

WA's conservation, parks and wildlife magazine

LANDSCOPE

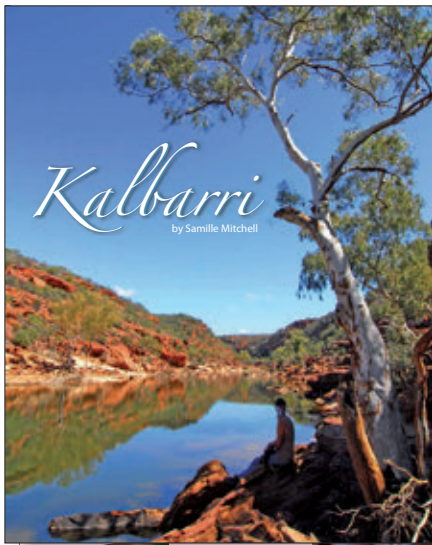
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Coral castles

Nature of the
Nullarbor

Marvellous
mangroves



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

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

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

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

Kalbarri

RRP \$29.95



Kalbarri banksias

Kalbarri banksias are the most common of the banksias in the area. They are a large, bushy shrub with a dense, rounded habit. The flowers are a vibrant pink and are borne in a terminal panicle. The banksias are a member of the Proteaceae family and are native to the region.

Common or unusual flora species

Kalbarri orchids

There are several species of orchids in the area, including the Kalbarri orchid. These orchids are often found in the same habitats as the banksias and are a beautiful addition to the local flora.



Reptiles and amphibians

Reptiles and amphibians are an important part of the Kalbarri ecosystem. The area is home to several species of snakes, lizards, and frogs, many of which are found nowhere else in the world.



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Department of Environment and Conservation

Our environment, our future



Brent Johnson



Leanne O'Rourke

contributors

Brent Johnson is a principal technical officer for the Department of Environment and Conservation's (DEC's) Science Division. Based at the Wildlife Research Centre in Woodvale, he has been involved in numerous fauna research projects since starting with the department in 1988. These include fire ecology studies, timber harvesting

impacts, threatened species recovery plans, *Western Shield* fauna translocations and meso-predator release research. He has worked extensively on the recovery of the chuditch since 1996. He has also taken part in biological surveys, including investigation into fauna on the Gngangara Mound as part of the Gngangara Sustainability Strategy. He is currently

preparing to undertake a major project aiming to eradicate introduced rodents from several islands off the Western Australian coast.

Leanne O'Rourke joined DEC as a media relations officer in 2008. Before this, with a Bachelor of Arts in Broadcasting from the Western Australian Academy of Performing Arts, she worked in communications, media and marketing for the Western Australian Government, did a stint as a broadcast journalist at BBC World News in London, worked as a researcher for ABC TV in Perth and produced documentaries and radio packages for Radio National and Triple J. Leanne enjoys combining her passion for writing with the opportunity to learn from DEC staff about WA's natural environment and participate in field trips to fascinating destinations such as the Nullarbor.

Penny Hussey taught high school biology in England, Ghana and Australia, before joining the then Department of Conservation and Land Management (now DEC) as executive officer for the Roadside Conservation Committee. She started the *Land for Wildlife* program in 1997 and enjoys working with landowners who are passionate about conserving native flora and fauna on their properties. She says *Land for Wildlife* members play a critical role in helping conserve the State's native species—flora, fauna and fungi.

Maria Duthie has recently retired as DEC's design and production coordinator after 15 years of working with the department's graphic design team. During this time she has designed all manner of projects, including books, *LANDSCOPE* magazine articles, brochures, reports and logos. Major design projects have included the books *Threatened animals of Western Australia* and *Flora of the South West* volumes 1 and 2. Maria has particularly enjoyed working on *LANDSCOPE* magazine, for which she has designed countless articles, including the article in this edition 'Coral castles and their inhabitants'.



Penny Hussey



Maria Duthie

editor's letter

I have had the good fortune and pleasure to have been associated in one way or another with this magazine for 20 years. And in that time, I've read every article that has been published in *LANDSCOPE*.

While I've read every article, I'm at times hard-pressed to remember exactly when we published feature articles on particular subjects, such as the dibbler (Summer 1998–99) or the Walpole Wilderness Area (Winter 2008).

If my memory wasn't up to scratch, my only recourse was to thumb through past issues of *LANDSCOPE* until I found what I was looking for. The problem was that we did not have a comprehensive index system for the magazine that would enable readers to easily find previously published articles.

That has now changed: we've recently launched a new online search facility to help you and other *LANDSCOPE* readers to locate *LANDSCOPE* articles.

Accessible from the Department of Environment and Conservation's (DEC's) website homepage, the electronic database enables users to enter keywords to find a list of *LANDSCOPE* stories by subject. Users can then go directly to the relevant story from their existing *LANDSCOPE* collections or order back copies from DEC.

The search facility includes all *LANDSCOPE* feature articles since the magazine's inception in 1985.

To access the *LANDSCOPE* online database, click on the *LANDSCOPE* icon at the bottom, left-hand side of the DEC homepage (www.dec.gov.au). When the catalogue opens, key in the relevant subject in the keyword box at the top of the screen. You'll then be presented with a list of relevant articles, including their title, magazine volume number, author and a short subject description.

We believe you'll find it invaluable in looking up particular animals, plants or reserves, or getting background information on special places you're planning on visiting in this awesomely magnificent State.

One such special place is the Nullarbor region, which straddles the Western–South Australian border. In 'Nature of the Nullarbor' in this issue of *LANDSCOPE*, Leanne O'Rourke travels to this iconic sweeping plain with some of DEC's leading nature conservation specialists, scientists and regional ecologists to observe and report on the features and rich biodiversity of this region.

Closer to home for most of us, Perth's native trees are of enormous value to biodiversity. In 'Perth's trees and tall shrubs', Robert Powell examines what trees and shrubs occur in the region naturally and their benefits to other forms of life.

That's just a short preview of the feature articles you'll find in this issue of *LANDSCOPE*. Enjoy the read and we'll see you again in the autumn.

Ron Kawalilak
Executive Editor

also contributing...

Jeff Short, Megan Stone, Ann Storrie, Robert Powell, John Huisman, Alan Kendrick, Michael Rule, Anne Cochrane, Melanie Smith, John Asher, John Hunter and Samille Mitchell.

Features



Cover illustration by Philippa Nikulinsky

The red-tailed phascogale (*Phascogale calura*) grows to 50 grams and is characterised by a brush tail with reddish colouring at the base. These tiny creatures were once widespread across southern and central Australia, but land clearing and introduced animal predation have reduced their populations to a few bushland remnants in Western Australia's Wheatbelt. They are ranked 'endangered'. Red-tailed phascogales are nocturnal and, after a flurry of activity during the mating season in early July, all male phascogales die from stress.

Back cover photo by Michael James/DEC
Dryandra Woodland

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An international project has resulted in the safekeeping of seeds from 1,100 Western Australian plant species.

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Department of Environment and Conservation

Our environment, our future 



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Saving plant diversity, one seed at a time

The first milestone in an international seed collection project has been reached after eight years, resulting in the safekeeping of seeds from 1,100 Western Australian plant species. What is the significance of the project and what happens from here? by Anne Cochrane

Safekeeping native seeds has been a key focus of Western Australia's international partnership with the Royal Botanic Gardens' Millennium Seed Bank (MSB) Project in Kew, the United Kingdom, since 2001 (see 'Our frozen future', *LANDSCOPE*, Winter 2001). The Department of Environment and Conservation's (DEC's) participation in the project draws to a close in December 2009 after the collection and storage of seeds of more than 1,100 native plant species from across Western Australia. DEC's conservation seed bank, the Threatened Flora Seed Centre, has stored seeds in Perth and sent duplicate samples of each collection to the UK for safekeeping. Currently, one third of all collections held in DEC's seed bank are duplicated at the MSB. The Botanic Gardens and Parks Authority in Perth, and conservation agencies and botanic gardens across Australia, have also taken part in the international project. The goal of securing 10 per cent of the world's dry-land flora in seed banks by 2010 has been achieved, with Australian

conservation organisations contributing seeds of one third of the total numbers of banked species.

Project results

In WA, DEC's seed collection and storage efforts have assisted in safeguarding some of our most iconic flora species and helped to secure long-term commitment to seed conservation in the State. Evidence of this commitment is demonstrated by State Government funding for a large, modern seed conservation facility in DEC's Biodiversity Science Centre and Western Australian Herbarium building in Kensington, due for completion in mid-2010. This state-of-the-art seed conservation facility will house more than 3,000 of the Threatened Flora Seed Centre's collections, representing samples of about 1,000 of WA's rarest, most threatened and poorly known

Right Fairall's honeysuckle (*Lambertia fairallii*) is threatened by *Phytophthora* dieback in Stirling Range National Park.
Photo - Todd Erickson







Left Collecting seed of the poorly known *Banksia strictifolia* for banking.
Photo – Anne Cochrane/DEC

Below Mount Lesueur grevillea (*Grevillea batrachioides*) is known from a single population in Lesueur National Park.
Photo – Andrew Crawford/DEC

across a species' geographic range. It aims to consolidate existing collections to ensure there is adequate material available for current and future flora recovery actions. By 2020 the department aims to have stored 90 per cent of Western Australian seed-bearing threatened and rare plant species across their geographic range in the seed bank, and conserved at least one population of 50 per cent of WA's poorly known flora. In addition to conservation-listed flora, seed will be collected from species that occur in threatened ecological communities and the eight national biodiversity hotspots in WA, in particular where management plans specify seed conservation and recovery.

All human life depends on plants, and most flowering plants depend on seeds for regeneration. Saving seeds helps save plant diversity. The Western Australian-MSB partnership has helped achieve a secure future for many of the State's conservation-listed flora. The important challenge in the future will be to mobilise sufficient resources in WA to continue seed collection and research, and to enable these seeds to underpin wild plant survival through species reintroduction and habitat restoration.

taxa. DEC's seed resources have also been used in helping populations of threatened flora to recover, and in research that supports the collections. The collections have also helped DEC meet both goals of Target 8 of the Global Strategy for Plant Conservation—that is, having 60 per cent of threatened flora in *ex situ* collections and 10 per cent used in recovery or restoration.

The Western Australian-MSB partnership has also helped raise awareness of plant conservation issues across Australia, and has helped galvanise additional funding for seed conservation and research at DEC. In addition, DEC has provided technical input into the revised edition of the Australian Network for Plant Conservation's *Plant Germplasm Conservation in Australia*. Through the collecting efforts and the research of DEC conservation geneticist David Coates, seed banking has become recognised as of utmost importance in saving plant genetic diversity for

future generations. Seeds secured from now-extinct populations appear to be genetically distinct from plants of the same species still alive in the wild. Seed by seed, we are saving plant diversity for future generations.

Where to now?

DEC will now focus on increasing the genetic diversity of the seed holdings by making collections from



Anne Cochrane is a senior research scientist working with the Department of Environment and Conservation in Albany. She manages the Threatened Flora Seed Centre and can be contacted on (08) 9842 4500 or by email (anne.cochrane@dec.wa.gov.au).



Spotted surprise: the chuditch comeback

The recent discovery of a chuditch near Perth has renewed hopes that this threatened animal is making a comeback. New sightings reveal the mammal may not only be returning to the Perth area but also to other parts of the State.

by Brent Johnson
and Samille Mitchell

Department of Environment and Conservation (DEC) wildlife officer Rick Dawson often receives calls from people who think they've seen threatened wildlife. So when he received a call from a resident of Wandi, Kwinana, to report a chuditch (*Dasyurus geoffroyii*) sighting, Rick advised that it was probably a bandicoot. After all, there had been no officially recorded captures of live chuditch in the Perth metropolitan area for years. Clearing for urban expansion and pressure from introduced predators had long wiped out any significant populations of this species on the Swan Coastal Plain.

But the resident was persistent, saying the small animal looked a bit like a cat and had white spots. Now this was more promising. Rick asked the resident to video the animal and send in the footage. By encouraging the animal with mince each night (which replaced the cat food that had initially lured the animal to the backyard), the resident was able to capture video footage. And sure enough, the mystery animal was a chuditch, though it bore a terrible leg wound.

Rick provided a trap and the resident soon caught the wounded animal. Rick was there first thing in the morning to collect it and took it straight to the vets at Perth Zoo. Unfortunately the

chuditch's wound was so badly infected that the animal had to be euthanased. The vets suspected that a rabbit trap had caused the injury.

While disappointing to lose the animal, this find and several others have sparked new hope that chuditch populations may be returning to former haunts in Western Australian bushland.

What's a chuditch?

The chuditch is a nocturnal native carnivorous marsupial with soft, white-spotted brown fur, large rounded ears, a pointed muzzle and large dark eyes. Its tail is about three-quarters of the head and body length and is black towards the end. Females are smaller than males, weighing 900 grams on average compared to 1,300 grams for males. Chuditch live for about two to three years in the wild.

Chuditch once occurred over nearly 70 per cent of Australia but land clearing, changes to fire regimes, predation, persecution (due to their liking for chooks) and possibly disease had reduced its range to the forests of south-west Australia with low numbers in the woodland and mallee areas of the Wheatbelt and south coast. This equates to about five per cent of the former range—a very significant reduction.



They are mostly solitary animals, which live in hollow logs, bird nests, rock crevices and burrows. Studies have revealed chuditch will use about 180 refuge sites within their home range during a year.

Chuditch eat a big range of invertebrates, small mammals, birds, lizards and occasionally fruits of forest plants. They also scavenge carrion such as road kill and seek food scraps from campsites and rubbish bins. After a very short pregnancy of about 18 days, females give birth to between two and six young, which remain in the pouch for about 60 days and then live in the den. They are fully weaned by four to five months of age when they then leave the den to seek out unoccupied territory. Juvenile mortality is thought to be very high at this early stage as they are susceptible to factors such as predation and starvation.

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Main Chuditch.
 Photo – Jiri Lochman

Left Hollow logs provide chuditch habitat.
 Photo – Len Stewart/Lochman
 Transparencies





Above Chuditch young.
Photo – Jiri Lochman

Return of the chuditch

In some areas, chuditch are one of the big winners from DEC's *Western Shield* project. This ambitious and wide-ranging project has involved ongoing fox baiting in national parks and reserves across the State, as well as the translocation of native animals back to their former range in some places. Chuditch translocations have been particularly successful with more than 300 captive-bred individuals released into selected parts of their former distribution (see 'Those spotted things', *LANDSCOPE*, Spring 1999).

The example of the Wandii chuditch is one of several exciting records of this animal returning to unpredicted locations. In recent times, chuditch have been recorded at Herne Hill, Midland, Ellenbrook, Gnaragarra and near Perth Airport, suggesting that they may once again be returning to the coastal plain. Sadly, most of these urban records involve chuditch killed by motor vehicles, yet they are still good records of chuditch presence.

Recently on Mount Gibson station, some 400 kilometres north-

east of Perth, a DEC employee was undertaking an early morning feral cat survey when an animal raced across the track. Dismounting from his quad bike, technical officer Neil Hamilton followed the animal to a nearby hollow log and was able to confirm the presence of a chuditch. This sighting represented a significant expansion from the core population in the south-west corner of the State.

In recent years, researchers have also recorded a number of chuditch sightings and captures on the eastern edge of the Wheatbelt, in a line from Mukinbudin to Ravensthorpe. The Ravensthorpe population appears quite sizable. Several captures of individuals from the northern Ravensthorpe Range and Fitzgerald River National Park indicate that they may exist throughout the south-eastern Wheatbelt zone. Further east, large tracts of bushland including the Jaurdi and Jilbadji conservation areas and several other reserves in the Goldfields may yield chuditch records if they are surveyed in the future.

The western woodlands to the east of the vermin-proof fence may also

contain good numbers of chuditch. Recently, University of Western Australia student Kelly Rayner completed an ecological study on chuditch found within an active nickel mining lease at Forrestania approximately 450 kilometres east of Perth. With support from DEC and Western Areas Nickel, Kelly has tracked a number of radio-collared chuditch and investigated their movement and habitat use within the mining lease. They appear quite able to co-exist with the mining infrastructure and some individuals have been found living under accommodation units and within drill core sample storage areas. The chuditch may well be attracted by the presence of prey items like house mice and abundant invertebrates also drawn to the mine camp.

The most recent easternmost record was a chuditch found dead on the road near Salmon Gums north of



Above Measuring a chuditch in Kalbarri National Park.

Photo – Brent Johnson/DEC

Left Chuditch in a cage at Perth Zoo.

Photo – Jiri Lochman



Esperance in 2008. This also confirms their presence in the south-east of Western Australia although an intensive search of the nearby unbaited Dundas Nature Reserve east of Norseman in 2009 failed to record any chuditch.

To the north, chuditch were translocated into Kalbarri National Park in 2000 and monitoring since has revealed that they have migrated into the rugged gorge country along the Murchison River. (See 'High hopes for Kalbarri wildlife', *LANDSCOPE*, Spring 2006). Captures and sightings from the outskirts of the Kalbarri township have also confirmed the movement of animals to the west. This population expansion was confirmed in June 2009 when a DEC team captured chuditch in traps set along the river

toward the eastern edge of the gorge country, away from the original release sites near Z Bend and The Loop. This translocated population now appears to be well established throughout this rocky habitat despite enduring serious drought conditions.

Regular monitoring of the southwest forests during the past decade has shown the populations there to be relatively stable. There are some 'hotspots' that have clearly benefited from fox baiting while other areas that would appear suitable have not shown such a positive response. Interestingly, Dryandra Woodland and Boyagin Nature Reserve have only recently recorded chuditch captures after many years of fauna monitoring. Both these conservation areas have been long-

term sanctuaries for many other species and it is surprising that chuditch have not been detected earlier.

Genetic comparison of natural and translocated chuditch populations has also recently been undertaken by PhD student Maria Cardosa. Maria's results suggest that this species is doing well with high levels of genetic variation and healthy population sizes being maintained in translocated populations.

Chuditch are mobile, adaptable and resilient creatures. Their former Australia-wide range indicates the diverse habitats they once occupied. Human perception of what is good country for chuditch may be derived from recent history and we now realise that we should never underestimate their capabilities. For example, one tagged individual was found to have moved 180 kilometres in 10 weeks. Chuditch from the Forrestania study have been recorded as travelling up to 10 kilometres in a single night on a regular basis.

Right Chuditch have successfully established from translocated populations in the Murchison River gorges in Kalbarri National Park.

Photo – Samille Mitchell/DEC

The future

Some of the chuditch's population growth and range expansion may be a result of movement from translocation sites while others may be using corridors of bushland to move from established chuditch localities to colonise new areas. From the examples here we can see just how easily this migration can be achieved. Existing remote populations may well have increased as a result of predator control and juvenile animals may now be dispersing into nearby habitat. For example, the successful translocation site at Lake Magenta may provide dispersing individuals to surrounding reserves. The Forrestania, Ravensthorpe and Fitzgerald River National Park populations may also be linked to Lake Magenta via road reserves and other bushland corridors. The prime requirements are a good food source and adequate shelter opportunities to protect themselves and their young from the elements and predation. Dispersing chuditch may find temporary 'lodgings' as they move through the landscape until a suitable territory is found.

The chuditch is ranked as 'vulnerable' in both State and federal legislation and, while many of the indicators mentioned are very positive, the criteria for de-listing the species from conservation ranking have been closely examined and are yet to be met. A very thorough review was undertaken in 2006 and, from this, it was recommended that the current listing was appropriate for the time being.

The very successful captive chuditch breeding program at the Perth Zoo closed down in 2000. However, proposals to reintroduce chuditch to rangeland areas such as Lorna Glen Conservation Reserve and Dirk Hartog Island would rely on this program starting again. In the meantime, future population increases must be through natural means which, in today's altered and fragmented environment, may be a



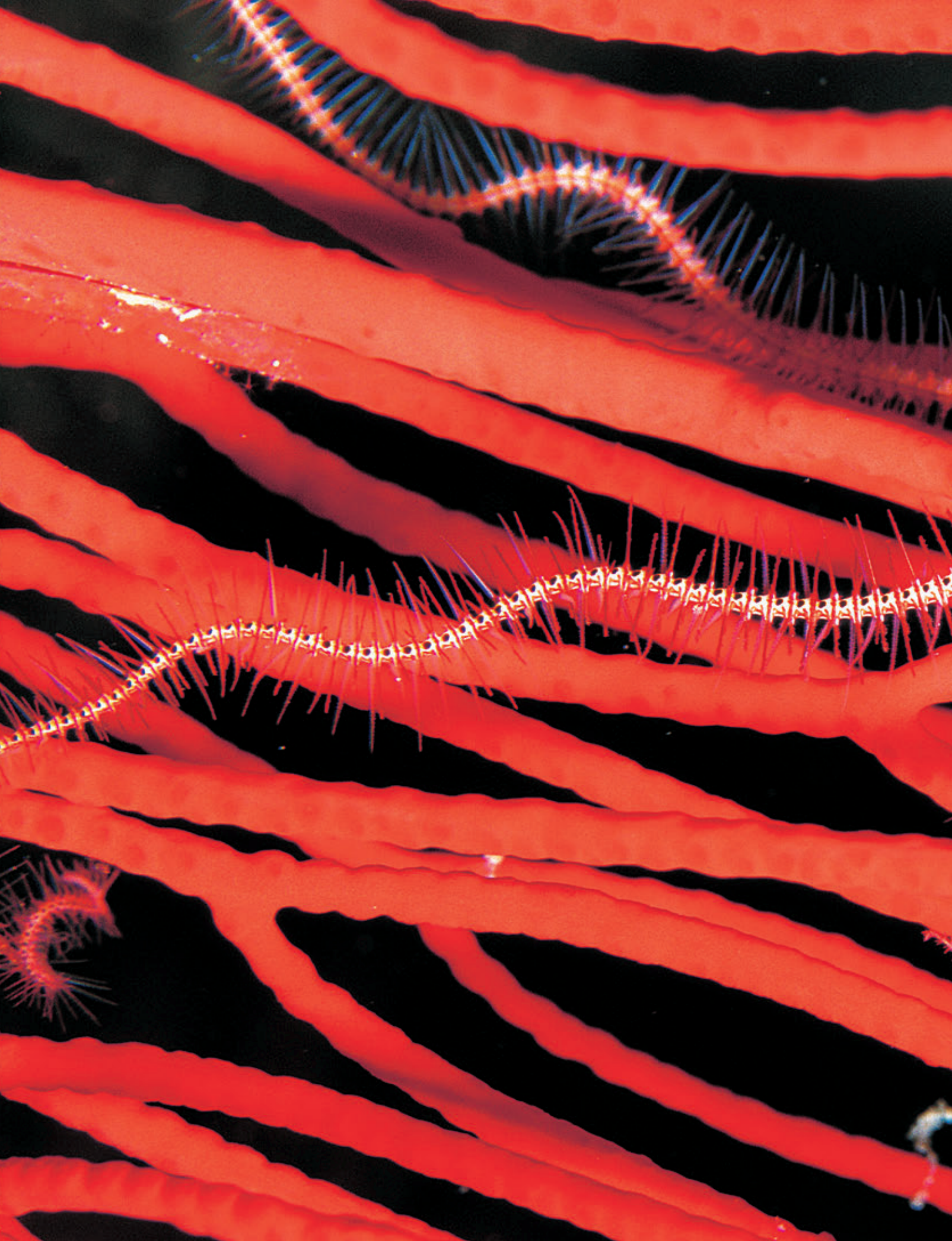
slow process. The possible population expansion will need to be supported by ongoing introduced predator control and good habitat management policies. More research into improving the effectiveness of fox baiting and the development of cat control techniques are essential requirements to assist this recovery.

From a once very uncertain future, this species is now undergoing a steady revival and is offering researchers many revelations about just how mobile and adaptable chuditch really are. More surprises are expected. Who knows, one day you may spot a chuditch in your own backyard.

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Thanks to Keith Morris and Peter Orell from DEC for their long-time involvement in the chuditch program. The authors also acknowledge the efforts of numerous other departmental staff, students and volunteers who have assisted.





Coral castles

and their inhabitants

Coral gardens not only fascinate divers with their colour and form but also offer homes for a kaleidoscope of marine creatures which have developed mutually beneficial relationships with their coral hosts.

story and photos by Ann Storrie

The stinging cells of coral polyps and their cousins, such as hydroids, jellyfish and anemones, keep away many unwanted predators. Some animals, however, have adapted to live either temporarily or permanently among the deadly cells. They may seek protection from their predators by sheltering around the polyps, or the polyps themselves may be a source of food that is unpalatable, or dangerous, to most other animals. The relationships between these ingeniously adapted animals and their hosts are often quite complex. They may be symbiotic where both the host and resident benefit from the relationship, commensal where the host does not benefit but is not damaged by the resident, or the resident may be a parasite that damages the host to some degree.

The wonderful world of sea whips

The common term 'sea whip' usually applies to either gorgonians or black corals that grow as long, slender, whip-like stems that may be either singular or part of a colony. The whips are usually in one plane with few or no branches. Some whips, such as the gorgonian red sea whip (*Ellisella* sp.) grow in colonies that jut out or



hang down from vertical walls. Many colourful clumps are found in the Rowley Shoals Marine Park. A torch or flash light is needed to bring out the brilliant red or orange hues of these whips. Single whips of *Junceella* species may grow to two metres in length and range from bright red to pale yellow and white. The spiral wire coral (*Cirripathes spiralis*) is a black coral that also grows a couple of metres long and has a corkscrew-like growth form. It is usually a dull orange or lemon yellow colour. Most whips harbour a myriad of marine creatures, some of which are so well camouflaged that divers rarely see them.

Many elongated fish such as razor fish, flutemouths and pipefish use the whip colonies for protection. Razor fish usually swim in schools with their heads pointed downwards to align themselves with the whips. They seem to bob slowly, but always manage to keep out of camera range on the opposite side of the whip colony. If necessary, they can quickly turn to a horizontal position and shoot off into the distance. Flutemouths and other pipefish also cleverly align themselves along the whips and, at a distance, can be difficult to distinguish from the corals.

Sea whip gobies (*Bryaninops* and *Pleurosicya* spp.) are mainly translucent with colours that vary according to their host sea whip. Some species are only found on black corals, others on wire corals, while others aren't fussy and will happily live on most whips and sea fans. A pair of these cute little fish may claim one large single whip as their territory, aggressively defending it from strangers. Their pelvic fins are joined and modified to form a sort of suction cup which the fish use to stick to the whip in a current. Their fins also enable the fish to flit quickly around



Previous page

Main Brittle star on sea whip coral.

Above Tiny transparent shrimp (*Periclimenes* sp.) are often found on huge black corals that jut out from reef walls.

Left Many gobies live on whip corals and have modified pelvic fins shaped like cups to create suction between the fish and the coral.



Above Hydroids like this look fluffy and soft to touch, but beware of their virulent sting.

the whip and they are often reluctant to hop off and swim, preferring to 'run' up and down the stem. If prey passes close by, however, they whip off their whip for a split second to catch their tasty morsel.

Some rather bizarre shrimps and crabs inhabit sea whips. Most common are the shrimps from genus *Pontonides*. They are often less than 10 millimetres in length and are perfectly camouflaged with body colour patterns that mimic the polyps of their whips. One elongated shrimp, *Tozeuma armatum*, is much larger. It can be several centimetres in length, yet is just as hard to spot as its tiny cousins. It has a long rostrum (nose) about one-third its body length, and its body colour, pattern and shape look like an entire whip strand. It grips a black coral whip with its tiny claws and, when it presses down on the whip, the impression is of a thickened strand of coral.

What may look like an armoured shrimp is a tiny spider crab, *Xenocarcinus tuberculatus*. This one rivals any science fiction creature in the weird category. Its carapace has several bumps or spines and its rostrum is long and tapering, though it is only a few millimetres in length. It lives

exclusively on black coral whips, often in conjunction with the *Pontonides* shrimps.

Whips are home to many species of allied cowries, or spindle cowries. These beautiful molluscs are elongated to mimic the shape of the whips and some reach five centimetres in length. Amazingly, some species have mantles that have protrusions that mimic the polyps, although often with the wrong number of tentacles for that host. Even more amazing is that, if the polyps on the host whip are retracted, the spindle cowrie can retract its 'polyps' too! How on Earth did it learn to do that? These spindle cowries are all parasites that feed on their host, and large white tracts are often seen on the whips where the molluscs have consumed the polyps.

Larger invertebrates such as crinoids (feather stars), basket stars, anemones and even hydroids perch on whips to take advantage of the height or distance from the reef wall to catch passing plankton. Anemones known as gorgonian wrappers (*Nemanthus* sp.) wrap around the stems, while some brittle stars use the whips for camouflage during the day. If they are

of similar colour to the whip they are hard to see when they are aligned, or wrapped tightly around the whip.

Beautiful beasts on black corals

Black corals are famous for their dried, polished, shiny stems that are used to make jewellery. Underwater, they are much prettier. They can be of many colours as the axis is usually surrounded by a thin layer of living tissue. They form whips and wire corals, as mentioned above, or they may be large and bushy, fluffy or spiky, or sea fan and gorgonian-like. They all belong to the family Antipatharia and are characterised by having an internal skeleton of a tough, dark protein called horn. This is covered by minute thorns or prickles and they usually have six, pointed, finger-like tentacles surrounding the mouth of each polyp.

As well as the array of tiny animals that live on the whip-like black corals, an assortment of interesting creatures also inhabits the bushy and fan-like



black corals. Schools of juvenile, and sometimes adult, cardinalfish and damselfish like to swim among their branches. Occasionally, large schools of transparent *Perichlimes* shrimps make their homes within tree-like black corals. An interesting black coral crab, *Quadrella maculosa*, is particularly difficult to photograph, although if you find the small bushy black corals on which they live, you will usually see a pair of crabs in each bush. The crabs have very long front claws, are quite robust and grow to about two centimetres. They are masters of movement among the thick, spiky branches of this coral and rarely sit out from the central stem to pose for photographers.



Although many people associate black corals with the tropics, some of the largest and most magnificent trees grow in our temperate waters. They often grow below 40 metres and many are still undescribed. A regular brittle star inhabitant that lives on black coral has a very apt scientific name, *Astrobrachion adhaerens*. This refers to the way it lives entwined around the black coral's branches. Don't even think of pulling them off as they are adhered extremely tightly.

Sea pen palaces

Sea pens are octocorals (soft corals with eight tentacles around each polyp's mouth) that have adapted to life in soft sediment. They grow in sand or mud and have an above-ground part called a rachis that contains the feeding polyps and a below-ground peduncle that attaches the colony to the substrate. Many are nocturnal in that their rachis retracts underground during the day and only emerges to feed at night. The rachis may be sausage or club-shaped, with polyps arising directly from the stem. Others form feathery quills with leaves of polyps in opposite rows down



Top left Juvenile trevally often seek shelter in stinging tentacles such as these of a large spotted jelly.

Centre left Beautiful egg cowries inhabit large leather corals upon which they feed and lay their eggs.

Left Porcelain crab on a sea pen.

Right Serpent stars, a type of brittle star, wind around branches of black corals.

the stem. Western Australia is blessed with a beautiful array of colourful sea pens from tropical to temperate waters. Diving in the Swan River or Cockburn Sound at night may reveal several amazing species. Many luminesce when touched. If you turn off your torch and gently skim your fingers down the pen, you will see coloured pulses of light radiating along the colony. However, you should check you are not disturbing any of the pen's little inhabitants before you do this.

Many shrimps and crabs inhabit tropical sea pens. Tiny gobies, *Periclimenes* species of shrimps, porcelain crabs and even squat lobsters may be found among the polyps or on the stalk of the pen. One small, translucent, white porcelain crab, *Porcellanella picta*, particularly likes to live in the spaces between the rows of polyp leaves. If you are very lucky, you may find mum (the largest crab), dad and several offspring all sitting in tiers between each sea pen palace leaf.

A large nudibranch, *Armina cygnea*, is common at certain times of the year around Perth waters, especially at Woodman Point and in the Swan River. It delights in consuming the polyps of an orange sea pen, *Cavernularia* sp. Sometimes, all that is left of the unfortunate pen is the thin, central stem that is made up mainly of calcium carbonate.

Leather coral coats

Leather corals are another large group of octocorals, or soft corals, that have a huge number of predators and hosts. Many leather corals encrust or spread over the reef, and can cover tens of square metres. Others are only several centimetres across. Most have a fleshy, leathery feel to them.

If you are ever looking for the spectacular, large, white egg cowrie, *Ovula ovum*, with a jet black mantle studded with white or yellow pustules, look in a mushroom leather coral. *Sarcophyton* species of leather corals are the primary



food source for egg cowries. The cowries are often found in pairs, nestled in the folds, or beneath the coral. Several other species of molluscs, including the bizarre, six to seven centimetre-long nudibranch, *Phyllodesmium longicirrum*, also feed on leather corals. This nudibranch may feed on a colony of corals for months, not moving until the colony is mostly consumed. Surprisingly, the nudibranch also gets much of its nutrition from *zooxanthellae* (single-celled algae that can photosynthesise) that live in huge, elongated outgrowths called cerata. Please don't pick up one of these nudibranchs as it may shed its cerata to escape.

Other less destructive animals that often use the leather coral's defences are large sponge crabs from the family

Dromiidae. Although often seen carrying sponges, these crabs will frequently pick a piece of leather coral to camouflage themselves. The crabs use their rear legs to hold the coral over their carapace. One of the funniest sights on a night dive is an enormous slab of leather coral trundling along the sea bed. If disturbed, the crab may hunker down under the protection of its coral. If this does not work, it usually takes off as quickly as its remaining legs will allow, coral waving and blundering into the rocky terrain around it!

Hydroid havens

Like corals, hydroids are cnidarians (possessing stinging tentacles around each polyp's central mouth). They



Above This tiny spider, or decorator, crab has planted hydroids on its body, legs and rostrum.

Left Spindle cowrie on back coral.

Below Crinoids (feather stars) often perch on sea whips to obtain a better vantage point to catch passing plankton.



usually live in colonies attached to the substrate. Some species are often mistaken for gorgonians and other sea fans, yet they do not have eight tentacles and they have a jellyfish-like sexual stage known as a hydromedusa. Many hydroids have a very intense, virulent sting that is quite painful to humans. Even so, several species of nudibranchs feed on hydroids, and many creatures live among the fronds of stinging tentacles.

This is where the decorator, or spider crabs, excel. Some species have very long rostrums, sometimes divided into two, and upon which they grow

complete fronds of hydroids. They may even grow hydroids over their entire body. These growths are often so well placed that their bodies and the adornments are indistinguishable. This ensures that their camouflage is perfect, unless they get it wrong. Occasionally, you will find a hydroid-coated crab happily grazing among bright red or orange soft corals that bear no resemblance to a hydroid, or the crab.

These are just a handful of the cryptic creatures that live among our corals. Spend a little time under water and you may just find yourself captivated by them.

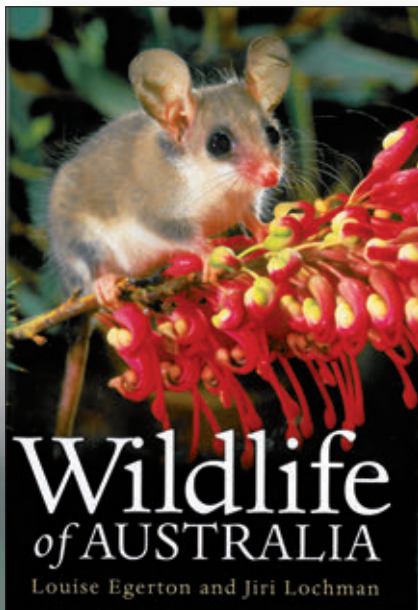
Ann Storrie is an accomplished underwater photographer and marine enthusiast. She has co-authored and photographed the Department of Environment and Conservation publications *The Turquoise Coast* and *Wonders of Western Waters*. Ann can be contacted by email (naturescapes.au@hotmail.com).

bookmarks by Samille Mitchell

Wildlife of Australia

Authors/photographer: Louise Egerton and Jiri Lochman
Publisher: Allen and Unwin
www.allenandunwin.com
448 pages, hardback, full colour
ISBN: 978 1 74114 997 5
RRP: \$59.99

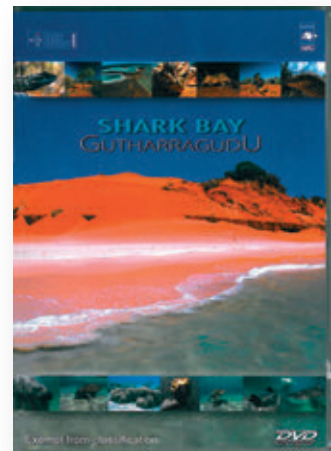
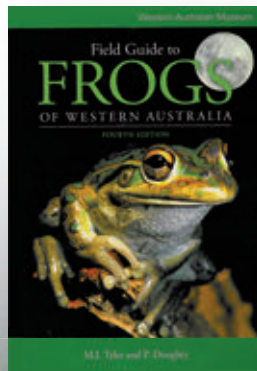
This stunning reference book features Australia's mammals, birds, reptiles, frogs, freshwater fishes and some invertebrates, with easy-to-read information on each. It also discusses the fascinating story of animal evolution in Australia, the impacts of a changing climate and it stresses the importance of protecting nature's intricate web of interdependent relationships. The text is complemented by more than 550 colour photographs, mostly by renowned Western Australian photographer Jiri Lochman, whose photos appear regularly in *LANDSCOPE*. This book would make a treasured addition to any nature lover's library.



Field Guide to Frogs of Western Australia fourth edition

Authors: Mike Tyler and Paul Doughty
Publisher: Western Australian Museum
www.wamuseum.wa.gov.au
160 pages, paperback, colour photographs
ISBN: 978 1 92084 340 3
RRP: \$35

This comprehensive field guide is designed to help everyone from the novice to the expert identify frogs from across Western Australia. Each species entry features a distribution map, colour photographs, description and information on habitat, calls, breeding biology and naming. The authors also make suggestions for further reading under each species. The introductory section provides an overview of Western Australian frog species and information on basic biology while a key at the back of the book also helps with species identification.



Shark Bay

Gutharragudu (DVD)

Producers: John Totterdell, David and Jennene Riggs and Hans Kempes
Publisher: Blue Office Productions and Maritime Information and Research Group Australia
www.mirg.org.au
45 minutes duration
RRP: \$33

This DVD unveils the many natural wonders of the Shark Bay World Heritage Area. Using beautiful video footage, the DVD reveals the geology, flora, fauna and European and Aboriginal history. Footage includes underwater recordings, including some spectacular close-ups of tiger sharks. It is a great introduction into what makes this area so special.





The endangered red-tailed phascogale is clinging to life in the Wheatbelt thanks to the combined efforts of farmers and conservationists.

by Jeff Short and Megan Stone

Farmers befriend phascogales



The red-tailed phascogale (*Phascogale calura*) is a small, squirrel-like, carnivorous marsupial that spends its nights hunting and its days curled up in the hollows of old-growth eucalypts. It is the size of a large mouse (typically 25 to 50 grams), is ashy grey on top, with a white underside and has a long tail that is a rich chestnut colour with a black brush at the end, leading one of the original European collectors to give it the name 'handsome tailed phascogale'. This unique tail makes it easy to tell apart from its closest relative, the brush-tailed phascogale (*P. tapoatafa*), and from other species of small rodent or marsupial. It has prominent large ears and eyes—vital attributes for its nocturnal lifestyle and for escaping its myriad of nocturnal predators.

The phascogale has a remarkable reproductive strategy whereby all the males die off after a frenetic mating period in July at the end of their first year of life. With only one chance to contribute to the future generation, the males put a mighty effort into their single breeding season, covering vast distances to seek out as many females as possible. Within a month of mating



the males all die, exhausted from their efforts at just 11.5 months of age. Females, on the other hand, can live to breed for a second and sometimes even a third year.

A friend in need?

The first red-tailed phascogale specimen known to European science was collected in Williams, 120 kilometres south-east of Perth, in the 1840s by John Gilbert—it was brought in by a domestic cat. Some 10 years later, Aboriginal people collected specimens from hollow limbs of trees on Gol Gol Creek, in New South Wales, for collector Gerard Krefft. This site, some

15 kilometres north of the junction of the Murray and Darling rivers, was at the then frontier of pastoral settlement. Hence, the phascogale was a species that once spanned arid Australia.

However, it has now contracted to less than 10 per cent of its former range and appears to be contracting still. It currently persists only in the southern half of the Western Australian Wheatbelt, where it coexists uneasily with intensive farming and associated extensive land clearing as well as a bevy of introduced species. Compounding these issues, the ongoing destruction and thinning of roadside vegetation is increasingly limiting their ability to move around the landscape. Consequently, the phascogale is one species that definitely needs a helping hand if it is going to persist.

Threats

Feral and domestic cats are likely to have played a large part in the demise of red-tailed phascogales across Australia. The few sparse recordings of red-tailed phascogales in the past 150 years beyond the Western Australian Wheatbelt occurred at about, or shortly after, the feral cat's arrival in the area and included the Murray-Darling junction in the 1850s, central Australia in the 1900s, and on the Canning Stock Route at the junction of the Great Sandy and Gibson deserts in Western Australia in the 1930s.

Their demise in these areas may also have coincided with the disruption of traditional Aboriginal land management resulting in a shift from small-scale, low-intensity fires set by Aboriginal people to large-scale, high-intensity wildfires.

Previous page

Main A red-tailed phascogale after release on a wandoo tree. Old-growth wandoo trees are an important source of nesting hollows for phascogales.

Inset A community volunteer releasing a red-tailed phascogale after trapping.

Above Red-tailed phascogale.

Left The prominent black brush and the brick-red base of the tail are distinctive features of the red-tailed phascogale.

Photos – Andrew Hide





Above left Community volunteer Brian Price with a captured cat at Wadderin Sanctuary.

Photo – Jeff Short

Above At least six phascogales sharing a nest in a nest box near Wagin.

Photo – Danielle Perrie

Right Local volunteers and octogenarians Brian Price and Mel Bristow repairing a fox-proof fence at Wadderin Sanctuary near Narembeen.

Photo – Jeff Short



Other key threats likely to have impacted on the red-tailed phascogale, particularly in south-west WA, are the spread of the fox into this area in the early 20th century and the wholesale land clearing that has occurred within the Western Australian Wheatbelt in the past 100 years, leaving only small and often isolated remnants of vegetation.

Pioneering work by Western Australian Museum scientist Darryl Kitchener in the 1970s suggested that phascogales could only persist in the largest of Wheatbelt remnants. However, we now know that that is not the case as phascogales are regularly caught in remnants as small as 20 hectares. Kitchener emphasised the importance of the presence of poisonous pea plants of the genus *Gastrolobium* in excluding stock and rabbits, and reducing the likely impact of foxes and cats. He also expressed concerns about fire. Scientists from the then Department of Conservation and Land Management (now the Department of Environment and Conservation—DEC), Tony Friend and Gordon Friend, later stressed that the species is likely to be severely affected by fire because of its dependence on highly flammable sites for nesting and refuge. However, though it remains a threat, fire no longer appears to be a significant issue in the Wheatbelt.

Farmers now actively and effectively suppress fire in Wheatbelt remnants, in contrast to their extensive use of fire during the pioneering phase of land clearing before the 1970s.

Conservation actions

Despite their troubles, it is not all doom and gloom for the red-tailed phascogale. Wheatbelt farmers and the local community have rallied to assist this species, which is now endemic to the area. Funding from the Australian Government via the South West Catchments Council has enabled widespread trapping surveys to help establish where phascogales occur, while also enabling some remedial actions to start. A key part of actions has been developing an increased awareness of the phascogale and its plight within Wheatbelt communities.

Farmers and local community members in and around the Wheatbelt towns of Wagin and Narembeen have been particularly active in working to conserve the phascogale. Farmers in Wagin and surrounding districts have provided access to their farm remnants for trapping surveys; reported sightings of phascogales for entry into a community sightings database and erected nest boxes to provide additional shelter in areas where natural hollows are limited. They have also enacted on-ground works such as fencing to exclude stock from remaining farm remnants and planting corridors of trees and shrubs to enable phascogales to move around the landscape. Farmers at Narembeen have created fox-free habitat in an area where phascogales have long been absent to permit their reintroduction.



Left Jeff Short releasing a phascogale after trapping in York gum–swamp oak habitat near Wagin.
 Photo – Andrew Hide

Above Researchers inspecting natural hollows in a stag of York gum on salt-affected land along Arthur River near Wagin.
 Photo – Jeff Short

Southern Wheatbelt

A trapping program has been carried out in the biggest remnants of native vegetation on farms in an area centred on Wagin and extending to Narrogin, Katanning, Darkan and Wickepin. Trapping in these remnants has revealed that the red-tailed phascogale is widespread throughout this area where suitable habitat of wandoo (*Eucalyptus wandoo*) and rock she-oak (*Allocasuarina huegeliana*) occur. This is often in areas high in the landscape removed from the threat of encroaching salinity. Another habitat stronghold is the extensive fringing vegetation along Arthur River and Wagin Lakes—much of this is highly

affected by rising water tables and salt. However, while rising salt may kill the original woodland trees, their dead stags remain. Often these are hollowed by termites, providing shelter for phascogales. In addition, dense salt-tolerant swamp she-oak (*Casuarina obesa*) often establishes to replace the former vegetation. This combination of hollow-bearing stags and a dense mid-storey canopy of swamp she-oak is ideal habitat for the phascogale.

In the same area, the Wagin Woodanilling Landcare Zone, in partnership with Wildlife Research and Management, has been instrumental in establishing and maintaining a register of community sightings of red-tailed

phascogales. Its members have actively worked to raise the profile of this species in Wagin and surrounding districts. They have gathered some 90 sighting records over a five-year period. This data provides insights different from that gained through the trapping program. For example, nearly 50 per cent of community records of this species come from specimens bought in by domestic cats, highlighting their vulnerability to predation by exotic predators. Records are often in tiny fragments of retained vegetation or in and around farm or other buildings in an extensively cleared landscape—not sites one would ever consider trapping. This suggests we may have underestimated the ability of this species to move around a highly modified landscape.

Community records that are particularly valuable are those of nesting



Above A community volunteer releasing a phascogale after trapping.
Photo - Andrew Hide



Above right Local volunteer Arthur Kershaw from Wagin about to erect one of many nest boxes he has constructed for phascogales.
Photo - Jeff Short



Right Nest of a red-tailed phascogale in a newly erected nest box.
Photo - Andrew Hide

phascogales. One such record was of a phascogale nesting in a 1960s schoolbag (complete with original school books) discarded in a woolshed. Another was of a phascogale nesting in the wall cavity of a local church. These records suggest an apparent shortage of suitable nest sites in the natural environment, and the highly specific requirements for nesting. Phascogales require a large cavity to accommodate their football-sized nest of wool, feathers and grass and a small entrance to exclude other species of competitors and predators. Phascogales must leave their still-naked young in the nest while they forage so they need a secure and warm refuge for their nest if the young are to survive.

Another key activity has been the provision of nest boxes for phascogales. In many patches of remnant bush in the Wheatbelt there is abundant foraging habitat but no trees with hollows available for refuge. This is because they were cleared at some time in the past and, although now regrown, typically consist of dense rock she-oak and some young wandoo. However, because it takes about 125 to 300 years for a hollow to form in a eucalypt, there are often none or very

few hollows available. In locations like these, nest boxes can be used to provide much-needed homes for phascogales.

Nest boxes are also useful in newly planted corridors between existing remnants where young trees have been planted but there are not yet hollows for shelter. They may also be useful in saline areas where swamp she-oak is coming up thickly, but there are no available hollows. Nest boxes can also be used to encourage the interest of local people if used in backyards or school sites adjacent to bushland.

Local Wagin identity Arthur Kershaw, supported by the Wagin Woodanilling Landcare Zone, has constructed more than 50 nest boxes

which have been erected in and around Wagin. Often, phascogales will share nest sites and as many as six phascogales have been observed using a single nest box at one time in winter before the breeding season. It is likely that phascogales huddle together to reduce the energy required to keep warm. Other small carnivorous marsupials such as dunnarts and antechinus will huddle also.

Trapping for phascogales on Wheatbelt farms provides a way of engaging with landholders and encouraging them to become involved in landcare activities to benefit resident phascogales. Recommendations emanating from this trapping program



since 2004 have resulted in the Wagin Woodanilling Landcare Zone supporting the creation of 15 kilometres of tree corridors with 16,720 native seedlings connecting more than 1,500 hectares, including 35 kilometres of fencing which protects 500 hectares of previously unprotected habitat. These on-ground activities were funded by the South West Catchments Council. In addition, several land owners have agreed to voluntary management agreements on their remnant bushland where phascogales are present.

Central Wheatbelt

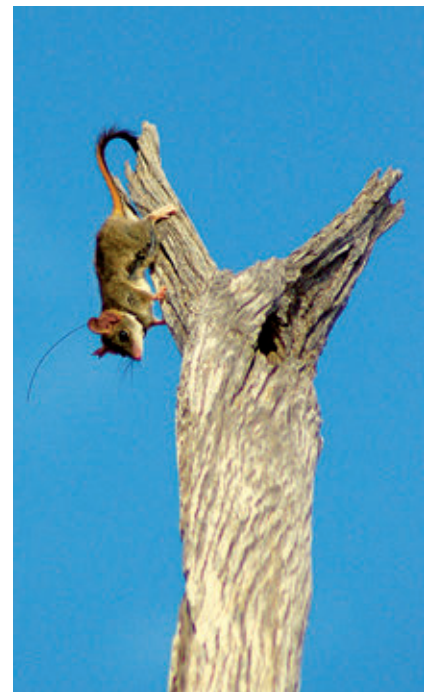
In contrast to the relative abundance of phascogales in the southern Wheatbelt, there is a scarcity or absence in the central Wheatbelt. Areas around Narembeen have been more extensively cleared, distances between remnant patches are greater, and often tree corridors along road verges are missing or incomplete. Sadly, phascogales present in large DEC reserves such as North Karlgarin, Bendering and Dragon Rocks nature reserves in the 1970s, were not trapped in surveys in the 1990s or since. The 1970s surveys were conducted in the latter phase of an extensive period of clearing following scientific advances that enabled soils deficient in trace elements to be used for cropping. Hence, the total area of bushland has declined and many of the former habitat connections have been severed. The reserves are now surrounded by vast paddocks of wheat that offer little opportunity for native species. The

prognosis here for phascogales and other native fauna is grim.

However, members of the farming community in these areas often retain a strong connection to their district's immediate past. Typically, farms have been handed down within the family and a father or grandfather originally settled and cleared the land. Hence, there is a rich oral history of the fauna that used to occur in the district or on the farm. For example, retired Narembeen farmer Mel Bristow, now 84, can still remember bilbies (*Macrotis lagotis*) in the district from the late 1920s (see 'Remembering the dalgyte', *LANDSCOPE*, Summer 2002-03). The continuity of knowledge at Narembeen has encouraged local efforts to attempt to restore lost fauna.

Community members at Narembeen have banded together to create the 430-hectare Wadderin Sanctuary for the protection of native wildlife. They constructed an 11.5-kilometre fox-proof fence around an area of granite outcrops, salmon and York gum woodland and mallee shrubland. They now have ambitious plans to re-establish as many as eight native species. Foxes and cats have been eliminated and nest boxes have been erected within the sanctuary.

Communications company Exetel provided support for the translocation of 20 red-tailed phascogales from remnant bushland on farms at Wagin to Wadderin Sanctuary during May 2009. Six of the 20 phascogales were tracked using small radio-collars weighing just 1.3 grams. All collared animals survived



Above left Part of the 11.5-kilometre fox-proof fence erected at Wadderin Sanctuary near Narembeen.
Photo – Jeff Short

Above Tiny radio-collars were fitted to phascogales to enable tracking to monitor survival and movements.
Photo – Jeff Short

the first four weeks of monitoring and 11 of the 20 individuals were known to definitely be alive going into the breeding season. However, the real test will be the survival of the females through spring and the successful rearing of their litters.

After more than a century of decline, it is encouraging that the phascogale is making a stand, with a little help from its farming and conservationist friends.



Dr Jeff Short provides ecological advice and practical support to remote and regional communities engaged in biodiversity conservation. He operates the consultancy company Wildlife Research and Management (www.wildliferesearchmanagement.com.au).

Megan Stone is employed by Wildlife Research and Management to survey for phascogales. She completed an Honours degree in Conservation and Wildlife Biology at Murdoch University in 2008.



Rabbits on the rampage for 150 years

The European rabbit was first introduced to the Australian mainland 150 years ago. While populations have waxed and waned with various control methods, the rabbit continues to survive in abundance in Western Australia today.

by Samille Mitchell and John Asher

One hundred and fifty years ago this year, an English man in Geelong, Victoria, fancied a spot of hunting and requested 24 European rabbits be sent from England to Australia. The man, Thomas Austin, requested the rabbits as well as five hares, 72 partridges and some sparrows reportedly stating: “The introduction of a few rabbits could do little harm and might provide a touch of home”.

Austin’s innocent assumption couldn’t have been more wrong. This introduction, and probably others that followed, sparked one of Australia’s biggest pest plagues.

Rabbits introduced from the First Fleet in 1788 were already on offshore islands and by 1827 feral rabbit populations in south-eastern Tasmania were already in the thousands.

But Austin’s introduction had brought rabbits to the Australian mainland—a move exacerbated by rabbits escaping from an enclosure soon after. Within 15 years, the rabbits had reached New South Wales and within another 15 years they had started to invade Queensland. The first rabbits in mainland Western Australia and the Northern Territory were recorded by 1900, though there are reports of rabbits on an offshore island in WA from as early as 1827. Mariners are said to have left rabbits on such islands as a source of food for future visits.



By 1926, an estimated 10 billion rabbits populated the country, causing such a serious agricultural problem that many farms were abandoned.

The impact

The spread of the European rabbit (*Oryctolagus cuniculus*) was marked as the fastest spread of an introduced species anywhere in the world. It also paved the way for the spread of the fox, by providing a reliable food source. But perhaps their biggest impact on the natural environment has been in competing with native animals for food. Because rabbits graze plants close to the ground, they often kill germinating seedlings and prevent regeneration.

In many rangeland areas, as few as four rabbits per hectare can prevent the regeneration of native plants, such as some *Acacia* species. During drought, rabbits can strip bark from shrubs and trees. This increased grazing pressure often results in the loss of vegetation cover, leading to soil erosion and impacting on rehabilitation areas and threatened flora. Digging by rabbits to make warrens may also cause soil erosion and tree losses.

In WA, rabbits are declared pests of agriculture under the *Agriculture and Related Resources Protection Act 1976* and, as such, landholders are required to control rabbits on their properties. They are estimated to cause \$200 million in damage across Australia each year.

Curbing the spread

As rabbits started to invade WA the State Government attempted to halt the invasion with the construction of a rabbit-proof fence in 1901. The fence started in Starvation Boat Harbour, about 120 kilometres west of Esperance,

Previous page

Main European rabbit.

Photo – Jiri Lochman

Inset Rabbit-proof fence near Latham.

Photo – Courtesy Battye Library/007245D

Above Rabbits paved the way for the spread of the red fox by providing a food source.

Photo – Dennis Sarson/Lochman Transparencies

Left Rabbit hunters in Northampton, 1947.

Photo – Courtesy Battye Library/001336D



Right The calicivirus had minimal impact on rabbits such as this one in the south-west.

Photo – Dave Watts/Lochman Transparencies

and stretched 1,833 kilometres to Eighty Mile Beach, where the Great Sandy Desert meets the Indian Ocean.

Despite the magnitude of this ambitious project, rabbits continued their invasion. Two more fences were built—one starting 120 kilometres further west of the original fence and running 1,160 kilometres north to join the first fence near Yalgoo and the other stretching 258 kilometres west from the original fence to Kalbarri.

However, the rabbit was undeterred and it wasn't long before they inhabited all suitable habitat types throughout the State. Their populations remained largely unchecked until the 1950s when the myxoma virus was introduced.

Myxomo virus

At its introduction, myxomo virus was hailed as the answer to rabbit control. The virus was spread by mosquitos and rabbit flea throughout rabbit populations across the country. Later, the European rabbit flea and the Spanish rabbit flea were introduced and continued the spread of the virus. While the virus did have an impact, it didn't kill all rabbits in a population (the Department of Agriculture and Food suggests that death rates vary from 30 to 90 per cent but are typically about 50 per cent). What's more, if an infected rabbit survives the virus, it acquires lifelong immunity to the disease. While sporadic outbreaks of myxomatosis still affect rabbit populations, a general resistance has reduced its efficiency. It wasn't long before scientists started searching for another control agent.

Calicivirus

Calicivirus, also known as the Rabbit Haemorrhagic Disease Virus, was released in WA in 1996 after undergoing rigorous testing on livestock and native species. It was deliberately released in WA about the same time as it started to appear in WA from rabbits already infected by the virus in other parts of the country. The virus spreads by biting insects and some species of fly.



At first, the virus was thought to be having a massive impact, slashing some rabbit populations by up to 90 per cent. However, other populations seemed relatively immune to the virus's spread, particularly in higher rainfall areas. So, while the virus has helped keep rabbit populations in check throughout the agricultural region and the rangelands, it has had little impact in the higher rainfall areas of the south-west.

While outbreaks of both calicivirus and myxomo viruses continue to occur, they are regarded as an aid in rabbit control that needs to be supplemented by other control measures.

The Department of Environment and Conservation will continue to manage rabbit infestations that threaten significant conservation values using the most appropriate and effective management option for the situation. The department also works with its neighbours under the guidance of its Good Neighbour Policy and recognises that a coordinated approach with landowners is essential to control rabbits and other pest animals.

Rabbit status today

The distribution and abundance of rabbits is mainly dependant on favourable rainfall conditions and varies by season and year. However, farmers and scientists are concerned that there appears to be a gradual increase in rabbit numbers in parts of Australia,

possibly due to an increasing immunity to the calicivirus within populations.

The increase may be exacerbated by the apparent success of the calicivirus during the past 10 years and a consequent reduction in other conventional control efforts. Climate change may also influence the future distribution and abundance of rabbit populations in Australia.

To help improve knowledge of rabbit numbers, a host of organisations has launched a web-based survey called RabbitScan. The survey encourages landholders to register data about rabbit sightings and warrens, which will go on a map showing the distribution and abundance of rabbit populations in Australia. The map will help with the future management of rabbit populations by identifying where they most occur. For more information on RabbitScan, visit the website at www.rabbitscan.net.au.

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In 1984 a biological survey of the Nullarbor region in South and Western Australia identified 794 vascular plant species, 44 mammals (15 now extinct), 249 birds and 86 reptile species. Twenty-five years later, two people involved in this study returned and rediscovered that it is largely the hidden treasures that you don't normally notice, the small things like mosses and large underground caves, that make this place so special. **by Leanne O'Rourke**



A wide, flat landscape under a deep blue sky. The foreground and middle ground are covered with sparse, low-lying vegetation, including small bushes and grasses, interspersed with patches of reddish-brown soil. The horizon is flat and extends across the entire width of the image. The sky is a deep, uniform blue, occupying the upper half of the frame.

Nature of the Nullarbor

Far beyond the proverbial black stump, past the salmon gums, coastal cliffs and the few deserted homesteads of Western Australia's south coast, lies a largely treeless land that is distinctly Australian—the Nullarbor. A visit to the famous sweeping plain that straddles the Western–South Australian border is perhaps one of the best ways of experiencing the openness, serenity and big sky for which this country is famous.

But visitors are easily fooled by the flat and seemingly monotonous landscape when travelling by vehicle along the straight stretch of road that traverses it. Time spent looking deeper reveals that beneath, between and above the deceiving lack of visual features, is a highly active and unique ecosystem.

Discovering the desert

The Nullarbor region covers almost 200,000 square kilometres of arid country between Norseman and Ceduna. Two-thirds in Western Australia and one-third in South Australia, it is flanked by the Great Victoria Desert



in the north, the Eastern Goldfields in the west and undulating plainland in the east. To the south, the Hampton Scarp drops away to the Roe Plain and Southern Ocean and the stunning cliffs of the Great Australian Bight near the State border. Under the Interim Biogeographic Regionalisation for Australia, the Nullarbor is broken up into two bioregions. The Nullarbor Bioregion is characterised by the well-developed soil profiles of the Carlisle Plain in the north, but centred on the vast limestone plain of the true

Nullarbor. Low woodlands dominate the Hampton scarp and Roe Plain of the Hampton Bioregion.

Early attempts by European settlers to cross the Nullarbor, home to the Spinifex Wangai Aboriginal people for thousands of years, were hampered by dehydration, mutiny and general hardship. Overcoming these challenges, Edward John Eyre was the first to successfully conquer the crossing in 1841, paving the way for much-needed communication between the colonies. In 1877, a 2,500-kilometre telegraph line extending across the plain from South Australia was completed linking WA to the rest of the world. For the past 92 years, the Trans–Australian Railway line has helped combat WA's physical isolation, transporting passengers and supplies from Kalgoorlie to Port Augusta across the Nullarbor. Since the Second World War the current route of the Eyre Highway has done the same in the south. Despite these transport links, so much of the plain is still very remote and most people just drive through without fully appreciating its fascinating ecology.

A groundbreaking survey

Beautiful in its own right, the Nullarbor Plain is little understood. Two people who hold some of the greatest biogeographical knowledge of the area are Department of Environment and Conservation (DEC) research scientist Norm McKenzie and botanist Greg Keighery. They were part of the team from WA and South Australia that originally recorded the biodiversity of the entire Nullarbor region some 25 years ago.

On a summer's day in 1984, Norm and Greg jumped in a truck with a small group of scientists and headed into the great unknown. Their mission: to set up a survey that would enable

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Main Baxter Cliffs near Caiguna, Nullarbor.

Photo – David Bettini

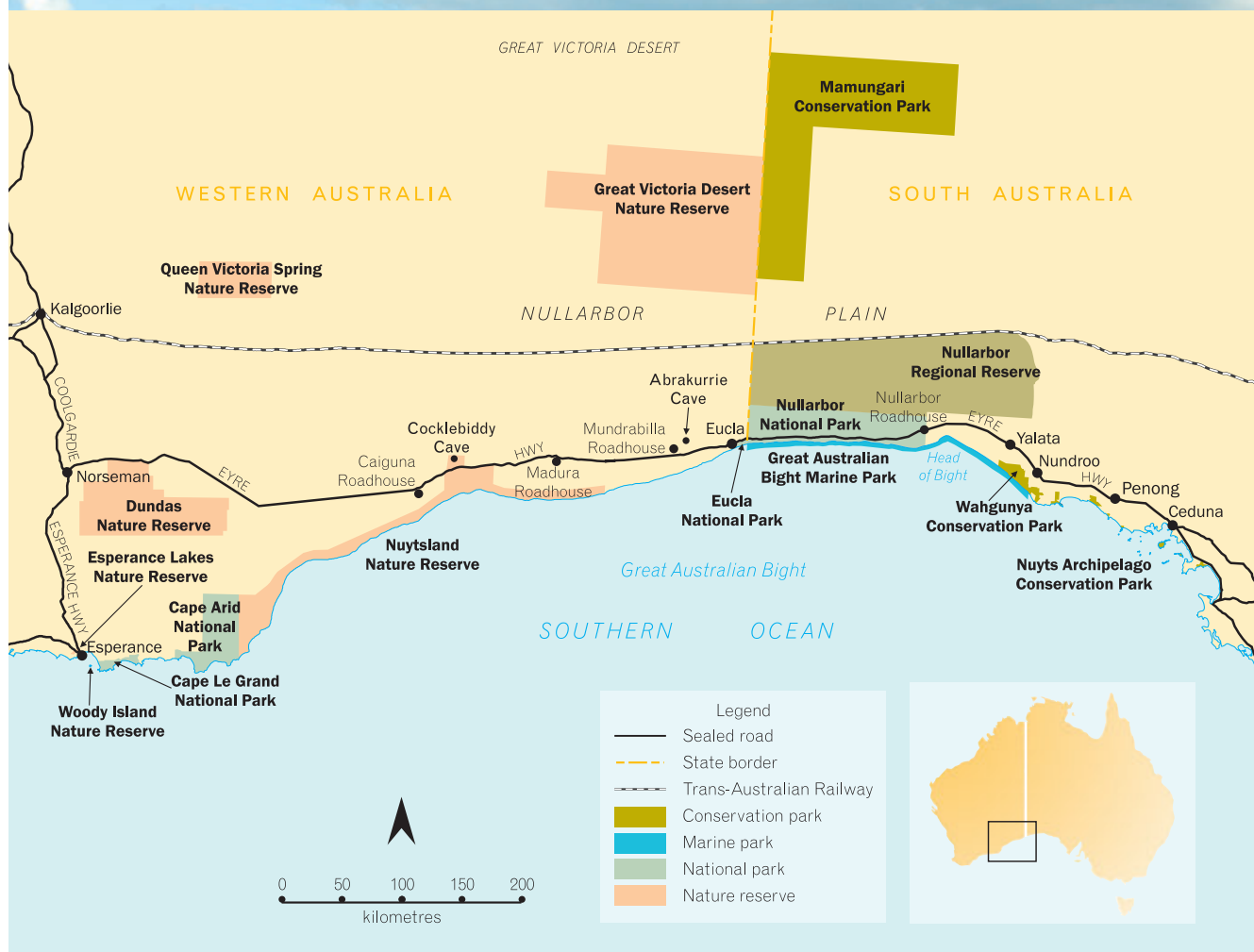
Inset Abrakurrie Cave.

Above Sand dunes, Eucla National Park.

Left The Kutowalla Doline is one of many collapsed cave entrances on the Nullarbor Plain.

Photos – Leanne O'Rourke





them to document the diversity of the Nullarbor Plain and Hampton region. They carefully selected a number of sites to establish full geographical coverage of the area and hammered in stakes to form their survey quadrats. It was the beginning of the first major biological ground survey of the Nullarbor, a survey that would consolidate earlier findings to become the only comprehensive source of information for years to come.

Their collections revealed undiscovered species including the small carnivorous marsupial *Sminthopsis dolichura* and some, like the Toolinna bunny orchid (*Eriochilus dilatatus* subsp. *orientalis*) and the Eucla daisy (*Senecio eulaensis*), are still being described today from the samples taken during their autumn and spring trips in 1984. At the time, the scientists redefined some of the biogeographical boundaries of the Nullarbor so they better reflected reality. Their newfound knowledge about local biodiversity informed the design of a Nullarbor reserve network that would lead to appropriate management

of the area on a landscape scale. And the research was to benefit more than just the region: broad-scale biological surveying would never be the same.

They realised that, even in a large survey such as this one, by studying species composition in small areas they could predict composition between study sites—the spaces where they did not sample. To test the theory, the scientists formulated comprehensive lists of what should be in the gaps and when they went out and actually collected the data, they found that their modelling was up to 90 per cent accurate. This pioneering prediction modelling continues to inform large survey design today.

Not only was the survey itself highly innovative, the extent of the collaboration between WA's Department of Fisheries and Wildlife, as it was at the time, and South Australia's Department of Environment and Planning was, and still is, unmatched. And it makes sense; biodiversity patterns do not recognise State boundaries after all.

Life on the land

Taking the Old Coach Road at the base of the Hampton Scarp from Burnabie to Madura is an exhilarating experience. The 1984 survey was the first time its features were scientifically recorded in detail. The vegetation is primarily made up of low woodlands consisting of western myall (*Acacia papyrocarpa*) over bluebush (*Maireana sedifolia*) creating cascading layers of green and blue hues. This is one of the only places in the world where you will find woodlands in such dry, sandy conditions. Hundreds of different eucalypts including spectacular salmon gums (*Eucalyptus salmonophloia*) fan up to the sky with flashes of orange exposed by peeling bark contrasting with the tufts of bluebush in the understorey.

Over the top of this striking escarpment is the Nullarbor Plain. This is the sunburnt country famed in the Dorothy Mackellar poem. But the sun is not always out and it is not uncommon to experience four seasons in one day. The Nullarbor averages 200



millimetres of annual rainfall which is enough to sustain the saltbush that dominates the flat landscape. Trees and collections of sticks very occasionally reach up to the sky but the abundant lichens and mosses in the region are diverse and fascinating. One example is the unattached *Chondropsis semiviridis* that collectively drifts, rolling out on its light side in the heat and curling up with its darker side exposed when wet. These fascinating species fix nitrogen and stabilise the soil's surface.

Birds are not a common sight on the Nullarbor except for semi-arid avifauna. The occasional emu or hooded robin may be observed and you would be fortunate to see a small flock of banded lapwings gathered beside a track. Although they are often hidden, there are 29 mammal species still in existence within the region. The most obvious are the kangaroos. Big western grey (*Macropus fuliginosus*) boomers are happy to stop and watch a convoy of four-wheel drives then bounce off into the distance at speed. The southern hairy-nosed wombat (*Lasiorhinus latifrons*) is also common around the Western Australian border but you would be lucky to catch a glimpse of a live animal. For much of the year these nocturnal creatures seem to huddle in the warmth of their warrens during cold desert nights. This is the biggest stronghold of the species and it is slowly migrating further west.

As in many parts of Australia, native mammals have severely declined in the Nullarbor region. Since the beginning of the 20th century, about 15 mammals have become extinct there. With efforts over the past 100 or so years to manage threats like altered fire regimes, introduced predators and weeds, it is now a slower process but still of major concern.

Top left Emus.

Centre left Banded lapwing.

Left Southern hairy-nosed wombat.
Photos – Jiri Lochman



A surface divide

The Nullarbor Plain occupies a significant spot in the hearts and minds of most Australians. Touted as an authentic outback experience, many Australians will cross via the wide open road at some point and it is seen as something of a rite of passage for backpackers visiting our shores. But the Nullarbor has, and still performs, a much more important function than just that of a massive gateway between east and west. It is not just a barrier for people, but also for pests.

The Nullarbor is one of the reasons WA is so different from eastern Australia. In recent geological time, it has been a major obstacle for plants and animals trying to make their way here and it is widely credited as one of the factors responsible for the rich biodiversity of the State's south-west. It has managed to keep species like European starlings and weeds out for a very long time and continues to act as a protecting force for native flora and fauna.

Unfortunately, the plain has not successfully prevented the spread of all pest plants and animals. Surprisingly, rabbits thrive in the arid zone and are a major threat for plants because they selectively graze seedlings like nitrogen-rich wattles that feed the soil, robbing the plants of essential nutrients (see 'Rabbits on the rampage for 150 years' on page 29). They select palatable species and compete with native species for food and consequently have contributed to the loss of a number of



Top Wombat warren, north of Eucla.

Above Entering Cocklebidy Cave.

Photos – Leanne O'Rourkes

mammals in the area. The first rabbits in WA were spotted in the late 19th century prompting construction of the costly and ineffective rabbit-proof fence. Sadly, the pests have now been there long enough to prevent even the long-lived shrubs and trees from regenerating.

Plant regeneration improved markedly when the calicivirus was released in the region to test its effectiveness. It was quite a successful trial that used the same plots as the 1984 survey knocking out nearly all of the rabbits in some areas. However, on the flipside, the wedge-tailed eagles that can be seen soaring above the escarpment looking for prey used to feed on the rabbits and their numbers

took a tumble when calicivirus went through. Once upon a time they would have fed on small mammals like numbats (*Myrmecobius fasciatus*) when they were abundant. Now they have to look harder or eat road kill and risk being hit by vehicles and being killed themselves.

Karsts and cave dwellers

Extensive as it was, the 1984 survey only just scratched the surface. But it is what lies beneath the surface that



Left Abrakurrie Cave.

Above Road to Cocklebiddy Cave.

Below left Along Eyre Highway near Caiguna.

Photos – Leanne O'Rourke



in many ways makes this place so interesting. The Nullarbor Plain is one of the world's biggest pieces of limestone, housing the largest continuous karst system on the planet and some of Australia's biggest underground caves.

Shaped by dissolved limestone or other carbonate rocks, karst landscapes account for as much as 15 per cent of the Australian continent, with only four per cent visible at the Earth's surface. Their features include steep-sided dolines

or sinkholes, towers and pinnacles, cave entrances and subterranean caves. Standing at the edge of a massive doline in the Nullarbor, some up to 35 metres deep and more than 200 metres across, is dwarfing. But the caves themselves are even bigger, ranging up to 120 metres deep and a staggering 28 kilometres long, like Old Homestead Cave. The largest chamber is found in Abrakurrie Cave and is 300 metres long, 30 metres wide and 15 metres

high. Some have extensive water-filled passages that are popular with cave divers, including a six-kilometre stretch in Cocklebiddy Cave.

Clambering over rocks into the dark, echoing humidity of a Nullarbor cave is like descending into a mysterious new world. They may appear empty at first glance but in reality they are teeming with life and activity. Many small critters, adapted over millions of years to life without light, find refuge here. Spiders, crustaceans, centipedes and many more troglobites and troglaphiles share this subterranean world with larger creatures like masked owls and chocolate bats (*Chalinolobus morio*). Specific bat maternity caves like Murra El-elevyn come alive at night like overcrowded hospitals.

The karst system was beyond the scope of the 1984 biological survey of the Nullarbor which was designed only as a ground survey. The scientists were, of course, aware of the karsts and results of previous studies like a 1978 resource management survey, but it



Above Baxter Cliffs, near Caiguna.
Photo – David Bettini

Right Eucla Telegraph Station ruins.
Photo – Leanne O'Rourke

would not be until many years later that interest in cave-dwelling troglofauna and stygofauna and the role they play in various ecosystems would pique the interest of scientists carrying out major biological studies. These days, cave organisms and the Nullarbor caves themselves are extremely attractive to scientists, adventurers and tourists. With this popularity comes a whole swag of management challenges, complicated by the caves' remoteness, that need to be considered to ensure that current and future generations can enjoy them in a safe and sustainable way.

Down memory lane

In June 2009, Norm and Greg, together with some of DEC's leading nature conservation specialists, scientists and regional ecologists, journeyed to the Nullarbor once more on a week-long trip, which also visited the Hampton region.

Times have changed significantly since the mid 1980s when only half a dozen DEC (then Department of Conservation and Land Management)

staff serviced the Esperance district which covered the entire south-eastern coastal section of the State including the Nullarbor. Now, there are about 20 staff in the district with a remarkable passion for their patch, enabling better and more effective management of the area's environmental values.

But that is not the only thing that is different about the region. Although biologically the Nullarbor changes quite slowly, there is evidence of tree and shrub loss and it is likely that the plain is growing and becoming more treeless. Some of the defining features around the edges are under threat, such as trees that are up to 200 years old and only reproduce very occasionally and the endemic species along the clifftops that are found nowhere else in the world.

But there is hope. According to Greg, there are still very few weeds in the Nullarbor and it does not suffer from the major disease issues that exist elsewhere. With good quarantine, sustained efforts to control weeds and rabbits, existing rehabilitation technology and sound management practices, it is possible to retain the simple yet intriguing Nullarbor community and slow down the landscape changes that threaten to alter the nature of this astonishing landscape.



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This article is based on interviews with DEC principal research scientists Norm McKenzie and Greg Keighery.

Since 1984, DEC has carried out a number of systematic biological surveys to build an inventory of WA's rich species diversity, recognised nationally and internationally. For information visit www.dec.wa.gov.au/science-and-research/biological-surveys/index.html.



Stokes National Park

Visitor infrastructure at Stokes National Park is being reopened thanks to new works to repair flood and fire damage in this coastal area near Esperance.

Above Historical Moir Homestead, viewed from the blacksmith's workshop.
Photo - Marie Lochman

Opposite page

Far right Lookout at Shoal Cape.
Photo - Klaus Tiedemann/DEC

The deep valleys and dunes of the 10,667-hectare Stokes National Park cradle the waters of the 14-square kilometre Stokes Inlet. The Young and Lort rivers flow into the upper reaches of the inlet but, when the water level is low in summer, they are cut off from the lagoon by a wide river delta. A sand bar blocks the estuary from the ocean, except when flooding occurs.

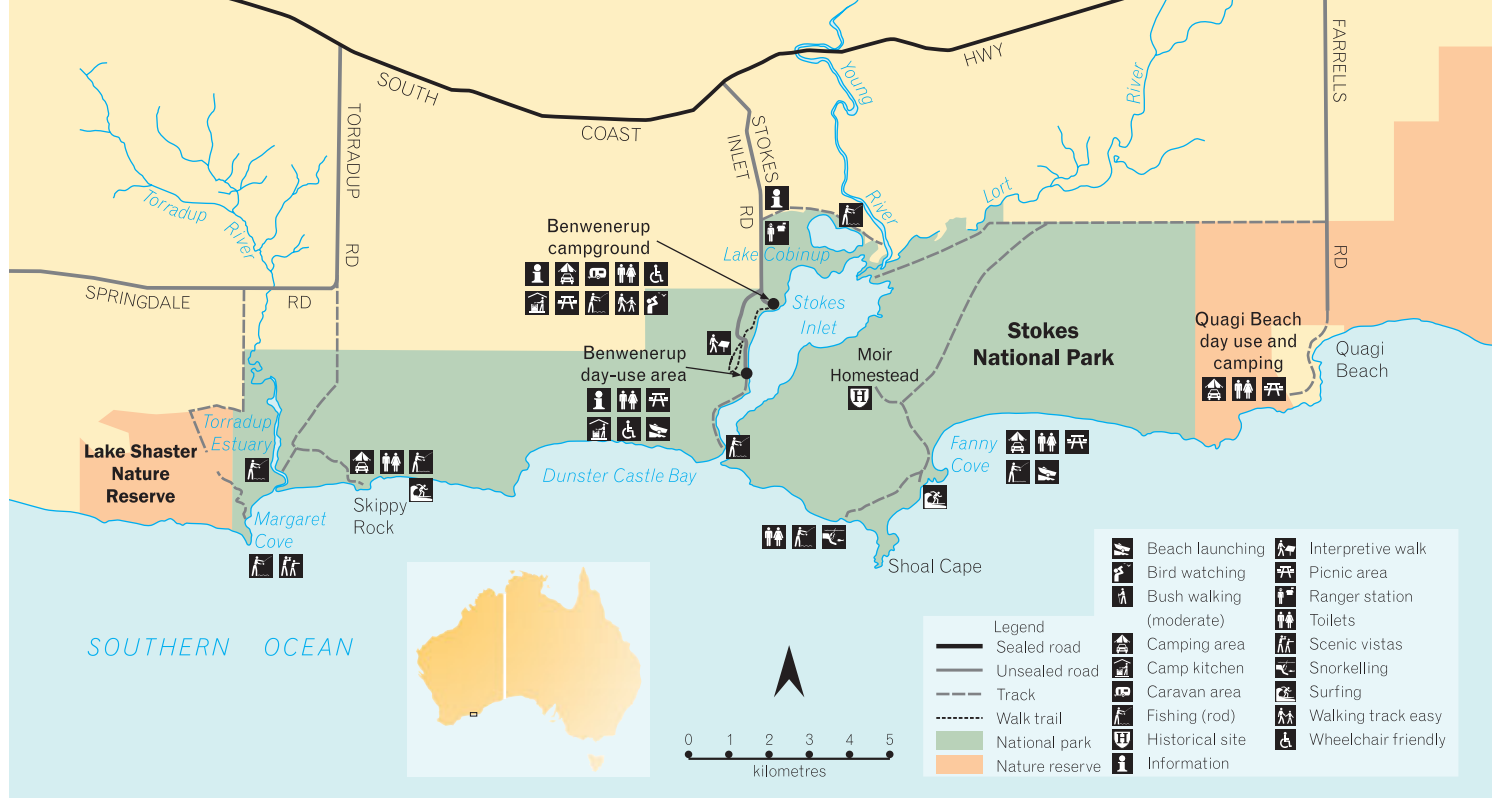
Wildfire swept through the park in November 2006, destroying much of the visitor infrastructure, and flood ravaged the coast in 2007, ruining the main access road to the Benwenerup campground on the western side of Stokes Inlet. However, works in the area have now resulted in the road being reconstructed and the creation of new, modern camping and day-use facilities as well as the reopening of the Stokes Heritage Trail. The fire has also sparked a burst of new life with fresh vegetation now cloaking the once-blackened landscape in new growth.

History

The area around Stokes Inlet was highly important to Aboriginal people who described the area from the Young and Lort rivers to the west and Thomas River to the east as 'one country'. About four family groups traditionally lived in the region and evidence of their occupation remains in features like an ochre quarry, possible burial sites and the mythological site Walitch Benwenerup, which means 'place where the eagle came to scratch (the cliff) and die'.

European presence in the area started in 1848 when John Septimus Roe led an expedition to explore country between Cape Riche and Russell Range to the east of Esperance Bay. During this trip, he named Stokes Inlet and Lort and Young rivers. Pastoral interest began in 1863 when the Dempster family selected and received land at Stokes Inlet for a 5,700-hectare pastoral lease around the inlet.

In 1873, the lease was transferred to John and Alexander Moir who



built Moir Homestead east of the inlet using bush timber and limestone quarried from nearby hills. The ruins of the homestead, blacksmith workshop, shepherds' camp, woodshed and stables remain today.

The Moir family passed responsibility for the land down through the generations until 1951 when the White family took on the lease. The family farmed here until 1970, when mining interests threatened to begin work in the area, and they surrendered the lease to the State Government on the condition it became a national park, which occurred in 1974.

Natural attractions

The mud flats, shallows and riverine delta at Stokes Inlet provide important habitat for waterbirds with at least 29 species occurring here, including large numbers of Australian shelduck, grey teals, little black cormorants, black swans and chestnut teals.

Migratory species also visit here each year, including the common sandpiper and red-capped plover. Australasian grebes, Australian pelicans, little pied cormorants, white-faced herons, great egrets and pied oystercatchers also visit the inlet—about 50 species use the inlet in total and 170 species have been recorded in the wider area.

The inlet is fringed by paperbarks, sedges and samphires while the waters are home to seagrasses and small green algae. When the sandbar breaks to the ocean, marine species like prawns (*Penaeus*

latisulcatus), mussels (*Mytilus edulis*), blue manner crabs (*Portunus pelagicus*) and small jellyfish enter the lagoon.

Exploring the park

Benwenerup campground and day-use area at Stokes Inlet is the most popular area in the park, accessible by two-wheel-drive vehicle. You can set out on one of three walk trails from here. The easiest option is the 1.5-kilometre Stokes Heritage Trail, which is also suitable for bike and assisted wheelchair access. You can continue on from here on a moderately difficult section of the trail, which extends 2.5 kilometres from the original trail in a climb to a limestone ridge with some views over the inlet. The third option is the easy 3.5-kilometre walk from Benwenerup day-use area to the mouth of Stokes Inlet, which passes through a forest of fringing paperbarks but is only accessible when the estuary water levels are low.

Boaters can launch their boats from the day-use area and fishermen can cast a line here for black bream and King George whiting and drop nets for blue manna crabs, either from a boat or the banks of Stokes Inlet or Young River. Be sure to check Department of Fisheries licence requirements before fishing.

Further afield, Fanny Cove, Skippy Rock and Shoal Cape are among several other sites accessible by four-wheel drive. They provide striking coastal scenery and popular fishing spots. You can see the ruins of the Moir Homestead on the way to Fanny Cove.

Camping

Benwenerup campground features 14 campsites, including space for group camping, individual camping and caravans and campervans. Campers can use camp kitchen facilities which include free gas barbecues, while toilets and picnic tables are also provided. Campers need to register at a self registration station and camping fees apply.



park facts

Where is it? Stokes National Park is about 80 kilometres west of Esperance.

Total area: 10,667 hectares.

What to see and do: Walking, fishing, picnic, boating, bird watching, surfing.

Facilities: Campground, camp kitchen, toilets, picnic tables and boat ramp.

Nearest DEC office: 92 Dempster Street, Esperance, phone (08) 9083 2100.





Perth's

trees
and
tall
shrubs

Perth's native trees and tall shrubs play highly important roles in our ecosystems. What trees and shrubs occur in the region naturally, and what are their benefits to other forms of life?

by Robert Powell

Perth is within the South-West Botanical Province, the south-west corner of Western Australia between Shark Bay and Esperance, which is renowned for the richness of its flora. Perth itself has a rich flora, with about 1,500 species occurring naturally in the Perth metropolitan region.

The vast majority of Perth's plant species, however, are low shrubs or herbs (soft plants). Only 30 to 40 species would satisfy the normal definition of a tree: a woody plant growing to a moderate height and branching some distance from the ground.

If we include shrubs that commonly grow more than three metres tall, Perth's trees and tall shrubs number about 80 species. Being the largest of Perth's plants, these are often the easiest to spot, and are also the likeliest to have been retained on land developed for housing or agriculture. They are

quite varied: between them they belong to 14 different plant families, and grow in almost all the available habitats. Wherever you live in the Perth metropolitan region, your natural environment would have included some of them.

Groups of species

The largest group of Perth's trees and tall shrubs is the eucalypts (genera *Eucalyptus* and *Corymbia*), with 16 species. The most typical is jarrah (*Eucalyptus marginata*). It occurs widely both in the Darling Range, as a tall forest tree, and on the sandy soils of much of the coastal plain, where it is less tall but stout and spreading. Another abundant tree, particularly in the Darling Range and on the eastern side of the coastal plain, is marri (*Corymbia calophylla*), whose large, woody fruits are known as 'honkey nuts'. Tuart (*Eucalyptus*

gomphocephala) is a large and vigorous tree of the sandy and limestone soils near the coast. Flooded gum (*E.rudis*) occurs in many of the region's wetlands and in the Darling Scarp.

Less common in the Perth area are such species as salmon white gum (*E. lane-pooliei*), butter gum (*E. laeliae*), Fremantle mallee (*E. foecunda*), rock mallee (*E. petrensis*) and Yanchep mallee (*E. argutifolia*). The mallees are small, shrubby species, with several stems arising from a large underground rootstock, or lignotuber. Mallees are generally more typical of much drier regions, further inland. The three species that occur in the metropolitan region grow on very shallow soils over limestone, where larger eucalypts cannot.

Mallees begin life with a single stem. When, however, the stem is killed in a fire, or is eaten or dies in a drought, the plant sprouts more than one stem from its lignotuber. As the plant develops, the lignotuber grows and becomes capable of producing more and more new stems. For some species, specimens may occasionally be found arranged in a circle perhaps as large as 50 metres in diameter. For some of these stands it has been determined that the specimens are genetically identical, formed from the gradual expansion of the lignotuber which, after a time, rots away in the centre. Such a stand, therefore, may comprise an individual plant thousands of years old.

In the same family as the eucalypts, the myrtle family, Myrtaceae, are the paperbarks and honey-myrtles, in the genus *Melaleuca*, of which eight Perth species grow as trees or tall shrubs. Whereas many people may think there is only one Perth paperbark, there are two widespread species, freshwater paperbark (*Melaleuca raphiophylla*) and modong (*M. preissiana*). A third,



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Main Tuart trees at Manning Lake, Hamilton Hill.

Photo - Jiri Lochman

Left Wetland with freshwater paperbarks at Star Swamp.

Photo - Rob Olver



Above Jarrah forest.
Photo – Jay Sarson/Lochman
Transparencies

Right Flower-spike of firewood banksia.
Photo – Jiri Lochman

Far right Flowers and foliage of basket bush.
Photo – Marie Lochman



saltwater paperbark (*M. cuticularis*), can be found round Lake Coogee, as well as by the Swan Estuary at Pelican Point and near Mount Henry. With a little practice, one can distinguish between these three, even at a glance. Two other species, banbar (*M. teretifolia*) and gorada (*M. lateriflora*), have somewhat papery bark too. Apart from the paperbarks, the best-known Perth melaleucas include moonah (*M. lanceolata*) and chenille honey-myrtle (*M. huegelii*). Moonah, also called Rottnest tea-tree, is common on Rottnest Island, and both are often seen in cultivation.

There are also eight Perth species of banksia that grow as trees or tall shrubs. With their proteoid roots (dense clusters of roots near the soil's surface), banksias absorb nutrients efficiently, and are especially well adapted to the infertile, sandy soils that occupy much of the coastal plain. Sadly, they are dying out in many places, unable to cope with changes associated with European settlement, such as sudden

drops in the water table. Candle banksia (*Banksia attenuata*) and firewood banksia (*B. menziesii*) are especially common on the coastal plain, with bull banksia (*B. grandis*) most typical of the Darling Range. Banksias now include the dryandras, two species of which occur in the metropolitan region as tall shrubs, parrotbush (*B. sessilis*) and pingle (*B. squarrosa*).

The wattles, genus *Acacia*, are very typical of much of Australia. Of the Perth species that grow as trees or tall shrubs, three occur near the coast: red-eyed wattle (*Acacia cyclops*), summer-scented wattle (*A. rostellifera*) and white-stemmed wattle (*A. xanthina*). Another species, coojong, or golden-wreath wattle (*A. saligna*), stands out in spring, with its showy display of

yellow flowers. It is also the most widespread, occurring in almost all the region's habitats. With its long-lived seeds, it often pops up where the land has been disturbed, even on demolition sites in the inner city. The tree itself is extremely vigorous and quite short-lived, often surviving less than 12 years.

Of Perth's remaining species of trees and tall shrubs, several grow near the coast, including peppermint (*Agonis flexuosa*), dune sheoak (*Allocasuarina lehmanniana*), Rottnest cypress (*Callitris preissii*), coast hop-bush (*Dodonaea aptera*), corkybark (*Gyrostemon ramulosus*), coast pittosporum (*Pittosporum ligustrifolium*) and basket bush (*Spyridium globulosum*). In this environment, sea winds are very salty and thus very



damaging to foliage. Species such as Rottneest cypress and coast pittosporum develop dense foliage, within which the individual leaves are protected. Basket bush, when growing near the coast among low shrubs, spreads wide but keeps very low, gaining protection from the surrounding shrubs.

Another habitat where many of Perth's tall shrubs grow is river valleys, particularly in the Darling Range. The species include wonnich (*Callistachys lanceolata*), toobada (*Callistemon phoeniceus*), river pea (*Gastrolobium ebracteolatum*), valley grevillea (*Grevillea diversifolia*), tall labichea (*Labichea lanceolata*), albizia (*Paraserianthes lophantha*) and brook peppermint (*Taxandria linearifolia*). Brook peppermint, which often occurs in thickets, is significant for the shade it provides along watercourses, creating a cool, damp habitat for frogs and aquatic life, as well as cover for birds, such as the red-eared firetail. Thickets of brook peppermint are the best places to look

Above left Marris and balgas, John Forrest National Park, Darling Range.
Photo – Rob Olver

Above Fruiting branches of coast pittosporum.
Photo – Robert Powell

Left Coojong, with candle banksia in the background.
Photo – Jane Emberson

Right Jewel bugs (*Coleotichus costatus*) feed on the seed-stalks of red-eyed wattle. Photo – Jan Taylor

Below right Christmas tree. Photo – Robert Powell

Below far right Recording insects on butter gum. Photo – Robert Powell



for a very scarce species of dragonfly, and Western Australia’s largest, the western petaltail.

A highly unusual species is Christmas tree (*Nuytsia floribunda*), which is the only member of its genus. It actually belongs to the mistletoe family, but is very different from other mistletoes in that it grows as a tree in the ground, rather than on the branches of host trees. It is famous for the brilliance of its flowers in early summer. During the short period when they are produced, they are one of the richest sources of pollen and nectar for insects and birds.

A similarly unusual Perth shrub is kingia (*Kingia australis*), which, like Christmas tree, is the only member of its genus. This grasstree is in a different family from and quite unrelated to Perth’s other grasstrees, in the genus *Xanthorrhoea*.



Conservation status

Some 24 of Perth’s trees and tall shrubs are uncommon in the Perth metropolitan region. Many occur widely elsewhere, but some species, such as Yanchep mallee and rock mallee, are uncommon in general. Yanchep mallee is declared as ‘rare flora’ under State legislation, and listed as ‘vulnerable’ under Commonwealth legislation. All these mallees occur on limestone ridges, which are of limited extent. Moreover, many ridges have been quarried for limestone, or had their vegetation cleared for housing.

Another habitat type that has diminished greatly in extent is the alluvial soils on the eastern side of the coastal plain, which began to be developed for agriculture soon after European settlement.

Sadly, environmental changes are affecting many of the common species too. As mentioned previously, banksias are dying out in many places. Many marri and jarrah trees have died or declined in health. Stresses such as the recent droughts have lowered their resistance to attack by fungi or wood-boring insects.

Value to biodiversity

Perth’s trees and tall shrubs are of enormous value to biodiversity in supporting other forms of life. This is particularly true where the tree or shrub is a local species, occurring naturally on the site, or planted where it would have occurred naturally.

Especially significant forms of life are invertebrate animals, which include insects, spiders, springtails, scorpions,

mites, centipedes, millipedes, snails and earthworms. Comprising many thousands of species, invertebrates are a large part of biodiversity; they are also essential in keeping ecosystems functioning.

Perth’s larger eucalypt species support a huge number of invertebrates. Studies have shown that jarrah or marri, growing in its natural environment, probably supports something like 800 different insects and spiders, in the foliage, stems and bark and in the leaf litter or topsoil under the tree. Flooded gum and tuart, which grow in more fertile soils, are likely to support even more. The larger wattle species too support a great many insect species. Trees also provide hollows for nesting birds and food for a variety of vertebrate species.



Above Flooded gums by the Swan River at Ascot.
Photo – Robert Powell

Most of the trees and shrubs commonly cultivated in Perth's city and suburbs are non-local species, from other parts of Australia or other countries, and these generally support far fewer invertebrates. If we seek to maintain Perth's biodiversity, we should retain or grow Perth's trees and tall shrubs wherever possible.

Beauty

Trees and shrubs can be striking for their masses of flowers—but there is so much more that can be admired or enjoyed in their subtler aspects, such as their shape, structure, patterns and details. Whatever the species of local tree or shrub, we can begin to appreciate its beauty once we get to know it better.

Perth's local trees and shrubs can give us a sense of place. Jarrah and tuart, for example, occur naturally in no other capital city, and moreover reflect our natural environment. Jarrah's woody character and very moderate size on the coastal plain reveal the infertility of Perth's sandy soils. Tuart's elegant splitting habit, and its broad,

rounded canopy and comparatively dense foliage, are a response to the salty winds near the coast. Because local trees and shrubs are used by many associated insects, they develop interesting irregularities and detail. By contrast, non-local trees and shrubs are more regular, and have less character.

Where Perth's trees occur in bushlands, with their associated plants, there is beauty in the whole plant combination, which defines a particular type of vegetation, or plant community, in response to the natural environment.

Unfortunately, as mentioned previously, many specimens of local trees are now in poor health, and no longer very natural in appearance. Nevertheless, there are still many fine specimens to find and admire.

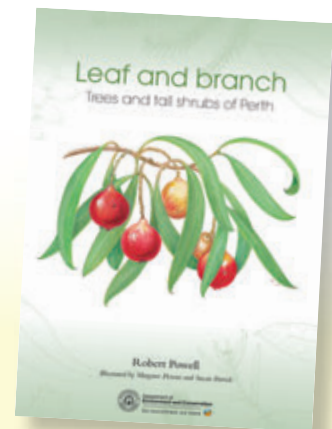
The public

Perth now spreads out in a vast area of suburbs, and it is this environment with which we are most familiar. Within the suburbs the housing density is increasing, leaving less and less room for trees. Most of those trees that do survive in grassed parks are non-local, planted species. Few Perth people today have much experience of local trees.

Perth does, however, have many bushlands, where local trees are readily

available to be discovered. To those of us unfamiliar with bushlands, they may seem strange and 'foreign', but there are many people who appreciate them. This is evidenced by the large number of 'friends' groups that have formed for Perth bushlands. Such groups do valuable work in helping to manage and protect the bushland concerned, as well as raising the public's awareness of it. Additional community groups focus on larger areas, carrying out revegetation programs with local trees and shrubs to increase the area's biodiversity. An excellent way to begin to learn about your local trees, and your natural environment in general, is to join a group that operates in your area.

In our rapidly changing world, the future survival of much of our natural flora is threatened. To keep our flora, we must be aware of our natural heritage and be caring custodians of it. The new edition of *Leaf and branch: Trees and tall shrubs of Perth*, published by the Department of Environment and Conservation, aims to encourage that awareness. It is full of information to help the reader not only to identify the species concerned but also to understand and appreciate them.



Robert Powell has recently retired from the Department of Environment and Conservation, where he worked for 34 years. Robert is the author of *Leaf and branch: Trees and tall shrubs of Perth*, which he recently revised. The book is available for \$29.95 from bookshops and tourist outlets, by phoning WA Naturally Publications on (08) 9334 0333 or by ordering online at www.dec.wa.gov.au/shop.

endangered

by Melanie Smith



Quartz-loving synaphea

The quartz-loving synaphea (*Synaphea quartzitica*) is a small shrub from the Proteaceae family. It is named after the chert (a type of rock containing quartz) hills in the Moora–Watheroo area, to which it is endemic. The heath community on the slopes of the chert hills is also a threatened ecological community containing other species of conservation significance (see ‘endangered’, *LANDSCOPE*, Spring 2000).

Quartz-loving synaphea is a small shrub generally less than 50 centimetres in height that has lobed leaves, with two or three pairs of lobes along the length. Small yellow flowers are widely spaced along a long inflorescence spike about six to 18 centimetres long and appear between July and August.

The species was first collected in 1908 from a site known as Cairn Hill, just north of Moora. Despite flora surveys in the area, the species had not been

recorded from any other location when it was described by Alex George in 1995. In June 1998 it was listed as declared rare flora (giving it special protection under government legislation) and ranked as critically endangered due to its small population size of only 45 plants, as well as its specialised habitat requirements and a number of threats associated with the population, such as mining, grazing and inappropriate fire regimes.

Not long after the quartz-loving synaphea was listed, three new populations were located in Watheroo National Park, bringing the total number of known populations to four and increasing the number of plants to nearly 200. It is not expected that any new populations will be found as little of the plant’s preferred habitat exists, most likely due to past clearing for agriculture and chert mining.

Efforts to aid the conservation of the species led to negotiations with the mining company that had tenements over the area, the landowners of Cairn Hill, and

several government agencies which resulted in Cairn Hill being gazetted as a class ‘A’ nature reserve in 2004. As a result of the greater security of the largest known population and more populations being found, the quartz-loving synaphea was re-ranked as endangered.

Although the species was well reserved, quartz-loving synaphea was still considered to be at risk of extinction and approval was given to undertake a translocation to increase the number of plants and populations. Botanic Gardens and Parks Authority staff used tissue culture techniques to grow seedlings from leaf shoot material taken from the natural populations. The seedlings were planted in 2005 at a separate site, free from threats such as mining and the *Phytophthora* pathogen which causes the disease *Phytophthora* dieback. A population of 54 plants now exists at the new location.

Photos by Melanie Smith

MARVELLOUS MANGROVES



BY ALAN KENDRICK, JOHN HUISMAN AND MICHAEL RULE



A new study by the Department of Environment and Conservation's Marine Science Program and Western Australian Herbarium seeks to uncover some of the hidden secrets of mangroves, the seaside trees that line nearly a fifth of Western Australia's shoreline and play a vital role in coastal protection and ecology. This article looks at the mangroves found in one of our wilderness wonderlands, the Shark Bay World Heritage Area.

The adage ‘beauty is in the eye of the beholder’ is perhaps never more appropriate than when reflecting on mangroves. To Western Australians familiar with the spectacular rocky shores and sandy beaches of the south-west, or the incredible coral formations of Ningaloo, the State’s muddy, sometimes bug-infested and often impenetrable mangrove forests would have to be well down the list of preferred locations in which to spend some quality time. Appreciation of mangroves does require some commitment and no small measure of understanding, for it is only when you realise the incalculable positive role that these plants play in coastal ecology can you accept that they are, indeed, ‘marvellous’.

What are mangroves?

A mangrove is a type of coastal plant that lives by the shoreline and is, at least sometimes, inundated by tides. They mostly occur on low-energy marine or estuarine shores and very rarely occur inland. An exception is Lake Macleod which supports the



largest inland mangrove area in Australia and possibly represents a relict from about 4,000 years ago when sea levels were higher—as sea levels dropped the mangroves may have been left stranded at Lake Macleod.

Mangroves disperse by floating seeds or propagules and their presence in individual locations can be due to a complex combination of environmental factors, including coastal morphology, currents, climate and tidal range. Once established, their intricate root systems can also modify the environment by trapping sediments and dissipating wave energy. By doing so, mangroves protect the shoreline from erosion and also prevent silty run-off from smothering offshore seagrasses and reefs.



‘Mangrove’ can refer to a single tree or a mangrove forest, and the latter is also sometimes called a ‘mangal’. Mangroves include a variety of trees, shrubs, palms and ground ferns, in Australia representing some 19 plant families, illustrating that the term mangrove does not imply a close taxonomic relationship. The species of mangroves are united by their habitat, not by their genetic similarity. However, many do share a range of adaptations that enable them to survive in their seemingly harsh saline environment. Some excrete salt through their leaves, while others have vertical roots known as pneumatophores, which facilitate gas exchange for the tree away from the sodden and frequently oxygen-depleted sediments. The trunks of mangroves are often buttressed or form multiple stilts (‘prop roots’) that provide support for the trees in muddy soils. This complex structure traps and stabilises sediments, enables the build up of nutrients in the mangrove habitat, and, in many cases,



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Main A relatively open stand of inundated white mangrove at Blind Inlet, near South Passage in Shark Bay.

Left The large pale yellow seeds of white mangrove can float, which aids dispersal of the species.

Photos – John Huisman/DEC



Above A low stand of white mangrove lines the shoreline of Dubaut Creek, south of Monkey Mia.

Photo – Michael Rule/DEC

Right A cluster of white mangrove pneumatophores, which are vertical exposed roots used for gas exchange.

Photo – John Huisman/DEC

provides shelter for a range of other organisms.

Worldwide, some 72 species of mangrove are known and more than half of those can be found in Australia, where almost 18 per cent of the coastline is lined by mangroves. The largest area and greatest species diversity occurs in Australia's warm and moist tropics and the extent and diversity of mangroves diminishes towards the south. This pattern is reflected in Western Australia, where about 75 per cent of the State's approximately 2,500 square kilometres of mangroves occur in the Kimberley. While this northern region supports 19 mangrove species, the diversity drops to nine species along WA's arid Pilbara coast and only one species at Shark Bay. While mangrove diversity and the physical processes contributing to their existence have been studied, the relatively poorly understood marine flora and fauna that live in WA's mangroves are the focus of a new study.

Shark Bay mangroves

Most visitors are familiar with Shark Bay's arid coast of red cliffs, sandy beaches and diverse and distinctive flora and fauna that led to its World Heritage listing. However, fewer people know that numerous and often large areas of the white mangrove (*Avicennia marina*) occur around the shores of the bay. Situated at about 26° south latitude, these mangroves represent the southern-most substantial concentration of this species on the Western Australian coast, although smaller isolated stands do occur further south, at the Houtman Abrolhos Islands (at about 28° south) and in the Leschenault Estuary (at about 33° south). More broadly, this species tolerates a wide climatic range and extends as far south as the coasts of South Australia, Victoria and the North Island of New Zealand.

Despite being recognised for their conservation significance, the mangroves of Shark Bay are poorly understood and some areas are known to be suffering from adverse visitor impacts. In June 2009, marine scientists from the Department of Environment and Conservation's (DEC's) Marine Science Program and Western Australian Herbarium joined DEC Shark Bay District staff to begin a study that will increase our understanding of mangroves in the Shark Bay World



Heritage Area and contribute to future monitoring of these habitats. Fifteen major mangrove sites were visited on the Wooramel Coast, Faure Island, Peron Peninsula, Dirk Hartog Island and in the South Passage area.

At each site the tree and pneumatophore densities were mapped, individual trees were tagged, measured and photographed for monitoring purposes, and samples of epiphytic seaweeds, sediments and associated in-fauna examined or collected.

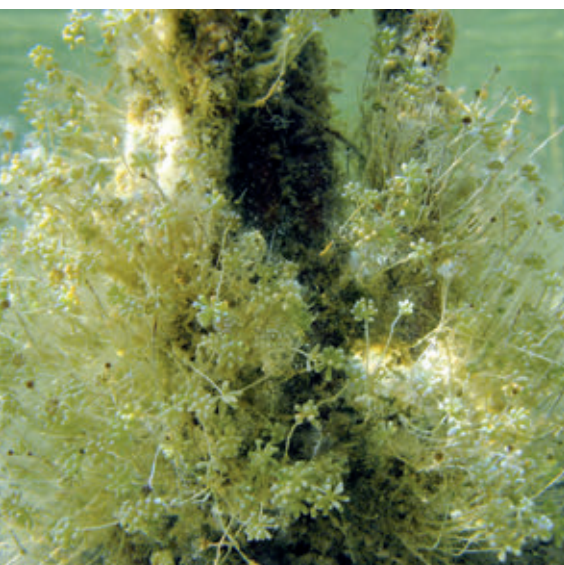


Above White mangrove.
 Photo – Marie Lochman



Left Unsightly rubbish at Uendoo Creek.
 Photo – Alan Kendrick/DEC

Below The green seaweed *Acetabularia* growing on pneumatophores.
 Photo – John Huisman/DEC



The reasons that dense mangrove stands only occur in particular locations in Shark Bay are not clear. They can be found along linear shores, filling shallow embayments, growing along the narrow channels associated with creeks or birrida-type (claypan) lagoons and within small coastal lagoons that have formed behind accreted sand banks. In addition to these relatively dense mangroves, many trees also occur in low densities along sheltered shores. Interestingly, the dense mangrove stands were found to vary widely in their size and structure. Some comprise mature trees with thick trunks and branches that are four to five metres

in height. While these stands were relatively open beneath the canopy, others consisted of apparently younger trees only two to three metres high, but which were so dense that entering the mangrove proved extremely difficult. In some stands, the trees were low and sparse. However, their thick and gnarly trunks suggested they were quite old but stunted and had not grown to their potential height. Small seedlings were also plentiful in most areas, these presumably becoming established when dying trees open a gap in the canopy, allowing light to penetrate.

Living with mangroves

Numerous plants and animals live among the Shark Bay mangroves, benefiting from the shelter and protection they provide, as well as the hard, stable surfaces that are relatively rare in such environments. Only a small number of seaweeds attach to mangroves, but they are typically species that are rarely found in other habitats and occur in unique associations on mangrove's vertical pneumatophores.



Above Leafy green seaweed *Gayralia oxysperma* on pneumatophores at Guichenault Point.

Right Littorinid snails (*Littoraria* sp.) cluster together on an *Avicennia* trunk just above water level.

Photos – John Huisman/DEC

Two red algae, *Caloglossa* and *Bostrychia*, are often found growing together, plus other unusual green and brown seaweeds. The diversity of these mangrove-associated seaweeds in Shark Bay has never been studied in any detail, and preliminary results from the expedition have recorded a species, *Acetabularia peniculus*, not previously known to grow on mangroves, plus one not before recorded from WA, *Boodleopsis siphonacea*. These, and the numerous other specimens collected during the expedition, will be incorporated into the Western Australian Herbarium's algal collection and be a permanent record of the species' existence.

Littorinid snails (*Littoraria* spp.) are abundant on trunks and branches at and above water level, while mudwhelks (*Terebralia sulcata*) can occur in large numbers where the muddy bottom is not overcrowded with pneumatophores. Several crab species, including the famously edible mud crab (*Scylla* spp.), burrow into the muddy mangrove sediments, while many fishes enter mangroves on flooding tides to feed and shelter among the complex roots. Even marine turtles are known to forage in mangroves.

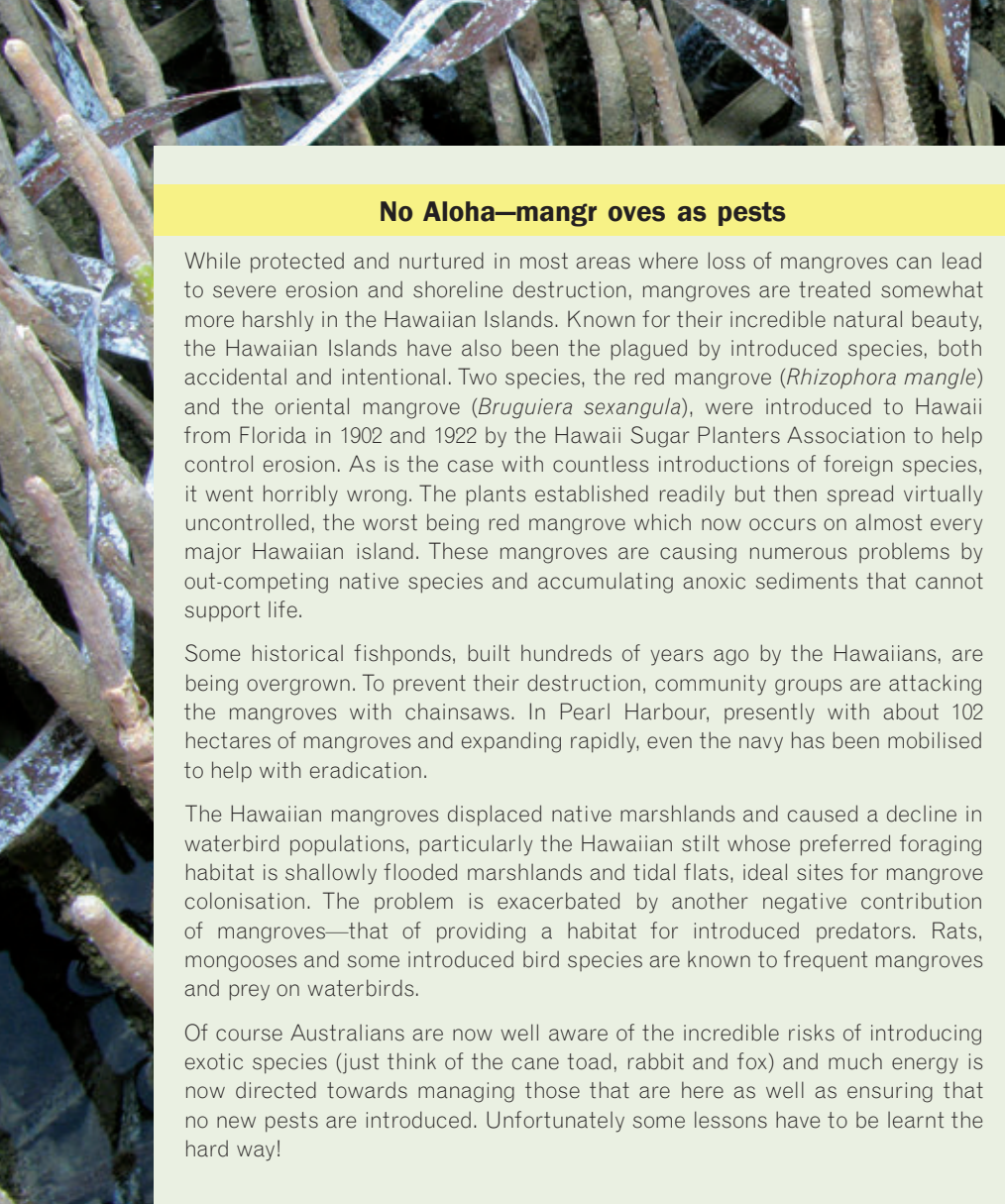


It's not only the marine life that Shark Bay mangroves support. Like any tree, a mangrove can be an important habitat for birds and insects. More than 200 species of birds are known to live in mangrove forests in Australia and about 25 of those are regarded as mangrove specialists. Shark Bay has the largest population of pied cormorants in WA and these can often be seen nesting in the mangroves. They frequently use pieces of the seagrass *Amphibolis antarctica* as nesting material, which is certainly plentiful as Shark Bay also supports the largest known seagrass bed in the world. Large concentrations of cormorants were seen nesting in mangroves near Big Lagoon on the Peron Peninsula and at Faure Island. So

many birds nest at these sites that the rookeries can actually kill areas of trees because of the high levels of urea the birds excrete.

Saltmarshes

Coastal saltmarshes, which are often associated with mangroves, are also common at Shark Bay. Saltmarshes principally comprise herbs and low shrubs, whereas mangroves are dominated by trees, and they typically grow on the landward side of the mangroves where they are less frequently inundated by tides. While saltmarsh is often referred to as the 'poor cousin' of mangroves due to its low and scrubby appearance, awareness of its ecological significance has been growing in recent



No Aloha—mangroves as pests

While protected and nurtured in most areas where loss of mangroves can lead to severe erosion and shoreline destruction, mangroves are treated somewhat more harshly in the Hawaiian Islands. Known for their incredible natural beauty, the Hawaiian Islands have also been plagued by introduced species, both accidental and intentional. Two species, the red mangrove (*Rhizophora mangle*) and the oriental mangrove (*Bruguiera sexangula*), were introduced to Hawaii from Florida in 1902 and 1922 by the Hawaii Sugar Planters Association to help control erosion. As is the case with countless introductions of foreign species, it went horribly wrong. The plants established readily but then spread virtually uncontrolled, the worst being red mangrove which now occurs on almost every major Hawaiian island. These mangroves are causing numerous problems by out-competing native species and accumulating anoxic sediments that cannot support life.

Some historical fishponds, built hundreds of years ago by the Hawaiians, are being overgrown. To prevent their destruction, community groups are attacking the mangroves with chainsaws. In Pearl Harbour, presently with about 102 hectares of mangroves and expanding rapidly, even the navy has been mobilised to help with eradication.

The Hawaiian mangroves displaced native marshlands and caused a decline in waterbird populations, particularly the Hawaiian stilt whose preferred foraging habitat is shallowly flooded marshlands and tidal flats, ideal sites for mangrove colonisation. The problem is exacerbated by another negative contribution of mangroves—that of providing a habitat for introduced predators. Rats, mongooses and some introduced bird species are known to frequent mangroves and prey on waterbirds.

Of course Australians are now well aware of the incredible risks of introducing exotic species (just think of the cane toad, rabbit and fox) and much energy is now directed towards managing those that are here as well as ensuring that no new pests are introduced. Unfortunately some lessons have to be learnt the hard way!



Background left White mangrove pneumatophores.

Above The introduced red mangrove in the Hawaiian Islands, where the species is a major pest.

Below Pied cormorants crowded together in a rookery on Faure Island.
Photos – John Huisman/DEC

removal and four-wheel driving. It can take many years before the slow-growing mangroves recover from such damage. The knowledge gained from this project will enable us to understand and manage these habitats better. While mangroves may not be the most visually stunning aspect of the Shark Bay landscape, they play an important role in maintaining shoreline integrity and providing habitat for a range of other organisms. For these reasons, it is imperative that they be protected from damage caused by irresponsible human behaviour. Marvellous they may well be, but immortal they are not.

years. In fact, saltmarsh occupies a greater area than mangroves in WA and it can support up to three times the number of plant species found in mangrove communities. At Shark Bay, mangroves and saltmarshes are often interspersed; with the latter typically dominated by samphires (possibly of the genus *Sarcocornia*).

Conservation

Increasing our knowledge of mangroves and their associated biota in the Shark Bay World Heritage Area will assist DEC to better manage these habitats. Unfortunately, some areas of mangrove and saltmarsh around Shark Bay have been adversely impacted by unmanaged camping, vegetation



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John Huisman is a phycologist (seaweed specialist) who holds a joint appointment with the Western Australian Herbarium (DEC) and Murdoch University. He is currently writing a book describing WA's tropical marine plants and also has interests in marine biosecurity. He can be contacted by email (john.huisman@dec.wa.gov.au).

Michael Rule is a marine biologist who works for the DEC Marine Science Program. He has an interest in temperate community ecology (particularly invertebrate communities) and is currently working on a range of projects in the temperate marine parks. He can be contacted by email (michael.rule@dec.wa.gov.au).

**Bushland
management
with**

friends

The Department of Environment and Conservation's *Land for Wildlife* program has recently celebrated its 2,000th property being registered. Registered *Land for Wildlife* sites are parcels of privately owned land, of which parts are managed for conservation. But how does the program work and what differences has it made since its inception in 1997?



by Penny Hussey

Fly over the south-west of Western Australia and you will see a patchwork of farms, roads, towns and bush. Part of this living quilt is blocks and strips of the native vegetation that originally covered the whole of WA before European settlement. Smooth, rounded granite rocks, jagged orange breakaways, creeklines and patches of forest, they contain the diverse suite of flora, fauna and fungi that make the southern half of WA a world biodiversity hotspot. Some of these patches of bushland are nature reserves, being managed specifically for conservation, but many are on private land. If our biodiversity is to survive, all these remnants must be managed as if wildlife matters.

Most landholders are proud of the biodiversity they look after and want to know more about it while also making sure that their management actions are the most appropriate for their particular site. To provide this on-site ecological advice, the Department of Conservation and Land Management (CALM) started *Land for Wildlife* (LFW) in 1997. Since then, more than 2,000 property owners have registered with the free program which is now run by CALM's successor

the Department of Environment and Conservation (DEC).

How does *Land for Wildlife* work?

The most important part of the program is a property visit, where landholders and a LFW officer move around the property to discuss any matters concerning landscape management that may arise, from the position of an eagle's nest to the cause of an acid saline seep, or the best location for a sandalwood plantation. There may also be questions about the names of plants or animals, the control of weeds or the use of fire. The exchange of information is two-way, as often the landholder has

Previous page

Main A farm with jarrah forest corridors.

Inset A jewel beetle feeding on a blue lace flower (*Trachymene coerulea*).

Photos – Jiri Lochman

Above A *Land for Wildlife* officer with a landowner in Wheatbelt bushland.

Photo – Avril Baxter

Below Wedge-tailed eagles are among those species offered better protection on *Land for Wildlife* properties.

Photo – Dave Watts/Lochman Transparencies

noticed something—the trigger for a regeneration event perhaps, or an insect pollinating a flower—that fills in a previously blank bit of the highly complex jigsaw that is our knowledge of the bushland ecosystem.



All this is written up in a report for the landholder. The report documents the nature conservation features of the property and suggests management actions that could be considered to improve their conservation value, integrated with whatever else is happening on the property. The decision of whether to undertake the actions rests entirely with the landholder, but the report provides the ecological background to help inform their choice (in bushland management, even 'doing nothing' will have an ecological consequence). Revisits after several years have shown that landholders undertake about 80 per cent of the actions suggested, and those that are not adopted often have an extraneous factor acting against them—for example, the inability to access a wide diversity of understorey plants for a revegetation project.

Although the property visit is the core of LFW, the LFW officers also provide general advice when asked, give talks and run workshops. In addition, there is a publications program, including the quarterly magazine *Western Wildlife* which has won the Sigma Landcare Media Award (WA Section) for excellence in environmental reporting.

Currently, the program employs 12 staff, 10 of them part-time field officers located across the south-west, and two full-time staff at DEC's State operations headquarters in Kensington.

Land for Wildlife in action

What sort of actions are commonly undertaken? One of the most obvious is to control grazing by installing stock-proof fences. In addition, landholders may put programs in place to control feral grazers such as rabbits or pigs, or predators such as foxes and cats. Weed management is also essential, especially if bushland rehabilitation or regeneration is to occur. It is also important to know what is a weed and what is native, so bushwalks, workshops and identification texts become vital. The landholder may embark on detailed work, such as erecting nest boxes or modifying a dam to create habitat for specific fauna—and this might lead to translocations onto the site of animals that once occurred there but have since

Photopoint monitoring



Photopoint monitoring reveals the changes to a landscape over time. These photos show a gravelly ridge on Bill White's property at Dumbleyung. The top photograph shows the land in October 2001 during the *Land for Wildlife* visit with palatable shrubs in the foreground heavily grazed. The other photograph was taken in July 2009, after a fence was erected to exclude stock in 2002. It shows how the low shrubs have regrown once grazing pressure was removed. Photos – Avril Baxter

gone locally extinct. It may also be necessary to consider actions to mitigate threats from wind or water erosion, rising water tables or salinity. Finally, the careful use of fire for regeneration needs to be considered. From this suite of possible actions, the LFW officers discuss with the landholder those that could be valuable at any specific site, and whether there are grants to kick-start the management.

Only if the community as a whole wants native flora and fauna to survive will there be enough effort for it to really happen. LFW members show goodwill and enthusiasm exists. They are looking after their piece

of bushland because they genuinely want to. All the LFW team agrees, it is both a pleasure and a privilege to work with such dedicated people.

Making a difference

So what have these landholders achieved since LFW started? For a start, collectively they have designated 306,498 hectares of their properties as 'LFW sites'. These are areas of the property where wildlife conservation is a principal aim of management, though there may also be other aims, such as 'management of secondary salinity'. Thus, these sites are effectively

private nature reserves, and are a very important adjunct to the formal nature reserve system. This is an amazing contribution that ordinary people are making to the conservation of our biodiversity—something that benefits, not just themselves, but all Australians.

Each of the 2,000 landholders has a great story to tell, but just a few have been selected to illustrate specific nature conservation management actions. Many use ‘before and after photos’, a technique called ‘photopoint monitoring’ which involves taking a photograph at some recognisable point and rephotographing again at regular intervals to note change. It is especially useful at the time of doing some management action, like fencing or

weed control, because one does forget what a place originally looked like.

Revegetation of saline seep

When LFW officers first visited Sarah and Geoff Mason and Caroline Goodden’s Victoria Plains property in June 2002, much of the bushland was in excellent condition, and there was only one really difficult site—a hillside saline seep. The LFW officer recommended methods of treatment and potential flora for planting, with the twin aims of halting the expansion of the seep and the expression of surface salinity and creating habitat for native fauna.

Seven years later, in 2009, the perimeter is held by dense banks of shrubs, and frogs and small birds

have returned. Although erosion still continues on the exceptionally harsh centre area, the site is now much more environmentally valuable.

After the second visit, Sarah wrote in an email to LFW:

“We have benefited so much from being a LFW member. I knew nothing when we first joined and was overwhelmed by the task of owning a patch of remnant vegetation. However, due to the many things I have learnt through workshops and the brilliantly accessible, though scientific, *Western Wildlife*, I now have the capacity to manage our bushland in a way which will maintain its biodiversity and condition. I also know that if I have an issue or question I can call upon the services of the LFW officers, who are always so helpful. As an aside we don’t keep magazines that we subscribe to... except *Western Wildlife* of which we have every issue since we became members. I am always promoting the organisation to other landholders as a great way to learn how to care for their patches of remnant vegetation.”

Creating an animal sanctuary



Woylies (top) thrive at Yelverton Brook because the landowners have installed a feral-proof fence (above) to keep predators out. Photos – Joy Ensor, Cherie Kemp

Keeping feral predators at bay

When they joined LFW in 1999, Joy and Simon Ensor were delighted to have it confirmed from the presence of soil diggings that quendas (*Isoodon obesulus*) were using their property, Yelverton Brook Eco Retreat Chalets and Conservation Sanctuary near Margaret River. But they had also seen foxes. To give the native fauna the best possible chance, they made the difficult and expensive decision to enclose the whole property in an electrified feral-proof fence. The fauna responded positively. Most exciting, perhaps, are the woylies (*Bettongia penicillata*). Three animals that had been in care, but were considered too damaged to go back into the wild, were released here, and they have now increased to 30. The whole property is a shining example of management to enhance conservation value, as well as providing a memorable bush retreat experience for visitors.

Creating corridors and buffers

Tim and Leanne Murray own a 713-hectare property in the Shire of Goomalling. The shire has been extensively cleared for agriculture and has on average only 4.6 per cent of the

Right A male stone curlew warns the photographer away from its nest in a farmyard corner at Highbury in the Wheatbelt.

Photo – Bill Warren

Below right The Shire of Murray registered land at Coolup Gun Club with *Land for Wildlife*, including this ephemeral wetland.

Photo – Heather Adamson



original native vegetation remaining. But the Murray property had only 0.56 per cent of its original vegetation. As the Murrays were interested in wildlife and the property includes a couple of freshwater lakes, the LFW visit in 2003 concentrated on ways of improving the biodiversity. As a result, bush corridors and buffers have been planted and so increased the area of land under native vegetation from four hectares to approximately 35 hectares. There has been a noted increase in bird life on the farm. The revegetation has also had benefits in that wind and water erosion has been contained and there has also been a reduction in the threat of salinity to the freshwater lakes. Tim and Leanne have made a real difference on their property and have been a catalyst to others in the shire due to their dedication and enthusiasm.

Hard work reaps positive result

In 1997, Barry Fowler, with his late wife Joy, registered their Coorow property, Glen Waddi, with LFW and in 2002 they also registered a property they leased. The leasehold contained 27 per cent remnant vegetation, mostly on upper slopes and rocky watersheds. The valley floors, which originally supported woodlands, are largely cleared and affected by secondary salinity. At the time of the LFW visit in 2002, the aims for the leased property were identified as ‘reinstating salt-affected areas’ and ‘fencing remnant vegetation to maintain it in natural state’. LFW provided advice on how to go about this, as well as where to look for funds.

The leased property was revisited in January 2008. By this time the Fowlers had erected eight kilometres of fencing around remnants and revegetated areas, and planted 3,000 seedlings along salt-affected creeklines. The seedlings were



grown from a range of local provenance seed collected by local women known as the ‘gumnut ladies’. The salt creek planting creates a link between the upper landscape and the valley floor and connects with a 40-kilometre bush corridor passing through properties in the adjoining Marchagee Catchment. They also planted 7,000 melaleuca seedlings as part of a DEC project.

By the time of the LFW revisit, the salt creek site had transformed from a bare and degraded area into one supporting healthy revegetation, natural regeneration and numerous echidna diggings. Despite drought in 2006 and 2007, the natural regeneration of native plant species was also occurring among remnants in the upper landscape.

Working with local government

As a technique for keeping out unwanted visitors, nothing beats signs that say, in effect: “Live ammunition in use—you could get shot”! Such is the case at the Coolup Gun Club reserve near Pinjarra, a superb bush island among mostly cleared agricultural land. It includes populations of rare flora and fauna and six hectares of excellent-quality seasonal wetland. The reserve is vested in the Shire of Murray, whose staff asked LFW to help develop a management plan, and to run a community bushwalk to assist with starting a ‘friends’ group. With plans in place and enthusiastic helpers, this little gem has a very bright future.



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

urban antics

by John Hunter



Christmas Tree Gully...

There's a 1957 song that starts: "If you're fond of sand dunes and salty air, quaint little villages here and there..." and it was so apt for those who lived in Perth's western beach suburbs in those days.

That era was a fun time of unsophisticated adolescence. There were not many people, not much traffic and no weekend restrictions. The world was our bowl of cherries and all we needed was a greased-up chain on our bikes and access to anybody's front garden tap when peddling to the beach got tough in the heat of summer.

In those days, the main beaches from Cottesloe to Trigg Island were separated by large tracts of bush with no road or path along the coast, so if we rode down to Scarborough and decided the waves could be better north or south, then it was quicker to run or walk the coast. It was on these forays to Trigg that we always stopped off for a rest and chat at our little secluded piece of the planet we named 'Christmas Tree Gully'.

From the beach, you could only see inland to the huge primary dunes but, one time while athletics training through those dunes,

I noticed an inland gully of unusual vegetation. It resembled a postcard picture from somewhere else, a hobbit-like scene of small, dark green rounded shrubs, some standing aloof like sentinels and others huddled in groups on the valley floor. Here, among the few large tuarts and grey-green saltbush, they looked like very conspicuous alien castaways in a secluded hideaway.

These trees were *Callitris preissii*—a native cypress sometimes called Rottnest Island pine or sand cypress. The dense and fine, rich green foliage of these pines is similar to that of cultivated conifers and, typical of their habitat, they were growing in dry limy soils and tolerating the relentless battering of salt-laden afternoon sea breezes. The trees here were quite thick and rounded with a spreading form, probably to help combat hot easterly winds followed by the rugged but cooling south-westerly 'Fremantle Doctor'.

The colour and shape of these cypresses enhanced the appeal of this dune valley and gave it a 'garden' feel. It was a place to shelter, turn on your transistor

radio, and lie back in the cool of the grove and talk kids' business before the final trek to Trigg.

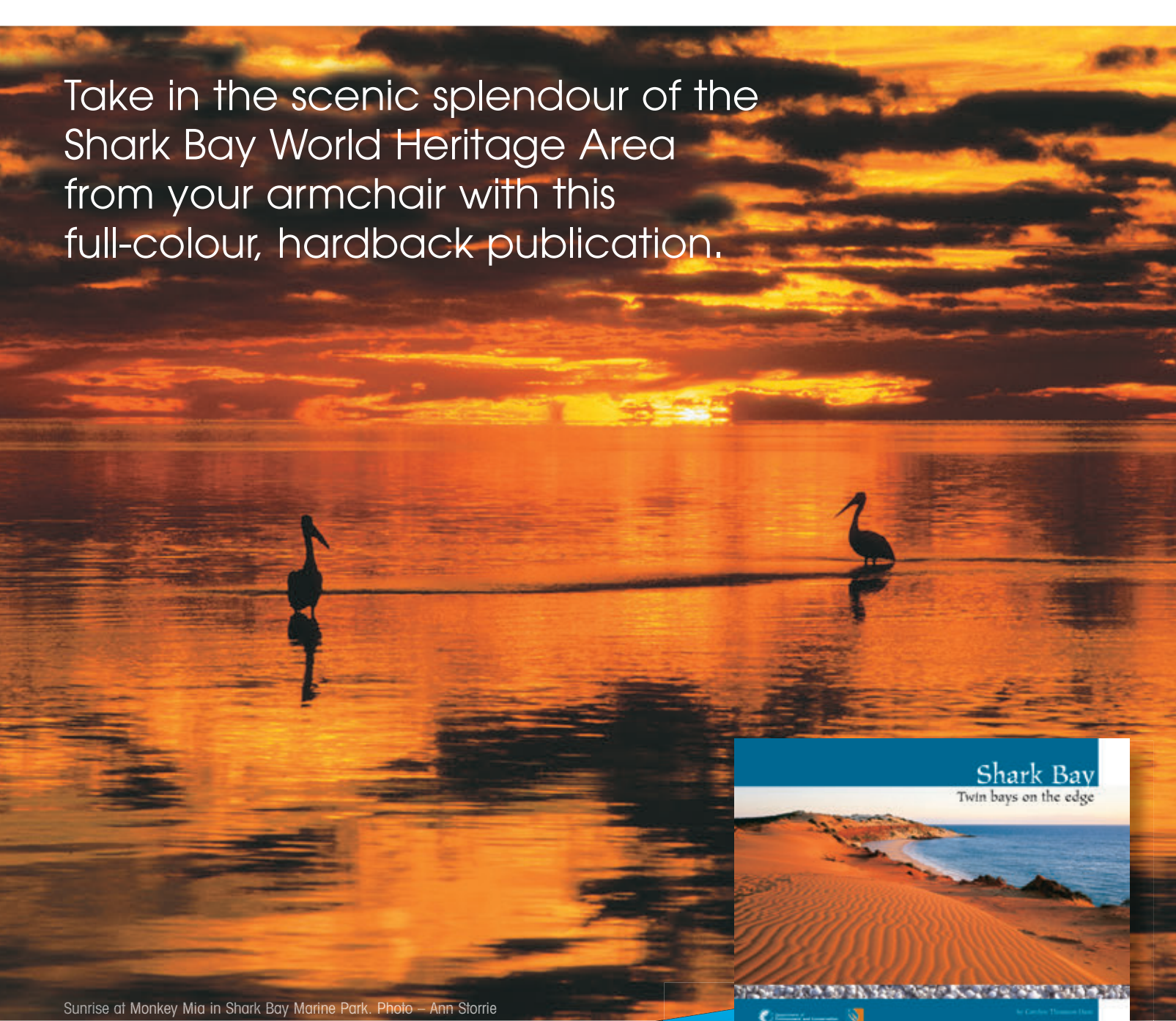
Over the course of time, many places in the suburbs that were the revered haven of children and even older folk have disappeared due to development. It is important for us all to keep our government bodies and local councils informed of the existence of special places and species in our neighborhoods.

The existence today of Trigg Bushland as one such special place has resulted in Christmas Tree Gully still being there as it was all those years ago. Now a stone's throw from suburban houses and just a kilometre from the rock 'n' roll echoes of the Scarborough Snake Pit, it still features its unique Rottnest Island pines. You should go there sometime and hear the whispers of the wind and ghostly mutterings of children through the cypress. Shhh... Elvis, is that you?

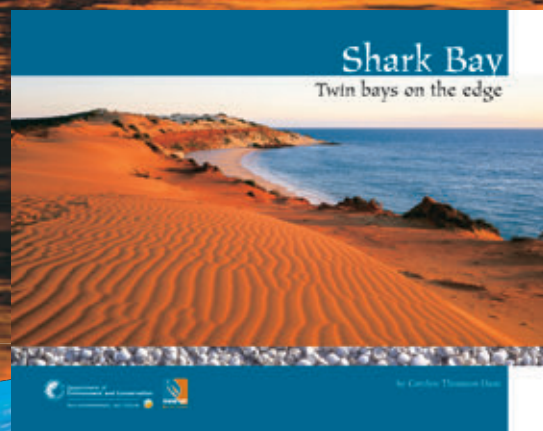
DID YOU KNOW?

- Rottnest Island pine and Rottnest teatree are part of a threatened ecological community.
- Rottnest Island pine has leaves only about three millimetres long. They are pressed closely together against the stem.
- Rottnest Island pine was named when first observed on Rottnest Island by botanist Cunningham in 1822. It is killed very easily by fire.
- Today, Rottnest Island pine occurs only from Trigg to Woodman Point, on Rottnest and Garden islands and in a few remaining stands along the Swan River in Peppermint Grove.

Take in the scenic splendour of the Shark Bay World Heritage Area from your armchair with this full-colour, hardback publication.



Sunrise at Monkey Mia in Shark Bay Marine Park. Photo – Ann Storr



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