WA's conservation, parks and wildlife magazine

LANDSCOPE

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Butterflies of the south-west

Perth's river dolphins

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Department of Environment and Conservation

Our environment, our future


Matthew Williams


Rory Chapple

contributors

Matthew Williams is the Department of Environment and Conservation (DEC) Science Division's biometrician. Although his principal role is advising on the design and analysis of research and monitoring projects, he also has a long-standing interest in the ecology and conservation of native butterflies and day-flying moths. He recently completed a major study of these insects in remnant bushlands around Perth, the results of which will provide baseline information against which to measure future changes in butterfly distribution and abundance.

Rory Chapple has been working on parks and visitor services projects in DEC's Midwest Region since 2004. Although most of his work is concentrated on community education and interpretation projects in the Shark Bay World Heritage Area, he occasionally assists with projects at Coalseam Conservation Park and in other Midwest reserves. Before life with DEC, Rory worked around Australia with a number of state park management agencies which has given him the chance to combine his love of nature with his desire to explore Australia's many wonderful natural areas.

Catherine Jack is a DEC communications project officer. She researches and writes articles for the department's internal communication vehicles. Based in Perth, she graduated from a degree in Public Relations and Cultural Studies at Murdoch University in 2008 and enjoys the opportunity to find out about the big range of work undertaken by DEC staff.

Frazer McGregor has been undertaking his PhD in marine ecology at Murdoch University since 2006. He has also been the caretaker of the North West Research Association Field Station in Coral Bay since 2004, where his studies on the foraging ecology and population dynamics of manta rays have taken place. He has lived in the Ningaloo region for nine years during which time the passion of his employers and colleagues has inspired his current work. He hopes to expand his studies on mantas to include the entire north-west coast, while promoting further research within the Ningaloo Reef region.

also contributing…

Andrew Williams, Brad Daw, Hugh Finn, Miranda Holker, Richard Robinson, Penny Hussey, Trevor Walley, Carolyn Thomson-Dans, Doug Coughran, John Hunter, Val English and Samille Mitchell.


Catherine Jack


Frazer McGregor

editor's letter

The building blocks for developing responsible citizens are laid in the early years. It is clear to many that the sooner children participate in activities with an environmental theme, the more likely they will develop a strong appreciation of the environment.

We are fortunate that nature can be appreciated wherever you are—from an urban backyard to the neighbourhood park to the remote outback. As a parent and now a grandad, I've learned to observe the natural world around me and draw a child's attention to the wonders of our environment.

Appreciate a wildflower's struggle to grow through the cracks in a sidewalk. Show children the differences between various wildflowers, smell them and take pictures. Explain that wildflowers must be allowed to go to seed so that more can grow next year; if the flower is picked it is unable to continue through its life cycle. Watch the animals and insects wake up. Observe a bird's nest under construction.

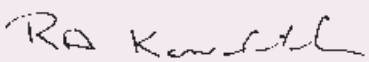
In this issue of *LANDSCOPE*, our own Urban Antics essayist John Hunter writes eloquently of his memories of silvereyes, "tiny birds of no fixed address" that "are the common nomads of our gardens", from his boyhood in coastal Perth, a time that sowed the seeds for his career as a naturalist and professional communicator.

Creating a wildlife haven in your backyard may be easier than you think, and is the subject of 'Animal attracting gardens' by *LANDSCOPE* editor Samille Mitchell. As any bush-survival expert will tell you, the three basic elements of survival are shelter, food and water. With the right native plants and some purpose-placed watering points, you will be amused and amazed by the insects, reptiles, amphibians, birds and the odd mammal that will take up residence.

Recent surveys by the Department of Environment and Conservation at more than 40 bushland sites in the Perth metropolitan area recorded 36 different butterfly species and more than 17,000 individuals. In 'Butterflies of the south-west', Mathew and Andrew Williams examine the fascinating world of butterflies and outline where to see them and how to contribute to their conservation.

And moving offshore, in 'Marvellous mantas', marine and coastal wildlife officer Brad Daw, PhD researcher Frazer McGregor, and Samille write about the phenomenon of swimming with manta rays and how we are ensuring our fascination with these creatures is not altering their natural behaviour and why this is important.

These are just a few of the articles in this issue of *LANDSCOPE* that draw attention to the wonders of our environment. Enjoy the read and we'll see you again in summer.



Ron Kawalilak
Executive Editor

Cover illustration by Philippa Nikulinsky
The Australian painted lady (*Vanessa kershawi*) is one of the most common and widespread of Australia's butterflies. It occurs in most towns, cities and agricultural areas. The butterfly has a wingspan of about 45 millimetres and is predominately orange in colour, with a complex pattern of orange, black and white markings on the upper side of the wing. It prefers open, sunny places and is most abundant in spring and early summer. *Illustration reference photo by Marie Lochman/Lochman Transparencies.*

Back cover photo by Dennis Sarson/ Lochman Transparencies
A native garden in full bloom.

Features


8


32

Volume 25 Number 1 Spring 2009

contents

Regulars

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Department of
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Our environment, our future

What's in a name? 'Snottygobble'

by Penny Hussey and Trevor Walley

The name snottygobble conjures weird and wonderful visions of this plant species. So how did such a name arise?

Growing up in Baldivis, Trevor Walley knew a low shrub whose yellow-green fruits, which he called 'snottygobbles', were sought out as bush tucker. The shrub's scientific name is *Persoonia saccata* and the very first popular book on Western Australian wildflowers, Emily Pelloe's marvellous *Wildflowers of Western Australia* published in 1921, gives it the common name of 'swottie bobs'. The next popular publication, *West Australian Wild Flowers*, first published by *The West Australian* in 1935 and running to many reprints and new editions, did not mention persoonias at all. By the publication of Erickson *et al's Wildflowers of Western Australia* in 1973, the whole genus *Persoonia* was being referred to as 'snottygobbles'. Where did this odd name come from?

A name's origins

Common names are part of the living, cultural heritage, reflecting ordinary people's knowledge of the land around them. As part of getting to know Australia, settlers would have transferred familiar names to unfamiliar, but vaguely similar plants. A good example is the name 'buttercup' given in Western Australia to species in the genus *Hibbertia*, not at all related to the buttercup of Europe. But they do have golden-yellow cup-shaped flowers that spangle the bush in springtime.

In the United Kingdom, yew trees have squishy fruits with a hard centre. Growing up in Wiltshire, Penny Hussey called these fruits 'snotty gogs' (or 'snotty globs') and remembers that naughty small boys liked to put them where a girl could inadvertently squidge them—like down the neck of her blouse. The girls, of course, responded with obligatory squeals of disgust! Arriving in WA, the children would soon have discovered any squishy fruits, especially if shown them by Aboriginal friends. It is likely

Above *Persoonia acicularis*.
Photo – Jiri Lochman

Left *Persoonia saccata* fruits.

Right *Persoonia sulcata.*
Photos – Trevor Walley/DEC

they simply transferred the name to their new land as an oral tradition.

Chinese whispers

Such things were not written down until much later and can change during this time, especially if they were part of the lore and language of school children. But once a name becomes formalised in a widely distributed publication, a 'common name' becomes set.

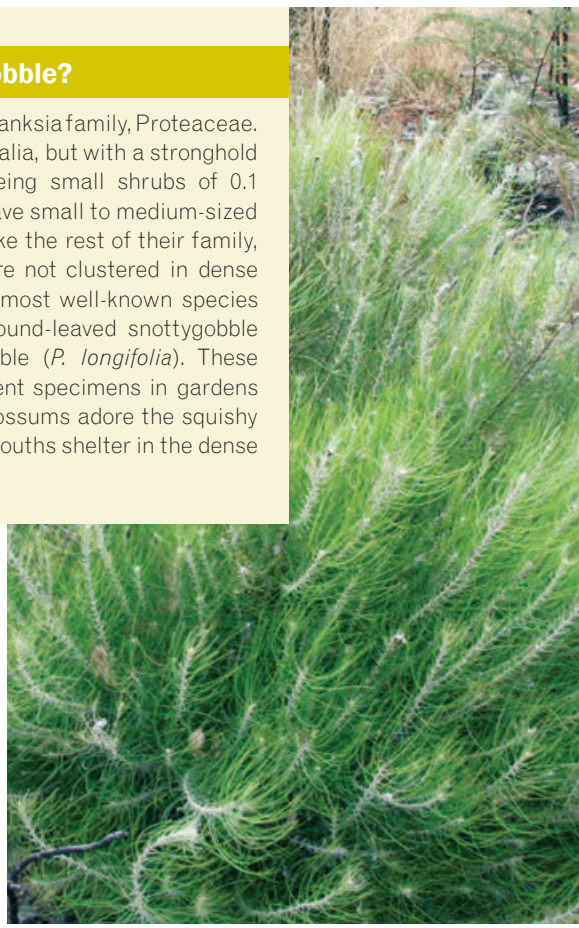
So this is how we think the name snottygobble got here—via settlers' kids. Although the plant was well known to be good bush tucker, alas no Nyoongar name—also transmitted in oral tradition—seems to have survived. Perhaps all the kids just liked the name 'snottygobble'—it is a super word—so that's the one that remained in use.

What's a snottygobble?

Snottygobbles (*Persoonia* spp.) are in the banksia family, Proteaceae. There are 98 species, all endemic to Australia, but with a stronghold in south-west WA. They range from being small shrubs of 0.1 metres to trees of 25 metres high. They have small to medium-sized leaves which are arranged alternately. Like the rest of their family, the flower parts are in fours but they are not clustered in dense inflorescences like banksias. Two of the most well-known species in WA are found in the jarrah forest, round-leaved snottygobble (*P. elliptica*) and long-leaved snottygobble (*P. longifolia*). These beautiful small trees would make excellent specimens in gardens of the Perth hills. Fauna like them too, possums adore the squishy fruit and night birds such as tawny frog-mouths shelter in the dense foliage during the day.

Penny Hussey is the Department of Environment and Conservation's (DEC's) *Land for Wildlife* coordinator. She can be contacted on (08) 9334 0530 or by email (penny.hussey@dec.wa.gov.au).

Trevor Walley is a DEC project officer and can be contacted by email (trevor.walley@dec.wa.gov.au).



Captivating Ningaloo Coast

The natural wonders of the Ningaloo Coast are being nominated for World Heritage listing. But what exactly is it that makes this region so special?

by Samille Mitchell

With plummeting ranges and arid landscapes sweeping down to the sea, an ocean painted in a palette of azure blues and a riot of underwater life, the Ningaloo Coast is one of Western Australia's most treasured natural areas. This natural wonderland is home to the wildly colourful fish and corals of the Ningaloo Marine Park. The adjoining Cape Range boasts an extensive selection of underground caves that harbour some of the world's weirdest and rarest creatures. And every year this coast is visited by several hundred of the world's biggest fish—the whale shark (see 'The Ningaloo whale shark experience', *LANDSCOPE*, Summer 2008–09).

Such are its natural riches that the Ningaloo Coast is being considered for nomination for World Heritage listing. Such a title would draw international attention to the region, bolster tourism and ensure its outstanding values are enshrined for current and future generations to enjoy. The area being considered for nomination stretches from Red Bluff in the south, then north along Cape Range peninsula, encompassing Cape Range National Park and Ningaloo Marine Park but excluding the towns of Coral Bay and Exmouth.

But what exactly are the reasons for the World Heritage nomination and how has the area changed over time?

Ningaloo past

Ningaloo's shores and hinterland nurtured Aboriginal people for at least 32,000 years. The lands were the home of groups including the Jinigudira, Baiyungu, Ingarda and Thalanji people. Burial grounds, middens and fish traps remain in the area today and provide clues to the people who lived here long ago. Limestone rock shelters and caves contain evidence of past Indigenous occupation including rock art. Among this evidence are shell beads found at Cape Range that are dated to more than 32,000 years ago. These provide some of the earliest evidence for human decorative ornamentation in Australia.

The Ningaloo Coast is also rich in maritime history, with many wrecks littering its ocean floor. It was first sighted by Europeans when Dutch explorers sailed the Western Australian coast during the 1600s. The first recorded landing on the Cape Range peninsula, near where Exmouth stands today, was in 1618 when Captain Jacobsz and the crew of the *Mauritius* sailed too far south-east of Java.

Two centuries later Matthew Flinders produced the first published representation of North West Cape on a map in 1814 in his *A Voyage to Terra Australis*, and Nicolas Baudin called it 'l'extremité nord-oeust' in his unpublished journal of 1801. His lieutenant Louis de Freycinet named Point Murat and the Muiron Islands on the same voyage, in 1803. In 1818, Australian Captain Phillip Parker King explored the region on the *Mermaid* and named Exmouth Gulf after Edward Pellew, First Viscount Exmouth (1758–1833).

Much later, pastoralism reached the area, with Exmouth Station starting in the 1880s and Yardie Creek Station in the early 1900s. Then, from 1913 to 1957, a whaling industry operated here—the remains of a whaling factory still stand at Norwegian Bay today.

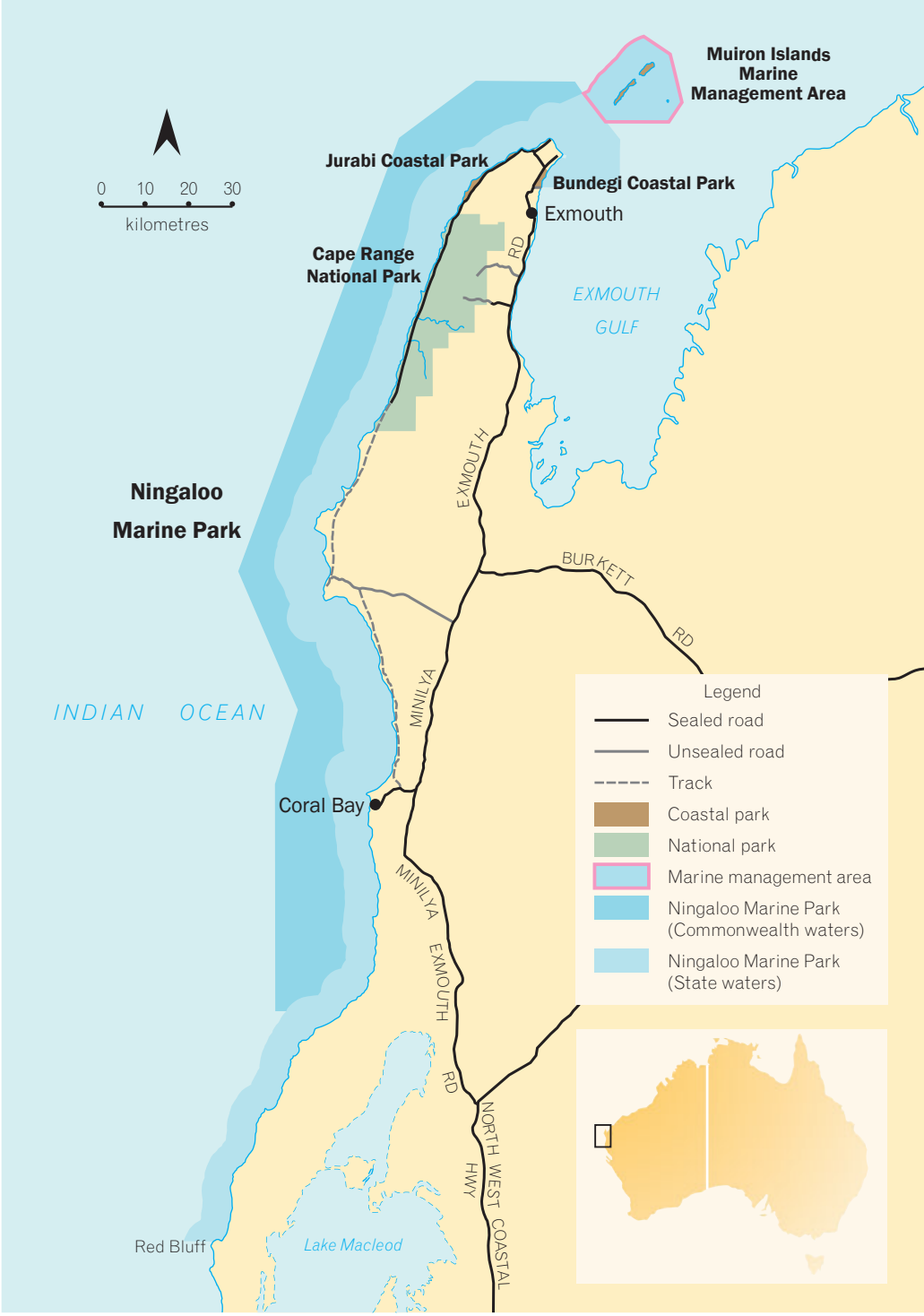
Despite the activity occurring within it, it wasn't until World War II that the area started to receive more attention. The military 'Operation Potshot' started in Exmouth and the town served as an Allied base. The base was maintained after the war and is still used by the Royal Australian Air Force. Later, oil exploration started in the Cape Range and the American naval communications station 'Harold E. Holt' was commissioned in 1968.

Most of the early tourists were fishermen keen to extract a bounty from the then untouched ocean. While fishing

Previous page
Main Green turtle and diver at Ningaloo.
Photo – Alex Steffe/Lochman Transparencies

Above Ghost crab.
Photo – Arina Abbring

Left Norwegian Bay whaling station.
Photo – Darlene Shepherd/Lochman Transparencies



Below right Staghorn coral on Ningaloo Reef.
Photo – Clay Bryce/Lochman Transparencies

remains an attraction, these days tourists visit the area to experience its natural beauty. Whale sharks put Ningaloo on the national and international tourism radar in the late 1980s. The towns of Coral Bay and Exmouth are gateways to the Ningaloo Reef and both towns provide a wealth of nature-based activities ranging from swimming and scuba-diving to snorkelling with turtles, whale sharks and manta rays (see 'Marvellous mantas' on page 32).

Marine marvels

If the Ningaloo Coast is renowned for any one thing, it's the Ningaloo Reef. This treasure chest of marine life stretches nearly 300 kilometres in a north-south direction and is protected in the Ningaloo Marine Park.

Perhaps the thing that makes Ningaloo most treasured to visitors is its close proximity to the beach. In many places you need simply to step from the beach and wade a few metres to enter the fairytale-like world of the reef. Indeed, the Ningaloo Reef is regarded as one of the world's best developed coastal fringing reefs. It is the only large reef in the world found so close to a continental landmass.

The reef and its creatures owe their existence to the Leeuwin Current which flows down the length of the State bathing the area with warming waters and bringing tropical life into an area that would otherwise be a temperate zone. Dive among the coral castles and you are bound to revel in the kaleidoscope of life. Fortresses of staghorn coral protect Clarke's anemone fish (*Amphiprion clarkii*), reef sharks patrol the waters in ghostly grey forms and schools of snapper and emperor fish flash silver as they reflect the sunlight. The area is home to more than 200 species of corals, 500 species of fish, more than 600 mollusc species and more than 90 species of sea stars, urchins and sea cucumbers. It is also well known for its manta ray populations. You can join swimming with the manta ray tours to experience

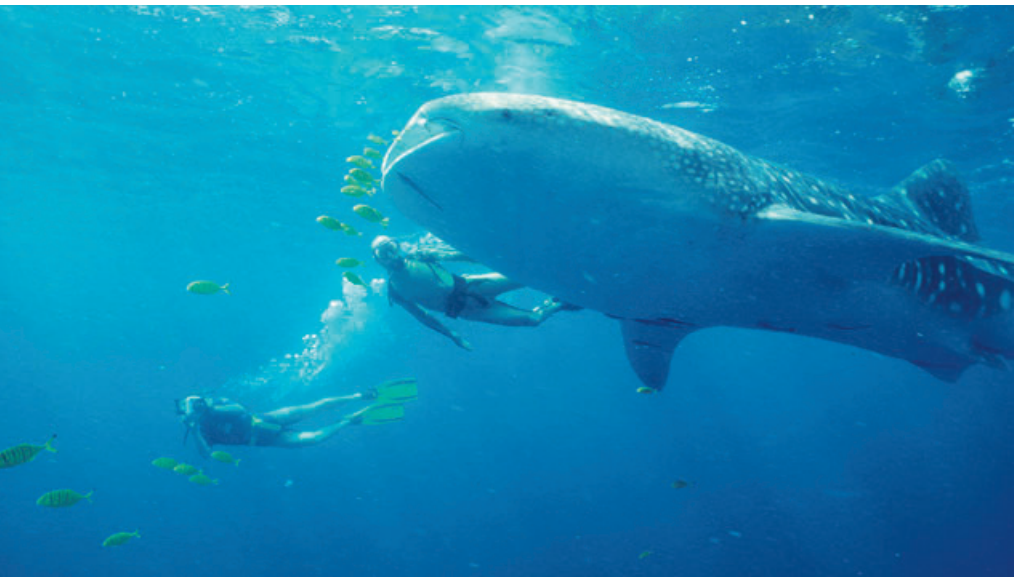
the supreme grace with which these creatures glide through the water with the gentle flap of their wings.

But of course the most famed of Ningaloo's marine creatures is the whale shark (*Rhincodon typus*). These gentle giants migrate to Ningaloo every year from about March to July. The only living representative of its family, the Rhincodontidae, the whale shark is the world's biggest fish, growing up to 14 metres long, and, although it is a shark, it is a filter feeder. As such, tour operators can safely offer snorkelling with whale shark tours along the Ningaloo Coast in season.

Marine mammals are also in plentiful supply here. About 1,000 dugongs (*Dugong dugon*) inhabit the region and eight species of whale and dolphin have been recorded, ranging from the blue whale (*Balaenoptera musculus*), killer whale (*Orcinus orca*), and humpback whale (*Megaptera novaeangliae*) to the Indo-Pacific humpback and bottlenose dolphins (*Sousa chinensis* and *Tursiops aduncus*). Visitors can join whale watching charters during the annual humpback whale migration from about July to September each year. Rare visitors also frequent these shores, with sightings of male and female elephant seals (*Mirounga leonina*), false killer whales (*Pseudorca crassidens*) and beaked whales also recorded.

The shores of the Ningaloo Coast and the Muiron Islands Marine Management Area are also globally important habitats for three species of marine turtle—the loggerhead (*Caretta caretta*), green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*). You're bound to see turtles when walking the beaches or boating as they pop their heads above the water like a periscope for a breath of air and dive under once more.

The best way of learning about the turtles is to visit the Jurabi Turtle Centre during the nesting season from December to February. The centre features interpretive information on the turtles and is the launching point for tours to experience the nesting process or watch hatchlings emerging from the sand. You'll also learn fascinating facts about the turtles, such as the tendency for females to hatch and then take to the seas for several decades until reaching sexual maturity before



Left Whale shark.
Photo – Geoff Taylor/Lochman Transparencies

Below Yardie Creek Gorge, Cape Range National Park.
Photo – David Bettini

Above Cape Range National Park.
Photo – Ann Storrie

returning to the same area where they hatched to lay eggs again themselves.

Terrestrial wonders

While it is the marine habitat for which the Ningaloo Coast is famed, the land also boasts a wonder world of fascinating, albeit lesser known, attractions, several of which are fundamental to the World Heritage nomination. The Ningaloo Coast landscape is dominated by the Cape Range, which stretches 70 kilometres long and forms the spine of the peninsula that meanders towards North West Cape north of Exmouth. This rugged range has plateaus soaring 314 metres high and forms a spectacular landscape of canyons and gorges, particularly within Cape Range National Park. It is particularly beautiful at places like Shothole Canyon and Charles Knife Gorge where plummeting canyons and soaring gorge walls create a landscape characterised by raw, dramatic beauty.

These gorges, together with the varied habitats of mangrove, intertidal flats, sand ridges, alluvial plains and dune fields, support up to 630 species of plants, 84 reptiles, five amphibians, 200 bird species and 30 mammals. Among the mammal species is the threatened black-footed rock-wallaby (*Petrogale lateralis*), formerly widespread throughout much of WA, but now known only from Cape Range peninsula, Barrow Island, Salisbury Island (Recherche Archipelago), Calvert Ranges in the little Sandy Desert and scattered remnant colonies in the Wheatbelt. Take a boat cruise along the rust-red walls of Yardie Creek Gorge and you may be lucky enough to spot these endearing creatures perched seemingly precariously on the rocks high above. This boat trip is also an excellent way to admire the bird life. Species like cormorants, galahs, and ospreys nest in the rocks along the gorge's colourful walls.

Hidden underworld

Perhaps more important to the World Heritage nomination than the sweeping landscapes of Cape Range is the landscape you can't see. For here an extensive underground karst system provides home to unique populations of cave-dwelling fauna. These fauna can be loosely divided into two groups—troglobites (creatures which live in an amphibious or terrestrial lifestyle) and stygofauna (creatures which live fully in water).

At least 38 species of these invertebrates occur here, 10 of which are endemic to the Cape Range peninsula underground system and some of which occur nowhere else in the world but their own underground cave or flooded sinkhole.

The stygofauna include cave-dwelling crustacean species such as remipedes, amphipods, copepods and ostracods. Then there are the atyid shrimp, the blind eel of the *Ophisternon* genus, which occur nowhere else but the Cape Range Peninsula, and the blind gudgeon (*Milyeringa veritas*), which is widespread in the peninsula, but is almost unknown outside the peninsula.

Left Owl Roost Cave.
Photo – Geoff Taylor/Lochman Transparencies

Below left Osprey.
Photo – Dave Watts/Lochman Transparencies

Below Parrotfish.
Photo – Ann Storrie

Given the dark environments in which they live, most of these creatures are without pigmentation and are eyeless, or have only residual eyes.

But more remarkable than their weird looks are the clues these creatures hold to our ancient past. You see, these beasts of the underworld are most closely related to other creatures in far-flung corners of the globe. So just how did they evolve in such isolation? The forefathers of today's creatures once lived in the same area but about 180 million years ago the supercontinent Pangea started to break apart, bringing about the formation of the ancient Tethys Sea. Gradually huge land masses drifted apart and the creatures that once shared the same habitats eventually dispersed to the farthest corners of the globe.

Take the remipede species (*Lasionectes exleyi*) for example. They occur in the Bundera Sinkhole on the coastal plain south of Yardie Creek, and they and their crustacean companions are the only known remipede community in the southern hemisphere or the Indo-Pacific region. Their closest living relatives occur in about seven subterranean communities in Mexico, Cuba, the Canary Islands off North Africa and the Caribbean and Mediterranean seas. While living in extreme isolation from each other today, they descended from marine creatures that once lived along the same coastline.

The story is similar with the troglobites, though their tale is more recent. These creatures tell the story of the break-up of Gondwana. From about 45 million years ago Gondwana had largely broken apart but what are now Australia and Antarctica were still joined. However, about 25 million years ago, as Australia continued to separate from Antarctica the landmass slowly drifted north, causing the once rainforest-cloaked land to become more arid. Many of the creatures from

Right Ningaloo Reef and Cape Range National Park.
Photo – David Bettini

Below right Dugong.
Photo – Geoff Taylor/Lochman Transparencies

this ancient epoch became extinct, except in the last remaining rainforest areas in the north and north-east of the continent. However, some, like the troglobites on the Ningaloo Coast, retreated underground to escape the encroaching aridity. Today the troglobites at Ningaloo are most closely related to rainforest fauna living in leaf litter in north-eastern Australia—their distant cousins.

Window to ancient times

The limestone geology of the Cape Range also helps paint a picture of the evolution of life along the Ningaloo Coast. Much of the Cape Range is the remnant of ancient marine deposits which gradually emerged from the sea after massive tectonic forces folded the earth and created a range above the ocean. In more recent geological time, changing sea levels have created four wave-cut terraces—geological features which mark ancient shorelines—which are clearly visible to those in the know. By examining these terraces and the fossil life within them, scientists can gain an understanding of the coral reef creatures that lived here at different points in time—a virtual museum of coral reef evolution over the past few million years.

Such a feature is all the more remarkable when you consider it in juxtaposition to the modern-day reef. It offers the unusual chance to witness the chronological evolution of landscapes and life forms over the years, from the uplifted ancient marine environments frozen in stone which now house mysterious underground fauna, to the abundant tropical life of modern-day Ningaloo Reef. With marine reserve and national park protection, and possibly World Heritage listing in the future, we can live with the confidence of knowing this special area will still be there largely unaltered for future generations to enjoy.

Samille Mitchell is a Department of Environment and Conservation publications officer and *LANDSCOPE* editor. She can be contacted on (08) 9389 4020 or by email (samille.mitchell@dec.wa.gov.au). Special thanks to DEC's Rebecca Coyle and Jacinta Overman for their help with this article.

It is the role of the Australian Government to submit the Ningaloo Coast World Heritage nomination. The State Government supports the nomination and is liaising with the Australian Government to prepare the nomination. It is expected that the nomination will be submitted to the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 2010. Assessment of nominations takes at least one year before a decision on listing is made by UNESCO's World Heritage Committee.

Bushfires, fungi and biodiversity

The little-known world of fungi is slowly being unravelled as new research looks into fungi's relationship with fire.

by Richard Robinson

Almost everyone knows about the plant and animal kingdoms but few realise that fungi also form one of the five kingdoms of life on Earth. Fungi are an important component of the biodiversity of natural ecosystems including eucalypt forests and woodlands. There is a great diversity of species of fungi. They come in a dazzling array of shapes, colours and textures and they play vital roles in maintaining forest and woodland health. For example, decay fungi initiate nutrient recycling by breaking down organic matter such as wood, leaf litter and dung. Other fungi attach themselves to the fine roots of plants to form minute structures called mycorrhizae (literally meaning fungus roots). Through mycorrhizae, plants gain nutrients such as nitrogen and phosphorus from the fungus partner and the fungus receives carbohydrates from the host plant. A large number of mycorrhizal fungi develop underground truffle-like fruit bodies that also form a significant part of the diet of many native animals. In older trees, wood-decay fungi contribute to the development of suitable habitat, including nesting hollows for certain species of birds and animals.

Recent research undertaken by Department of Environment and Conservation (DEC) staff has investigated how fungal communities respond to fire and how fire can enhance the diversity of fungi across a landscape.

Bushfires are a common occurrence during the dry summers typical of south-western Australia. Prescribed fire is used to maintain a mosaic of post-fire stages for biodiversity conservation and to reduce the intensity of unplanned fires ignited by lightning, accidental causes or arson. Forest areas subject to timber harvesting are also burnt to remove logging debris and create conditions suitable for forest regeneration. Most forest fungi inhabit the organic soil layer, litter and woody debris and fire can have a direct effect on fungal communities by partially sterilising soil, altering the availability of soil nutrients and reducing or totally consuming litter and debris. The extent to which these factors are influenced depends on the intensity and season of the fire.

Fire survivors

A number of species are either adapted to persist with fire or depend on fire to produce fruit bodies and therefore to reproduce. Stone maker (*Laccocephalum tumulosum*), native bread (*Laccocephalum mylittae*) and leathery sawgill (*Neolentinus dactyloides*) are among the first organisms to respond

Previous page
Main *Marasmius crinisequi.*
Inset top *Plectania* sp.
Photos – Richard Robinson/DEC
Inset bottom Leeuwin-Naturaliste National Park during a prescribed burn.
Photo – Brett Dennis/Lochman Transparencies

Above left *Peziza tenacella*.

Left *Anthracobia muellerii.*
Photos – Richard Robinson/DEC

Above *Mycena* sp.
Photo – Andrew Dovoll/Lochman Transparencies

Right Stone maker fungi.
Photo – Richard Robinson/DEC

following a fire and produce large and abundant mushroom-like fruitbodies within two or three days of even the most devastating bushfire (see 'Fruits of fire', *LANDSCOPE,* Winter 2001). They fruit from underground tuberous or root-like structures and only fruit after fire. In the absence of green feed immediately after fire, western grey kangaroos often consume mushrooms produced by leathery sawgill.

Fire-enhanced fungi

Fire causes a temporary rise in soil pH and alkaline post-fire conditions favour a number of species. In autumn, species of cup and disc fungi are very prolific. Many have colourful fruit bodies and species such as *Peziza tenacella* and *Anthracobia muelleri* can produce hundreds or even thousands of them. The majority of these fungi only fruit in the first autumn after fire. They release their spores, which settle into the soil in recently burnt forest and are capable of surviving until the next fire, after which they germinate and fruit again. Other fungi also fruit in large numbers after fire, and continue to fruit for several years. In each consecutive year, however, they produce fewer fruit bodies. A number of small mushroom-like fungi and the tiny funnel-shaped *Cotylidia undulata* appear on the burnt forest floor among charcoal once the fire moss, *Funaria hygrometrica*, becomes established. *Cotylidia undulata* is also found in Europe, where it is considered to be rare. However, in Western Australia it is quite common which probably reflects the difference in both the natural occurrence and social acceptance of fire in the Australian landscape.

Recovery and recycling

Many species of soil-borne fungi are mycorrhizal, and generally, more mycorrhizae are present on the roots of plants in long-unburnt jarrah forest compared to recently burnt forest. But some mycorrhizal fungi, such as

Tricholoma eucalypticum, are equally common in burnt and long-unburnt forest and may be important in providing germinating seedlings with mycorrhizae to enhance nutrient uptake, which is important for sustaining rapid growth and recovery of plants after fire. The coral fungus, *Ramaria capitata*, can also be found pushing up through soil in recently burnt forest and, in the spring, masses of morels (*Morchella elata*), with their distinct ribbed and pitted conical fruit bodies, may be found.

With increasing time since fire, fire-associated fungi are gradually replaced by those more common in forest that has been unburnt for longer periods of time. A succession of species takes place on the soil, while at the same time increasing numbers of decomposer species contribute to the restoration of the soil's organic layer by breaking down the leaf and twig litter that gradually builds up. As a result, the assemblage of species making up fungal communities in karri forest differs each year after fire for at least five years.

Above *Ramaria capitata.*

Below *Marasmius alveolaris.*
Photos – Richard Robinson/DEC

Fungi that inhabit and decompose litter and wood are vital components of the nutrient cycling and recycling process. If intense wildfire consumes their habitat many of these fungi are also lost. Some may survive in the mineral soil, and be available to colonise and decay litter deposited by the recovering trees. Different species of decay fungi colonise litter and wood through the various stages of decay. Therefore, re-colonisation by many species may depend on spore dispersal from surrounding forest that has not been recently burnt, the rate of litter and wood build-up and the rate and stage of the decay process. There are many species of *Mycena* and *Marasmius* that specialise in decomposing leaf, twig and branch material falling from the crowns of burnt and recovering overstorey trees, while others colonise logs from fallen trees. *Marasmius*

crinisequi and *Mycena mijoii* are two of the first to reappear on and among fallen leaves. *Marasmius alveolaris* fruits on small freshly fallen branch material after about two years, and crust or skin fungi such as *Hyphodontia barva-jovis* can be found on the lower side of small branches after about five years. The peppery coral fungus (*Clavicorona piperata*) prefers well-rotted wood and the black cup fungus (*Plectania* sp.) is found on twigs in deep litter and takes much longer to recolonise. *Panellus ligulatus* fruits on moss-covered wood and is only found in long-unburnt forest in the wetter parts of the south-west.

When enough litter has accumulated and is sufficiently decomposed to enable the upper organic layer of soil to be restored, fruit bodies of *Entoloma* are found once again. Many plants develop fine root mats in the upper organic layer and mycorrhizal fungi, including species of *Amanita, Cortinarius* and *Russula*, return and soon develop an amazing array of colourful mushrooms.

Food for mammals

Truffle-like fungi are found below the ground or on the surface of the soil under the leaf litter. They are often spherical or almost so, with a firm, fleshy texture and are an important food source for small native animals such as woylies (*Bettongia penicillata*) bush rats (*Rattus fuscipes*) and the rare Gilbert's potoroo (*Potorous gilbertii*). Species that fruit in the soil tend to have hard casings and are capable of surviving intense fire. Many have distinct odours which are intensified by heat, making them easier for animals to locate and dig up. However, species such as *Hysterangium* produce soft fleshy fruit bodies directly under litter and don't usually survive fire. They only return when the litter and soil organic layer is restored.

Fire drives biodiversity

Recently burnt forest supports a large number of fungi not found in forest unburnt for five years or more. Although the diversity of fungi on recently burnt sites is lower, their abundance is many times higher and they don't fruit in or inhabit long-unburnt forest. Many fungi that are found at intermediate stages of recovery are not found in either recently burnt or long-unburnt forest. As a result, different communities of fungi are present at varying stages of recovery after fire, and landscapes or large regions with a mosaic of forest and woodland burnt at different times and intensities in the past have the most diverse communities of fungi. No single fire regime is suitable for all the organisms and communities found in the south-west, but it is becoming increasingly accepted that regimes that are diverse in time and space are essential for maintaining biodiversity.

Above Morel fungi (*Morchella elata*).
Photo – Richard Robinson/DEC

Down the track

Fire management in Australia is evolving. Projects within DEC and in cooperation with other research and management partners are helping to solve the difficulties associated with conserving biodiversity while also providing protection from intense wildfire. DEC has an adaptive approach to fire management, and monitoring fungi, along with other organisms, provides information to assist with decision-making about the use of fire. There is still much to learn about native Australian fungi. Most are undescribed and their ecology is difficult to study, but gradually the mystery is being unravelled.

Richard Robinson is a senior research scientist at the Department of Environment and Conservation, based at the Manjimup Research Centre. He works within the Science Division's Landscape Conservation group as a forest health and fungi specialist, conducting research on how forest management activities, such as timber harvesting and prescribed fire, affect fungal communities and how pathogenic fungi affect tree and forest health. He can be contacted on (08) 9771 7997 or by email (richard.robinson@dec.wa.gov.au).

Butterflies of the south-west

With spring upon us, more people find themselves spending time outdoors. The birds are calling and Western Australia's world-renowned wildflowers are coming into bloom. It's also a time when many of **south-western Australia's butterflies** start to appear.

by Matthew Williams and Andrew Williams

For most butterfly species in the south-west there is only one generation each year, and the adult butterflies appear in spring or early summer—so the only time they can be seen is between mid September and late December. Although several other species breed throughout the year and can appear in any season, these too are usually most abundant in spring. So now is the time to look out for them.

Butterflies are widely recognised as valuable indicator species—their diversity and abundance reflects the ecological health of the environment. This is because butterflies are very particular in their choice of food sources. Most species have caterpillars that will only feed on one or a few closely related species of plants (their food-plants), and the adult butterflies are important pollinators of native plants. Thus butterflies are closely tied to the diversity and health of their habitats.

Butterflies in Perth

Like other organisms, butterflies are increasingly dependent on remnant vegetation for survival. The urban and agricultural areas of the south-west are now disturbed landscapes, with the remnant vegetation comprising fragments of varying sizes and conditions. The intervening areas contain few resources for many butterflies and present a substantial barrier to their dispersal. The clearing of bushland for housing and agriculture has robbed many native butterfly species of their habitats and, sadly, most have been unable to adapt to the changed environment.

However, many butterflies still persist in remnant bushland and continue to thrive there. Recent surveys of butterflies and day-flying moths by the Department of Environment and Conservation (DEC) at more than 40 bushland sites in the Perth metropolitan area recorded 36 different butterfly species and more than 17,000 individuals. Some species were remarkably abundant—more than 5,000 Australian painted ladies (*Vanessa kershawi*) were recorded, and, for several species, more than 1,000 individuals were seen. Only five species of day-flying moths were seen, but the brightly coloured spring-flying sun-moth (*Synemon* sp.) was common in many Perth bushlands.

Sun-moths are a remarkable group of moths that look and behave very much like butterflies, and are often mistaken for them. This family of moths evolved in Gondwana more than 50 million years ago, and today there are about 150 species in South America (the giant butterfly-moths) and 45 in Australia (the sun-moths). Although the spring-flying sun-moth is still common round Perth and elsewhere in the south-west, the graceful sun-moth (*Synemon gratiosa*) is very rare and declared endangered. Historically it has only been recorded between Mandurah and Neerabup on the Swan Coastal Plain—a region now heavily impacted by clearing. Several sites where the graceful sun-moth was recorded in the past have since been converted to housing and other uses. During the surveys, it was recorded at five bushland sites in the northern suburbs, but in very low numbers. More studies to conserve this species are occurring.

Previous page
Main Common grass-blue.

Above Australian painted lady.
Photos – Geoff Walker

Left Western xenica on garden daisy.
Photo – Eleanor Williams

At some of the sites surveyed, remarkable numbers of butterflies were seen. More than 400 western xenicas (*Geitoneura minyas*) were recorded during two 90-minute visits to Bold Park, Floreat, in October 2003, with about half of these concentrated around Camel Lake. Similar numbers were encountered adjacent to the lakes north of Thomsons Lake Nature Reserve. These low-lying, shady areas with thick swards of grasses also favour other species such as the marbled xenica (*G. klugii*), western brown (*Heteronympha merope*), western grass-dart (*Taractrocera papyria*) and wedge grass-skipper (*Anisynta sphenosema*).

The most widespread species occurred in more than 80 per cent of the sites surveyed, including the Australian painted lady, yellow admiral (*Vanessa itea*) and marbled xenica, as well as the introduced cabbage white (*Pieris rapae*) and monarch (*Danaus plexippus*). Several sites had more than 15 species, and Koondoola bushland, a large bushland remnant in Perth's northern suburbs, topped the list with 27. Two main groups of species were identified—those that rely on native vegetation for breeding and are restricted to bushland, and a smaller group of species that have adapted to breed on introduced plants and so disperse widely throughout the landscape.

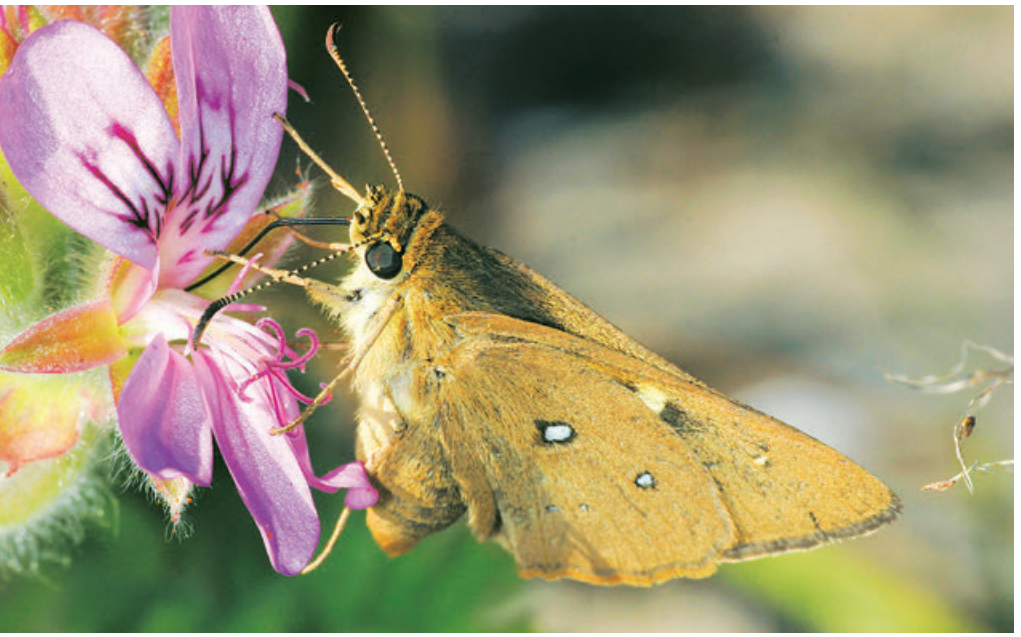
Top Western grass-dart.
Photo – Andrew Williams

Above Blue iris-skipper.
Photo – Geoff Walker

Right Purple flag, a food-plant for the blue iris-skipper.
Photo – Andrew Williams

Those relying on native vegetation are often restricted to only a few bushlands, even though they can be quite common there. These species, such as the spectacular western jewel (*Hypochrysops halyaetus*), usually have very specific habitat requirements. This species breeds on the very common bushland plants stinkwood (*Jacksonia sternbergiana*) and rattlepods (*Daviesia divaricata*), so could be expected to be widespread. But the butterfly also requires the presence of a particular type of ant. The ants tend the caterpillars, which live inside the ants' nest during the day and only emerge at night to feed (see 'Jewels of the west', *LANDSCOPE*, Autumn 1998). As a result, the western jewel occurs in relatively few areas north of the Swan River.

Similarly, the blue iris-skipper (*Mesodina cyanophracta*) breeds on the very common purple flag (*Patersonia occidentalis*), but a high abundance of this plant is needed to sustain a



Above Spotted jezebel butterfly eggs, on a quandong leaf.
Photo – Robert Powell

Left Spotted jezebel (*Delias aganippe*).

Below left Large brown skipper (*Motasingha trimaculata*).
Photos – Geoff Walker

population. In many small bushlands there may be insufficient plants, causing the butterfly to die out. And, like almost all butterflies, the caterpillars live on the plant foliage and are killed by fire. In reserves that have been subjected to broadscale wildfire, the blue iris-skipper has been eradicated. In the past, these burnt areas would have been recolonised from surrounding populations, but in today's fragmented landscape the butterfly is unable to cross disturbed areas to re-establish populations in these sites.

Where to see butterflies

In general there are three sorts of place where butterflies are most common. One is where their particular food-plants grow. Females detect their food-plants, often by smell, and spend some time visiting to lay their eggs. Males, too, may frequent these sites.

Another place is where there are many nectar-producing flowers, in warm, sheltered spots, where the adult butterflies feed. Some of the nectar plants particularly favoured by butterflies include pimeleas, dasypogons and grasstrees (*Xanthorrhoea* spp.).

The third is hilltops. Male butterflies of many species establish territories on the tops of hills, where the females go to find their mates—this behaviour is called 'hilltopping'. Of the butterflies that hilltop, some favour hills close to where their food-plants are growing, whereas others, such as the spotted jezebel (*Delias aganippe*), go to the top of the highest hill in the general area. Some butterflies hilltop during the middle of the day whereas others, such as the yellow admiral and the Australian painted lady, normally do so in the mid or late afternoon.

Reabold Hill in Bold Park is one of the few places round Perth where the spotted jezebel is seen on a regular basis, because males congregate there in spring. It is generally uncommon on the Swan Coastal Plain, where its mistletoe food-plants are scarce. Elsewhere in the south-west, however, where the orange-leaved stalked mistletoe (*Amyema miquelii*) that grows in eucalypts is widespread, the jezebel is often quite common and seen around many hilltops.

Contributing to butterfly conservation

As a result of changes to the environment, many butterfly species are becoming increasingly scarce. Weeds in bushlands replace the native food-plants on which many butterflies breed, and fires can destroy or reduce butterfly populations. Global warming is influencing weather patterns and creating an increasingly dry climate in southern Australia, affecting the abundance, health and vigour of the plants on which butterflies breed. Sightings of butterflies are therefore all the more to be cherished.

Right Silver-spotted ochre (*Trapezites argenteoornatus*).

Below right Long-tailed pea-blue (*Lampides boeticus*).
Photos – Geoff Walker

We can help butterflies by growing their food-plants (see 'Butterfly gardening', *LANDSCOPE*, Winter 2004), and by managing bushlands to control weeds and wildfire. Many Perth bushlands have 'friends' groups that are involved in this task.

As much is still unknown about where butterflies occur and what plants they breed on, those interested in butterflies can make a valuable contribution to knowledge of these native animals by identifying and recording the species that occur in their local area. A collection of photographs of local butterflies is a valuable way to record them (and photographing them can be a challenge!). Photographs also make later identification possible. Monitoring the diversity and abundance of butterflies over longer periods can also identify undesirable changes or trends, enabling timely adjustment of management practices.

The new DEC Bush Book *Common Butterflies of the South-West* provides information on 31 of the most commonly seen species. It also includes one common example of a specialised group of day-flying moths found in WA, the sun-moths. These are often confused with butterflies because, like butterflies, they have clubbed antennae and fly in sunny conditions. The book describes and illustrates each species, with information on size, distribution, habitat, behaviour and flight times.

Rare species

It can also be fascinating to look out for rarer species, many of which are endemic. Among them are such splendid species as the laterite ochre (*Trapezites waterhousei*), which breeds on Basil's asparagus (*Xerolirion divaricata*). This plant only grows on a few decaying laterite and granite outcrops in the semi-arid zone. It's easy to find the butterfly if you go to sites where the *Xerolirion* food-plant grows. Still other intriguing species include lycaenid butterflies which have developed close

Above Ants attending larvae.
Photo – Peter Marsack/Lochman Transparencies

Below Blotched dusky-blue (*Candalides acasta*).
Photo – Geoff Walker

associations or symbiotic relationships with ants. In some cases the butterflies are entirely dependent on the ants for their survival!

Symbiosis with ants

One example of a fascinating ant–butterfly symbiotic relationship is with the arid bronze azure butterfly (*Ogyris subterrestris*), which was recently rediscovered in the north-eastern Wheatbelt. Now listed as critically endangered, the larvae of this rare species live entirely underground within the ant's nest, being fed by the ants, predating their larvae, or both.

Chemical signals released by the larvae convince the ants to accept them into the nest, ensure that they are well fed, and even protect them from predators. Typical of many subterranean species, the larvae are pure white. But they are not blind—when mature, they seek out the entrance to the nest and pupate nearby. This enables them to escape from the nest, as the adult butterfly that emerges lacks the chemical defences possessed by the larvae and is attacked by the ants.

The butterfly's escape from the ant nest is the final insult: as it emerges from its pupa, still within the ant's nest, with crumpled wings and unable to fly, it would seem to be at its most vulnerable. However, the butterfly is covered with a dense layer of powdery talc-like scales which are easily dislodged. The ants vigorously attack the butterfly, but these scales clog the jaws of the ants, disabling them for long enough to enable the butterfly to exit from the ants' nest, expand its wings, and fly away. In return for putting up with such behaviour, it's thought the ants may benefit from food that the larvae secrete.

Learning about these wonderful inter-dependent relationships gives us insight into the complexities of our extraordinarily diverse natural environment.

Butterflies and moths – the difference

People often ask about the differences between a butterfly and a moth. There are microscopic differences between the two groups (for example, all butterflies have a well-developed proboscis and often feed at flowers, while many moths do not have working mouthparts and are thus unable to feed), but these microscopic features aren't very useful without a microscope. Some 'rules of thumb' can be useful in distinguishing the two groups:

- ***Butterflies fly during the day whereas moths fly at night.*** While generally true, as the vast majority of moths fly at night, several other species only fly during the day.
- ***Butterflies have antennae that end in a distinct club***. This is one of the best distinguishing features, as moths with clubbed antennae are quite unusual—more commonly the antennae are without a club or are feather-like.
- ***Moths fold their wings flat***. While not true for all moths, this can still be a useful way of separating the groups in combination with other features.

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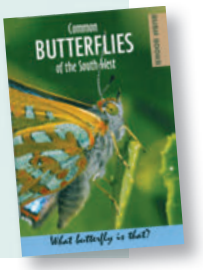
Information in this article is based on the new DEC Bush Book *Common Butterflies of the South-West*. The book is available for $6.50 from bookshops and tourist outlets, by phoning WA Naturally Publications on (08) 9334 0333 or by ordering online at www.dec.wa.gov.au/shop.



bookmarks by Samille Mitchell

Mawson's Huts: The Birthplace of Australia's Antarctic Heritage

Produced by: Mawson's Huts Foundation
Publisher: Allen and Unwin
www.allenandunwin.com
192, hard cover, colour and black and white photography
ISBN: 978 1 74175 436 0
RRP: $95
Proceeds from the sale go to the Mawson's Hut Foundation.

This beautiful book begins with an historical account of Dr Douglas Mawson's Australasian Antarctic Expedition of 1911–14. It details the expedition's scientific triumphs, its tragedies and provides an account of Mawson's gruelling attempts at survival, including many excerpts from his journal. The bulk of the book shows fascinating historical images of the expedition, including the huts these hardy men survived in. The photos paint an intimate picture of the men and their daily lives in this inhospitable, far-flung corner of the globe. Modern-day photos of the huts' remains and Antarctica's spectacular scenery and animals complete this magnificent publication.

Great Whales

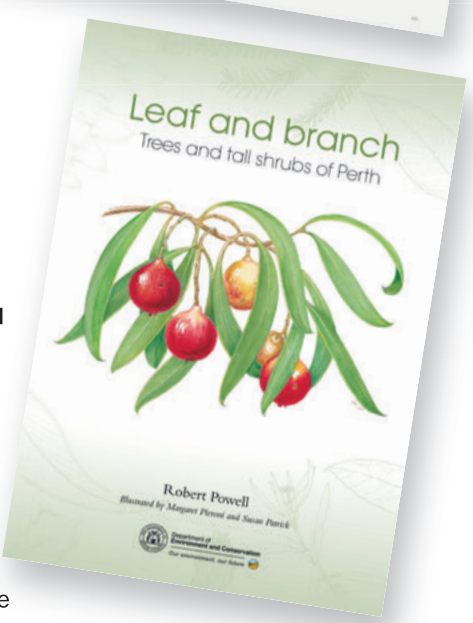
Author: John Bannister
Publisher: CSIRO Publishing
www.publish.csiro.au
160 pages, paperback, colour photographs
ISBN 978 0 64309 373 7
RRP: $39.95

This book provides a detailed account of seven of the 'great whales' of Australia—the blue, fin, humpback, sei, Bryde's, southern right and the sperm whale, as well as a smaller species, the minke whale. It describes their mammalian structure and biology, conservation, future and relationship with humans over time.

Leaf and branch

Author: Robert Powell
Publisher: Department of Environment and Conservation
www.dec.wa.gov.au/shop
256 pages, paperback, fully illustrated
ISBN: 978 0 73093 916 0
RRP: $29.95

This fastidiously researched and succinctly written book provides an overview of the trees and tall shrubs of the Perth area. More than a field guide, the book serves to heighten readers' appreciation of the sometimes subtle beauty of our native trees and shrubs and highlight their importance in supporting associated life. It comes accompanied by line drawings which beautifully illustrate each species. While the bulk of the book is dedicated to individual species, other areas of the book look at topics like plant communities, associated life, cultivation and how the reader can help conserve species.



Walpole and Nornalup Inlets Marine Park

Tall karri forest meets the sea at the Walpole and Nornalup Inlets Marine Park. It is the State's newest marine park, declared on 8 May 2009.

Above Nornalup Inlet.
Photo – David Bettini

Opposite page
Far right Sea squirt.
Photo – Eva Boogaard/Lochman Transparencies
Centre right Sunset at Walpole Inlet.
Photo – Gary Muir
Right Rest Point boat ramp, Walpole Inlet.
Photo – Alex Bond

When William Nairne Clark and his party rowed into Nornalup Inlet—and thence up the Deep and Frankland rivers—in 1841, he recorded "lofty wooded hills, with tall eucalypt trees growing close to the water's edge, and crowning the summits of these high hills, thus casting a deep gloom over the water and making the scenery the most romantic I ever witnessed in other quarters of the globe".

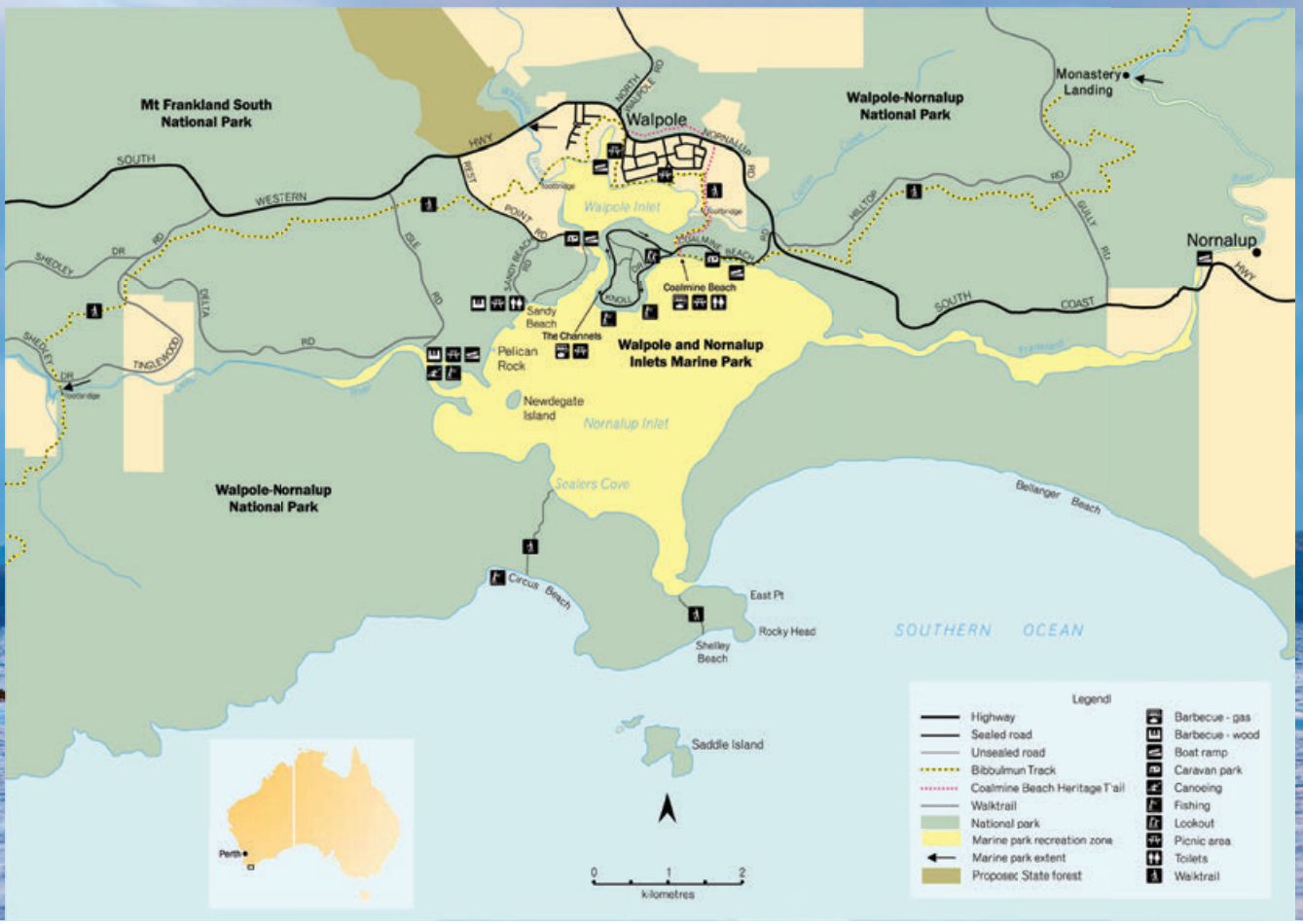
The town of Walpole is adjacent to the shallow (mostly about one-metre-deep) 100-hectare Walpole Inlet, which is fed by the freshwater Walpole River. The larger (1,300-hectare) and deeper (up to five metres) Nornalup Inlet is fed by the freshwater Deep River and the saltier Frankland River. The marine park encompasses the Walpole and Nornalup inlets and the tidal parts of the Frankland, Deep and Walpole rivers.

The estuaries are joined by a natural one-kilometre-long and two-metre-deep channel, bordered by steep granite hills and rocky shores. These are known locally as 'The Knolls' and are clothed with dense karri forest.

The Walpole and Nornalup inlets are a permanently open estuarine system—one of very few in the south-west—that experiences marine-like conditions for most of the year. Seagrasses, algae and a diverse array of shellfish and other animals live in the estuary floor. Some prawn species, the blue swimmer crab and mud burrowing crab are also found in the inlets.

The open inlet mouth, the mixing of fresh and salt river waters, river deltas and two large inlets result in diverse marine habitats and a great range of fish species. Black bream, whiting, trevally, herring, juvenile Western Australian salmon and even pink snapper are just a few of at least 40 fish species that have been recorded here, including larger fish such as sharks, which are uncommon in other estuaries.

Black swans, ducks, grebes, swamphens, moorhens, coots, cormorants, herons, egrets, ibis, pelicans, whimbrel, sandpipers, stints, oystercatchers and plovers—among other birds—all use the marine park. Gulls and terns are abundant, and shearwaters, gannets and albatross may also be observed. Ospreys and white-

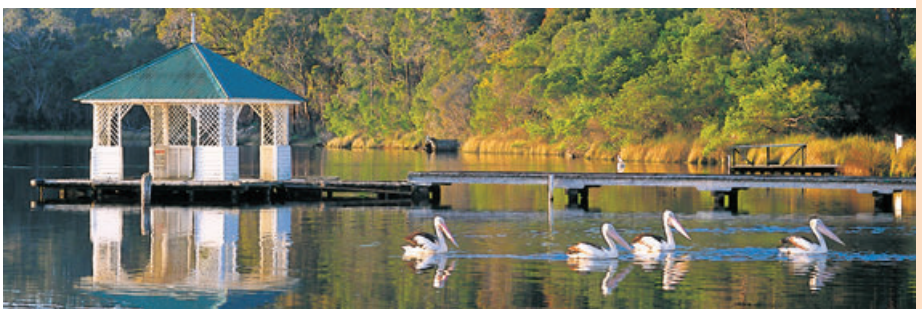


bellied sea-eagles ply the inlet waters for fish. Migratory shorebirds use the tidal delta flats.

Enjoying the marine park

The untouched nature, wildlife and scenic quality of the Walpole and Nornalup inlets provide a wealth of opportunities for canoeing, boating, recreational fishing and other water-based activities. A major attraction of the inlet system to visitors is the perception of naturalness and remoteness that can be experienced, particularly in parts of the Nornalup Inlet and the Frankland and Deep rivers. Nature-based tourism charters from Walpole are available so people can get up-close to the wildlife and experience the marine park's stunning scenery.

The entire Walpole and Nornalup Inlets Marine Park is zoned for recreation, and recreational fishing is therefore permitted in all areas. The marine park supports excellent recreational fishing opportunities for a number of fish species. Check first with the Department of Fisheries to find out about bag limits, minimum sizes and any licences that may be needed. Commercial fishing has been banned from the inlets since early last century.



park facts

Where is it? About 450 kilometres south of Perth on WA's south coast.

Total area: Approximately 1,442 hectares.

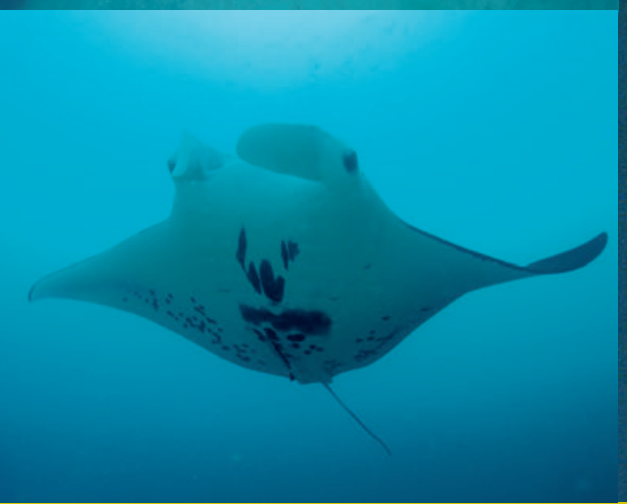
What to do: If you don't have your own boat, local nature-based boat tours are available and highly recommended.

Must see sites: 'The Knolls', where steep granite hills and rocky shores adjacent to the marine park are clothed with majestic karri forest.

Naming: The park takes its name from the Walpole and Nornalup estuaries. Nornalup is an Aboriginal name meaning 'place of the tiger snake'. Walpole Inlet was named after Captain W Walpole, who served aboard the *Warspite* in 1808 with James Stirling, who later became the Governor of WA.

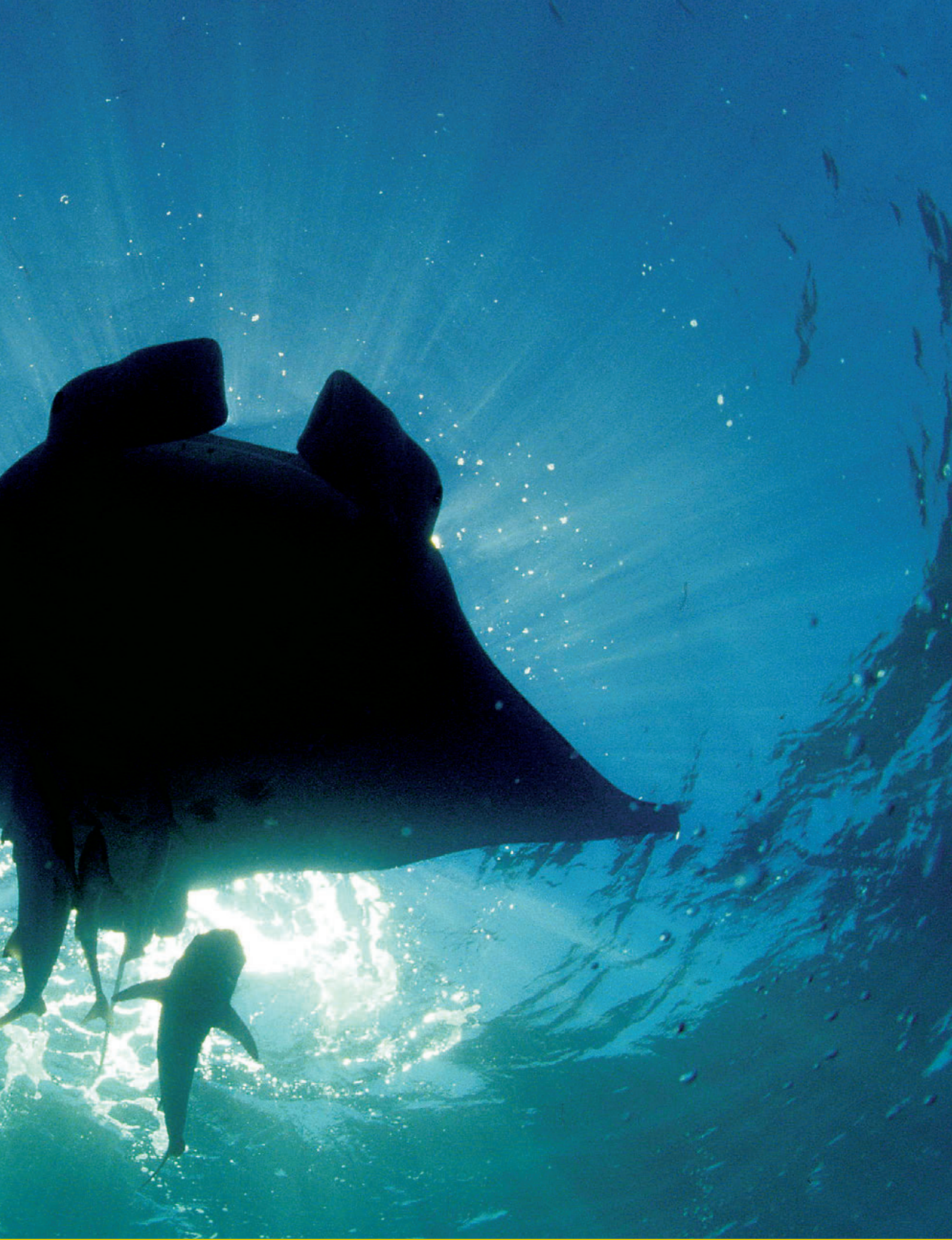
Nearest DEC office: Department of Environment and Conservation, South Coast Highway, Walpole WA 6398, phone (08) 9840 0400.

Marvellous mantas



Swimming with manta rays has become a popular activity for tourists at Coral Bay. But how are we ensuring our fascination with these creatures is not altering their natural behaviour and why is this important?

by Brad Daw, Frazer McGregor and Samille Mitchell



It's mid morning as the snorkellers enter the ocean near Coral Bay and peer into the watery darkness. They swim in unison, excitedly watching, until slowly, a ghostly black shape begins to emerge.

It's hazy at first but as the manta ray moves closer they can make out its wings, its tail, its filter-feeding mouth. It flies by them with supreme grace, a gentle flap of its wings propelling it effortlessly forward. The manta ray suddenly banks, arching itself upwards. Doing a 'loop the loop', the manta starts feeding on a pocket of plankton. The snorkellers delight and swim after the magnificent creature, in awe of its beauty and grace.

Such an experience is an everyday occurrence at Coral Bay in Ningaloo Marine Park where tour operators offer the chance to swim with manta rays. But are such interactions altering the lives of the very animals these people have travelled so far to admire?

The manta ray

Manta rays (*Manta* spp.) are the world's biggest rays, with wingspans reaching up to seven metres across. Unlike some rays, manta rays are regarded as relatively harmless to humans as they contain neither a stinging barb nor functional biting teeth.

With the largest brain-to-body ratio of any shark or ray, manta rays may be just as curious about us as we are of them. They often approach boats and swim alongside scuba divers and snorkellers. Although they may approach humans, direct contact can be harmful to them as touch can remove their mucus membrane, causing lesions and infections on the skin.

These gentle giants inhabit tropical waters across the world where they are increasingly popular as ecotourism ventures. Sadly they are also commonly seen in fish markets, a by-catch of ever-increasing global gill net fisheries. In Australia, without direct fishing pressure, their conservation status is currently deemed to be secure.

Manta rays are filter feeders, feeding mostly on zooplankton and fish larvae by filtering water through their gills as they swim. Manta rays are known to frequent 'cleaning stations' near reefs where small fish swim into their gills and over the skin to eat parasites and remove dead skin in a mutually beneficial relationship.

Manta rays are renowned for their grace, effortlessly 'flying' through the water. They are also powerful enough to propel their entire body out of the water if startled or to escape a predator or suitor—an amazing sight for anyone lucky enough to witness it.

Ningaloo mantas

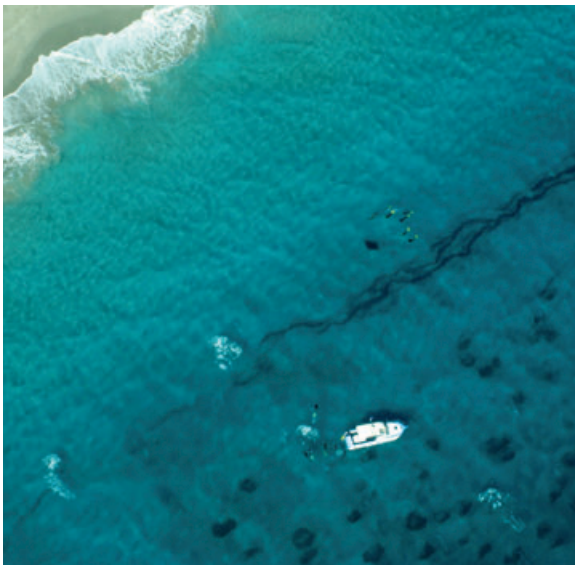
The Ningaloo Coast of Western Australia is thought to harbour a globally significant manta ray population, with ongoing observations revealing that the most consistent large aggregations in the marine park occur in and around Bateman Bay, a 20-minute boat ride north of Coral Bay. Bateman Bay is also the prime location for one of the most popular and rapidly growing tourism activities in the area—manta ray interaction tours.

In 2006, the Coral Bay Progress Association obtained funding from Coastwest to set up the Manta Ray Monitoring and Education Program. This program is using the unique ventral pattern on manta rays to photographically identify individual rays. As of early May 2009, more than 470 individual manta rays had been sighted during in-water interactions within the relatively small Bateman Bay area. Most of manta rays were seen foraging within 200 metres of the beach, or at shallow lagoonal cleaning stations. Of these, more than one third have been re-sighted, with some 'resident' individuals now recorded more than 40 times.

Worldwide, only two other similar programs have identified more individual manta rays—in Mozambique, where more than 850 manta rays have been identified over five years, and in

Previous page
Main Manta ray.
Photo – Clay Bryce/Lochman Transparencies

Insets Diver filming manta ray.
Manta ray.
Photos – Glen Cowans



Top left A snorkeller obtaining an identification photograph.
Photo – Meg Green

Top Manta ray interaction often occurs very close to the beach.
Photo – Marianna Tombini

Above Diver on Ningaloo Reef.
Photo – Glen Cowans

the Maldives where a long-running program has recorded well over 1,000 individuals, throughout the Maldivian archipelago.

The results of the Ningaloo program to date indicate that the Bateman Bay lagoonal area and the greater Ningaloo Reef complex are highly significant for manta rays in a national and global context.

Why Ningaloo?

So why is Ningaloo such an important area for manta rays? The answer could lie in the reliable food sources available to these remarkable creatures. Studies at Ningaloo have revealed that manta rays will forage alone or in schools of up to 100 individuals, changing their foraging behaviour from slow bottom skimming to elaborate somersaults depending on the density and size of zooplankton swarms. These foraging behaviours are commonly seen within the shallow lagoon of Bateman Bay, sometimes as close as two metres from the beach, and offshore on shallow banks and in deeper channels inside the barrier reef crest.

A PhD project run through Murdoch University is investigating the exact nature of these planktonic fluxes to determine the importance of this seemingly unique area and work out whether such fluxes are produced within the lagoon areas or are oceanic zooplankton concentrated by the hydrodynamics of the lagoon. Research to date has shown that manta rays within Bateman Bay are mostly searching for and targeting very specific crustacean swarms that live in a plankton phase for their whole lives and are known as haloplanktonic. They also appear seasonally at specific locations to target small spawning events of meroplanktonic crustaceans such as crab larvae, which only spend some of their time in a plankton phase. Both crustacean types may be endemic to the Ningaloo area.

Manta ray migration

While the Bateman Bay area appears from photographic records to be an important location for a number of mature 'resident' individuals who know exactly where to find year-round prey, there are many transient and seasonal mantas that travel much further afield in search of large zooplankton pulses associated with seasonal water temperature variations. The latest tracking and re-sighting data

have shown that manta rays will move long distances along the Ningaloo Reef to forage for food and search for mating opportunities. Records since November 2007 show mantas making multiple north-south traverses of the reef, some of up to 160 kilometres in a week, and also foraging to depths of more than 100 metres.

In September 2008, 25 per cent of individuals observed in the Exmouth Gulf were found to be individuals that had been initially identified within Bateman Bay (a swimming distance of some 180 kilometres south). Others have only ever been observed in the northern section of Ningaloo Marine Park and the Exmouth Gulf, suggesting a complicated system of overlapping home ranges common to many shark and ray species.

Further insight into manta site fidelity and migration is being made possible thanks to the Australian Acoustic Tracking and Monitoring System's Ningaloo Reef Ecosystem Tracking Array. This project has involved installing fixed receiving stations along the Ningaloo Marine Park to detect a variety of tagged sharks, rays and fishes that pass nearby. As part of this project, 37 manta rays have now been tagged to determine their movements and habitat use within the marine park. Preliminary results show that mantas use lagoonal sections of the reef far more frequently than expected and travel long distances over very short periods.

One individual tagged in November 2007 was detected four days later, 100 kilometres north inside Mangrove Bay. Four days later it had returned to the original tagging location. This individual continued to search for food along the reef for a fortnight until it settled into Bateman Bay where

Top left An all-black manta ray cruising the shallow waters of Bateman Bay.
Photo – Paul Markey

Left Laser sizing a 3.8-metre mature female manta ray.
Photo – Luke Riley

Right Boats anchored at Coral Bay.
Photo – Bill Belson/Lochman Transparencies

Below right Manta ray.
Photo – Glen Cowans

it remained for three months. Other tagged mantas (both male and female) have been detected within Bateman Bay over a 12-month period while others show a much more seasonal pattern, returning to the same areas almost to the day each year. What this means for tourism is that the year-round reliability that is unique to Bateman Bay is likely to be highly dependent on a focal group of animals that are essentially resident within the wider Bateman Bay area.

Manta antics

While the Bateman Bay area appears to be an important area for manta rays to source food, years of observations by tour operators and more recent photographic evidence has shown it to be equally important as a site for essential non-foraging behaviours such as the formation of mating chains, copulation activity, birthing and numerous maintenance activities such as being cleaned of parasites. In May 2009, researchers accompanied by Department of Environment and Conservation (DEC) staff were thrilled to encounter the smallest photographed manta in the identification catalogue. The small female was accurately sized using parallel lasers at a little over 1.5 metres. Age estimates are difficult to confirm in these often elusive animals, but given a birthing size of approximately one metre, this female was likely to have been only a few months old.

These findings and ongoing observations indicate that the Bateman Bay area may well be a preferred and critical habitat for a number of manta rays who use it for a range of essential life cycle activities. It is without doubt the most significant site along the Ningaloo Reef known so far for manta rays and may well be unique in its importance on a regional basis.

As Bateman Bay is also one of the main areas for tourist interactions with manta rays, it is essential that this important area is given greater protection so these remarkable creatures can continue to delight both local and international tourists.

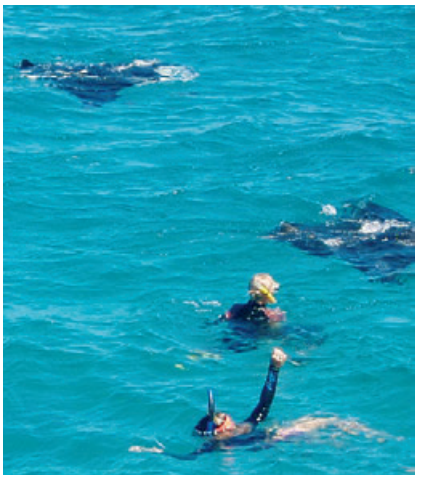
Ningaloo tours

Six tour operators currently offer manta ray interaction tours from Coral Bay, introducing an estimated 10,000 passengers a year to the magical world of the manta ray. Based on the ticket price alone, this equates to an industry worth more than $1.2 million a year, not to mention indirect economic benefits from accommodation and other spending.

The fact that manta ray tours operate every day of the year (weather depending) from Coral Bay means that they are the core wildlife-based adventure tour for many operators, unlike whale shark and whale watching tours, which are highly seasonal.

Coral Bay is particularly popular for manta ray interaction tours because of the reliability and ease of sightings year round. While there are seasonal fluctuations, records have shown that manta rays can be found 90 per cent of the time, with an interaction success rate estimated at more than 80 per cent.

The tourism industry relies on being able to offer their product with as higher level of certainty as possible. Therefore, sustainability of the presence of manta rays in significant numbers is vital to the success of their operations. Tour operators are as enamoured with the manta rays as their passengers, and are concerned about protecting not only the animal but the areas deemed critical to their ongoing presence. Some



Left Manta ray.
Photo – Shannon Conway/Sallyanne Cousans Photography

Above Snorkellers with a group of surface-feeding manta rays.
Photo – Bec Towers

operators express real concerns that the sheer number of tours may have the potential to disturb manta rays and cause behavioural changes at essential 'cleaning stations' where tour activities are often focused. They also express concern about disturbance to manta rays and the risks to swimmers from interactions with manta rays engaged in courting and mating.

As such, the tour operators have been working with DEC to develop a code of conduct for interactions.

A concerning case has come to light at Bora Bora in French Polynesia where uncontrolled manta ray tours inside a tropical lagoon have directly attributed to the local manta rays abandoning the entire lagoon in preference for the deeper, less-accessible water. Not only has this displaced the manta ray population but it has also caused the local tour industry great hardship—situations DEC is keen to avoid for both manta rays and tour operators in WA.

DEC will continue to work with tour operators on a new plan to ensure the ongoing sustainability of manta ray tourism in Bateman Bay and surrounds. The plan will guide the industry in a similar way to the whale shark interaction management program, developed between DEC and tour operators and internationally regarded for its success in satisfying human curiosity about whale sharks while protecting the sharks themselves. Such a program will also need to manage non-commercial activities in the area as recreational boating activity increases throughout the Ningaloo Marine Park. Public education and awareness are as essential to a positive result as the management of commercial activities.

Plan for the future

In developing the manta ray management plan, DEC is working closely with tour operators who have largely supported increased management of the industry and the development of a new code of conduct. While details of the management measures are still being worked out, it is expected to contain requirements for all tour operators to adhere to the code of conduct as part of their commercial tour licences. The new code will also lay out new requirements for maximum numbers of people allowed in the water with a manta ray, as well as restrictions on approaching manta rays that are engaged in mating behaviour.

Into the future

Once adopted, such a plan should enable tour operators to continue introducing visitors to the world of the manta ray, while also protecting the species. After all, increased awareness and appreciation of the species can only help in their preservation. With the right management, people will be able to continue donning snorkel and mask, slipping into the waters of the Ningaloo Marine Park and marvelling at the manta ray's beauty and grace. And the mantas will be able to continue going about their daily lives, unperturbed by the human visitors.

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Frazer McGregor is undertaking research towards his PhD at Murdoch University on the trophic ecology of manta rays at Ningaloo Reef.

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Coalseam Conservation Park: a natural jewel in the northern Wheatbelt

Come winter and spring and people from far and wide journey to the Midwest's Coalseam Conservation Park to immerse themselves in wildflowers, particularly after good winter rains. But it wasn't wildflowers that first put the area on the map. Coalseam was the first area in Western Australia where coal was discovered.

by Rory Chapple

It was 1839 and around the globe the industrial revolution was in full swing. The population of the fledgling Swan River settlement was about 2,000 settlers and the Government was in desperate need of an energy source for transport and power generation. In the 1800s power meant coal, and to further develop the growing Western Australian settlement the governor put up a sizeable reward of 2,560 acres (about 1,036 hectares) of land for anybody who discovered a "significant bed of coal".

Seven years later, in 1846, three brothers Augustus, Francis and Henry Gregory undertook a seven-week expedition to find suitable grazing and agricultural lands north of Perth. They stumbled upon the banks of the Irwin River where they found two exposed seams of coal near where the Midwest town of Mingenew lies today. Ecstatic with their find, they eagerly took turns in removing a quantity of coal from the seams to take back to Perth as proof of their discovery. Augustus recorded the event in his diary:

"We therefore entered the bed of the river to examine it, and found two seams of coal—one five feet thick and the other about six feet thick—between beds of sandstone and shale. Having pitched the tent and tethered the horses, we commenced to collect specimens of the various strata, and succeeded in cutting out five or six hundredweight of coal with the tomahawk, and in a short time had the satisfaction of seeing the first fire of Western Australian coal burning cheerfully in front of the camp…"

Their return to the Swan River settlement was met with considerable jubilation. The brothers had made the first discovery of coal in Western Australian history, which led the Government to declare a 10,000-acre coal reserve in the area. Henry, the actual discoverer of the coal, collected his reward and a return trip was quickly organised to further investigate the find. Geologist Dr F Von Sommer led the party and although he confirmed that a significant amount of coal existed in the two seams he also found the coal to be poor quality because of its high ash content.

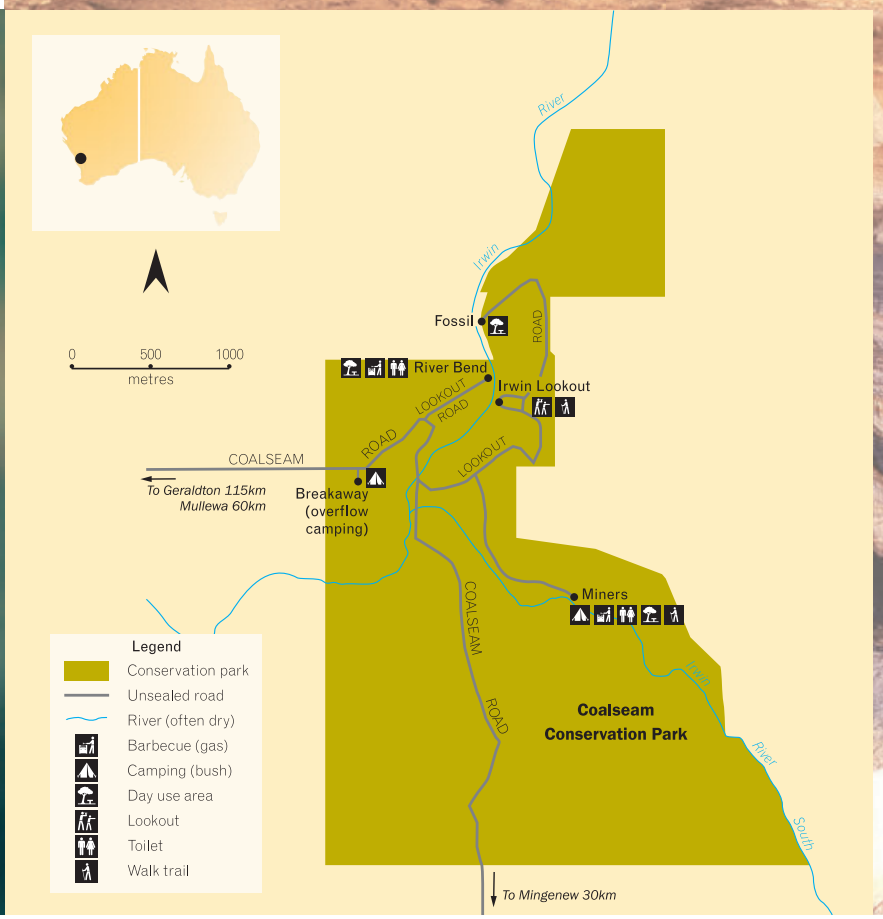
The Irwin River coal deposit never became a profitable commercial venture. Despite further exploration and increased interest at various times during the nineteenth and twentieth centuries, the poor quality of coal and considerable distance from Perth meant nothing much came of the discovery. The coalfield was eventually declared an uneconomical mining venture and in 1978 the coal reserve was vested with the Shire of Mingenew for the 'preservation of natural features'.

The discovery of the coal seams by the Gregory brothers and subsequent push to develop the mineral resources of the area had a surprisingly different end result. The protection afforded by the coal reserve and hilly nature of the country meant the area was never developed for agriculture like most of the other land around the reserve. Today, the 754-hectare reserve managed by the Department of Environment and Conservation is known as Coalseam Conservation Park

Previous page
Main View of the Irwin River valley from Irwin Lookout.
Photo – Dennis Sarson/Lochman Transparencies
Inset Pompom head (*Cephalipterum drummondii).*
Photo – Ann Storrie

Above Explorer Augustus Gregory.
Photo – National Library of Australia

Left A 1907 photo of a mineshaft in the bank of the Irwin River.
Photo – WA Campbell/Former Department of Industry and Resources



Above Pink and grey galah.
Photo – Jiri Lochman

Above right background Rocky cliff face.
Photo – Rory Chapple/DEC

Right Everlastings lure visitors in winter and spring.
Photo – Ann Storrie

and is a natural jewel in the mostly flat and cleared landscape of the northern Wheatbelt.

A cross section of time

Coal deposits are generally found deep underground so why does coal occur as an outcrop along the Irwin River? To find the answer we need to examine Coalseam's geological history and go back to Gondwanan times, 290 million years ago.

It is difficult to imagine the landscape of the Midwest during Gondwanan times. The Earth was going through a period of global cooling; temperatures were much lower than today and huge glaciers covered the area. There were no flowering plants or mammals on Earth and ferns were the dominant plant group. About 269 million years ago, the Earth began to warm and the glaciers in the Midwest began to retreat. The movement of these massive blocks of ice ground up the underlying rock to create vast amounts of sediment. Massive amounts of silt and sand were deposited, creating a broad coastal delta-plain upon which temperate swamps began to thrive.

The cool, humid conditions of the time were ideal for growing and preserving the luxuriant plant material. The layers of decaying vegetation gradually formed peat, which was buried, compressed by overlying sediments, slightly heated and slowly transformed into seams of coal. Tens of millions of years later, the Irwin River coal seams, siltstones and sandstones were uplifted, tilted and then exposed by river erosion.

Visitors to the park today can stand on the banks of the Irwin River, gaze across at the cliff face and read the

geological history of the park. Layers of siltstone, sandstone, claystone and coal spanning more than 200 million years of geological history are right before your eyes, exposed by the erosion of the Irwin River, just like peeling back the skin of an onion, revealing the park's dramatic geological history.

Coalseam is now a well-known geological site in WA and many educational institutions travel to the area for geology field trips. But Coalseam doesn't only attract university students and geologists—the area is also of interest to many people because of its abundance of marine fossils. The area was once covered by a Permian sea, abundant with corals, gastropods and other small marine creatures. Evidence of this early life on Earth can be seen in a section of the Irwin River upstream from the main visitor area where narrow bands of limestone line the banks of the river. In the cliff face you can see beautifully preserved specimens of small marine creatures, so well-preserved that you could easily believe they were alive only a few years ago.

Top Everlastings carpet a hillside at Coalseam.

Centre left Carpets of pink schoenias delight visitors in spring.

Left Coal seams have been exposed by erosion along the banks of the Irwin River. *Photos – Ann Storrie*

Right Orange immortelle (*Waitzia acuminata*).
Photo – Ann Storrie

Far right Blue heronsbill (*Erodium cygnorum*).
Photo – Rory Chapple/DEC

Below right Masked woodswallows.

Below far right Crested pigeons.
Photos – Jiri Lochman

Wildflower splendour

For most visitors to Coalseam the attraction is not just fossils or geology, it's the impressive spring wildflower display. The park is among the most botanically diverse areas in WA's northern Wheatbelt region and comes alive after good winter rains. The park lies between the northern sandplain country, where woody heath plants flower profusely in spring, and the arid lands of the Murchison region, where spectacular everlastings bloom each spring. This combination of flowering annuals and perennials are one of WA's botanical highlights.

The park's variety of landforms from flat-topped hills to deeply dissected gullies and alluvial plains create a myriad of habitats for different plant species. On the plateau, a low-nutrient, thin sandplain covering the hard, iron-rich laterite capping supports a highly diverse 'kwongan' heath community. Here you'll find needle bush (*Hakea preissii*), sandplain wattle (*Acacia murrayana*), broom bush (*Melaleuca uncinata*) and graceful honeymyrtle (*Melaleuca radula*). On the Irwin River floodplain, reddish loams have formed from silt and sand washed down from the valley sides and from the upper reaches of the river. These soils are seasonally wet and relatively rich in nutrients. They support a wattle-dominated scrub that includes jam (*Acacia acuminata*) and orange wattle (*Acacia saligna*), with scattered large York gums (*Eucalyptus loxophleba*).

During spring, a carpet of everlastings transforms the usually sparse wattle understorey, covering the valley slopes. Everlastings are short-lived annual herbs, mostly from the daisy family, that dry out to produce papery petals and seeds that are dispersed by the wind. Carpets of pompom heads (*Cephalipterum drummondii*) are mixed with the pinks of lawrencellas and rhodanthes. Parakeelyas (*Calandrinia polyandra*) form a carpet of mauves, in and among which you'll find the delicate flowers of the fringed lily (*Thysanotus manglesianus*).

The attraction in Coalseam's annual wildflower displays lies in the change you see through the season. A whole suite of annuals burst in to flower early in the season but are replaced by late-season flowering species in September and October. Several visits to the park at different times in spring will reveal the full botanical wonder of the park.

Animals

Unlike Coalseam's wildflowers, the park's animal life can be difficult to observe. Mammals are mostly nocturnal and many reptiles can be cryptic. For most visitors, birds are the only wildlife they'll see. Despite this, if you exercise patience and have a sharp eye you may spot mammals such as the echidna (*Tachyglossus aculeatus*), euro (*Macropus robustus*) and red kangaroo (*M. rufus*). Reptiles such as the bobtail (*Tiliqua rugosa*), Gould's sand goanna (*Varanus gouldii*), western blue-tongue (*Tiliqua occipitalis*), western netted dragon (*Ctenophorus reticulatus*), mulga snake (*Pseudechis australis*) and gwardar (*Pseudonaja nuchalis*) are relatively common throughout the park.

A range of different birds can easily be observed at Coalseam. Look

Above Interpretive signage reveals some of Coalseam's history to visitors.

Above right Two hundred million years of geological history are exposed in the cliff towering over the Irwin River.
Photos – Ann Storrie

Below right Graceful honeymyrtle (*Melaleuca radula*).
Photo – Marie Lochman

for both the singing and the spiny-cheeked honeyeaters in areas where there are flowering trees and shrubs. Wedge-tailed eagles soar overhead and peregrine falcons can occasionally be seen along the cliff face in front of the Irwin Lookout. Galahs nest in tree hollows near Miners Campground and red-capped robins can be seen flitting around near ground level. Australian ringnecks (or mallee ringnecks) are common in the park as are nankeen kestrels, black-faced woodswallows, black-faced cuckoo-shrikes and crested and common bronzewings.

Exploring the park

Coalseam Conservation Park is inland from Geraldton, approximately 30 kilometres north-east of Mingenew and 60 kilometres south of Mullewa. If there has been good winter rain, the spring wildflower season from about August through to October is when the park is the most beautiful but also the busiest. Although the park is open year-round, most people avoid the summer months because of the extreme heat.

A number of sites have been developed to provide access to the park's features. Camping is provided at Miners Campground and volunteer campground hosts make visitors welcome over the busy wildflower season. The campground has unpowered sites for both tents and caravans and picnic tables, gas barbecues and toilets are provided. A short walk from the campground is the disused Johnson coal shaft, which was sunk in 1917 but yielded no commercial quantities of coal. There is a viewing platform above the shaft and interpretive signs which explain the history of the site.

For a good perspective of the surrounding landscape head for the Irwin Lookout where you'll enjoy dramatic views of the valley below. A short loop walk links viewing points along the cliff top. Keep an eye out for soaring peregrine falcons and wedge-tailed eagles.

The Riverbend site lies close to the usually dry Irwin River and offers picnic tables, barbecues, toilets and an information shelter with signs covering the area's geology, flora and fauna. Riverbend gets its name from a section of the Irwin River that has carved a striking cliff face into the Victoria Plateau. A cross-section of the underlying rock layers are exposed offering an insight into the interesting geology of the park. The layers of rock span five evolutionary periods and provide valuable visual evidence of how the local landscape was formed. If you explore the river banks downstream from this site, you may find some marine fossils. To find the fossils you'll need to look carefully as they are generally very small—most are only thumbnail size or smaller. Many visitors are surprised that they look like marine creatures we know today but what is most surprising is that they are about 100 kilometres from the sea and more than 250 million years old!

The Fossils picnic area has no formal facilities and is situated on the banks of the Irwin River. Here you can either rest and admire the view or take a stroll along the river.

Rory Chapple works on parks and visitor services projects in the Department of Environment and Conservation's Midwest Regional office. He can be contacted on (08) 9921 5955 or by email (rory.chapple@dec.wa.gov.au).

endangered

by Val English

Rare plant community on massive limestone ridges

A number of distinctive plant communities occur on the limestone-rich soils of the Swan Coastal Plain. One particularly restricted community called '*Melaleuca huegelii – Melaleuca systena* shrublands of limestone ridges' occurs near Perth on shallow soils over limestone or massive Tamala limestone ridges. The community was originally described in a 1994 report about the flora and plant communities of the southern Swan Coastal Plain. It occurs from near Yanchep in the north, to Lake Clifton in the south. This community is a species-rich shrubland of chenille honeymyrtle (*Melaleuca huegelii*), and coastal honeymyrtle (*Melaleuca systena*) often over heath species including parrot bush (*Banksia sessilis*) and spider net grevillea (*Grevillea preissii*). When long unburnt, the community can develop an attractive mossy understorey.

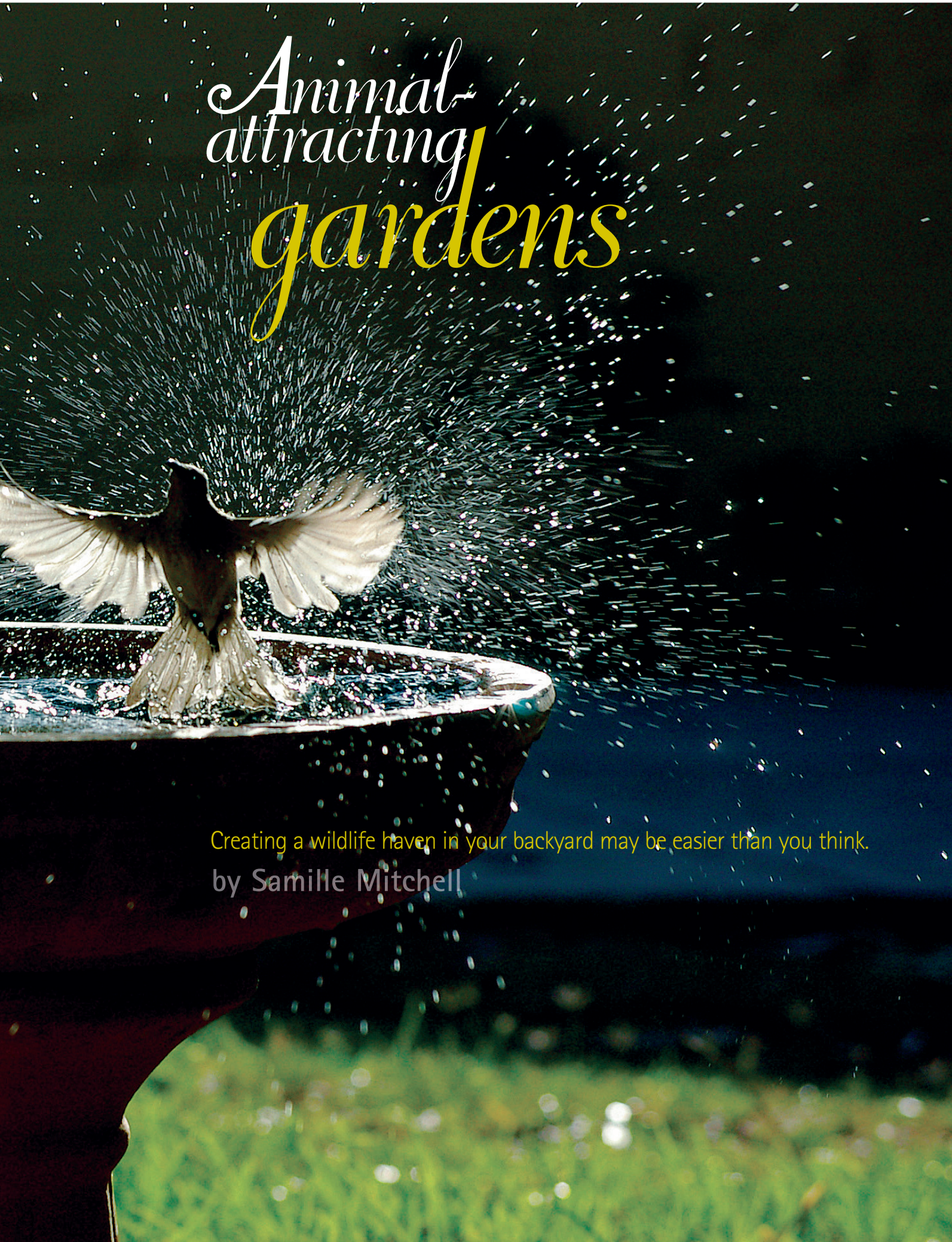
The shrubland is known from less than 150 hectares, and less than a quarter of this area is within secure conservation reserves. A similar but more common plant community is found on lower slopes or in pockets with deeper soil, and is dominated by a different group of species that includes trees or mallees.

The ridges of Tamala limestone on which the community occurs, arise intermittently on middle and late Pleistocene and early Holocene ridges (formed between at least half a million years ago and about the past 10,000 years) that are roughly parallel to the coast on the Swan Coastal Plain. This aeolianite (wind-deposited) limestone is mainly composed of shell fossils and quartz sands that formed ancient dune systems. The dunes have been leached by percolating ground water, and lithified (changed into rock) by water percolating through the shelly sands dissolving the lime content, and then re-depositing it and cementing the grains together.

Limestone is a source of road-making material and has many other uses, and quarrying remains one of the main threats to the community. In addition, the frequency of fires, impact of recreational uses and illegal rubbish dumping are generally increasing as urban areas expand. These additional factors can all lead to degradation of the community by causing changes to its composition, and increasing weed invasion.

The community has been listed as 'endangered' because of its restricted distribution and threats. Actions recommended in a recovery plan that is being implemented include seeking to increase the area of the community held within secure reserves, minimising clearing, improving management of fire and increasing general awareness of the importance of conservation of this limestone ridge community.

Photos by DEC



Animal-attracting gardens

Creating a wildlife haven in your backyard may be easier than you think.

by Samille Mitchell

In a suburban backyard several birds are swooping into the bird bath sending water from their wings in a spray of silvery droplets. Nearby, a butterfly lands on its food-plant, a lizard scurries through the leaf litter and a frog hops from a rock into a shrub-lined pond. It's an idyllic scene. And it's one that can be achieved in most backyards.

While most of us are aware of the benefits of planting native plants in reducing water use, what of the myriad of other joys that native plants bring to our backyards?

Local plants

Native plants not only require less water than their exotic counterparts but also reduce the need for pesticides and herbicides, not to mention eliminating lawn-mowing, which burns fossil-fuels. They also generally require less pruning, which helps reduce green waste going to landfill. However, not all natives are equal. Plants that

grow naturally within Australia can be termed native, but they may not be native to your particular area. For the best environmental benefit, you'll need to plant plants that are native, or local, to your particular area.

This can be tricky if you live deep in the suburbs where the local plants have long gone. Look for any pockets of bushland and try to replicate the plant types. Otherwise you could contact your local council to ask about the nearest bushland with your soil style and request a plant list. Councils may also be able to point you in the direction of a local 'friends' group that could help. Alternatively, contact Greening Australia for a list of species that occur in certain soil types.

Feathered friends

A backyard filled with birds does wonders for the human spirit. It is simply delightful to watch the antics of tiny honeyeaters bathing in a bird bath, take in the melody of magpies calling in the early mornings or perhaps watching willie-wagtails rear their young in a nest.

But even more important than the joys of watching birds is the fact that providing a habitat for birds in an ever-growing urban environment helps them to survive. Without backyard gardens, many bird species would be locally extinct.

In Perth, common native birds you may see in the backyard include the singing honeyeater, brown honeyeater, red wattlebird and Australian ringneck parrot (commonly called the twenty-eight). The red wattlebird is also quite common, and is recogisable from a small pink-red flap of skin, or wattle, behind the eye at the base of the bird's cheek. Australian magpies occur in relatively open gardens (see 'Birds in the garden', *LANDSCOPE*, Summer 2003–04).

Birds not only nurture the human spirit but are also important in pollinating many native plants. Insect-eating birds also help keep insects at bay. So how can you create a bird-attracting garden? Basically, you need to provide three elements—water, shelter and food.

Previous page
Main A brown honeyeater dives in and out of a bird bath.
Photo – Doug Coughran
Insets Motorbike frog (*Litoria moorei*).
Rainbow bee-eater.
Photos – Sallyanne Cousans
Lesser wanderer (*Danaus chrysippus*).
Photo – Daniella Van/Sallyanne Cousans Photography

Top Flowering native garden.
Photo – Jiri Lochman

Left Native garden in full flower.
Photo – Sallyanne Cousans

Top Water sources such as bird-baths are important in attracting birds to gardens.
Photo – Doug Coughran

Above left A silvereye at a bird feeder.
Photo – Sallyanne Cousans

Above right A brown honeyeater feeding on the nectar of an Illyarrie (*Eucalyptus erythrocorys*).
Photo – Doug Coughran

Water is the easy part—a bird bath positioned near overhanging shrubs will attract birds, as will a pond (a pond may also attract frogs—see over page). Birds are most likely to use such a water source if the bath or pond has some overhanging vegetation to provide perches and an access or escape route.

You also need to create a variety of potential habitats or foraging areas, including some open areas, some with shrubs and some with trees, to provide shelter that will attract different types of birds.

Flowering plants such as grevilleas and banksias are good for attracting nectar-feeding birds. Also plant species that attract insects, like wattle or eucalypt species, as insects in turn attract insect-eating birds and are beautiful and diverse in their own right.

It's also worthwhile leaving leaf litter to accumulate in some areas to attract insects and other invertebrates, as well as lizards, which will in turn attract birds who feed on them. Leaving leaf litter also has the added advantage of encouraging the growth of fungi species, which are vital to the ecology in recycling nutrients and in forming mutually beneficial associations with the roots of many plants (see 'Bushfires, fungi and biodiversity' on page 16).

You can also consider providing a feeding station to attract birds but be careful not to supply too much food or to offer it too regularly—birds may come to rely on the food source leaving them vulnerable if you go away. Also, what you feed may not match the birds' natural diet, causing dietary imbalances.

You can attract nectar-feeding birds like honeyeaters and silvereyes with a feeder containing a diluted solution of honey. Use one teaspoon of honey to two tablespoons of water to match the concentration of nectar in bird-pollinated plants. Do not use sugar as it

contains only sucrose and none of the vitamins present in honey and nectar.

You may also like to consider providing nest boxes positioned high in a tree to encourage birds to nest in your garden. Be sure to keep the entrance reasonably small so as to prevent cats from entering.

Butterflies

Unfortunately, the most common butterflies you're likely to see in your backyard are introduced species like the cabbage white and yellow and orange palm darts. However, with some extra effort, you may be able to attract native species too (see 'Butterfly Gardens', *LANDSCOPE*, Winter 2004 and 'Butterflies of the south-west' on page 22).

To encourage a particular butterfly you need to plant nectar plants on which they can feed. Try species like Western Australian waitzias (*Waitzia* spp.), *Grevillea crithmifolia*, coastal banjine (*Pimelea ferruginea*), grasstrees (*Xanthorrhoea* spp.) and plants in the genera *Baeckea, Leptospermum, Melaleuca* and *Thryptomeme*.

Top left Grevilleas attract various bird species like this yellow-throated miner.
Photo – Ann Storrie

Centre left Chequered swallowtail butterfly *(Papilio demoleus).*
Photo – Geoff Walker

Left Striated pardalote.
Photo – Doug Coughran

Top right Little eagle at a Padbury bird-bath.
Photo – Jason Coughran

Top A Major Mitchell cockatoo, likely to be an avairy escapee.

Above Grey butcherbird.
Photos – Doug Coughran

Birds in the home garden – a personal experience by Doug Coughran

Want to attract a diverse range of bird species to your garden and create your own micro ecosystem but you are not quite sure whether it's all worth it because you live in the suburbs? Who would think that you will attract much of a response apart from a few native honeyeaters and the trusty introduced doves? You would be surprised what is around—my garden in Padbury now attracts species like a little eagle, Major Mitchell cockatoo (no doubt an aviary escapee but nevertheless an unexpected visitor) white-tailed black-cockatoos, boobook owls and striated pardalotes to name a few.

So what is the secret to attracting such a diverse and unexpected bird diversity of more than 28 species that visit this Padbury garden? Ask any bush-survival expert the three basic elements for survival and the answer will promptly be shelter, food and water. Applying these three basic elements to your suburban garden can surprise you with the ensuing results. You will be amazed by what species will turn up over time. Most nature-loving gardeners have planted natives to save water and our nutrient-poor Perth soils support a flora-rich diversity that do attract nectar-feeding birds—that's the easy part.

Two of the three basic elements seem to be addressed but what mostly is lacking in most Perth gardens are purpose-placed watering points. We all know water is precious and water conservation is an essential component of our urban dwelling but a miscellany of bird-baths will complete the necessary third element.

The bird-baths should not be placed completely in the open but strategically within and alongside shrubbery to provide timid birds a sense of security by the shelter. Also, by providing several choices of watering points, you will overcome the stress of several species or individuals competing for a single water supply for preening and drinking.

Once several tiers of native flora have established, leaf litter builds, insects, reptiles, amphibians and song birds regularly use the garden, then the predatory birds will be attracted to your micro-ecosystem. They will amuse and amaze you and, who knows, may even de-stress your urban lifestyle.

However, it's much more helpful to the butterflies if you provide plants on which they can breed. These are called the butterfly's food-plants. You may like to consult the Department of Environmental and Conservation Bush Book *Common Butterflies of the South-West* to work out what butterflies are attracted to what plants.

Good butterfly gardens should help larvae and pupae to survive. You can encourage the breeding cycle by having food-plants scattered over the garden. When larvae pupate, they often seek hiding places among the foliage of low shrubs. So by making sure there are masses of dense low shrubs in the garden, or other nooks and crannies where the larvae and pupae can hide, more can survive and emerge as butterflies. Breeding butterflies benefit other animals too—the eggs, larvae and pupae of butterflies are food for birds, lizards wasps and spiders.

Another tip in encouraging butterflies to your garden is to limit the use of insecticides and herbicides, both of which threaten butterfly larvae.

Frogs

Frogs not only delight with their fascinating form but also play an important role in pest control. What's

Above Motorbike frog.
Photo – Sallyanne Cousans

Right Fence skink (*Cryptoblepharus plagiocephalus*).
Photo – Jiri Lochman

more, many frogs have declined across much of the world so anything you can do to provide a new environment will help the survival of these delightful creatures (see 'Frogs in the garden', *LANDSCOPE*, Winter 1993).

The slender tree frog (*Litoria adelaidensis*) and the motorbike frog (*Litoria moorei*) are the most common frog species found in suburban gardens, particularly in greenhouses and ferneries or areas with water, such as ponds.

Frogs' skin needs to be moist so oxygen can diffuse through the frog and be picked up by the blood circulating just underneath. If exposed too long to a dry atmosphere, water will evaporate from the body and the frog will dry out and ultimately die.

As such, it's important to provide a damp, shady and moist environment to attract frog species. The best way of doing this is to install a pond and, as frogs and dragonfly nymphs eat mosquitoes, a pond doesn't necessarily mean a mosquito problem.

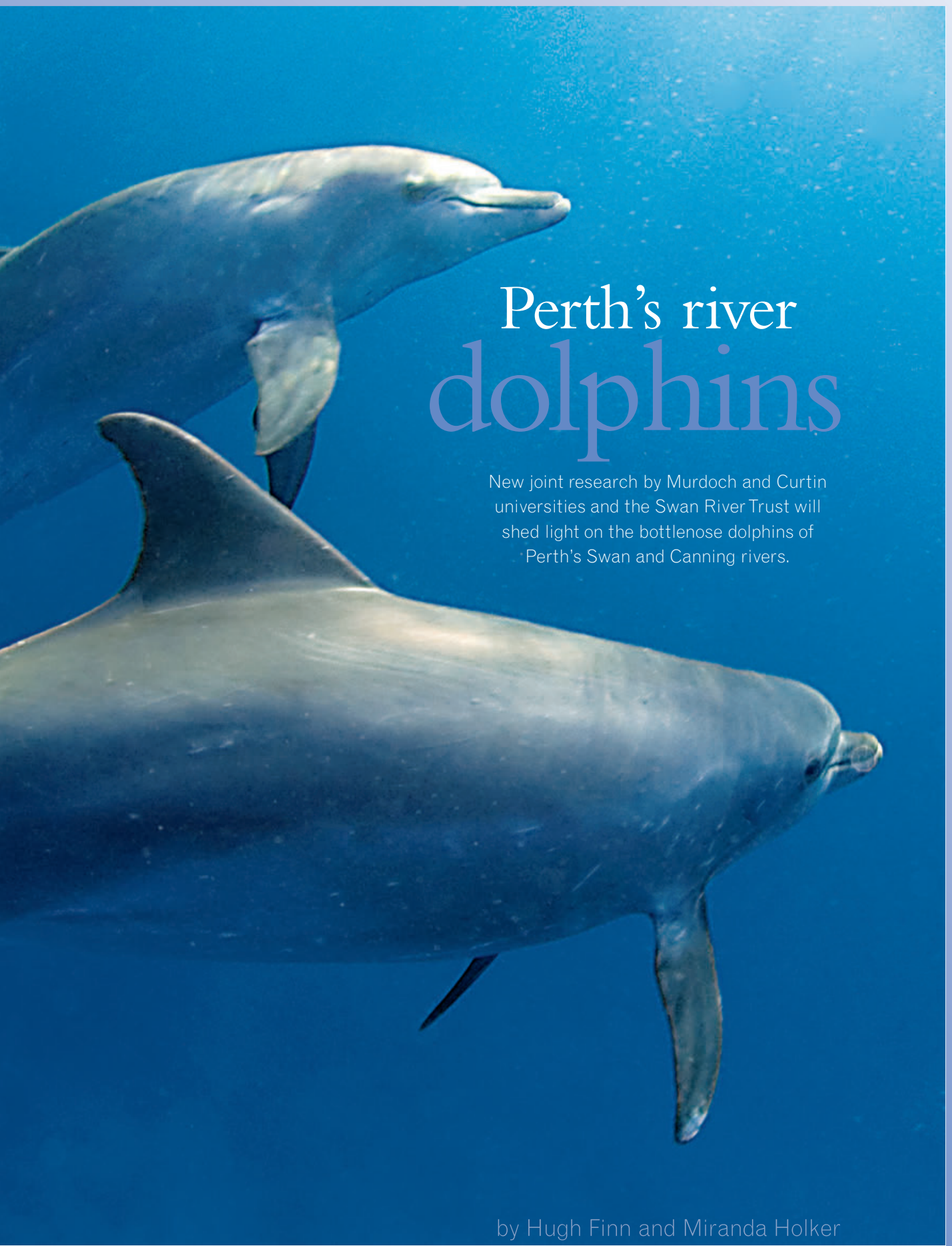
You can create an inexpensive pond from black plastic and old tyres with rocks and reeds around its edges to hide the construction materials. Place the pond in a part sunny, part shady area but not directly under trees. Make sure the pond has shallow edges and a flat base and is at least 50 centimetres deep in one spot.

Also add plants, small logs and rocks around and in the pond to provide more habitat and improve the 'look' of the pond, and add washed sand or gravel to the base. You may also like to include a circulating pump to make the water less appealing for mosquitoes and plant water lilies to help discourage algal blooms.

Because of their permeable skin, frogs are susceptible to pesticides and other chemicals in the garden, so keep chemical use to a minimum. However, as frogs eat most common garden pests, your need for pesticides may be reduced anyway.

While you may be keen on having frogs in the backyard, do not introduce frogs to the garden from other areas—there's no telling what their effect will be on local species.

Samille Mitchell is a Department of Environment and Conservation publications officer and *LANDSCOPE* editor. She can be contacted on (08) 9389 4020 or by email (samille.mitchell@dec.wa.gov.au).



Perth's river dolphins

New joint research by Murdoch and Curtin universities and the Swan River Trust will shed light on the bottlenose dolphins of Perth's Swan and Canning rivers.

by Hugh Finn and Miranda Holker

Bottlenose dolphins (*Tursiops* sp.) are among the most iconic marine species in Western Australia. Occurring along the entire coastline in ecosystems ranging from estuaries to the open ocean, their distribution reflects their ability to adapt to a range of environmental conditions, including the handful of estuaries and bays that occur along the south-western coast of the State.

Few estuarine inhabitants better epitomise the beautiful yet fragile status of the Swan and Canning rivers than the bottlenose dolphins that range along their reaches, which stretch from the Darling Ranges, through the heart of the city before spilling into the ocean at Fremantle.

In many ways dolphins are like a living representation of the river's journey across the Swan Coastal Plain. They move like the river themselves, always in motion, generally running with the tide but content at times to move against the natural flow. They can be seen almost anywhere along the estuary, from the upper reaches beyond Caversham to the mouth of the river. They sit on top of the estuarine food chain, large predators that will consume almost anything the rivers provide.

But the rivers and the dolphins occur alongside a city of more than 1.4 million people. How are Perth's 'river dolphins' faring and how are their lives shaped by living in an estuarine ecosystem that has been—and will be continue to be—profoundly influenced by the city surrounding it?

These questions are the focus of a new research partnership involving researchers from Murdoch University and Curtin University, river managers from the Swan River Trust, and community members from along the river.

A river in trouble

The Swan Canning estuary draws together two river systems—the Swan and the Canning. This is also the name given to one of WA's newest and most unique protected areas—the Swan Canning Riverpark. Officially named in 2006, the riverpark protects part of the Swan and Canning rivers and adjacent public land. The Swan Estuary Marine Park also protects important parts of the Swan River. Both are based on the idea that the estuary should be managed so that future generations can derive the same enjoyment from the rivers as we do today.

But the rivers' future is not assured. While it is often said that the estuary is in trouble, what this means for life in the rivers is often not well understood. Dolphins are one way to tell the story of what this means.

Similar to dolphins in other estuaries and coastal bays, the dolphins inhabiting the Swan Canning estuary form a small 'community' of individuals that are resident year-round and range across a relatively limited area. This makes members of the community vulnerable to the diverse human pressures affecting the estuary.

Understanding pressures

There are two ways to understand the pressures and how they impact on dolphins. The first are the more obvious ones—disturbance from boat traffic, high levels of anthropogenic noise,

Previous page
Main Bottlenose dolphins.
Photo – Shannon Conway/Sallyanne Cousans Photography

Above left Bottlenose dolphin in the Swan River.
Photo – John Goldsmith

Left Perth's river dolphins live side by side with humans.
Photo – Hugh Finn

Above Swan River.
Photo – Len Stewart/Lochman Transparencies

Above right Skimming algae from the surface of the Swan River.
Photo – Dennis Sarson/Lochman Transparencies

Right Canning River Regional Park.
Photo – Brett Dennis/Lochman Transparencies

harassment from over-eager onlookers and entanglement in discarded fishing line. Entanglement is perhaps the single greatest threat to dolphins in the Perth metropolitan area. Researchers from Murdoch University, for example, documented seven instances of entanglement in Cockburn Sound from 1996 to 2003, including five calves. Although adults may survive entanglements, calves often do not and, if they do, often suffer serious injury.

The second set of pressures are more difficult to see, but are no less important in their influence on the lives of dolphins and, in particular, their health and the ecosystem around them. The symptoms of these processes are actually visible and obvious at times—for example, algal blooms and fish deaths—but the causes underlying them invoke questions of chemistry and are therefore more obscure.

The real problem is the nutrients such as nitrogen and phosphorus that enter the estuary from drains, streams and other inputs. The trouble with these nutrients is that, during a summer environment of low river flows, still waters, abundant light and high temperatures, they provide a virtually unending supply of sustenance for the microscopic algae known as phytoplankton.

When phytoplankton grow to excessive abundance and begin to die and degrade, the degradation process uses up all or almost all of the oxygen in the water, leaving large areas absent of oxygen, particularly near the riverbed. Animals living in deoxygenated areas either suffocate in place or move away. In addition, sometimes the phytoplankton themselves are toxic, leading to the phenomenon of harmful algal blooms and associated fish deaths, closures of areas to humans, and nuisance masses of algal scum.

While there is uncertainty about whether algal blooms in the estuary could adversely affect dolphins, evidence from estuaries in other areas of the world indicates that toxic forms of phytoplankton do have a harmful effect on dolphins. And frequent algal blooms inevitably compromise the integrity of an ecosystem, making it less productive, less diverse and less able to sustain dolphins. The populated nature of the Swan Canning catchment means the dolphins may also be exposed to other potentially harmful substances and organisms, which in turn could make them more susceptible to disease.

Dolphins in research spotlight

The deaths of three dolphins in the estuary in the first half of 2009 (one in April and two in June) emphasise the need for careful management of the estuary and its resident dolphins. With the support of the Swan River Trust, work began on an integrated research and community monitoring project that will improve both the scientific basis for dolphin conservation and community engagement in river management. The Swan River Trust, the dedicated Government management agency for the Swan Canning Riverpark, oversees a large and diverse environmental management program, involving water quality monitoring, applied research, and community education and training.

Funding from the Swan River Trust's Swan Canning Research and Innovation Program (SCRIP) is supporting a multi-faceted Murdoch University study. The study is using a biopsy dart system to collect small skin and blubber samples for laboratory analyses. The tissue samples will be tested for the presence of contaminants, including heavy metals and pesticides. The samples will also be integrated into two other ongoing studies, one using stable isotope analysis to examine the structure of the Swan River food chain and the other investigating the population genetics of bottlenose dolphins in south-western WA.

Murdoch and Curtin university researchers are also examining photographs of river dolphins to evaluate the incidence of skin lesions. While there are many possible causes for these lesions and their presence is not necessarily a concern, evidence from other study areas suggest anthropogenic factors such as pollution can contribute to their occurrence. Thus lesions may provide a useful indicator of the health of the dolphin community and, indirectly, the estuary system around them. Similar studies in Cockburn Sound and Bunbury will provide a comparative dataset for the Swan River.

Finally, researchers at the Murdoch University School of Veterinary Medicine are conducting autopsies of deceased dolphins along the south-west of WA to learn more about dolphins and the factors causing disease and mortality. Although disease has recently gained recognition as an important influence in terrestrial wildlife populations, our understanding of disease in dolphins is very limited. Of particular interest is how environmental factors influence the

Above left Bottlenose dolphin
Photo – Eva Boogaard/Lochman Transparencies

Left Toxic blue–green algae.
Photo – Dennis Sarson/Lochman Transparencies

Above Bottlenose dolphin.
Photo – John Kleczkowski/Lochman Transparencies

Right Bottlenose dolphin.
Photo – Rachel Hutton/Swan River Trust

Far right Monitoring river dolphins.
Photo – Miranda Holker/Swan River Trust

incidence of disease. Estuaries present a number of ecological challenges for organisms. They are extremely dynamic, with salinity and temperature changing seasonally and sometimes with each tidal cycle. For dolphins, one challenge of living in an estuary may be greater exposure to potentially harmful pathogens such as viruses, fungi and bacteria.

Perth's river dolphins

The SCRIP project is not the first to focus on the dolphins of the Swan River. During the course of his PhD research with dolphins in Cockburn Sound, Murdoch University researcher Hugh Finn studied the Swan River population from 2001 to 2003. Findings from his work form the basis for our understanding of dolphin ecology in the Swan Canning Riverpark.

Hugh photographed the distinctive dorsal fin markings to identify individual dolphins in the Swan River. Data was also collected on group size, behaviour, and habitat. Studying known dolphins provided information on how dolphins select habitats and move through the rivers.

Although more than 40 dolphins were observed, a group of 18 dolphins accounted for the vast majority of sightings and likely constitutes the resident community for the Swan River. Members of this resident community use the estuary on a daily or near-daily basis, often travelling from Fremantle up river to forage for fish along the edges of the lower reaches, around moorings and boat pens, and in the deeper basins in the middle reaches of the river. This community includes several adult females with dependent calves, one or two 'alliances' of tightly bonded adult males, and a large group of sociable youngsters.

It is possible most, if not all, of the resident community were raised in the Swan River, as local knowledge of seasonal conditions, tidal movements and prey patterns is likely to underpin dolphin ecology in the estuary. Researchers hope to answer this question by comparing the relatedness of the Swan and Canning rivers' resident dolphins with those of other dolphins in the Perth metropolitan area, once a larger south-western WA genetics project is complete.

An estuarine ecology

Life for the river dolphins—particularly females with calves—centres mostly on finding food and their time in the estuary is largely spent foraging for fish. A dolphin's diet is broad and may include finfish such as mullet, whiting, bream and herring, and cephalopods such as octopus.

Dolphins considered as Swan River residents actually spend about half their lives in the ocean outside of the estuary, and their movement patterns into and

Above Perth's river dolphins live close to riverside homes.
Photo – John Goldsmith

Above right The River Guardians Dolphin Watch project enlists the community in monitoring river dolphins.
Photo – Miranda Holker/Swan River Trust

Below right Dolphins forage around Port Fremantle.
Photo – Hugh Finn

around the estuary are probably linked to tidal patterns. As these dolphins are really 'part-time' estuary residents, they are also likely to feed in marine habitats such as Owen Anchorage and the seagrass meadows on Parmelia and Success banks between Cockburn Sound and Fremantle. The stable isotope research may shed light on the extent to which the river dolphins are associated with marine and estuarine food chains.

In the estuary, dolphins tend to spend most of their time in the lower to middle reaches of the Swan River and, in the Canning River, following tidal movement upstream before turning back towards the river mouth when the tide turns. However, some dolphins at least occasionally range into the upper reaches of the Swan River, sometimes as far as Caversham—more than 40 kilometres from the river mouth.

The ecology of the river dolphins also reflects the diversity of habitats available to them in the estuary. The river edges and man-made structures such as moorings, boat pens and the Fremantle Port are important foraging areas, while deeper parts of the river like the Melville waters are used for resting. The northern end of the Fremantle Port is particularly important, with dolphins foraging around ships and tugs and stopping to rest and socialise on their way back down the river. The Swan River is, in many ways, a very human river and the human presence provides both problems and opportunities.

Community

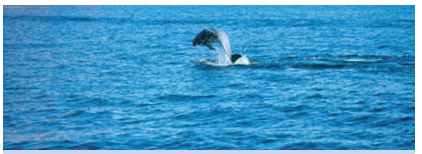
For the first time, members of the Perth community can get involved with the river dolphins by taking part in the Swan River Trust's River Guardians *Dolphin Watch* monitoring project. While previous research focused on the lower and middle reaches of the Swan River, *Dolphin Watch* is gathering information about dolphins in the Canning River and the upper reaches of the Swan River. These areas are also the parts of the estuary most affected by algal blooms and deoxygenation, adding to the value of studying dolphins in these areas.

Dolphin Watch is open to members of River Guardians, the Swan River Trust's community engagement program which connects interested people with the Swan and Canning rivers. Training is provided before volunteers take to the rivers, where they record the time, date, and location of dolphin sightings, the number of dolphins sighted, whether a calf was present, which way the dolphins were travelling, and any noticeable behaviour.

Volunteers are trained in basic observation techniques and how to 'observe but not disturb', in keeping with regulations in the *Wildlife Conservation Act 1950* and Department of Environment and Conservation protocols for marine mammal interaction. This includes staying more than 100 metres away from dolphins and taking measures to avoid disturbing animals, such as turning boat motors off. Shore-based observations are ideal as volunteers can observe animals closely without the dolphins knowing they are present.

As well as tapping into the wealth of knowledge in the community, the project will also increase the knowledge and awareness members have of issues affecting the Swan and Canning rivers. *Dolphin Watch* volunteers are making a valuable contribution to scientific research, while gaining skills and networking with others involved in caring for the rivers.

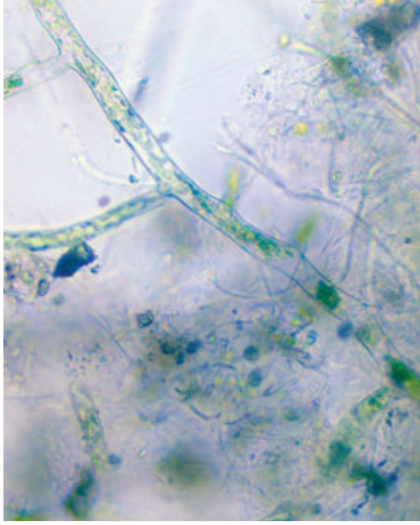
It is free to become a River Guardian. To find out more visit www.riverguardians.com or call the Swan River Trust on (08) 9278 0900.



Dr Hugh Finn is a postdoctoral fellow at Murdoch University's Animal Biology School of Biological Sciences and Biotechnology.
Miranda Holker is a Swan River Trust publications officer and can be contacted on (08) 9278 0900 or by email (miranda.holker@dec.wa.gov.au).

LIVING FOSSILS AT LAKE THETIS

BY CATHERINE JACK



New visitor infrastructure at Lake Thetis near Cervantes enhances the experience for visitors who come here to see stromatolites—examples of the earliest forms of life on Earth.

In the beachside landscape of Nambung National Park, it is easy to feel that you have been transported back in time amid the flowing sand dunes and the surreal limestone structures that emerge from the dunes. However, the Pinnacles are not the only natural wonder to intrigue your senses.

On the outskirts of the park, just over a kilometre from the centre of the Cervantes town site, lies a saline lake home to a threatened ecological community of rare living fossils called stromatolites. Examples of the first forms of life on Earth, stromatolites are rock-like structures formed by layers of cynobacteria on their surface which deposit calcium, cementing sediment into the bulbous structures.

For a long time these living fossils were thought to have only existed in ancient times, until they were discovered in isolated, highly saline ecosystems such as Lake Thetis. Other examples of stromatolites in Western Australia can be found at Hamelin Pool in Shark Bay and Lake Clifton, south of Perth. The earliest examples of these rocky-looking structures are found in the Pilbara in Western Australia and are dated to 3,370 million years old.

Windows to the past

The University of NSW has found stromatolites to be a great model for studying the origins and evolution of life on our planet, and perhaps other planets too. Stromatolite studies at the university have looked at some of the fundamental questions of how life evolved—what is the mechanism that leads to life, how and when did life arise on Earth and did it happen elsewhere in the solar system or universe?

The university's studies of stromatolite communities at Shark Bay revealed that stromatolites have remarkable biodiversity values, with more than 100 species of bacteria in each form. This unexpected diversity suggests that Earth was teeming with life when the first stromatolites were forming 3.5 billion years ago, which in turn suggests that evolution must have been occurring for tens of millions of years before this—a finding that is making scientists re-think figures on when life first occurred on Earth.

Due to their makeup of cyanobacteria, stromatolites played a more significant role in changing the Earth than any other organism. These photosynthetic bacteria converted carbon dioxide into oxygen on a massive scale, changing the composition of the atmosphere and causing an oxygen catastrophe that would have killed off many of the organisms alive at the time, for which oxygen was poisonous. While poisonous to many organisms, the oxygen enabled animals to survive, which in turn provided food for our early ancestors.

Previous page
Main New visitor infrastructure protects the stromatolites at Lake Thetis.
Photo – Ann Storrie
Inset Cyanobacteria.
Photo – Clay Bryce/Lochman Transparencies

Left Interpretive signage explains the natural environment.
Photo – Ann Storrie

Above Stromatolites at Lake Thetis.
Photo – Jiri Lochman

Lake life

Stomatolites have a growth rate of about one to three centimetres per 100 years, making the size of the Lake Thetis examples all the more intriguing. It is estimated that Lake Thetis was isolated from the sea about 4,800 years ago when sea levels dropped and coastal dunes formed around the lake. The stromatolites growing in the lake are estimated to be about 3,500 years old. Fed by rainfall and ground water input, Lake Thetis has no connecting rivers or creeks and is almost one-and-a-half times saltier than sea water. However, while the water is alkaline and nutrient poor, it supports a range of life in an ideal environment for bottom-dwelling microbial communities. The lake contains some small fish, amphipods and a few crustacean species adapted to living in highly saline environments.

There are other bacterial communities living at Lake Thetis, including 'blister' (crenulate) mats of cyanobacteria found growing on the margins of the lake in the flood zone and a pink-purple coloured substance with cottage cheese consistency known as a flocculent mat. These bacterial communities, especially those found on the surrounding flood plain, are sensitive and easily disturbed.

Exploring the lake

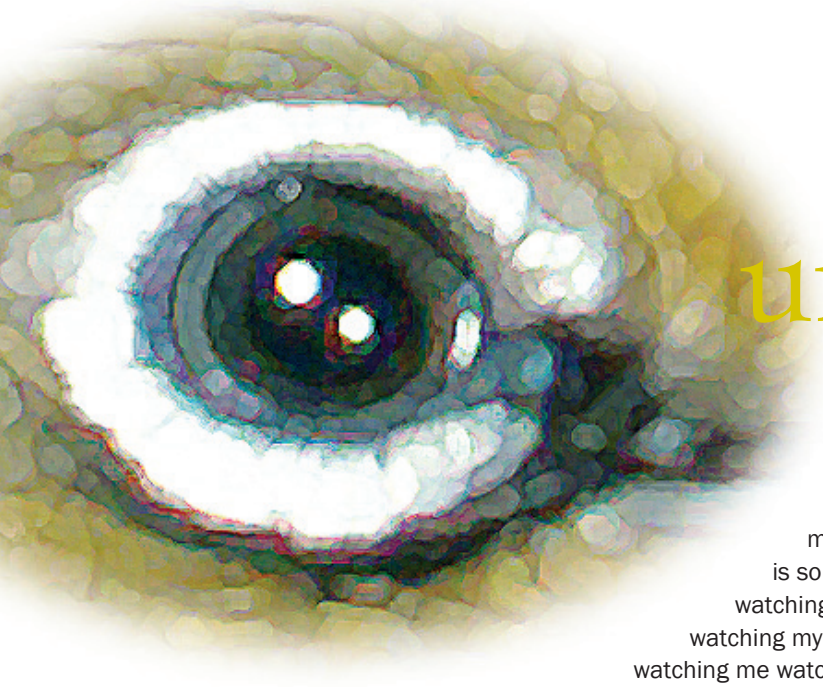
The Lake Thetis stromatolites are considered to be some of the best examples of their kind in the world and, for many years, have attracted high numbers of local and international visitors, along with geologists and other academics. However, over time disturbance from visitors driving up to the water's edge to take a stroll around the stromatolites began to degrade the shoreline and surrounding area.

In 2007, a change in tenure officially included the lake into Nambung National Park. As the visitors to the area increased, damage to the stromatolites became the catalyst for a massive restoration project completed by the Department of Environment and Conservation, in conjunction with the Northern Agricultural Catchments Council and the Federal Government.

The three-year Coastal Assessment and Restoration project, of which the Lake Thetis project was the main milestone, was completed in 2009. The restoration of Lake Thetis features a new car park taking vehicles away from the lake shore, a low boardwalk that enables visitors to get up close to the stromatolites without disturbing the fragile environment, a 1.5-kilometre interpretive walk trail which winds through the various vegetation types and towards some of the best examples of stromatolites, and a lookout with views over the serene lake and surrounding coastal environment.

The ancient forms are most easily visible during the drier months when the water level is at its lowest with the best examples found at the south-western edge of the shoreline. If you are feeling energetic and want to explore more of the region, a longer beach and bush walk trail is available. The walk stretches between Thirsty Point and Hansen Bay with a detour into Lake Thetis. Visit during wildflower season and you will be blessed with a stunning display of colour on your journey.

Catherine Jack is a Department of Environment and Conservation communication project officer and can be contacted on (08) 9389 4009 or by email (catherine.jack@dec.wa.gov.au).



urban antics

by John Hunter

A sense of place...

It's still the middle of winter. The sun rises over the Darling Ranges at about 7.20am when there are no clouds and pokes me in the eye while I lay in bed. I'm lucky, in the summer I'll still wake up with the sun just after 5am. Think of all the daylight I'm saving.

At this time of the year the sun's rays highlight bits of dust in the air as they float and cavort above my head... thank goodness they are just specs, or these microscopic tree trunks might do some real damage.

The rain-drenched decking is already starting to waft shafts of steam into the still cold air and in the distance a pole-top kookaburra glares Earthwards... it'll be slim pickings for it this morning. Out in the backyard, the steaming heavily mulched ground under six productive olive trees has inched its way down the slope and both fruit and leaf litter ooze over a sandstone retaining wall. Now I know how ancient ruins end up below ground.

My exotic olive trees are loaded and I've already taken off 20 jars. When the fruits are on the ground, however, crows love them, my shitzu loves them, and even doves eat the 'littlies' and poo ink on my limestone wall. Then at night, the town rats play footy with them in the ceiling... aw, what the heck... such is life.

A flicker
catches
my eye, there
is something
watching me,
watching my movement,
watching me watching. Through a maze of pale blue-green leaves at eye-level, I see an eye in a white circle. It's too early for games and my peepers are still cobwebbed by a prior night of indulgence. Another movement... huh... I see you now you little twerp, a 'greenie'. Flashes of childhood escapades rage forth. The birds are back, or is it that I have been away doing other things?

These tiny birds of no fixed address are the common nomads of our gardens.

Also known as grey-breasted white-eye (*Zestrops lateralis*) or silvereye... or greenie, they are at times considered a pest to some that have gardens of fruit and flowering shrubs.

While they eat just about all the insects, bugs and small spiders you could name, plus the nectar and fruit of native and cultivated plants, they also enjoy, in relevant areas, a diet of the dreaded potato moth larvae, midges and scale insects.

Beyond backyards, silvereyes mainly frequent scrub, thickets and heaths especially in coastal dunes and around water. They also frequent eucalypt forest and woodlands with good understorey. Found in greater numbers in the south-west of the State, they travel north each autumn. Some reach as far as their northern boundary of Shark Bay, but move south again in late winter to breed.

I think it must have been the blaspheming of my grandad that made me aware of the greenie in Subiaco during the 1940s. While he was doing his utmost to protect the grapes on his shade-house, I was enjoying an up-close and personal experience, an awakening to nature.

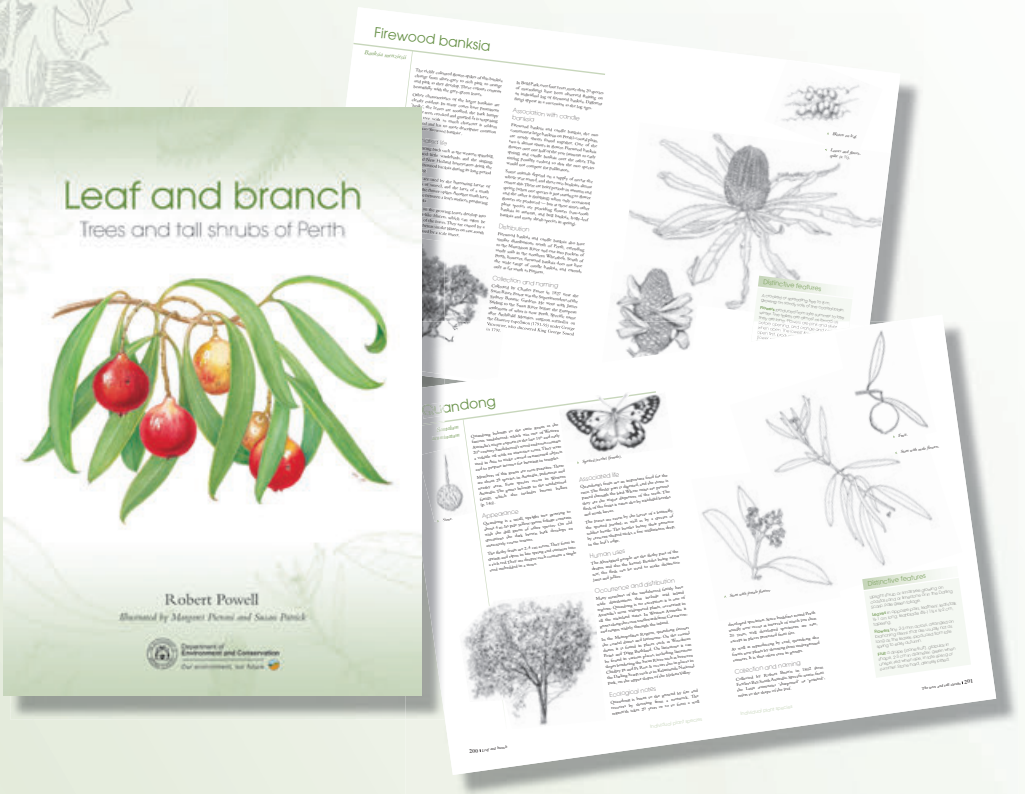
During my adolescence in Scarborough, our street gang of after-school friends would eagerly punish each other with paddy melon fights in a nearby drainage thicket of flowering melaleucas. Then the greenies would arrive. As sad as it wasn't in those days, it was open warfare to see who could bring down a greenie with a paddy melon.

And now as I stand and stare at this little greenie with its white eye-ring and fine olive-green feathers, I can't help wonder... do you recognise me? Thanks for the memories and, by the way, eat all you want.

DID YOU KNOW?

- The silvereye is usually recognised by a persistent contact call of 'psip' and 'peeeh, peeeh, peeeh', and a spirited canary-like song. They also mimic the calls of some swallows, cuckoos, honeyeaters and fantails.
- The silvereyes in WA have a more yellowish colouring in their back feathers, rather than grey like elsewhere.
- Current research is using silvereyes to see whether urban noise pollution affects song development, learning and evolution in native birds.

Discover Perth's trees and tall shrubs



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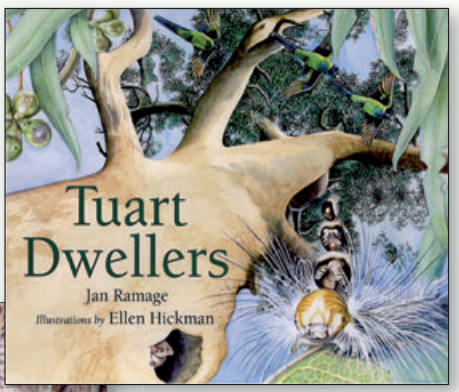

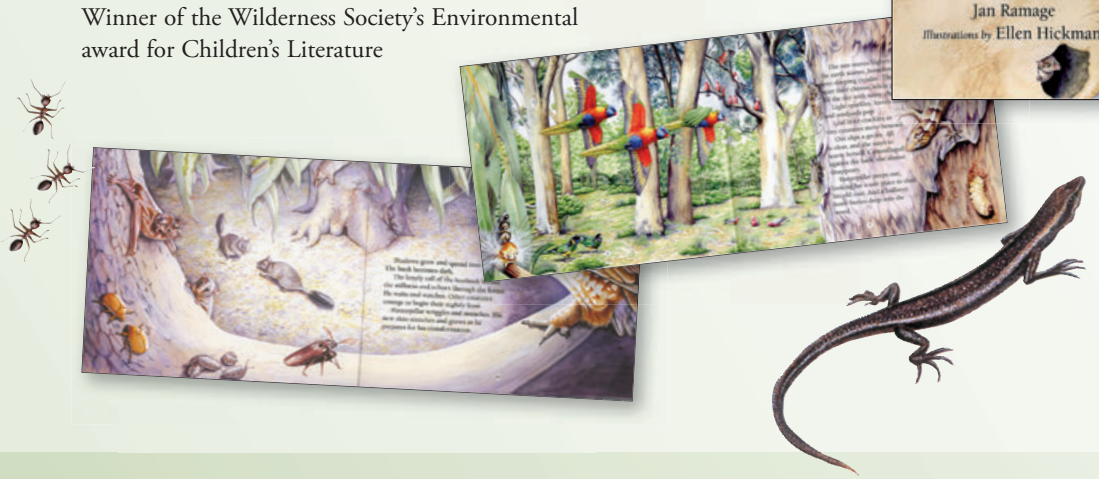

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