang Dawang Joint Planning Guidelines with DEC's Daryl Moncrieff and Laurina Bullen. The development of the framework was funded by DEC and supported by CSIRO through the contribution of Rosemary. This work could not have been completed without the generous contribution of time and energy by many Miriuwung and Gajerrong peoples.





by Dave Algar, Neil Hamilton, Mike Johnston and Mike Lindeman

New tools for **fighting** **ferals**



Trials of a new cat bait and delivery device have achieved success in targeting feral cats on Christmas Island, sparking new hopes for protecting the island's iconic wildlife.

There is extensive evidence that the introduction of domestic cats (*Felis catus*) to islands around the world can adversely affect populations of endemic land animals and birds. Animals that have evolved for long periods in the absence of predators are particularly susceptible to cat predation.

On Christmas Island, four of the five mammal species which were present at settlement by European people have become extinct. The bulldog rat (*Rattus nativitatus*) was a diurnal species and was common at the time of settlement while Maclear's rat (*R. macleari*) was highly arboreal, nocturnal and extremely abundant. The Christmas Island shrew (*Crocidura attenuata trichura*) has not been seen since 1985 and is believed extinct and, most recently, the Christmas Island pipistrelle (*Pipistrellus murrayi*) is also thought to have become extinct.

While several causes are likely to have contributed to the demise of these native animals, including disease, habitat destruction (land clearing and natural catastrophes such as cyclones) and the proliferation of exotic crazy



ants (*Anoplolepis gracilipes*), a major culprit is the introduction of exotic competitors and predators such as the feral cat.

A recent Parks Australia report lists five threatened species which are vulnerable to cats on Christmas Island—the emerald dove, Christmas Island hawk-owl, Christmas Island thrush, Lister's gecko (*Lepidodactylus listeri*) and pink blind snake (*Typhlops exocoeti*). Other species considered at risk from cat predation include the blue-tailed skink (*Cryptoblepharus egeriae*) and forest

skink (*Emoia nativitatis*). A recent study of red-tailed tropicbirds on Christmas Island has shown predation, primarily by cats, has resulted in no chicks surviving nesting during the past three years. It has also been demonstrated that cats are hunting adult birds. This provides a clear message that increased management of cats is required to improve the survival prospects of these species.

Christmas Island

Christmas Island covers an area of 135 square kilometres and is located in the Indian Ocean about 360 kilometres south of Java and 900 kilometres north-east of the Cocos (Keeling) Islands. Major land uses are phosphate mining and conservation, with 63 per cent of the island reserved as national park. More recently, the island has become known as the location of a detention centre for asylum-seekers.

The island rises steeply from the surrounding ocean and consists of a series of fringing limestone terraces, separated by rugged limestone cliffs and scree slopes, rising to a central plateau at about 200 metres and extending to 360 metres above sea level. Christmas Island has an equatorial climate with a distinct wet (December–April) and dry season. The mean annual rainfall is 2,154 millimetres with most falling in February and March and least in August to October. Temperature varies little from month to month. The mean daily maximum is 28°C in March and April and the mean daily minimum is 22°C in August and September. Humidity also varies little between months and usually ranges from 80 to 90 per cent. The conserved areas on



Previous page

Main Deans Point, Christmas Island.

Photo – Alex Steffe/Lochman

Transparencies

Inset Feral cat.

Photo – Neil Hamilton/DEC

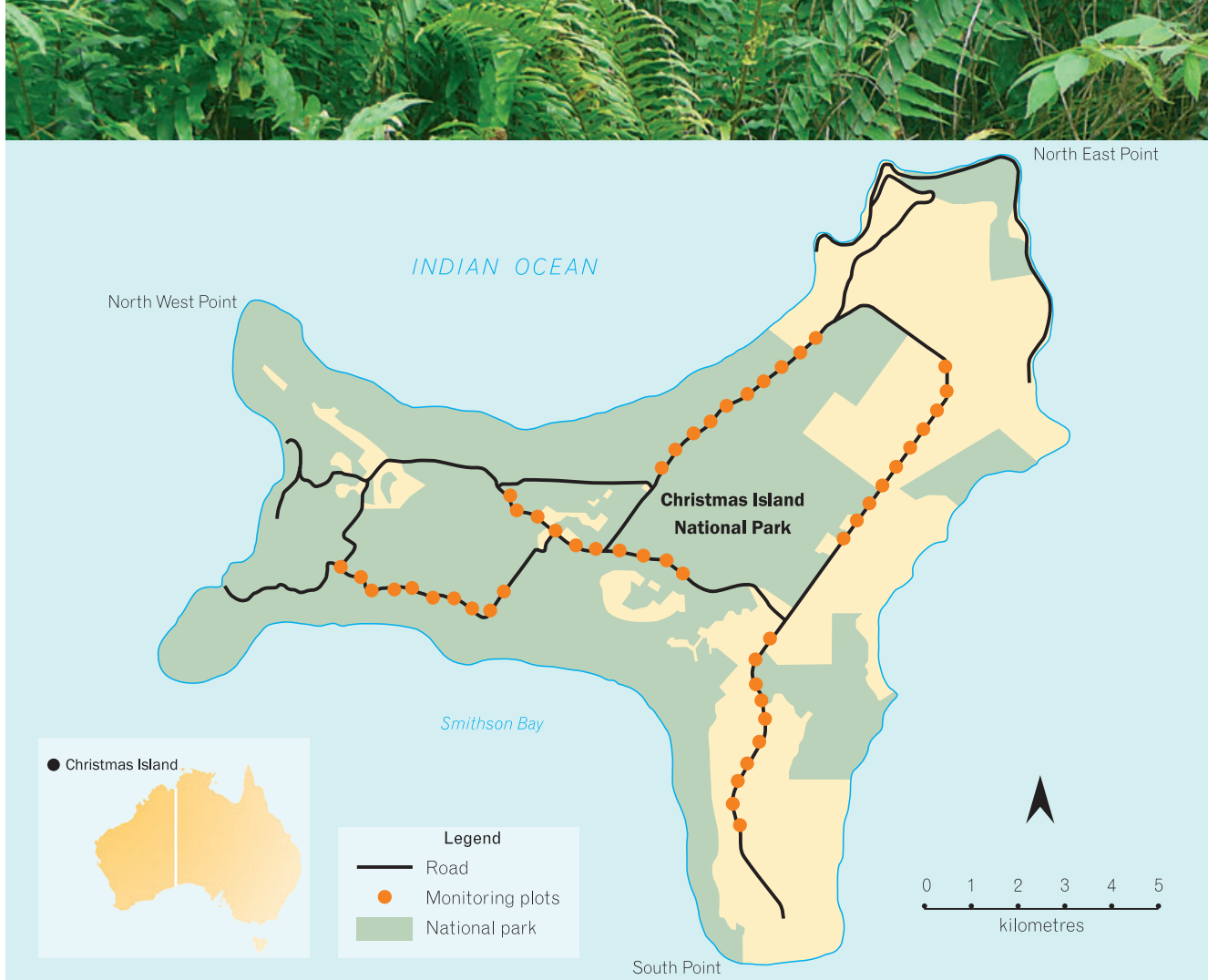
Above Dave Algar setting a bait station.

Photo – Mike Lindeman/DSE

Left Dolly Beach, Christmas Island.

Photo – Alex Steffe/Lochman

Transparencies



the island are mostly vegetated with tropical rainforest.

Cats were taken to Christmas Island at the time of first settlement in 1888 and it didn't take long for a significant feral population to develop. Initially, cats were concentrated around the settlement and mining areas where they had access to discarded human food. Feral cats are now abundant and widespread across the island. The Department of Environment and Conservation (DEC) and collaborators have launched a new bait and bait delivery device to combat feral cats at this tropical site.

Curiosity killed the cat

Baiting is recognised as the most effective method of controlling feral cats but requires an understanding of the risk posed to non-target species. The toxin used in Western Australia (and select other sites) for feral cat baiting is known as 1080. Most WA native animals have a natural degree of tolerance to the 1080 poison because it is derived from native plants called gastrolobiums or 'poison peas' with which they have evolved.

Conventionally, poison baits intended for feral cats are laid on the ground. This can present a significant hazard to wildlife species, particularly in the eastern states of Australia where tolerances to 1080 are significantly lower than in the west. To provide a technique for broadscale feral cat baiting campaigns where 1080 may pose a risk, a collaborative project for the development of a 'humane, felid-specific toxin and bait delivery system' was initiated. The project is a collaboration between the Australian Department of the Environment, Water, Heritage and the Arts, the Victorian Department of Sustainability and Environment (DSE) and DEC.

The project involves bringing together the feral cat bait (*Eradicat*®) and an encapsulated pellet known as the 'hard shell delivery vehicle', which contains the toxicant. The toxin is known as a 'para-aminopropiophenone' (PAPP), which works by converting healthy haemoglobin into methaemoglobin that cannot transport oxygen. Independent veterinarians and animal welfare groups consider the death of a cat from PAPP toxicosis to

be humane. The use of an acid-soluble 'hard shell delivery vehicle' ensures that the toxin does not disperse throughout the bait but releases in the cat's stomach where it quickly overwhelms the cat's physiological processes.

This method of delivering the bait also plays a key role in reducing the potential exposure of non-target species. When feeding, feral cats simply shear food items into manageable portions and swallow those portions whole. Thus, they will reliably swallow a pellet that is implanted into a bait. Conversely, most wildlife species process food items more thoroughly in the mouth. This means animals other than cats tend to reject the pellet as they eat. Direct injection of PAPP toxin into the bait (without the delivery device pellet) is not appropriate because it is more likely to present a risk to non-target wildlife species and also requires more toxin.

This bait delivery and toxicant combination is soon to be registered and will be known as the Curiosity Feral Cat Bait. Registration involves meeting specific requirements and approvals from the Australian Pesticides



and Veterinary Medicines Authority (APVMA). Field trials to demonstrate the effectiveness of the bait and toxin combination are required and these will occur across climatic zones where feral cats are a threatening process. To start with, these trials were conducted on islands where non-target species risks could be ameliorated or are non-existent. An earlier trial in Victoria's French Island National Park resulted in a significant baiting efficacy at a low cat density in the temperate site. A significant baiting efficacy was also demonstrated on Dirk Hartog Island off the WA coast, a semi-arid site, where at least 80 per cent of feral cats consumed toxic baits during a recent baiting program. The results of the Christmas Island study and those from French and Dirk Hartog islands will be included as part of the dossier submitted to the APVMA when seeking registration of this product as an agricultural chemical.

Getting the technique right

Previous baiting trials on Cocos (Keeling) and Christmas islands highlighted the potential problem of certain non-target species removing ground-laid baits. On the Cocos (Keeling) Islands, land crabs (*Cardisoma carnifex*), which dominate the forest floor, hermit crabs (*Coenobita perlata*), black rats (*Rattus rattus*) and feral chickens (*Gallus domesticus*) readily

consumed baits placed on the ground. Similarly on Christmas Island, robber crabs (*Birgus latro*) readily removed ground-laid baits. Any baits consumed by non-target species are not available to feral cats resulting in lower baiting efficacy.

However, scientists found that suspending baits from a 'gantry' device, about 30 to 40 centimetres above the ground, prevented most non-target animals from removing the baits. And, significantly, the baits were still attractive to the feral cats. This baiting strategy was adopted to test the new bait delivery and toxicant combination.

The feral cat baits used were manufactured at the DEC bait factory in Harvey. The bait is similar to a chipolata sausage in appearance—weighing about 20 grams before drying and about 15 grams after drying, before it is blanched and then frozen. The baits are made of 70 per cent kangaroo meat mince, 20 per cent chicken fat and 10 per cent digest and flavour enhancers. The delivery device contains about 78 milligrams of PAPP toxin in pellet form and, importantly, there is no risk of secondary poisoning.

Each of the 524 bait stations consisted of two joined non-toxic cat baits suspended from a gantry using six to eight pound fishing line. The bait stations were located at 100-metre intervals along most of the road and track network on the island. A 'sand

Above left A robber crab climbing a bait station.

Photo - Neil Hamilton/DEC

Above The pipistrelle is thought to have become extinct.

Photo - Lindy Lumsden/DSE

pad' of crushed rock phosphate dust was placed beneath the baits to detect cat activity.

Non-toxic feral cat baits were placed at each bait station until removed by a cat. After the baits were removed, toxic baits were then placed at the bait station. This ensured a strategic deployment of toxic baits in areas where cat activity was observed rather than across the entire island. Each bait station was examined daily, over a 15-day period, to see whether the baits had been taken and whether evidence of cat activity could be seen on the sand pad. Bait removals by non-target species were also identified by tracks on sand pads and recorded. Baits were replaced following removal and all baits stations were re-baited with fresh non-toxic baits at least every four days.

Cat abundance before and after baiting

To find out how efficient the baiting was, cat activity was surveyed at a number of monitoring plots before and after the baiting program.

To supply a measure independent of food (in this case baits), active plot stations containing an audio lure known as a 'Felid Attracting Phonic' and a felid scent lure were used to attract cats to monitoring plots in each survey. Fifty of these plots were located at half-kilometre intervals along a transect of five kilometres, with five transects across the baited zone. Cat activity at the plots was recorded during five consecutive nights during the two survey periods.

Cat activity was recorded on 96 of the 524 individual bait stations during the 15 days of baiting. Of the 96 stations with activity, 55 stations were visited on more than one night, sometimes multiple times during the baiting period, and 41 stations were visited only on the one night. A total of 183 baits were removed by cats during this period, of which 78 were toxic. It was not possible to determine how many stations an individual cat visited on a given day. As bait station activity could not be ascribed to individuals, a value for the maximum and minimum number of cats poisoned over the survey route was determined.

Although the sand pad method could not detect multiple visits to bait stations on the same night, it seems unlikely that this occurred because the bait would typically be removed by the first cat. So, the total number of toxic baits consumed was considered to indicate the maximum number of individuals poisoned (78 cats) over the 52.4-kilometre baited route. The minimum number of individuals poisoned (38 cats) was calculated by ascribing bait removals from consecutive bait stations to the same animal, even if more than 10 stations were involved. Realistically, the number of feral cats poisoned during this program will be somewhere between the two extremes.

The comparison for the pre- and post-baiting monitoring periods indicated a significant reduction in cat activity following the baiting program.

Above right A walk to Margaret Knoll on Christmas Island.

Photo – Alex Steffe/Lochman Transparencies

An 87 per cent decline in cats was recorded, indicating a highly effective baiting program.

Into the future

Both the community and authorities on Christmas Island are concerned about the abundant feral cat population in the national park, as well as the cat population in the settlement. Many have raised concerns about the threat of the cats to the survival of a number of endangered fauna. Previous research has demonstrated that the cats on the island also have a very high

prevalence of *Toxoplasmosis*, a parasite that can lead to serious human health complications.

Organisations responsible for the management of Christmas Island have recently tendered for the preparation of a feral cat management plan for the island. A collaborative project between DEC and DSE has been endorsed to write this plan that will hopefully lead to an effective cat control campaign in the very near future. A baiting program using Curiosity Feral Cat Bait will play a significant role in this control campaign.



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Mike Lindeman is also a research scientist at DSE's Arthur Rylah Institute in Heidelberg, Victoria. He has assisted with the development of techniques for improved control and monitoring of vertebrate pest species including feral cats, red foxes and deer. He can be contacted by email (michael.lindeman@dse.vic.gov.au).

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Porongurup National Park

With karri forest, wildflowers, giant granite boulders and a network of walking trails, Porongurup National Park offers a popular natural refuge north of Albany.

Above Devil's Slide, Porongurup National Park.

Photo – Jiri Lochman

Right Rufous tree-creeper.

Photo – Wayne Eddy/Sallyanne Cousans Photography

Far right Karri forest.

Photo – Marie Lochman

Porongurup National Park offers an enchanting world of ancient moss-covered rocks, lush karri forest and towering granite peaks amid a sea of farmland. The 12-kilometre Porongurup Range winds through the park, dazzling displays of wildflowers enliven the undergrowth with colour during spring and peaks climbing up to 670 metres high offer views of the Stirling Range and, on a clear day, the Southern Ocean.

History

Although the Porongurup Range was visible to the early settlers of Albany, it was not until 1828 that Captain Wakefield led a party to climb the hill on the eastern side of the range. His Aboriginal guides Mokare and Nankina told him the area was called Purringorep, which formed the base for its current name.

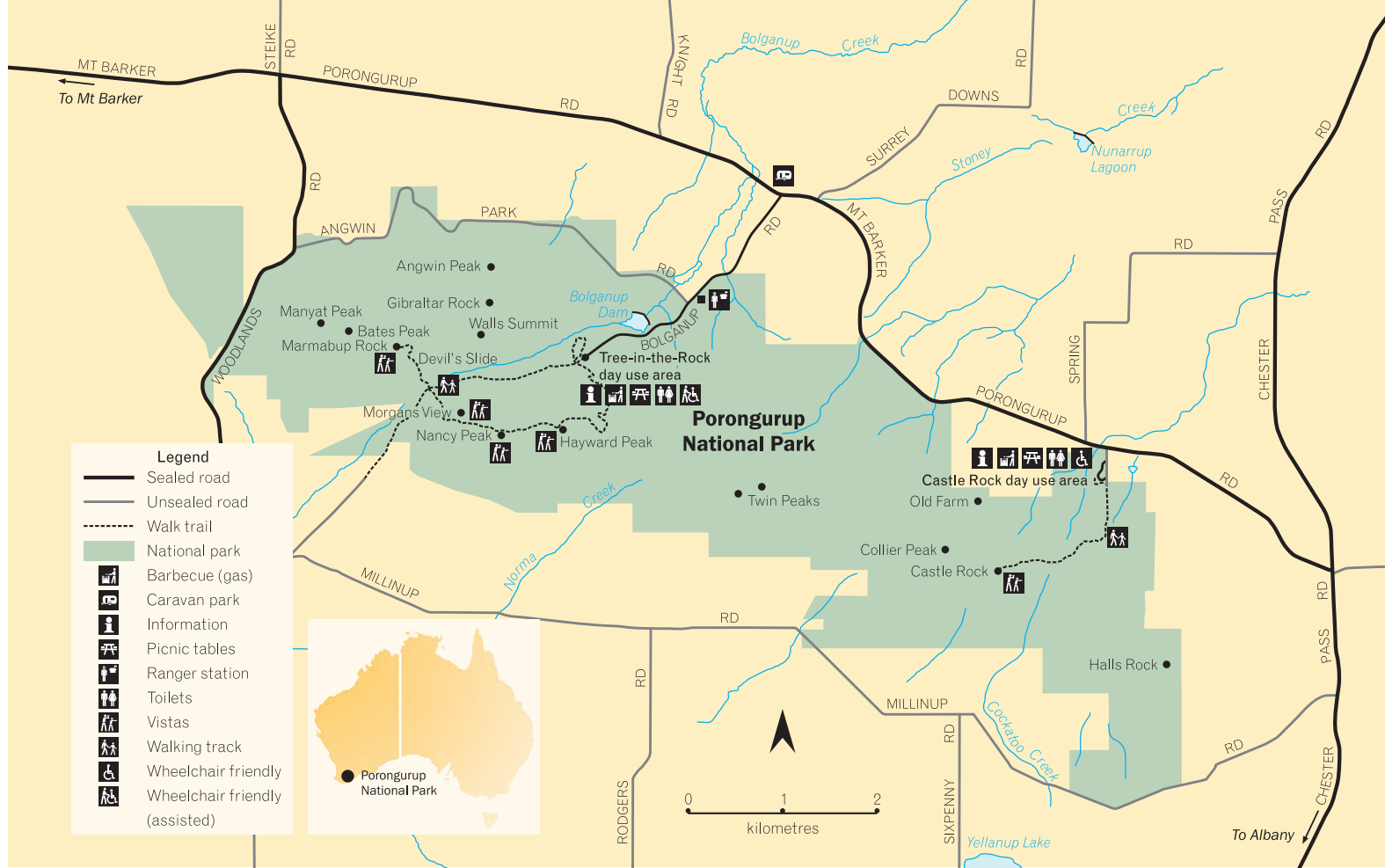
Botanist James Drummond visited in 1843 and 1848, describing the karris as “the finest I have ever seen in any country” and the mosses and lichens as “luxuriant as I have ever seen in

the moist rich valleys of the south of Ireland”.

Natural attractions

The granite rock that forms the Porongurup Range is more than 1,100 million years old. This ancient landscape was exposed by the relentless forces of nature as it weathered away softer rocks surrounding the ridge to reveal the range's outlines. In the process, the range became an ecological island. Its climate and soils differ greatly from the surrounding lowlands, and protect a suite of plants and animals not seen in the nearby surrounds.

Perhaps the most well known of these species is the mighty karri (*Eucalyptus diversicolor*) that cloaks the range in green growth. Fossil pollen found throughout the south-west shows that, in an earlier wetter era, karri forest grew far beyond its present extent. As the climate became drier, the karri forest retreated to its present stronghold between Manjimup and Walpole. However, where the soil was right and the rainfall higher, small



outlying populations survived. The Porongurup Range is one such island of karri growth.

Many of the plants and animals typical of the main belt of karri forest have also survived here. You may see creatures such as the western grey kangaroo (*Macropus fuliginosus*), brush wallaby (*M. irma*) and birds such as the rufous tree-creeper and the brilliant scarlet and yellow robins.

About 750 plant species occur in the park and are particularly beautiful in spring when wildflowers burst into bloom. Wattle and hovea shrubs are particularly stunning, especially when they occur together *en masse*, while about 55 species of orchid also occur in the park.

Exploring the park

To gain an appreciation for the whole park, set out on the 23-kilometre scenic drive along Bolganup, Angwin Park, Woodlands, Millinup, Chester Pass and Mount Barker–Porongurup roads. The roads are mostly sealed (Angwin Park Road and Millinup Road are unsealed) with some steep sections, and the drive offers beautiful views over the range. For a shorter version, take the five-kilometre stretch of Angwin Park Road between Bolganup Road and Woodlands Road for views over the granite outcrops and Stirling Range to the north.

To get up close to the natural environment, set out on one of the five walk trails. Two of the trails, the 600-metre loop Bolganup Trail and the 5.5-kilometre return Hayward Peak and Nancy Peak Walk, start at the Tree-in-the-Rock picnic area. This area is nestled amid an enchanting cathedral of karri trees. These forest giants shade out the sky above and add a mystical, fairytale feel to the setting.

The four-kilometre one-way Wansbrough Walk intersects the Nancy Peak Walk, as does the five-kilometre return Devil's Slide Trail.

At the eastern end of the range is Castle Rock. A three-kilometre return walk takes you past a 'balancing' rock which sits seemingly precariously atop a granite outcrop. You can climb some metal stairs to stand on the 'battlements' of Castle Rock and take in views of the surrounding countryside.



park facts

Where is it? 40 kilometres north of Albany via Chester Pass Road, the Mount Barker–Porongurup Road and Bolganup Road.

Total area: 2,511 hectares.

What to do: Bushwalking, picnicking, rock climbing, abseiling.

Facilities: Barbecues, toilets and picnic tables.

Park fees: Entry fees apply.

Nearest DEC office: A resident ranger, based at the main entrance on Bolganup Road, looks after the park. DEC's South Coast Regional Office is at 120 Albany Highway, Albany, phone (08) 9842 4500. Please check with the local office regarding trail closures.

The new [Pinnacles Desert](#) Discovery interpretive centre and related visitor infrastructure has transformed the visitor experience for people journeying to Nambung National Park.



A tall, slender rock pinnacle stands prominently in the foreground of a desert landscape. The rock is light brown and shows signs of weathering and erosion. In the background, numerous other smaller pinnacles of varying heights and shapes are scattered across a sandy desert floor. The sky is a clear, pale blue, and the overall scene is bathed in warm, golden light, suggesting a sunrise or sunset. The text 'Discovering the Pinnacles Desert' is overlaid on the upper right portion of the image.

Discovering the
Pinnacles
Desert

by Samille Mitchell

About three hours' drive north of Perth, thousands of eerie limestone pillars rise from a desert of shifting yellow sands. The 'pinnacles' of Nambung National Park near Cervantes lure 300,000 visitors a year who stroll or drive among the geological oddities and marvel at their form. Some of the pinnacles look like tombstones guarding long-forgotten graves, others like stalagmites reaching towards the heavens. They are both grotesque and beautiful in form as they cast long shadows and transform from yellow through to gold in the late afternoon light.

But, these days, a visit to the Pinnacles Desert is not just about witnessing the limestone structures themselves. Today, visitors can learn much about these strange natural creations and Nambung National Park's other natural and cultural phenomena at the new state-of-the-art Pinnacles Desert Discovery interpretive centre.

Pinnacles Desert Discovery

The Pinnacles Desert Discovery centre opened in November 2008 to enhance the experience for visitors to Nambung National Park. Using soundscapes, video footage, backlit panels, objects and static displays, the centre takes visitors on a sensory journey through the national park.



The centre also features a retail gallery, improved car parking, new toilet facilities, a new ticket booth and a group shade shelter. Visitors can set out from the centre on a marked 1.5-kilometre walk trail through the Pinnacles Desert.

Such facilities were designed with sustainable development principles in mind, incorporating solar power, passive solar building design, rainwater collection and use, and an environmentally friendly primary sewage treatment facility.

The building was designed by Woodhead International project architect John Nichols, whose brief was to come up with a building design that blended with the site rather than imposed upon it. Coming up with such a brief was a lengthy task involving

extensive planning and liaison with the community.

Creating the concept

In envisaging the Pinnacles Desert Discovery centre, Department of Environment and Conservation (DEC) staff recognised the difficulties in balancing the needs of the hundreds of thousands of visitors with preserving the area's natural and cultural features. They also had to deal with a remote setting and a lack of services—everything from waste management and power to water and communications facilities needed to be put in place.

On top of this, there was debate as to the most appropriate location for such a facility. As such, DEC commissioned consultants to develop a master plan to review six potential sites to determine the area best suited to an interpretive facility.

Most stakeholders surveyed during the development of the master plan believed a facility that interpreted the natural wonders of the Pinnacles Desert needed to be located within at least six kilometres of the features, and that any development should not be visible from within the desert so as to avoid detracting from the feeling of a 'remote' experience. There



Previous page

Main The Pinnacles Desert shrouded in mist.

Photo - Alice Gillam/Sallyanne Cousins

Above Pinnacles Desert Discovery centre.

Left Inside Pinnacles Desert Discovery.

Photos - John Gollings

was also a general concern that the number of visitors was starting to have a detrimental impact on the site and that visitors needed to be carefully managed to ensure these impacts were minimised.

The consultants conducted extensive visitor surveys to identify what tourists valued at the site and what they felt was needed to improve their experience. At the same time, other consultants were contracted to review existing visitor numbers, market sources, patterns and trends. The results of these surveys informed the design of facilities and the types of service that would be delivered. In addition, DEC consulted extensively with the Yued traditional owners of the area to ensure they were supportive of any development and were involved in the design and development process.

From the extensive consultation and research, it became clear that the centre should not impinge on the remote and natural values of the Pinnacles Desert—rather than being a ‘feature’ of the site it should blend in with the environment. Facilities needed to be simple in design, not visible from the desert, offer an interpretive experience and include sustainable building design, environmentally sensitive power delivery and sewage treatment.

The resultant product was a finalist in the World Architecture Awards in Barcelona in October 2008 and won the Federal ‘Best of State (WA) Commercial Interior Design Award’ in 2009. The centre also took out the State Tourism Award in 2009 for best ‘New Tourism Development’.

Winds of time

While the Pinnacles Desert Discovery centre has breathed new life into the area and enhanced the experience for visitors, the pinnacles themselves remain the main attraction. So how did these odd-looking natural structures come to be here? The answer lies in the conspiring forces of sea, wind, sun, rain, plant growth and fire.

The process began during an ancient epoch rich in marine life, when seas broke down shells into lime-rich sands and the waves tossed the sands ashore. From here, the winds took on a role, blowing the sands inland to form



high, mobile sand dunes. Then the rain stepped in, falling on the dunes and dissolving small amounts of calcium carbonate as the water percolated down through the sand. The sun played its part by drying out the dunes and cementing grains of sand together to eventually produce a hard limestone rock called Tamala limestone.

At the same time, vegetation that became established on the surface stabilised the sand and decayed plant and animal matter caused a more acidic layer of soil and humus to develop over the remaining quartz sand. The acidic soil accelerated the leaching process, and a hard layer of calcrete formed over the softer limestone below. Plant roots exploited cracks which formed in the calcrete layer, forming a channel for

water to seep to the softer limestone beneath. This softer limestone was slowly leached away and the channels gradually filled with quartz sand. The subsurface erosion continued until only the most resilient columns remained.

Fire then played its part, denuding higher areas of vegetation so the wind could carry away loose quartz sands. As the winds blew the sands away, limestone pillars slowly emerged from the surrounding plains in the form of the pinnacles we marvel at today.

More than pinnacles

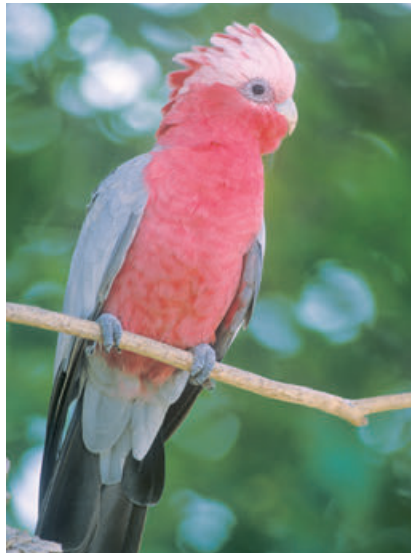
The 18,972-hectare Nambung National Park also protects beaches, coastal dunes, shady tuart tree groves, caves, cliffs and low heathlands rich in flowering plants. The heathland is



Above Pinnacles Desert.
 Photo - Bill Belson/Lochman
 Transparencies

Far left Native wisteria.

Left Galah, which frequent Nambung National Park.
 Photos - Jiri Lochman



particularly beautiful in winter and spring as wildflowers burst into bloom. During this time you may see old man's beard (*Clematis linearifolia*) and native wisteria (*Hardenbergia comptoniana*) clambering over the vegetation in white and vibrant purple growth. Wattles such as red-eyed wattle (*Acacia cyclops*) and saw tooth wattle (*A. truncata*) are also common, as are banksia species such as candle banksia (*Banksia attenuata*), firewood banksia (*B. menziesii*) and sawtooth banksia (*B. prionotes*).

Such vegetation harbours several native mammals and birds. The western grey kangaroo (*Macropus fuliginosus*) is the most obvious inhabitant, often visible in the early mornings and late afternoons. You may also see an echidna

(*Tachyglossus aculeatus*) trundling along a bush track or emus, galahs or threatened Carnaby's black cockatoos screeching from the tree tops. Keen-eyed visitors may also spot a bird of prey such as a black-shouldered kite or osprey hovering above the ground in search of a meal. Also look out for reptiles such as bobtails (*Tiliqua rugosa*), Gould's monitors (*Varanus gouldii*) and non-venomous south-west carpet pythons (*Morelia spilota imbricata*)—even if you don't see the species themselves you may note their tracks left behind in the sands of Pinnacles Desert.

Exploring Nambung

You can explore the park's natural wonders at the Pinnacles Desert as well

as one of several recreational sites in the park. Visit Lake Thetis to set out on a 1.5-kilometre return loop trail around the lake where you'll see a threatened ecological community of stromatolites and other bacteria (see 'Living fossils at Lake Thetis', *LANDSCOPE*, Spring 2009). Stromatolites provide clues to some of the earliest life on Earth. The first stromatolites formed 3.5 billion years ago and may have played a key role in transforming life on the planet. Cyanobacteria in the rocky structures converted carbon dioxide into oxygen on a massive scale, thus paving the way for the earliest oxygen-dependent life. You can learn about the stromatolites' fascinating role in the Earth's history by reading interpretive signage along the walk trail.

On the coast, Hangover Bay lures ocean lovers with its wide sweep of sandy beach and azure water. The bay is particularly popular for swimming and snorkelling and features barbecues, a picnic area with shelters



and interpretive information on the area's natural features and the adjoining Jurien Bay Marine Park.

Nearby Kangaroo Point offers another coastal recreation area, with toilets, barbecue facilities, picnic sites and beach access. This is a popular shore-fishing and boating area.

Aboriginal history

Aboriginal artefacts at least 6,000 years old have been found in the park and include campsites, artefact scatters and shell middens, as well as ceremonial places and sites with mythical associations. These were left by the Yued people who frequented the Nambung area. These people would visit the area each summer, drawn to the lakes and swamps of the interdunal valleys of the limestone belt which provided tortoises, fish, waterbirds and shellfish.

Wells were particularly important in the arid stretch of coast north of the Moore River, and native wells and paths marked the regular progress of Aboriginal people through and around their country. The limestone belt was also of considerable significance to Aboriginal mythology, particularly in association with caves and underground caverns. The mythical Wagyl serpent is said to have passed through blowholes, pools and springs that lead into underground caverns on its journey to the sea.



Above Hangover Bay.
Photo - Dennis Sarson/Lochman
Transparencies

Many place names in the area have Aboriginal origins, although not necessarily local to the area. For example, Wyip and Warrup pools in Nambung National Park were named after two Aboriginal people who accompanied explorer George Grey's party on its forlorn trek to Perth (see 'Captivating Kalbarri' on page 46). The descendants of the traditional Aboriginal owners now live in Perth, Geraldton, Moora, Mingenew, Three Springs, Mogumber and other nearby towns.

European history

The first-known European recording of the Nambung area dates back to 1658 when the North and

South Hummocks appeared on Dutch maps. The pinnacles may have been mistaken for "a small city a short distance inland" by the Dutch mariners but they could not be investigated further because of treacherous reefs guarding the coast.

In 1839, George Grey was shipwrecked at Kalbarri and, on his trek back to Perth, he discovered a watercourse in the Nambung area, naming it the Smith River after a member of his group who perished nearby. However, JS Brooking later



Above Visitors explore the Pinnacles Desert on foot.
*Photo – Dennis Sarson/Lochman
 Transparencies*



Left Pinnacles Desert drive.
*Photo – Brett Dennis/Lochman
 Transparencies*

renamed the Smith River the Nambung River, originally recorded as Namban River. The spelling ‘Nambung’ was adopted in 1938, the name being derived from an Aboriginal word possibly meaning crooked or winding.

From 1889, a stock route ran between Dongara and Perth, passing through the area now known as Nambung National Park and Southern Beekeepers Nature Reserve. The route was soon abandoned but was not officially closed until 1971. During World War II, the army used the route and, after the war, it provided a dusty highway for apiarists, hunters, trappers and holiday makers.

The Nambung area gained more attention in the early 1900s when phosphate was discovered in the caves of the Nambung River valley. Local

farmers mined the phosphate on an intermittent basis from 1906. In 1927, the area was afforded protection with the declaration of a temporary reserve to protect the caves and their dazzling formations.

Despite this early period of activity at Nambung, it appears the pinnacles remained undiscovered. Their first recorded mention seems to have come from a geological survey report in 1934.

Into the future

The development of Nambung National Park and the construction of the Pinnacles Desert Discovery centre have attracted hundreds of thousands of visitors to this remarkable part of the State. But visitor numbers are expected to skyrocket further with

the completion of the long-awaited Indian Ocean Drive in late 2010. This coastal drive from Perth to Geraldton will provide an alternative route to the Brand Highway, bringing unprecedented numbers of visitors along the coast and through Nambung National Park.

DEC has planned for the increase in visitor pressure with the development of the Pinnacles Desert Discovery centre and its related infrastructure. It has also earmarked Hangover Bay for a major upgrade that will at least double the amount of visitor infrastructure there. With such planning, more and more people will be able to immerse themselves in the wonders of Nambung National Park, without damaging the very environment they’ve come so far to admire.

Samille Mitchell is a Department of Environment and Conservation (DEC) features writer and editor. She thanks DEC staff George Watson, Derren Foster and Keith Hockey for their help with the article.

endangered

by Jill Pryde



Meelup granite community

'*Calothamnus graniticus* heaths on south-west coastal granite' is a threatened ecological community that occupies about 40 hectares of near-coastal rocky outcrops. These particular heaths occupy a narrow band parallel to the western shores of Geographe Bay near Meelup in the south-west of Western Australia. The plant community occurs between boulders and on exposed slopes usually near headlands. The dominant shrub in the community is a one-sided bottle brush, *Calothamnus graniticus* subspecies *graniticus*. This grows up to three metres high, is endemic to the area and is a priority four species, meaning it is considered rare, but is not currently threatened. It becomes wind pruned, especially near the shore, and is dark green in colour, with deep red claw-like flowers. The shrub stands out against the

granite and provides a distinctive appearance to this community.

The Meelup granite community is species rich and includes plants that have adapted to specific conditions that include shallow soils and patterns of very wet and dry periods. The community includes the hop bush (*Dodonaea ceratocarpa*), basket bush (*Spyridium globulosum*), swishbush (*Viminaria juncea*) and rock thryptomene (*Thryptomene saxicola*), with smaller shrubs over sedges and a myriad of herbs including orchids, sundews (*Drosera* spp.) and native ferns.

The distinctiveness of the Meelup granite community was first identified in 1986 following a flora survey of Meelup Regional Park. The community, which is ranked vulnerable, is likely to have always been restricted in distribution and is confined to seven small occurrences within the park. The park is vested with the Shire of Busselton and its

management is overseen by the shire-appointed Meelup Regional Park Management Committee.

Specific threats to the community include too frequent fire and weed invasion. Some of the weeds recorded in the park are 'declared plants', which have the potential to be extremely invasive unless managed. Dieback disease, caused by the plant pathogen *Phytophthora*, has been recorded within the park and has the potential to impact susceptible flora. The pathogen spreads naturally through water travelling down slope, or it can be spread by soil movement caused by people, cars and horses. Management of weeds, fire and visitor impacts are major management issues and have been identified in the Shire of Busselton's 2008 draft management plan for the park.

Photos by Jill Pryde



The numbat

back by popular appeal

Western Australia's State animal emblem has teetered on the brink of extinction and experienced population ups and downs ever since. But what is the status of this iconic native marsupial today and what is being done to conserve its future?

by Tony Friend



In the early 1980s, one of the world's most beautiful animals almost became extinct. By 1985, only two tiny populations of numbats (*Myrmecobius fasciatus*) remained on the entire planet. An animal that had been found right across southern Australia, from inland New South Wales to the west coast of the continent, had dwindled to about 300 individuals in the far south-western corner of its range. Its demise followed the spread of the introduced European red fox across the continent, from its point of introduction in southern Victoria. The small termite-eating marsupial had disappeared from South Australian mallee country, from the red dunes of central Australia and from most of the rich Western Australian farming belt, where more than 90 per cent of the bush had been cleared.

A species in decline

There had been many warnings of the imminent extinction of this little animal. Naturalist and collector Gerard Krefft had trouble finding a specimen of the numbat in his year



camped near the confluence of the great Murray and Darling rivers in 1857. Hedley Finlayson documented the rapid decline of the numbat and numerous other small marsupials in the north-west of South Australia and adjacent areas between 1933 and 1950. He related these declines to the spread of the red fox.

In the 1940s, natural history author Charles Barrett, writing about the southern agricultural area around Kojonup, predicted it would not be long before the numbat joined the long list of casualties of European settlement. There was a brief revival of medium-sized marsupials in the south-west in the 1950s, following

the reduction in fox numbers due to the high use of 1080 poison to control rabbits. However, in the 1970s, following the successful introduction of myxomatosis, poison-baiting to control rabbits became unnecessary, fox numbers rose, and once again marsupial numbers plummeted.

Numbats have always been in the public eye. The colourful appearance of this small animal, combined with its daytime activity, led to a high awareness of its presence in the south-western farming regions it frequented. In 1935, Eva Wills, a resident of the Brookton area, became the first person to document the nesting burrow of the numbat. In the late 1950s, when CSIRO wildlife researcher Dr John Calaby set out to compile all available information on the numbat in the south-west, he gleaned many anecdotal records from local residents. Added to collection data from specimens in the Western Australian Museum, he was able to build up a comprehensive picture of the numbat's decline and persistence.

Calaby's factual account of numbats in the south-west, published in 1960 in the Proceedings of the Zoological Society of London, did not include information he gathered from Aboriginal people during his trips to desert areas. He did share some of these experiences with author Jill Morris, however, who constructed a charming children's story, *Rusty the Nimble Numbat*, around his information about the discovery of a numbat in the Everard Ranges in north-western South Australia.

Into the spotlight

The adoption of the numbat as WA's mammal emblem in 1973 was very timely, as its most dramatic



Previous page

Main A juvenile numbat in a watchful pose on a log in Dryandra Woodland.

Photo - Jiri Lochman

Left An adult numbat stands close to a log refuge.

Photo - Sharon Wormleaton



Above In early June, numbat young are still attached but are quite large. They will be deposited in a nest in early August.

Above right Numbat habitat in Tutanning Nature Reserve.

Right A male numbat showing the red stain of the scent-marking gland on the upper chest.

Photos – Sharon Wormleaton

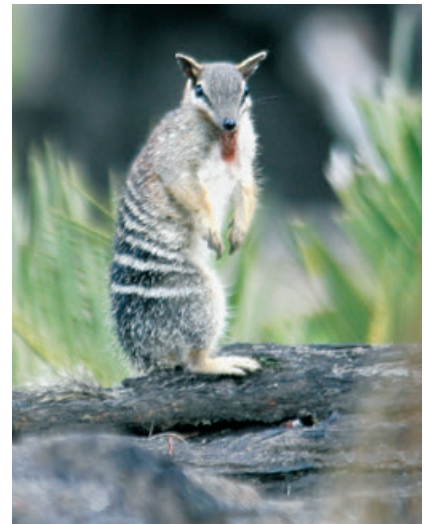


decline followed soon afterwards. This symbolic status must have helped raise awareness of the numbat in the eyes of the public and their political representatives. When numbat numbers crashed in the late 1970s, concern rose within the WA community and calls were made for something to be done. This concern generated a successful recovery program, which led eventually to the establishment of eight new numbat populations spanning the breadth of Australia (see 'Numbats forever', *LANDSCOPE*, Spring 2001).

One of the first actions, in the early 1980s, was to gather current information on numbat distribution by appeals to the public, followed by on-ground surveys, which involved searching for the distinctive diggings made by numbats as they feed on termites in their underground galleries. This campaign generated many recent

sighting reports that were verified by finding numbat diggings but showed that the decline and extinction of numbat populations was still occurring. During the 1980s, numbats became extinct in the northern jarrah forest between the Brookton Highway and Jarrahdale, on the Swan Coastal Plain around Jandakot and in jarrah forest west of Collie. By the mid-1980s, numbats survived only at Dryandra, near Narrogin, and Perup, near Manjimup.

An experiment in fox control carried out at Dryandra using the selective poison 1080 showed that removal of foxes was followed by a steep rise in numbat numbers. The recovering Dryandra population was used to provide numbats for translocation to other areas. Using wild-to-wild translocations, new numbat populations were established at Boyagin Nature Reserve near Brookton and Dragon Rocks Nature Reserve south-east of Hyden. Some numbats were taken into captivity at the Department of Environment and Conservation's (DEC's) Woodvale Research Centre so that breeding methods could be developed. The colony was then transferred to Perth Zoo and captive breeding began to contribute significantly to the recovery effort. Successful reintroductions were carried out, using both wild and captive-bred



numbats, to the Batalling forest block east of Darkan, and Tutanning Nature Reserve near Pingelly. The presence of numbats on display at Perth Zoo from the mid-1980s put numbats in the public spotlight and the development of a new display in the late 1980s, showing these animals in a natural setting, has helped educate Perth residents and visitors about the numbat ever since.

Fifteen Dryandra numbats made the flight to South Australia in 1994 and were released at the fenced Yookamurra Sanctuary, then owned by Earth Sanctuaries Limited. The presence of highly visible numbats at Yookamurra was a great boon for public



Left A young numbat peers from the safety of a hollow stump.
Photo - Sharon Wormleaton

Below left A young feral cat inside a den log, which was surrounded with remains of numbats, goannas and birds, in Dryandra Woodland.
Photo - Karen Rusten/DEC



wildlife habitat, protection of wildlife habitat from the effects of *Phytophthora* dieback and broadscale fox baiting through the *Western Shield* program. The species recovery work, however, had been funded largely by Australian Government grants and the impact of the withdrawal of this funding has been felt already and seems set to continue.

Community steps in

The most exciting recent development in popular support for numbat recovery was the formation of the Perth-based community group 'Project Numbat' in the early 2000s. The 160-member group supports numbat recovery and works to raise public awareness of the numbat and its plight. Through fundraising activities such as running sausage sizzles in schools, selling merchandise with a numbat theme and a wine marketing scheme, the group raises funds, and a significant proportion of these are passed on directly to the recovery program. This money has supported the purchase of radio-collars and the charter of radio-tracking aircraft used to locate wayward numbats. Given the shortage of funds from other sources, this was very timely and funding from Project Numbat has enabled the completion of necessary tasks on several occasions.

The current numbat translocation site under the numbat recovery program and *Western Shield* is Cocanarup Timber Reserve, near Ravensthorpe and adjacent to Fitzgerald River National Park. Numbats from Perth Zoo and Dryandra have been released in the area each December since 2006, breeding has been recorded and one young numbat born in the area has been captured. All signs indicate that

awareness of the species. Many parties of school children visited Yookamurra from nearby Adelaide and had their first encounter with these remarkable animals. A community group 'Save the Numbat' started in South Australia to support the reintroduction of numbats to that state and raise money for radio-collars by selling chocolate numbats and other merchandise.

In the late 1990s, Jill Morris incorporated the story of the numbat research and recovery programs into her new children's book *Numbat Run!* This book illustrates the numbat in its present-day status, providing readers with snippets of information about numbat ecology, other animals that share its habitat, including its predators,

and how the research and recovery programs are going.

Between 1989 and 2009, Australian Government funding became available for numbat recovery through several threatened species funding schemes. Threatened mammals, regarded as iconic species, had been supported well through these grants. Funding schemes changed dramatically in 2009 with the introduction of a new approach by the Australian Government. Single species recovery programs are no longer funded, but landscape-scale initiatives that address threatening processes and aim to improve overall habitat quality are supported. This is an approach that has been employed by DEC for many years, and includes fire management of



Above John Tucker from the Friends of the Fitzgerald River National Park community group and Canadian volunteer Cass Stabler radio track numbats with DEC officer Karen Rusten at Cocanarup Timber Reserve.

Photo – Andy Chapman

the translocation has been successful. The local community group Friends of the Fitzgerald River National Park, have supported the Cocanarup translocation most generously. Their main task is the monthly tracking of each individual numbat, reducing the number of monitoring trips needed from the DEC base in Albany.

Earth Sanctuaries Limited carried out the successful translocations to two fenced sanctuaries, Yookamurra in South Australia and Scotia in New South Wales. These properties were acquired by the Australian Wildlife Conservancy (AWC) in 2003 and their management continues to strongly support the recovery of threatened mammals. The fence at Scotia has been completely upgraded and a second section freed from foxes, cats and rabbits. AWC has recently moved some numbats from the first to the second area. Another numbat translocation

is proposed by the Arid Recovery project, into its fenced area at Roxby Downs in South Australia during the next year or two.

An uncertain future

So how is the numbat faring now and what does the future hold? In 2005, a workshop held as part of the International Union for the Conservation of Nature's Global Mammal Assessment changed the numbat's classification in the Red List of Threatened Species from vulnerable to endangered, despite the increase in populations, based mainly on the uncertain status of the very important Dryandra population. Numbers of numbats at Dryandra fell after the initial rapid increase with fox removal and have not recovered. In fact the numbat sighting rate during the 2009 annual survey was the lowest since 1981, before fox control. It is suspected that feral cats have been favoured by the lack of foxes (see 'Will curiosity kill the cat?', *LANDSCOPE*, Autumn 2007) and certainly evidence of the predation of numbats by cats at Dryandra has increased recently.

While the numbat is actually in a better position through the work of

government agencies, non-government organisations, community groups and individuals, the threat posed by feral cats needs to be addressed urgently. Fenced sanctuaries may have to be used more widely until a solution for the cat problem is found. It is likely that other small to medium-sized native mammals in the south-west are under threat from cats. There is strong support from the community for the recovery of iconic species such as the numbat, woylie (*Bettongia penicillata*) and Gilbert's potoroo (*Potorous gilbertii*). With the extinction of a tiny bat, the Christmas Island pipistrelle (*Pipistrellus murrayi*) in 2009, Australia lost its first native mammal since the last thylacine died (See 'New tools for fighting ferals' on page 24). Let's work together to prevent the loss of any more.

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Captivating *Kalbarri*

by Samille Mitchell

Stunning scenery, ancient creatures, Aboriginal and European history and wildflower wonders combine to make Kalbarri National Park among the most popular parks in the State.



Kalbarri is nestled at the mouth of the Murchison River, which journeys more than 700 kilometres from the desert heart of the State to drain into the dazzling Indian Ocean. The township is perched at this meeting place of river and ocean waters, providing sweeping views of tranquil river reflections and the seemingly endless ocean beyond. Some 190,000 hectares of spectacular national park embrace the township, offering an enchanting world of gorges, cliffs, sandplains and wildlife.

To the south of Kalbarri, the national park boasts rugged coastal cliffs, which plunge 100 metres to the eternal pounding of waves at their base. Inland, the national park takes in the environs of the Murchison River, which has sculpted some 80 kilometres of majestic gorges into the ancient landscape.

Kalbarri National Park is home to a riot of wildflowers and many species of wildlife—from endangered native animals such as the woylie (*Bettongia penicillata*) and chuditch (*Dasyurus geoffroi*) being reintroduced to the national park to the ubiquitous western



grey kangaroo (*Macropus fuliginosus*) and bigurda or euro.

An ancient landscape

The gorges of Kalbarri National Park have been sculpted by the hands of time. This process began more than 420 million years ago when Australia was part of the ancient landmass Gondwana. This was an era when the oceans were teeming with primitive fish, seaweed and fungi. It was an age when corals were starting to develop and plants were just beginning to gain a tentative grip on life outside the oceans. This ancient land was virtually uninhabited by plant or animal life—a wasteland characterised by violent weather and dramatic upheavals in the earth.

The shifting sands of this ancient environment have captured secrets to life here some 420 million years ago. Wind-borne sands fell across the land, in the process covering and preserving tracks left in the damp earth. Fast forward through the millennia and the erosion of the rocks has revealed these ancient call cards.

Rocks riddled with markings bearing a ‘can of worms’ appearance are the signature of ancient worms, known as skolithos, which once burrowed in the sand here, while different markings in the rock reveal the footprints of a creature which looked like a giant scorpion.

Still different tracks imprisoned in the rocks in Kalbarri National Park show the path of a giant cockroach-like arthropod with 11 pairs of legs, known as an euthycarcinoid. The discovery of these tracks in Kalbarri was particularly exciting for scientists. Previously euthycarcinoids were known from France and the United States and were dated at about 300 million years old. But the tracks in Kalbarri are aged at 420 million years—thereby increasing the known life range of these creatures by 120 million years.

Scientists have also unearthed fascinating fossil finds in the sandstone north of Kalbarri. They have discovered the incomplete tail of an unidentified creature thought to be a theropod dinosaur—the same group of dinosaurs that includes the famous *Tyrannosaurus rex*. The theropod found at Kalbarri was thought to have roamed here during the early Cretaceous period about 144 to 127 million years ago. It is the only example of dinosaur bone from this era found in WA.

In the same area scientists also discovered partial remains of an ancient creature of the genus *Platypterygius*—extinct dolphin-like animals that grew up to seven metres long. Kalbarri



Previous page

Main Murchison River gorge.
Photo – Marie Lochman

Left Dramatic bands of red and white rock characterise Kalbarri National Park’s river and ocean gorges.
Photo – David Bettini



Above Sunset at Eagle Gorge.
Photo – Jiri Lochman

Right Fossilised tracks thought to be that of an ancient giant sea scorpion.
Photo – Jiri Lochman



European arrival

The first European people to set foot in Kalbarri may have been the first white people ever to have lived in Australia. Long before Captain Cook sailed the eastern coast, two survivors of the *Batavia* shipwreck of 1629 were marooned on the WA coast as punishment for their role in a gruesome mutiny on the nearby Abrolhos Islands. Many believe the duo were left to fend for themselves at the place now known as Wittecarra Creek in Kalbarri. A plaque on a stone at the site commemorates this important yet little-known part of Western Australian history.

Much later, during the expansion of the Swan River Colony, surveyors and explorers set out into the unexplored north and interior to report on the land's mineral and pastoral potential. Among these early explorers was Captain George Grey, who journeyed north with an American whaling ship from Fremantle on 17 February 1839 to explore the coast around Carnarvon.

A series of misfortunes meant Grey and his men were forced to abandon their expedition and return south. Crammed into two whaleboats with limited supplies, they began the

sandstone has also revealed the remains of an ancient marine animal called *Leptocleidus clemai*—a type of pliosaurid reptile that lived in the region about 146 to 65 million years ago. Two specimens of this fossil were unearthed in the area and are thought to have come from creatures sized 2.5 to three metres long. It's believed these strange-looking beasts inhabited close-inshore marine environments in the same way sea lions do today.

First inhabitants

Long before European settlers arrived in the Kalbarri area, Aboriginal people known as the Nanda inhabited the region's diverse and spectacular environment. The Nanda lived in an area stretching from modern-day Kalbarri and Northampton north to Shark Bay, where the Malgana also lived.

While no-one is exactly sure how long these people have lived here, there is little doubt they have done so for thousands of years. Dozens

of sites, particularly on modern-day Murchison House Station at Kalbarri, bear testimony to these early days. Stone flints, grinding stones, red ochre and charcoal art, burial sites and middens can still be found.

Aboriginal people believe mythological Dreamtime beings sculpted the land to its present design. A serpent known as the Beemarra was and remains particularly revered for its role in creating the landscape. It features in red ochre artworks near Kalbarri. Even today, the Beemarra is respected by Aboriginal people and Nanda will throw a handful of sand into the water on approach to blind the snake and stop it from poisoning the water.



Above Dawn at Nature's Window which overlooks The Loop.
Photo – Brett Dennis/Lochman Transparencies



Left Kalbarri catspaw.
Photo – Marie Lochman

arduous journey. Travelling south along the soaring and impenetrable face of the notorious Zuytdorp Cliffs, they were forced to row for 56 hours straight. Finally, utterly exhausted, they attempted a landing at what is now known as Kalbarri.

After both boats were dashed against rocks in the surf, the men were left stranded, without boats and without supplies. And in such a manner, this rag-tag group of men became the first

officially recorded Europeans to visit what is today called Kalbarri.

Murchison House Station was established near modern-day Kalbarri townsite in 1848, making it one of the oldest pastoral stations in WA. It was started by Charles Von Bibra to supply meat to convict lead miners. Von Bibra also bred Arab stallions for the British army in India from Murchison House. Later, the station was taken on by the most unlikely of

would-be pastoralists—the eccentric and wealthy Prince Mukramm Jah, the eighth Nizam of Hyderabad. The Nizam collected military and large earth-moving equipment and varied collections of these artefacts are still scattered around the station today.

Despite the activity occurring all around it, very little development occurred in Kalbarri itself, or the 'Mouth of the Murchison' as it was then known. However, in the 1900s, fishermen started to visit the mouth of the Murchison on fishing holidays.

It wasn't until 1951 that the Kalbarri townsite was finally gazetted, incorporating land resumed from the Murchison House Station and a reserve. The name Kalbarri is thought to be derived from an Aboriginal word for edible seed. A school opened in 1959 with 12 students from grades one



Above Mitchell's hopping mouse.
Photo – Babs and Bert Wells/DEC

Below Bigurda or euro.
Photo – Jiri Lochman

to nine and the town grew steadily. In 1963, Kalbarri National Park was gazetted, largely thanks to the efforts of people such as the town's first school headmaster Ross Graham.

Wildflower treasure trove

Today, Kalbarri is revered for its stunning seasonal wildflower displays. Depending on winter rains, the Kalbarri landscape can explode into masses of vibrant colour from about July to October each year. The flowers are most spectacular on the Kalbarri sandplain and near the river gorges in Kalbarri National Park. Kalbarri's spectacular wildflower showing is created thanks to the mix of vegetation zones in the area. Kalbarri is positioned at the northern limit of the South-western Botanical Province and contains portions of the Zuytdorp, Kalbarri, Murchison Gorge and Eurardy vegetation systems. Of the 1,071 species of flora recorded in the area, 223 (21 per cent) are at the northern limit of their natural range. Of all the flora species in Kalbarri, more than 80 are classed as declared rare or priority flora in need of protection.

Twenty-one of Kalbarri's plant species are found only here, making the health of the Kalbarri environment vital to their survival. One of the best known of the endemic species is the Kalbarri catspaw (*Anigozanthos kalbarriensis*), a small yellow or red plant that is usually seen on recently burnt country in August and September.



Animal life

The diverse habitats in Kalbarri National Park are home to a suite of mammal species. They range from tiny dunnart species such as the hairy footed, little long tailed and fat tailed dunnarts (*Sminthopsis* sp.) to larger species such as the western grey kangaroo. Other, less commonly seen species such as the ash grey mouse (*Pseudomys albocinereus*), Mitchell's hopping mouse (*Notomys mitchellii*), spinifex hopping mouse (*Notomys alexis*) and honey possum (*Tarsipes rostratus*) also remain relatively abundant.

However, other mammals such as the woylie, chuditch, black-footed rock wallaby (*Petrogale lateralis*), the tammar wallaby (*Macropus eugenii*) and possibly others such as the bilby (*Macrotis lagotis*) and boodie (*Bettongia lesueur*) have long gone. The woylie and chuditch are thought to have disappeared by the 1960s, largely victim to fox predation.





Above Albatross in flight.
Photo – Samille Mitchell/DEC



Left A malleefowl.
Photo – Ken Stepnell/DEC

No concrete evidence of bilby and bettong inhabitation has been discovered, yet old timers have spoken of these animals living here until the mid 1900s. The last tammar wallaby in Kalbarri was recorded in the 1990s when it was hit by a car near Meanara Hill, near the eastern town entry. The last confirmed black-footed rock wallaby sighting was also in the 1990s, at Hawks Head gorge. Foxes are largely to blame for the demise of the tammar wallaby, while fox predation and competition from goats for food and shelter are thought to have caused the local disappearance of the rock wallaby.

The Department of Environment and Conservation's (DEC's) *Western Shield* program is aimed at controlling feral animal populations and reintroducing native mammals back to their former range. In addition to targeting foxes, DEC conducts goat-control programs. Such work has paved the way for several former native animals to be reintroduced to the park. The chuditch and woylie have been reintroduced to the park, which is part of their former range. After release, the species flourished for several years, although, more recently, woylie populations in Kalbarri (and those elsewhere in the

State) have declined. The cause of this is unknown, but is most likely related to predation by introduced predators (see 'Down but not out: solving the mystery of the woylie population crash', *LANDSCOPE*, Winter 2008). Trapping is carried out twice-yearly and has revealed new individuals with pouch young, indicating the woylie and chuditch continue to cling to life in Kalbarri, as long as the fox population remains under control (see 'High hopes for Kalbarri wildlife', *LANDSCOPE*, Spring 2006).

Several other mammal species may also be considered for reintroduction to the park and include the quenda (*Isoodon obesulus*), western barred bandicoot (*Perameles bougainville*), boodie, rufous hare-wallaby or mala (*Lagorchestes hirsutus*) and banded hare-wallaby (*Lagostrophus fasciatus*). The black-footed rock wallaby is also earmarked for reintroduction, once goat numbers are proven to be under control.

While mammal species have declined over the years, Kalbarri's bird life remains abundant. With both

Right Moon wrasse feeding on exposed oyster.

Photo – Clay Bryce/Lochman
Transparencies

Below Peaceful scenes in a remote section of the Kalbarri river gorge.

Photo – Samille Mitchell/DEC

ocean and river environments, there is a large diversity of birds, with more than 160 species recorded in recent years. These include two threatened species, the malleefowl and Carnaby's black cockatoo, and one other specially protected species, the peregrine falcon. The malleefowl and two other large ground nesting species, the Australian bustard and bush stone-curlew, appear to have increased in number since fox control was implemented. Several new and active malleefowl mounds have been recorded in and around the park with an apparent increase in activity levels noted by park staff.

Due to the health of this malleefowl population, eggs from Kalbarri mallee fowl mounds have been transferred to the Peron Captive Breeding Centre in Shark Bay to establish a population of the bird in Francois Peron National Park.

Riot of underwater life

Kalbarri waters are home to a riot of fish, invertebrate and coral life. The warm, southerly flowing waters of the Leeuwin Current nurture a mix of both temperate and tropical species.

While Kalbarri waters have never been subject to significant study, the popular snorkelling spot 'Blue Holes' has been monitored and provides a good insight into a typical Kalbarri marine environment. Monitoring here has revealed 200 species of flora and fauna—a wonder world of algae, seagrasses, sponges, corals, crustaceans, molluscs and fish.

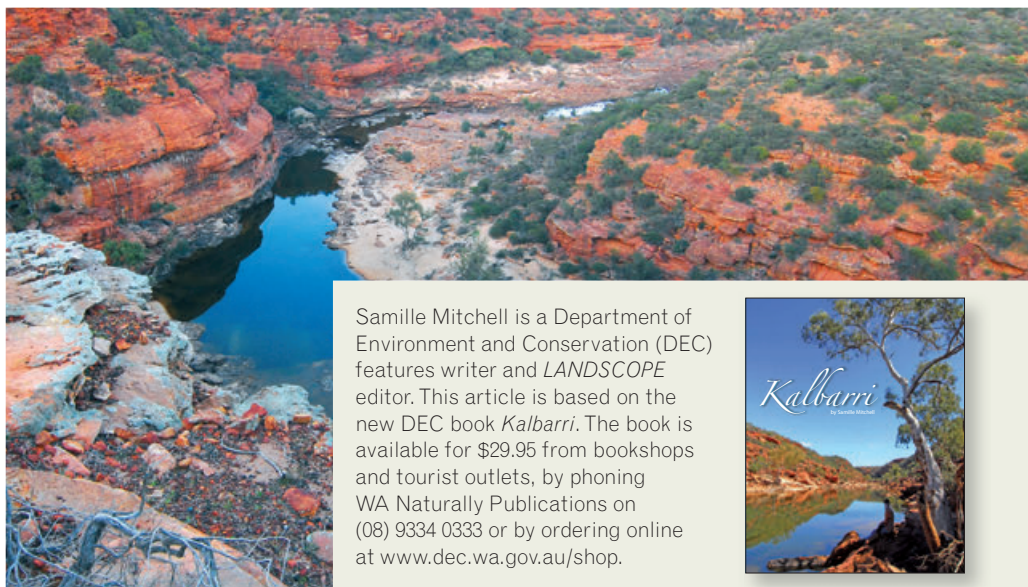
You just need to walk among the rocks to appreciate the sea life here. Spiny urchins inhabit crevices in rocky pools, hermit crabs shuffle across the rocks and sea stars adorn the ocean floor. Don a snorkel and mask to see even more of this fairytale-like underwater world. You may delight in the sight of creatures such as the brilliantly coloured wrasse, butterfly fish, stripey and gobies darting about



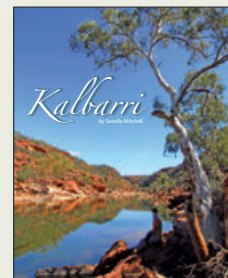
in the aquarium-like pools. Banded shrimp live under ledges, whiting and mullet inhabit the shallows and octopuses lurk in the dark caverns—or you may spot one marooned in a rock pool as the tide retreats.


Of the 71 fish species recorded at Blue Holes, many are tropical. You'll also notice some bright and colourful corals when snorkelling or diving in Kalbarri. Eleven species of coral have been recorded at Blue Holes, while more are likely to exist offshore. These corals are typical of coastal areas in south-west Australia.

Kalbarri waters are also home to several species of marine mammal. A permanent population of about 100 bottlenose dolphins (*Tursiops* sp.) lives here. Each year Kalbarri waters come to life with the mass migration of humpback (*Megaptera novaeangliae*) and southern right (*Eubalaena australis*) whales. From about July to November, these ocean giants pass Kalbarri on their annual migration from Antarctic waters. Kalbarri is becoming well known as a whale watching location because of the close proximity the animals travel to the shore.



Samille Mitchell is a Department of Environment and Conservation (DEC) features writer and *LANDSCOPE* editor. This article is based on the new DEC book *Kalbarri*. The book is available for \$29.95 from bookshops and tourist outlets, by phoning WA Naturally Publications on (08) 9334 0333 or by ordering online at www.dec.wa.gov.au/shop.





The **ant**,
the **butterfly**,
the **leafhopper**
and the **bulldozer**

by **Tim Gamblin**, **Matthew Williams** and **Andrew Williams**

The delicate complexities of a symbiotic relationship between a butterfly once thought to be extinct, a sugar ant and a sap-sucking leafhopper are only just being discovered.



Above A female arid bronze azure butterfly (*Ogyris subterrestris petrina*).
Photo – Geoff Walker

Above right Matthew Williams and Andrew Williams 'pooting' ants—sucking them into test tubes for collection as voucher specimens.
Photo – Tim Gamblin

Exclamations of 'wow' and 'incredible' are typical responses from even the most seasoned naturalist upon hearing of the extraordinary relationship between a sugar ant, a threatened butterfly and a leafhopper living together in subterranean galleries close to the Wheatbelt town of Mukinbudin. This is the stuff that reinvigorates a passion for biology or sparks it in those so far untouched. The life history of the critically endangered arid bronze azure butterfly (*Ogyris subterrestris petrina*) is not only a wonderful example of the interrelatedness of life but is also a fine illustration of a threatened species being managed to provide an agreeable outcome for all stakeholders.

This butterfly, which had not been seen for almost 14 years, was recently rediscovered in the northern Wheatbelt. Concerningly, imminent roadworks threatened to destroy its habitat less than six months after it was found. This is the story of how the Mukinbudin Shire, the Mukinbudin Conservation Group, the Department of Environment and Conservation (DEC) and volunteers worked together

to help this rare butterfly and its host ant keep their habitat from being bulldozed for a new road.

The arid bronze azure butterfly is a medium-sized, fast-flying butterfly endemic to Western Australia. It is predominantly dark brown to black, with iridescent bronze or purple-bronze flashes on the upper sides of the wings. Like most species of azure butterfly (members of the genus *Ogyris*) it is both rare and highly localised in occurrence. Azure butterflies are members of the lycaenid family, a group of butterflies with coppery or blue wings.

The butterfly was discovered near Lake Douglas, 12 kilometres south-west of Kalgoorlie in the early 1980s. It was known from just this one site and searches of surrounding areas over several years failed to locate any other populations. Then, around 1993, the population at Lake Douglas disappeared. DEC staff and butterfly enthusiasts continued to search unsuccessfully for the arid bronze azure. Fearing the butterfly may be extinct, a *LANDSCOPE* article was published appealing to the public to report any possible sightings (see 'Endangered or extinct? Kalgoorlie's arid bronze azure', *LANDSCOPE*, Summer 2005–06).



Above Members of the Mukinbudin Conservation Group help with research.
Photo – Clare Smith

The rediscovery

In 2006, a keen butterfly enthusiast and photographer, Geoff Walker, planned to visit WA, including the Lake Douglas site, with the faint hope of locating the arid bronze azure. In late October, having failed to find the butterfly, he headed west towards the coast.

The rediscovery happened by chance. Geoff was driving through a small remnant of woodland close to Mukinbudin. He described seeing a large, dark butterfly darting across the road. He knew it had to be an *Ogyris*. He slammed on the brakes, forgetting for a moment that he was towing a two-tonne caravan!

Geoff managed to photograph several of the butterflies at the site and reported these to DEC's Science Division in Perth. DEC senior technical officer Andrew Williams immediately visited the site and obtained a series of specimens which were provisionally identified as the 'long-lost' arid bronze azure butterfly. Specimens subsequently sent to Dan Schmidt at Griffith University for genetic analysis confirmed this identification.

The new locality was in a small patch of remnant bushland, only about one hectare in size, sandwiched between a road and a railway line. The area was a

road and rail reserve embedded in, but not actually a part of, a nature reserve. Andrew revisited the site in November and established transects, both in the site where the butterfly had been seen and on the adjacent nature reserve, to map the occurrence of the butterfly. He found that the core of the population was centred on the small patch of bushland in the road and rail reserve and that relatively few butterflies were found outside this area.

Word of the discovery spread rapidly through the butterfly community. Local DEC nature conservation officer David Jolliffe was advised of the possible threat from butterfly collectors visiting the site. Although the arid bronze azure had been proposed for listing as an endangered species more than 10 years earlier, at that time the Threatened Species Scientific Committee felt there were insufficient survey data to be sure the species was endangered. So, like all of the butterflies outside conservation reserves, the new population had no formal protection.

The ant and the butterfly

In order to reproduce, the arid bronze azure butterfly has a close association, or symbiotic relationship, with the 'pale coloured' or 'Goldfields' form of a sugar ant (*Camponotus terebrans*). The butterfly larvae (caterpillars) feed on, or are fed by, the ants. They live entirely within the ant's subterranean nest during their development. The ants protect the butterfly larvae from predators and the ants, it is thought, are

rewarded with secretions produced by the larvae.

The butterfly larvae also emit chemical signals that mimic those of the ants and produce sounds to convince the ants that not only do they pose no danger, but should be given the best hospitality. In similar ant-butterfly species relationships, the ants will care for the caterpillar as well as, if not even better than, the ant queen. When fully developed, the larva pupates inside the ants' nest. When the adult butterfly emerges, it must make a hasty exit towards the light as, unlike the larva, they do not emit signals of immunity and the ants will attack them.

Large numbers of sugar ants are required to support a colony of the butterflies—it is thought about 500 ants for each larva. This means the butterfly's survival depends not only on the presence of the ants, but on massive colonies of them. This was confirmed when surveys found high densities of ant nests within the main butterfly breeding area.

Due to the ant-butterfly relationship, any threat to the ant colonies is also a threat to the butterfly. In order to effectively preserve and manage the butterfly one must protect the ant colonies. Therefore, one of the critical recovery actions for the conservation of the butterfly species is the establishment of a monitoring program to detect signs of decline of the ant colonies and to better understand the environmental variables or habitat required for their persistence.

An important question to ask is: what do the ants require from the environment to establish strong colonies? This will take more time to answer completely but initial results are very interesting. A sample of ant colonies was mapped throughout the area and habitat data for each ant nest gave an indication of some of the environmental variables required for the presence of the ant. It was found that proximity to disturbance (such as nearby tracks or other cleared areas) and the presence of eucalypt trees were critical to the presence of sugar ant nests.

Given that many areas close to the site with similar habitat have no ant nests and no butterflies, it is believed that there are other subtle requirements



Left A pre-pupal larvae of the arid bronze azure butterfly with attendant sugar ant (*Camponotus terebrans*).

Below left Habitat of the 'pale coloured' or 'Goldfields' form of the sugar ant—smooth-barked eucalypt species in open woodland with light disturbance.

Below right A sugar ant feeds from a leafhopper (*Pogonoscopus myrmex*) while others keep guard.

Photos – Tim Gamblin



streamlined compared with those that live above ground—probably an adaptation to their mainly subterranean life within the ant galleries.

It is little known that certain species of leafhoppers were found to cohabit below ground with ants. While it is not new to science that lycaenid butterflies often associate with ants, it is far less common that their caterpillars develop entirely below ground and even less well known that leafhoppers also share the ant galleries. For both caterpillar and leafhopper to occur together in a single ant nest is quite remarkable and possibly unique.

What is not known is how much the ants rely on the leafhoppers for food. If they depend heavily on the leafhoppers to maintain strong colonies then the original question should also include the leafhoppers: what do the ants and the leafhoppers require from their environment to promote strong colonies?

Aside from the protection the ants provide, the answer is likely to be related to the sap they obtain from the eucalypts: its quality and quantity. This may explain why ant nests are found with particular species of eucalypt, particularly those that are smooth-barked such as gimlet (*Eucalyptus salubris*) and the Lake Grace gum (*Eucalyptus loxophleba* sp. *gratia*).

The bulldozer

Although the news of a new population of the arid bronze azure was widely known, the exact locality was kept confidential. In February 2007, local butterfly enthusiast Daniel King asked for details of the site so

for the presence of ant colonies which are as yet unknown. More than 100 sites in the Wheatbelt and Goldfields superficially appear to be good potential habitat for the ants, but have been searched without positive results.

Ants farming leafhoppers

As well as hosting the larvae of the butterfly, it was found that the ants also host leafhoppers within their nests. Leafhoppers are sap-sucking insects with piercing mouthparts to puncture the bark of plants so they can feed on the nutritious sap. When the ant nest was disturbed, ants were seen carrying leafhopper adults and nymphs in their jaws to safety undercover. Leafhoppers were also observed in other nearby ant nests, indicating that this was an organised symbiotic relationship.

As most sugar ants are nocturnal, the site was visited in the evening. On the trunks of many trees the

ants were observed 'shepherding' their leafhoppers to 'pasture' to feed on the tree sap. Unlike many herbivorous insect species that are 'farmed' by ants in the tree canopy, most of the leafhoppers were located between one and three metres above the ground on the tree trunk. Each leafhopper was closely attended by several ants, giving them protection from predators. Ants were observed feeding on the excess sap excreted by the leafhoppers. Some of the leafhoppers disturbed by the intrusion were promptly marched back down the trunk and into the ants' nest and it is assumed that the entire 'herd' would be shepherded below ground to safety before sunrise.

The leafhopper species was collected and identified as *Pogonoscopus myrmex* and had not been recorded from nests of the 'pale coloured' form of this species of sugar ant before. This leafhopper species is small and



Left A male arid bronze azure butterfly.
Photo – Geoff Walker

he could see the butterfly and perhaps locate additional populations. The news he brought on his return to Perth was a blow: a major road-widening project was threatening the site.

DEC's local conservation officer immediately contacted the local shire and discovered that the road adjacent to the butterfly population was a 'black spot'—a common car crash location—and that a project to re-align the road was already in progress. A permit to clear the remnant vegetation between the road and railway line, the core habitat of the butterfly, was in the process of being submitted to DEC.

With this imminent and major threat to the habitat of the only known population of arid bronze azure butterflies, the rare species was again nominated to the Threatened Species Scientific Committee for formal listing. This was possible because many more surveys had been conducted in the region since the previous application. Due to the level of threat posed to the butterfly, it was assessed as critically endangered and gazetted as schedule one (rare or likely to become extinct). The listing halted the roadworks and also prevented collectors from taking specimens. It also provided the incentive for the then Avon Catchment Council (now Wheatbelt Natural Resource Management) to fund a baselining program of the arid bronze azure's habitat as part of a monitoring project for the catchment.

Additional surveys of the site by DEC staff from Merredin and Perth confirmed that the area under

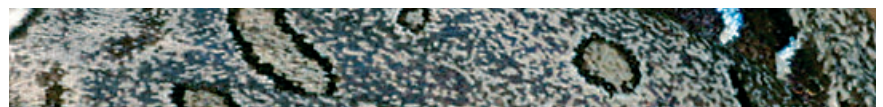
application for clearing was a major part of the breeding area of the arid bronze azure. Mukinbudin Shire's plan to clear this area to eliminate the black spot had been made before the discovery of the butterfly and, once the shire was alerted to the significance of the area, it was keen to assist in reducing the threat to the butterfly. However, all parties agreed that eliminating the black spot for the safety of road users was also crucial. Some compromise solution needed to be found.

The compromise and the future

The Mukinbudin Shire modified its road realignment plan so the new road would be closer to the railway line, passing through land that had already been cleared. The shire also

plans to rehabilitate the old road area with local plants, providing additional habitat for the ants, the butterflies and the leafhoppers. This will also provide connectivity between the butterflies' core breeding area and the adjacent nature reserve. Thus the new road will not only resolve the black spot issue but preserve the area of dense ant colonies. Despite the delay in road construction and an increase in the cost of the roadworks, the compromise meets the objectives of all stakeholders and offers the best opportunity for the long-term survival of the butterfly.

Planned future actions at the site include continued monitoring of the butterfly and ant populations, searching for more populations of the arid bronze azure in surrounding areas, and, if the need arises, translocations of the butterflies to other sites with suitable habitat. An interpretive shelter is planned near the butterfly site where visitors can learn more about the ecology of the arid bronze azure, the threats it faces and how the public can contribute towards the conservation of this species.



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Conserving roadside vegetation

Many people may overlook roadside vegetation as having little conservation value but these plant communities play a vital role in conserving native flora and wildlife.

The Roadside Conservation Committee and its predecessors began working to conserve roadside vegetation in Western Australia 40 years ago.

by Mia Podesta
and Cressida Lehmann

Roadside vegetation plays a vital role in the conservation of Western Australia's unique flora and fauna. It provides essential habitat for rare and threatened species, forms corridors that facilitate species movement and, in many areas, composes a significant part of the remaining native vegetation. Roadsides are also the window through which tourists and residents look at the land, meaning they set the tone for the character of the area and create a local atmosphere.

Roads, and therefore road reserves, were originally created for the use of horse and cart. These same road reserves must now safely accommodate large numbers of high-speed cars, large heavy haulage trucks and wide loads. Unfortunately, the ever-widening road width required to accommodate modern-day vehicles is slowly reducing the width of road reserves containing remaining native vegetation.



The origins of roadside conservation

In WA, roadside conservation began formally in 1952 when a policy was implemented to create a two-tier reservation system consisting of conservation reserves and roadside reserves to connect them. Later, in 1960, Premier Sir David Brand, the 'father of roadside conservation', initiated a policy that all road reserves opening up new country should be wider than required for the establishment of the road alone.

He recommended road reserves be increased from one chain (20 metres) to three chains (60 metres) or even up to 10 chain widths (200 metres). Examples of road reserves which adhere to these recommendations include the majority of those along Brand Highway and Coorow-Greenhead Road.

Community concern about the loss of wildflowers and the ongoing degradation and destruction of roadside vegetation resulted in the formation of a committee to look after these vulnerable areas. The Road Verge Conservation Committee (RVCC) was formed in 1969. However, the RVCC was limited by a lack of funding and many worthwhile initiatives were not carried to fruition. As a result, the committee disbanded after 14 years of operation.

In 1984, a definitive commitment of funds for a full-time executive officer from the then Department of Conservation and Land Management and Main Roads Western Australia led to the rebirth of roadside conservation. RVCC's successor, the Roadside Conservation Committee (RCC), was created to 'coordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and



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Main Wildflowers line a roadside reserve.
Photo - Marie Lochman

Above Flowering shrubs on Julimar Road reserve, Toodyay.
Photo - Cressida Lehmann/DEC

Left Roadside vegetation provides a corridor for wildlife.
Photo - Bill Belson/Lochman Transparencies



Above Salmon gum arches on the Coorow-Latham Road, a *Flora Road*.
Photo – Cressida Lehmann/DEC

Below Sceptre banksias line a road near Kalbarri.
Photo – Graham Zemunik/Sallyanne Cousans Photography

Right *Flora Road* project sign.
Photo – Cressida Lehmann/DEC



the people of Western Australia'. The committee remains in operation today.

Triumphs of the RCC

In the past 25 years the RCC has made significant changes to roadside conservation thanks to strong partnerships with key stakeholders and committed volunteers. Its members have sought to change perceptions on the need to retain and manage roadside vegetation and increase community appreciation of roadsides, as well as provide practical skills to manage them.

An important initiative of the RCC has been the roadside survey project. Roadside vegetation is surveyed by local volunteers according to several biological characteristics to give a condition rating. The resulting map is an important tool in developing strategies for the management of roadsides, and raising community awareness. Since 1989, 47 shires across the south-west have been mapped for their conservation value.

The RCC has trained local shires in roadside management techniques for 29 years. The training programs aim to

raise awareness among works crews of the values of roadside vegetation and the best ways to balance the practicalities of road construction and maintenance with conservation outcomes.

The RCC has published a wide range of material including technical handbooks for roadside maintenance, guides for adjoining land managers, wildflower drive pamphlets and journal articles.

The RCC also manages the *Flora Roads* program, which recognises roadsides of high conservation value with significant tourism and landscape value. A select group of 33 roads from 16 shires are distinguished as *Flora Roads*.

Vision for the future

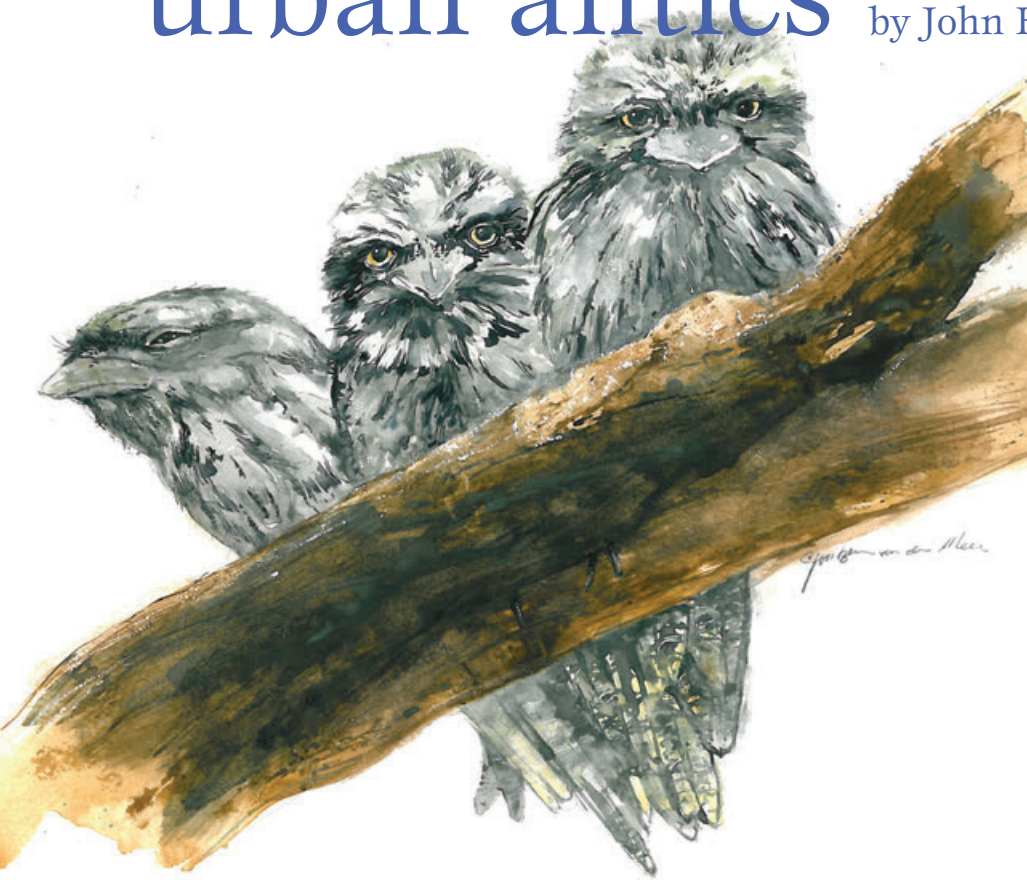
Despite the achievements of the RVCC and the RCC, there is still evidence that roadside vegetation is in decline. During the next 25 years, the RCC will strive for continued advancement in roadside vegetation management to ensure the preservation of those values for which roadside vegetation is so important.



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urban antics

by John Hunter



Real muppets

They're gone... thank goodness. I must have spent the best part of an hour every day for the past two months under park trees getting bruised vertebrae and bloodshot eyes, mesmerised beyond reason by a bunch of would be 'muppets'.

Lately it's been a scorcher, over 40°C in the water bottle for three days and, to add, it hadn't rained for two months. Squinting skywards in those conditions to get your kicks has got knobs on it. So, where are those damned birds?

I can smell the heat stress of the surrounding tuarts and other vegetation. My nostrils harbour a strange odour of bush salad with a dash of eucalyptus and a quiver of panic that exudes from all leaf and bark. A deep desire to console the living things around me is excruciating but I dare not hug a trunk or mutter out loud in case someone is watching this madman. There are no pedestrians however, I am safe. "Where are those birds???"

What is it about the very common tawny frogmouth (*Podargus strigoides brachypterus*) that stirs

the soul of many observers and photographers alike?

While owl-like in many ways, the frogmouth is more closely related to the local nightjar and oilbird of northern South America. Members of this special group of birds, also referred to as caprimulgids, have large heads, short wide beaks, weak legs and feet and are crepuscular, meaning they are active in the dim light of dusk or during the night.

The frogmouth's main attraction seems to be its accessibility to observers, in that it regularly uses the same low, near to horizontal roosting perches within a few metres of the ground. It is a bird also very reluctant to fly off when quietly approached by humans and

it goes through an amazing variety of camouflage postures to resemble a bit of the tree on which it roosts. The attraction to me, however, is its golden yellow eyes which, when enticed by a fat hand-held earth worm or moth, are as subtle as regular dinner plates on a doll's house table.

This modern-day descendant of some long gone dinosaur is usually seen, with great difficulty, during summer, sitting in a family group hunched up tight together under a small canopy of leaves on a eucalypt or sheoak branch. At first, you have to find the blob of grey with black streaks and, in my case, three round heads with... one tail? Mum on one side, dad on the other and junior in the middle facing the other way. Here, during the day, they rest and sleep. When approached by humans or other perceived danger, they stiffen with flattened plumage and with skyward pointing beaks, resembling three broken sticks.

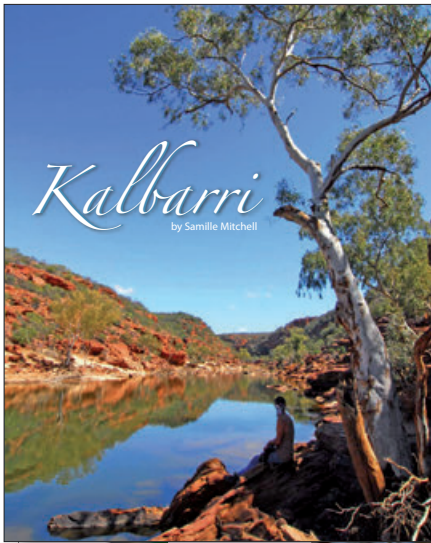
It was at night while walking the dog through the local park that I discovered the frogmouths. Through the eerie shafts of streetlight, utterly silent forms fluttered in aerobic confusion in front of me. I could feel the waft of air displacement on my cheeks and glimpsed a feathered flash. Serious thoughts of a toilet stop flashed through my mind and yes... I would really need to bring a b-i-i-g fly swat next time.

Next morning, there were my giant moths, in the same spot, and on the branch above my head.

Today I am back again for another photo, another bruised vertebra. Where are they, have they gone, or did that bunch of sticks just move?

DID YOU KNOW?

- There are many instances where frogmouths are hit by cars while chasing insects illuminated in the beam of headlights.
- Unlike the owl, which takes prey on the wing with its talons, frogmouths pounce on prey which comes to them and snap it up with their large beaks.
- Feathery bristles around the bill and spreading towards the tip of the beak help in catching insects in the air.



Visually stunning, this new book captures the beauty of Kalbarri and its national park.

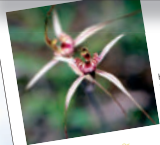
Kalbarri takes you back in time to learn about the area's original Aboriginal inhabitants and leads you through the subsequent history, from early European explorers to modern-day development. It delves into the fascinating geology which shaped Kalbarri's spectacular river and coastal gorges, and it reveals something of the ancient creatures that once roamed here.

The book also details some of the more common or interesting flora and fauna species you may encounter in the area, as well as its marine environment.

Finally, the book provides information on the myriad ways you can explore Kalbarri and its natural wonders.

Kalbarri

RRP \$29.95



Kalbarri banksias

Kalbarri banksias are the '12 apostles' of the Kalbarri National Park. They are the most common and most iconic of the park's flora. They are a type of Banksia that has adapted to the harsh, dry conditions of the park. They are a type of Banksia that has adapted to the harsh, dry conditions of the park. They are a type of Banksia that has adapted to the harsh, dry conditions of the park.

Common or unusual flora species

Kalbarri orchids are a type of orchid that is found in the park. They are a type of orchid that is found in the park. They are a type of orchid that is found in the park. They are a type of orchid that is found in the park.

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Reptiles and amphibians

Kalbarri is home to many species of reptiles and amphibians. These include the Kalbarri snake, the Kalbarri frog, and the Kalbarri lizard. These animals are adapted to the harsh, dry conditions of the park. They are a type of reptile or amphibian that is found in the park.



Available from good bookshops, newsagents, tourist information centres and Department of Environment and Conservation (DEC) offices, by mail order (postal charges apply) addressed to Locked Bag 29, Bentley Delivery Centre, WA, 6983, by contacting DEC on phone: (08) 9334 0333, fax: (08) 9334 0498, TTY (hearing impaired) facility: (08) 9334 0546 or order online at DEC's website at www.dec.wa.gov.au/shop.



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