

WA'S PARKS, WILDLIFE AND CONSERVATION MAGAZINE

LANDSCOPE

Volume 32 Number 1 Spring 2016 \$7.95

**EIGHTY
MILE BEACH**

Tradition meets
science



The Pilbara
A journey of
protection

Cryptic creatures
Ingenious evolution

Bramley National Park
A mountain biking haven



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ON THE COVER

Front cover Albany daisy (*Actinodium cunninghamii*) is a slender shrub that grows to one metre high. With white and pink flowers it blooms from August to November in sites in the south-west and along the south coast. The beetle is in the family Cleridae and is in the genus *Eleale*.
Photo – Mark Brundett/Parks and Wildlife

Back cover Mountain bike riding is one of the world’s fastest-growing sport and recreation activities and is enjoyed by many in places throughout the south-west, including in Bramley National Park.
Photo – Elements Margaret River

Parks and Wildlife’s Goldfields Region covers more than a third of Western Australia. The landscape is surprisingly varied and extends from the Wheatbelt, through the spectacular eucalypts of the Great Western Woodlands and the mulga woodlands to the Nullarbor Plain and the Gibson and Great Victoria deserts. The Goldfields Region is home to many Aboriginal groups from the traditional communities in the Gibson Desert and the Spinifex people of the Great Victoria Desert, local Aboriginal people around Kalgoorlie-Boulder and in the north-east Goldfields, and the Wiluna Martu people who hold native title at Matuwa and Kurrara Kurrara and the adjacent deserts.



As land managers in this part of the country, working with Aboriginal people is now a central and priority component of our work. Over many years I have had the unique opportunity to pioneer joint management in the Goldfields and forge long-term relationships with many traditional owners, who have welcomed me into their communities and families. Developing these relationships and building goodwill has been achieved over many years by spending considerable time on country listening to and learning from Aboriginal people, across a number of generations.

The extensive joint management work undertaken has not been without challenges. The Parks and Wildlife Goldfields Region covers 34.3 per cent of WA and includes 8.6 million hectares of conservation reserves. Travelling to remote areas raises logistical, mechanical and practical issues to put work on the ground. These trips have been one of the most enjoyable parts of my job and have taken me to places few have been privileged to visit. It is with pride that I retire from my position as regional manager after more than 32 years knowing that the department has created meaningful relationships with traditional owner groups throughout the region with great land management, cultural and conservation outcomes. We have also provided employment and traineeship opportunities for a number of rangers, many of whom continue to work with and for the department today. I thank all those who taught me and gave me the opportunity to pass on knowledge to the many staff and visitors to the Goldfields.

Significant work with traditional owners is also being carried out in the Pilbara at Eighty Mile Beach, which you can read about on page 28.

Ian Kealley, Goldfields Regional Manager
Department of Parks and Wildlife

Contributing

Ray Cranfield worked for Parks and Wildlife in the WA Herbarium for 38 years before retiring in 2013. During that time he was awarded a Churchill Fellowship to study community involvement in lichen recording, having developed a passion for these largely under-researched micro-fungi. He continues his passion as a WA Herbarium research



associate and volunteer. While his interest is in collecting statewide, his research has led to the development of a state census and mapping of the species primarily in the southern Wheatbelt region.

Jesse Murdoch is a Parks and Wildlife visitor interpretation officer (marine) based in Broome. After starting with the department in March 2016 she has run various education programs at Eighty Mile Beach and has been involved in many community events. Jesse has a marine science background and is passionate about marine conservation and educating the wider community about the magnificent marine parks of the Kimberley.



Kelly Rayner is a technical officer for Parks and Wildlife’s Animal Science Program. She is currently working on the Pilbara northern quoll research program, but has also worked on translocation and reintroduction programs for threatened species, rodent eradication programs on Western Australian islands and fauna monitoring programs throughout the state since joining the department in 2010. She combines her love of the outdoors and her passion for conservation whenever possible and feels extremely fortunate to work in the beautiful Pilbara landscape.



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This page Coalseam Conservation Park.

Photo – Damon Annison

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Department of
Parks and Wildlife







READERS' PIC

Matuwa (formerly known as Lorna Glen)

Words and photo by Jennifer Eliot

“A thunderstorm brews at Matuwa, the Indigenous Protected Area formerly known as Lorna Glen, east of Wiluna before unleashing thumping desert rains.”

Have you got a fantastic nature photograph you would like to see published in *LANDSCOPE*? Send it, along with a 100-word description of the species or how and where you took the shot, to landscape@dpaw.wa.gov.au.



Above Rock-wallabies were photographed in Kalbarri National Park in August 2015. Photo – Remi Vignals

‘Country cousins’ join Kalbarri rock-wallabies

Kalbarri National Park’s elusive black-flanked rock-wallaby population has been bolstered by a contingency of animals from the Wheatbelt released into the park in May.

The species was considered locally extinct in Kalbarri National Park, having not been seen in the area for 20 years, until a rock climber filmed two wallabies in a gorge in the park in August 2015 (see ‘Surprise! Rock-wallabies found in Kalbarri National Park’, *LANDSCOPE*, Autumn 2016).

The May release was the first of a number of releases of wallabies planned by Parks and Wildlife, with the assistance of WWF Australia, over the next three years. Feral cat, fox and goat control will also be carried out to help safeguard the animals as part of Parks and Wildlife’s *Western Shield* program.

This project is being funded by Parks and Wildlife, the Australian Government’s National Landcare Programme and WWF Australia.

Wildflower tool showcases WA flora

Each June to November, colourful and beautiful wildflowers blanket the Western Australian landscape which has become famous for its annual display.

With more than 10,000 species of flowering native plants, it can be difficult to tell one from another. However, a new tool is helping to bridge the gap between the scientist and the tourist, the botanist and the general public, through a collection of botanical photos.

An annual subscription to the website (www.wildflowerswa.net/) costs \$27.50 and provides online access to nearly 3000 images and information profiles of more

than 800 Western Australian species. It also gives you access to an intuitive search function that includes 12 different search criteria including location, flower colour and flowering time.

WildflowersWA is the brainchild of horticulturist and wildflower enthusiasts John and Margaret English, experienced ecologist Dr Libby Mattiske and experienced botanist and software developer Cameron Blackburn. Other experienced ecologists and wildflower enthusiasts have also contributed and the project team has worked closely with Parks and Wildlife staff from the WA Herbarium.



Guest columnist



Marion Fulker
*Conservation and
Parks Commission
Chair*

Like most Australians I am a 'coast hugger' replacing my childhood Sydney on the east

coast for Perth on the west coast some 30 years ago. During my formative years my grandparents undertook a sea-change long before it was trendy and moved to the northern rivers area of New South Wales. Thus began a unique interaction in the school holidays between coast and bush which contain some of my happiest memories.

Therefore, I am very pleased to have been appointed to chair the newly established Conservation and Parks Commission. The Commission removes the delineation between the marine and terrestrial environments, if you like between the wet and the dry and the intertidal areas in between, to create a holistic approach to planning the management within a single entity.

Not only will we continue to create new parks, manage existing ones and set policy, our remit also sees us interacting with traditional owners in the negotiations of individual Indigenous Land Use Agreements.

The Commission comprises seven people, including Chris Doepel (Deputy Chair) and Kim Colero from the previous Marine Parks and Reserves Authority and Brian Middleton, Ross Dowling and Regina Flugge from the former Conservation Commission along with Noongar woman Ingrid Cumming. We are supported by a specialist team.

The Commission is already operational having held three meetings. I am incredibly impressed with the depth and breadth of knowledge demonstrated around the table. We have lots to do in the coming months including undertaking background work needed to create a number of new parks and develop the associated management plans.

Western Australia is renowned for its high biodiversity values and natural beauty, and the Commission's work seeks to conserve it for current and future generations to enjoy.



Government of **Western Australia**
Conservation and Parks Commission



Yanchep National Park welcomes campers

Above Elna Opperman and Gillian Milne from Holland enjoying the experience of camping at Yanchep National Park.

Photo – Mark Varley/Parks and Wildlife

People are taking advantage of the opportunity to experience camping in a bush setting in the greater Perth region, thanks to a 12-month camping trial at Yanchep National Park.

During the camping trial, the park's Henry White Oval has been converted into a campground that accommodates caravans, campervans, camper trailers and tents.

Yanchep National Park manager Julia Coggins said camping provided another attraction for the park, adding to the more than 320,000 visits it receives each year.

"Visitors can now come to see the koalas, explore the caves, learn about the area's European and Aboriginal culture, walk on one of the many bushwalks, play a round of golf, enjoy some of the delicious food and drink on offer or simply soak up the environment without having to rush home at the end of the day," she said.

The trial is part of the State Government's *Parks for People* initiative aimed at increasing the number of affordable camping options in WA's spectacular natural areas and follows on from the highly successful Great Aussie Camp Outs of 2014 and 2015.

Camping fees at Yanchep National Park during the trial are \$10 a night for adults, \$6.60 for concession holders and \$2.20 for children aged six to 15 years. Children under six are free. All fees collected are invested back into Yanchep National Park.

Discover camping at Yanchep National Park

Scan this QR code or visit Parks and Wildlife's 'LANDSCOPE' playlist on YouTube.



The survey says ...

We have been busy collating and interpreting the data from the *LANDSCOPE* readers' survey conducted earlier this year. If you are interested in finding out about our readers and what they think of themagazine you can access the results at shop.dpaw.wa.gov.au.

Thank you to everyone who submitted feedback.





Bramley National Park

Long popular among visitors to and locals of Margaret River looking for a forest getaway, Bramley National Park is also now catering to mountain bike riders who are looking for a thrilling adventure in one of the region's beautiful national parks.

Surrounding the popular south-west town of Margaret River, Bramley National Park provides visitors with stunning forest areas as well as a plethora of ways to enjoy the natural environment. The national park is home to a number of native species including western ringtail possums (*Pseudocheirus occidentalis*), brush-tailed phascogales (*Phascogale tapoatafa*), quenda (*Isodon obesulus*) and the endemic Margaret River hairy marron, and provides vital habitat for Baudin's, Carnaby's and red-tailed black cockatoos. It is ablaze with colour in spring when wildflowers carpet the landscape. And there is a rich Aboriginal history to discover. One of the best things about this national park is the choice of ways

Above Bramley National Park.
Photo – Marie Lochman

Above right 10 Mile Brook Trail in Bramley National Park caters to riders of a range of ages and abilities.
Photo – Margaret River Busselton Tourism Association

to explore it – whether on two wheels on one of the mountain bike trails or on foot on the 26 kilometres of walking trails.

ALONG FOR THE RIDE

Mountain bike riding is one of the world's fastest-growing sport and recreation activities and Western Australians are along for the ride. The \$13 million *South West Mountain Bike Master Plan*, completed in 2015, outlines a comprehensive plan to provide for cycle tourism in the area. The Margaret River area already has many existing trails and Bramley National Park has been identified as a high priority for future trail development.

Funded through the *Parks for People* initiative and developed in partnership with the Margaret River Offroad Cycling Association, Department of Sport and Recreation, Lotterywest and the Shire of Augusta-Margaret River, the first section of a new trail in Bramley National Park was opened in November 2015. Called the Paper Trail, it is already proving popular

among riders who are travelling from afar to ride it. The trail has acquired a reputation as being the most difficult trail in the Margaret River area – a challenge welcomed by many riders – thanks to its rock drops and jumps. The 600-metre section is the first part of an eight-kilometre trail network which, when complete, will offer a purpose-built adventure tourism experience. It was created through a mix of volunteer and contract labour and by using natural features and contours in the landscape. The second part of the trail will be opened later this year.

BACK ON TWO FEET

Another way to explore the park and meander among its magnificent karri, marri and jarrah trees is on one of a number of the walk trails in the park. A 15-kilometre-return trek out to 10 Mile Brook Trail is a moderately easy walk that winds along the edge of Margaret River and takes in an ever-changing landscape. Feasting on a packed lunch is a welcome reward at the half-way mark picnic area.



“... one of the best things about this national park is the choice of ways to explore it – whether on foot on the 26 kilometres of walking trails or on two wheels on the mountain bike trails.”

Alternatively, shorter walks (which can be designed to journey to some of the beautiful river swimming spots or the region’s famed breweries or cafes) can be enjoyed by people of a range of ages and abilities. Getting out for a bushwalk can be a welcome activity for those who may have over-indulged in some of the delicacies that the region is famed for.

A PLACE TO REST YOUR HEAD

For a longer forest getaway (but with some of the modern conveniences that many people desire), visitors to Bramley National Park can stay at Wharnccliffe

Mill – a bush camp that offers powered campsites, caravan sites, cabins, an eco-lodge, dormitory facilities and safari tent camping. The camp – which is run under a lease agreement from Parks and Wildlife – caters to small and larger groups and provides showers, toilets, barbecues, picnic tables, table tennis and a communal camp fire pit. It minimises its environmental impact by generating its own power, using rainwater and running a state-of-the-art waste water treatment facility. It offers visitors information and education about the natural environment and sustainable living.

Top left Canoeing on the Margaret River can be a wonderful way to explore Bramley National Park. *Photo – Margaret River Discovery Co*

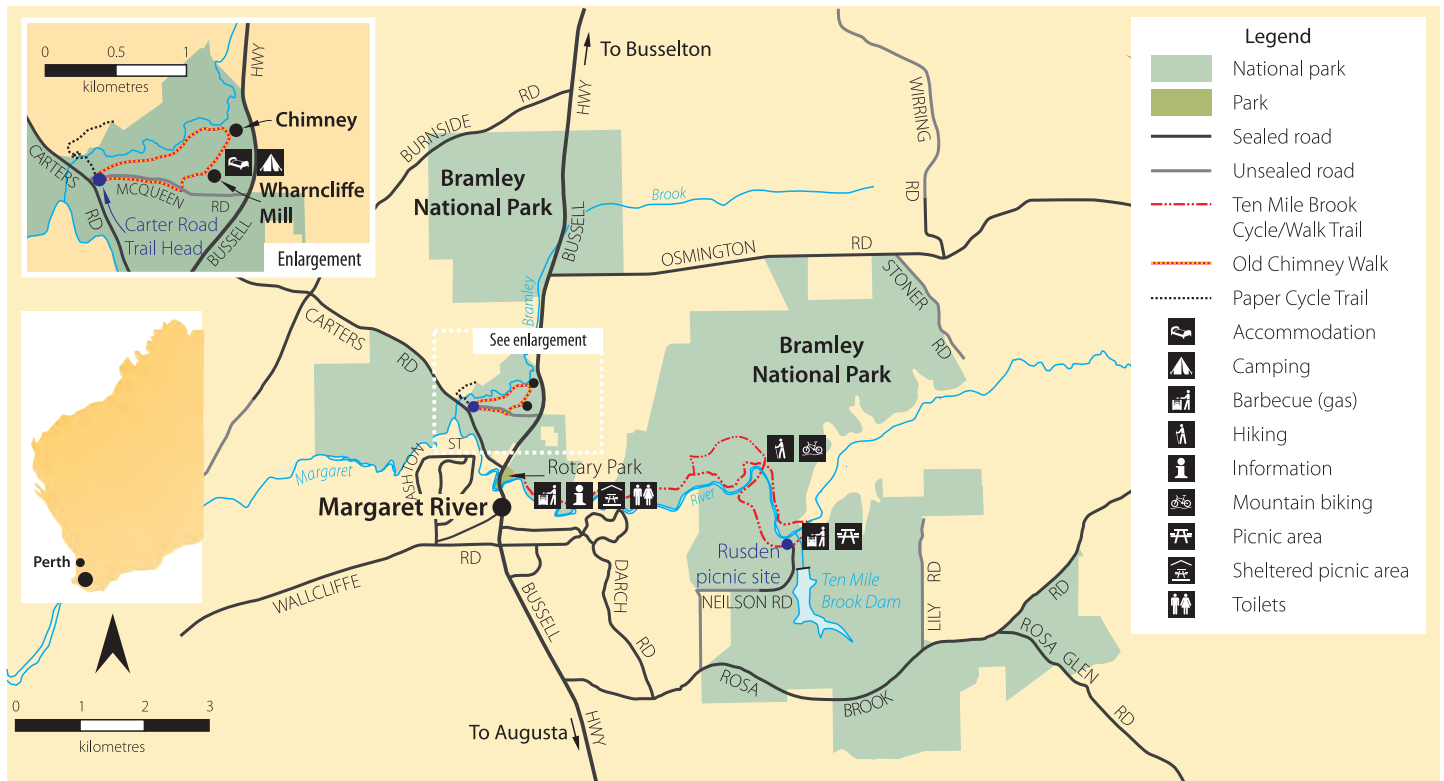
Above far left *Chorizema diversifolium* is one of a number of species that occurs in the park. *Photo – Jiri Lochman*

Above left Wharnccliffe Mill offers a range of accommodation options. *Photo – Wharnccliffe Mill*

Top A kiln associated with the Wharnccliffe Mill remains as a reminder of park’s heritage. *Photo – Ann Storrie*

Above Enjoying the nature playground at Wharnccliffe Mill. *Photo – Wharnccliffe Mill*

Parks for People Bramley National Park



CULTURAL RICHNESS

Wharncliffe Mill has partnered with Josh Whiteland from Koomal Dreaming to offer group cultural experiences. Groups can take part in short sessions where they learn how local Aboriginal people hunted for food and sample some of the traditional food. There are also demonstrations of tool making and musical performances. Those with a bit more time can sign up to a two-day cultural immersion program where they have the opportunity to explore the area's caves, go on a guided bushwalk and spend time hearing about Aboriginal Dreaming stories. These activities add to the experience of this beautiful natural area

which has been sacred to the traditional owners of this area for thousands of years, and is now becoming a favourite of many modern-day visitors too.



Do it yourself

Where is it? Bramley National Park is a two-minute drive (five-minute walk) from Margaret River or three-hour drive south of Perth.

What to do? Camping (at Wharncliffe Mill), mountain bike riding, birdwatching, bushwalking, photography, wildflower appreciation, swimming at the weirs, geocaching and picnicking.

Facilities: Wharncliffe Mill has campsites, accommodation, toilets, showers, playground and cooking facilities for guest use. Rusden (10 Mile Brook) picnic area provides toilets, gas barbecues; Rotary Park has toilets, picnic shelter, gas barbecues and Carters Road walk trails (see interpretation panels for information).

Nearest Parks and Wildlife office: Busselton (Blackwood District), 14 Queen Street, Busselton 6280, phone: (08) 9752 5555.



Above left Wharncliffe Mill offers a range of cultural experiences.

Left Bramley National Park is gaining popularity among mountain bike riders.

Photos – Wharncliffe Mill

Discover mountain biking in Bramley National Park

See how mountain bike enthusiasts are taking up a number of opportunities in this increasingly popular sport, thanks to the release of the *South West Mountain Bike Master Plan*.

Scan this QR code or visit Parks and Wildlife's 'LANDSCOPE' playlist on YouTube.





DISCOVER WA



The launch of the *DISCOVER WA* app heralds that the future is well and truly here – and it's very impressive. By downloading the app to their phone, users can immerse themselves in 3D images of national parks and get a virtual reality tour of a number of WA's most spectacular destinations.

Using the direction of your gaze to navigate through a map of the State, you can journey to a range of natural areas where you then get taken 'inside' stereoscopic 360-degree photos. Then, audio grabs and pop-up information boxes provide more information about each place.

This really has to be seen to be believed. It opens up vast possibilities for people to 'visit' these places from wherever they are. This will help with planning trips, provide opportunities to people with mobility challenges, help people to appreciate our beautiful and remarkable natural environment and simply provide a great deal of fun for those who check it out.

DISCOVER WA is available to download free from the 'App' store and GooglePlay. Virtual Reality goggles can be purchased from numerous online sites and technology stores.

AUSTRALIAN WILDLIFE AFTER DARK

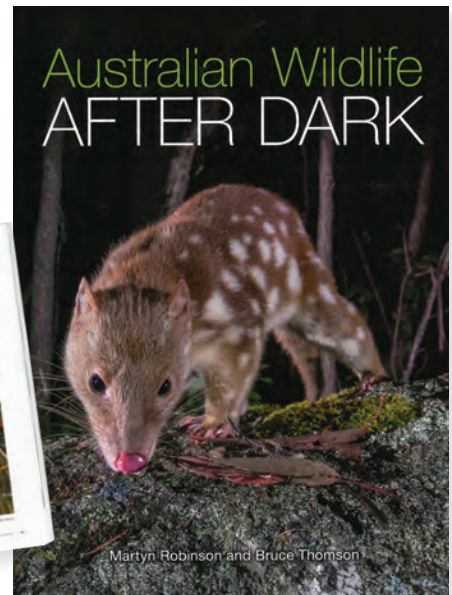


One of the things that makes many of Australia's animals so remarkable (and elusive) is that few of them are actually active during the day. *Australian Wildlife After Dark* aims to shed some light on some of our cryptic nocturnal animals, including how they live, what they eat, their mating habits and how they elude their predators.

The book separates the animals into those who use sight, sound, smell and touch to sense, and details a diverse range of species that go bump in the night, including insects, birds, reptiles and mammals.

The photography in *Australian Wildlife After Dark* is absolutely superb, courtesy of internationally renowned wildlife photographer Bruce Thomson, and Martyn Robinson uses interesting and relatable language to provide the information.

The 160-page *Australian Wildlife After Dark* is available for \$35 from www.publish.csiro.au and all good bookstores.



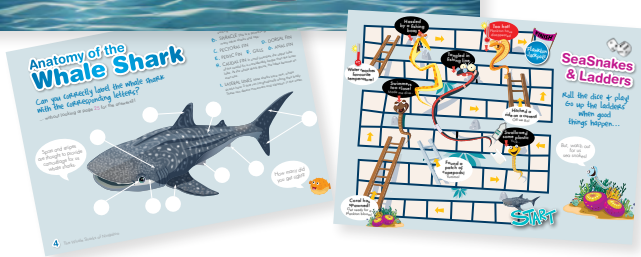
THE WHALE SHARKS OF NINGALOO



Did you know that whale sharks have a primitive gill slit called a 'spiracle' or that they grow 50 centimetres every year for the first 10 years? *Ningalulu* the whale shark journeys through the pages of *The Whale Sharks of Ningaloo* answering these and many other questions and providing a raft of fascinating facts and figures about these magnificent giants.

This spectacularly illustrated activity book aimed at primary-school-aged children is jam-packed with information and activities that are sure to keep the kids amused for hours (even in the car) and makes for a delightful souvenir of time spent in Ningaloo. And for \$6.95 per copy, you could easily be persuaded to splash out and buy a few copies for the family.

The Whale Sharks of Ningaloo is available from Parks and Wildlife's online shop (shop.dpaw.wa.gov.au), by phoning (08) 9219 9071 and from bookshops and other retail outlets throughout the State.

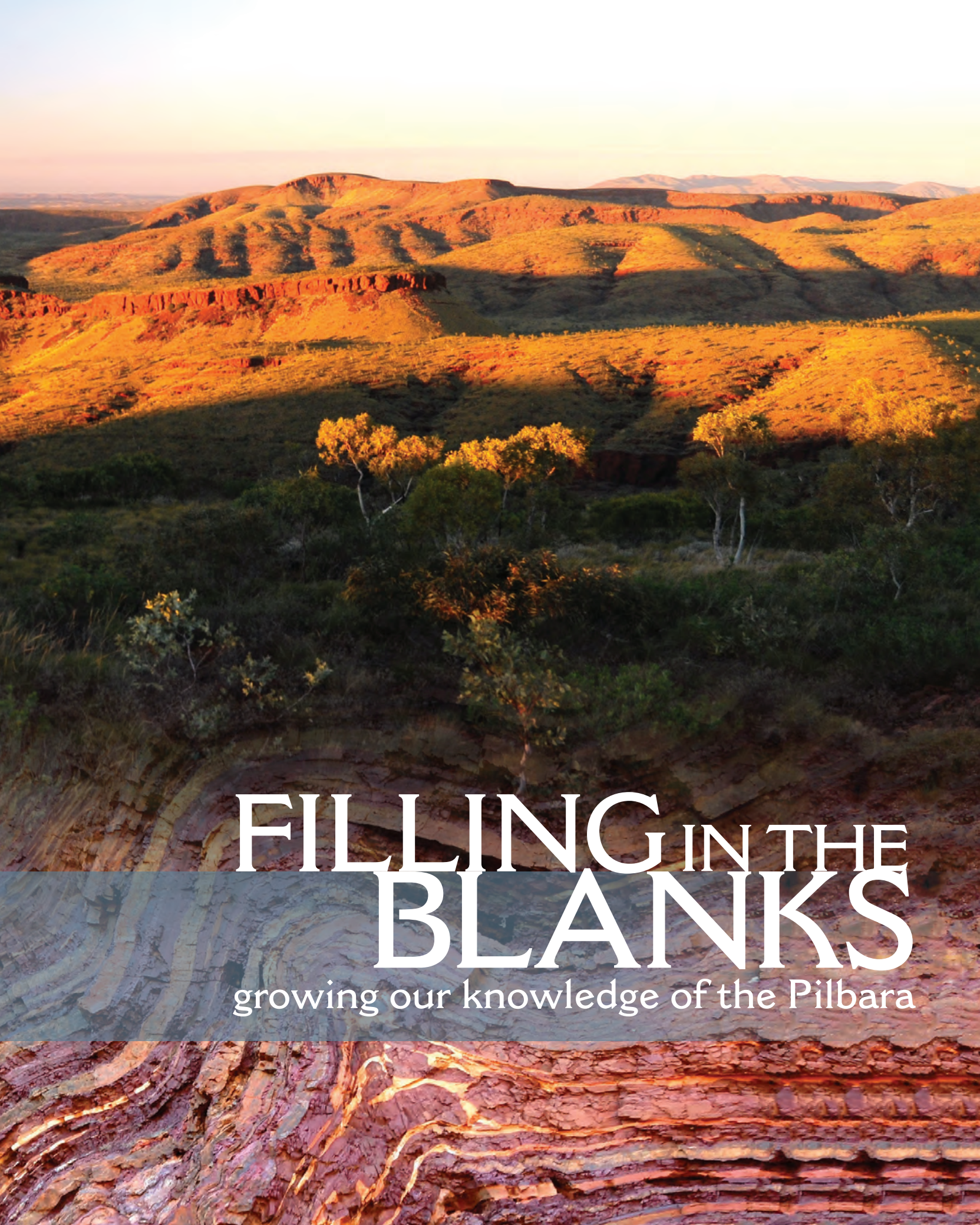




Western Australia's magnificent Pilbara region is home to a number of threatened animals. It is also becoming increasingly popular among holiday makers and those who journey there for work. These people can play an important role in 'citizen science' if they keep their eyes peeled for some of the area's most precious species and report these sightings, helping us bolster our understanding of this special environment.

BY KELLY RAYNER, FIONA CARPENTER AND DAVID PEARSON





FILLING IN THE BLANKS

growing our knowledge of the Pilbara



Previous page

Main View from Mt Sheila.

Photo – David Pearson/Parks and Wildlife

Inset Rock face in Hamersley Gorge, Karijini National Park.

Above Tracks, such as those of a quoll, provide important clues into species distribution.

Left A northern quoll captured on Dolphin Island.

Photos – Kelly Rayner/Parks and Wildlife.

The Pilbara contains some of Western Australia's most diverse and ancient landscapes. Once sparsely populated only by traditional owners and hardy pastoralists, this region has rapidly developed in recent decades to be a major resource hub for the country. Those who have watched these changes over time have seen outstations become industrial areas, mountains transformed into vast open cut mines and small towns grow into major regional centres. Long-operating ports that once shipped sheep and asbestos have been surpassed by those created to ship cattle, iron ore, salt and gas.

The development of the Pilbara has also made it easier for the broader community to visit and stay in the area. In the early part of the 20th century it took travellers several weeks on a ship from Fremantle to the Pilbara to get there. As time passed, this became a five-day drive on gravel roads, but now frequent commercial flights travel to a number of Pilbara centres most days of the week. These days it is not out of the question to have a weekend getaway 'up north' with

the family. In particular, it has become a popular destination for 'grey nomads' during the cooler winter months, and it is common to come across travellers who are on their third or fourth visit to the region with their camper or caravan because there was so much they didn't see during their last visit. Calling the Pilbara 'a vast landscape' is an understatement and, given it is more than double the size of the state of Victoria, it is a huge achievement to see and appreciate even a small portion of the region.

HOME TO THREATENED SPECIES

The expansive Pilbara region is home to a raft of unique plants and animals. In particular, the area is an important stronghold for four threatened native species – the northern quoll (*Dasyurus hallucatus*), the greater bilby (*Macrotis lagotis*), the Pilbara leaf-nosed bat (*Rhinonicteris aurantia* Pilbara form) and the Pilbara olive python (*Liasis olivaceus barroni*). These species face threats resulting from the increased accessibility of the Pilbara, such as

habitat alteration from development and pastoralism, predation and competition from introduced animals and changed fire regimes. Cane toads (*Rhinella marina*) are also likely to be a threat to quolls and pythons in the future (see also 'Island battlefield: Toads versus native fauna' on page 42). One of the most important steps in recognising how threatening processes may impact these species is determining where these animals currently occur, and where they formerly existed, so informed decisions can be made for their future management.

Parks and Wildlife, with support from the oil and gas and mining industries, and environmental consultants, has carried out a range of projects to locate these animals through trapping surveys or sightings, and through observations of evidence such as scats, tracks, shed skins, remains, burrows, dens and diggings. However, given the great size of the Pilbara, collecting this information can be challenging. Some of the most important records, particularly historical information, have come from anecdotal accounts of these animals



“The burrows and diggings of reptiles, particularly goannas, can often be confused with those of bilbies. Bilbies, however, create uniquely shaped burrows that have a high domed entrance and large spoil heap.”

from pastoralists, traditional owners, community members and visitors to the region. These records are extremely valuable and the tales that come with such unique sightings are often as interesting as the records themselves. Information from members of the public can continue to add to our knowledge of the area.

QUOLL SPOTTING

One of the more charismatic and well-known animals of the Pilbara is the northern quoll. The smallest of the four quoll species in Australia, the northern quoll is the only one of these carnivorous marsupials found in the region.

In the Pilbara, northern quolls are generally associated with rocky areas, waterholes and creek lines, sheltering in crevices or hollow logs during the day. However, many reports from pastoralists tell of animals in the roofs of homesteads, particularly during the breeding season when females may give birth and nurture litters of up to eight young. Mining staff occasionally come across animals denning under dongas or in machinery. One particular animal living in Karratha was found to be the culprit behind the destruction of top shelf liquor in the local bottle shop. Like many animals, northern quolls can wind up in some unusual places in their search for food and shelter.

Quolls are easily identifiable by the white spots on their brown coat, a feature that helps them blend in with the dappled light at night when they are active. They are relatively small (less than one kilogram) and will quickly seek shelter in crevices among rocks if disturbed. Their distinctive elongated corkscrew scats are deposited in obvious places, such as on top of rocks and in bare patches of ground, and will contain hair, bone and insect exoskeleton. Finding tracks from quolls can be difficult as there are typically few areas of soft substrate in their rock habitats, but once recognised their tracks are readily identified.

DIGGING UP BILBY RECORDS

Australia's Easter icon, the greater bilby, can be found sparsely across the Pilbara, Kimberley and desert regions of WA. Historically known as the dalgyte or rabbit-eared bandicoot and traditionally by Aboriginal people by other names such as ninu, walpajirri, mankarr or ahert, the bilby is listed as 'vulnerable' and is now restricted to less than 20 per cent of its former distribution across Australia.

Bilbies are usually found in areas with sandy or loamy soils which enable them to build their deep, spiralled burrows. They can be found in a variety of environments including sand plains and dunes, *Acacia* shrublands, woodlands and thickets,

Above Bilbies build long, spiralled burrows.

Above left Bilbies can be found in areas rich in witchetty grubs, termites and ants.

Top left Bilbies have distinctive tracks due to their unusual gait and prominent front claw markings.

Photos – Martin Dzimirski/Parks and Wildlife

tussock and hummock grasslands and around drainage lines. Bilby activity is often observed where they are foraging for witchetty grubs living in the roots of different *Acacia* species or targeting termites, ants, trapdoor spiders and bulbs.

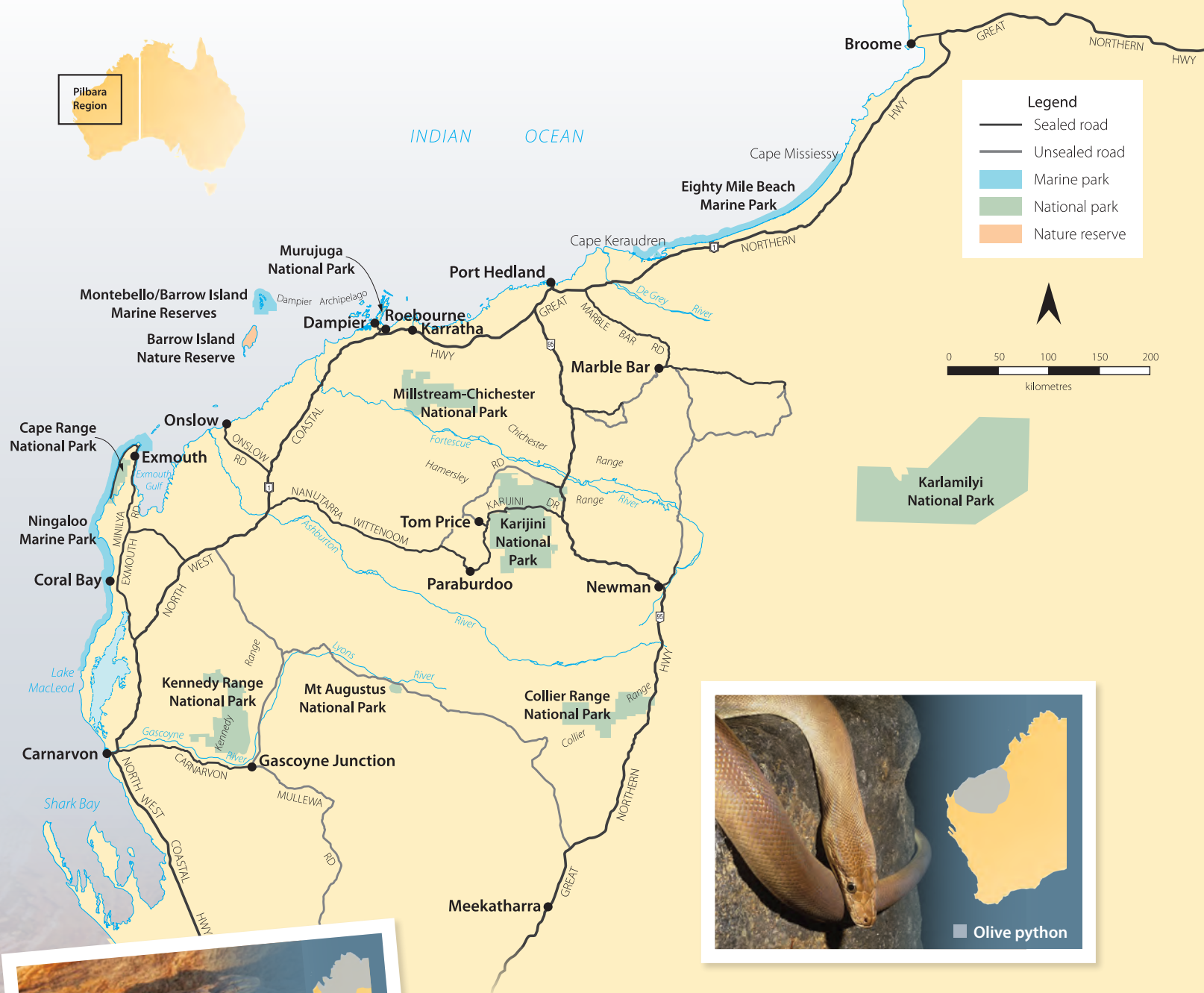
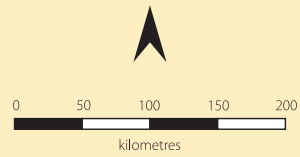
The burrows and diggings of reptiles, particularly goannas, can often be confused with those of bilbies. Bilbies, however, create uniquely shaped burrows that have a high domed entrance and large spoil heap. They can also be located through their unique cylindrical scat pellets, that are often found around, or within the spoil of, their diggings. Their unique tracks with the offset front feet creating three distinct parallel line marks from their three claws and adjacent hind feet, which sometimes show a drag mark of their large toe, are also distinctive when the soil conditions are right to maintain prints.

Pilbara Region

INDIAN OCEAN

Legend

- Sealed road
- Unsealed road
- Marine park
- National park
- Nature reserve



".. please keep an eye out for evidence of these threatened species of the Pilbara."





Exploring the Pilbara

The Pilbara is a beautiful place to explore, full of stunning locations for everyone to enjoy. However, it is important to travel responsibly, both for your safety and the safety of others. Plan your travel and let someone know your intended route, take plenty of spare food and water, pack a first aid kit and carry a form of emergency communication as many areas are not covered by mobile phone reception. Your vehicle (and especially its tyres) needs to be in

good condition as dirt roads are rocky and often corrugated. Be patient on the roads and enjoy your journey. Look out for road trains, particularly on dirt roads when thick dust will restrict your vision. Avoid driving at night in the bush as collisions with kangaroos and other animals or even threatened species are particular risks. Campgrounds in Karijini and Millstream-Chichester national parks are available to tourists, as well as a veterans' retreat at the Meentheena Proposed Conservation Park. Some pastoral stations also operate small campgrounds and welcome visitors for a small fee. Make sure you research your destinations, take note of current conditions and please keep an eye out for evidence of these threatened species of the Pilbara.



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Clockwise from far left Photos – David Pearson/Parks and Wildlife, Marie Lochman, Mark Cowan/Parks and Wildlife, Jiri Lochman
Map distribution data courtesy of Department of Environment and Energy

Above Millstream-Chichester National Park.
Photo – Tourism WA

Above right Pilbara olive pythons can grow to more than four metres.
Photo – David Pearson/Parks and Wildlife

The bilby has blue-grey and fawn fur, and a black tail with a white tip. Their large ears and pointed snout make them a unique and well-adapted marsupial for the arid and semi-arid habitats of northern Australia. Lucky travellers and people living in northern WA may have sighted a bilby ambling across roads and tracks, but recorded sightings are few due to the bilby's nocturnal and elusive nature. Non-invasive survey and monitoring techniques, primarily using signs of bilbies in the field and genetic research, are currently being undertaken by Parks and Wildlife, with funding from Fortescue Metals Group and Millenium Minerals, in order to establish a better understanding of the status of bilbies across the Pilbara.

A GIANT PREDATOR

The Pilbara olive python is a little-known species that occurs across the Pilbara and northern parts of the adjoining

Gascoyne region. Despite the large size reached by adults (in excess of four metres in length), they are difficult to locate because of their nocturnal and cryptic habits and probable low densities. In the cooler months, Pilbara olive pythons spend much of the day concealed in rocky crevices, logs or under flood debris. The high Pilbara summer temperatures result in a concentration of potential prey at water points, and these pythons can be observed in ambush positions submerged on the edge of waterholes or in reed beds. Their diet is varied, with rock-wallabies, northern quolls and fruit bats being major mammal prey, while birds such as ducks, corellas and pigeons are also eaten.

The first detailed information on the biology of this magnificent predator came from a radio-tracking project conducted by Parks and Wildlife with the assistance of Pilbara community volunteers who followed pythons at study sites on the Burrup Peninsula (near Karratha), Tom Price, the Robe River near Pannawonica and at Millstream Chichester National Park. Pilbara olive pythons were found to occupy discrete home ranges, returning to favourite shelter sites and ambush sites frequently. The cooler dry season is the time for mating, with a break from hunting for the adults. Females appear to attract suitors with a 'perfume' (pheromone) trail and the males may stay and mate with a female over a number of days. Females coil around their eggs to protect

and incubate them and the bootlace-thin hatchlings emerge from nest sites around January each year.

Pilbara olive pythons are easy to recognise; the entire body is a uniform olive or red-brown colour with a distinct neck and wide head. On the top and bottom lips of the mouth are a number of indents with heat-sensitive pits used in hunting. Pilbara olive pythons are generally slow-moving and deliberate in their movements, but if harassed or frightened, they can arc their body off the ground and curl their neck into an 'S'-shape ready to strike. If encountered on a bush track or around a waterhole, stay a safe distance away and you may be rewarded with an opportunity to observe their bulk and graceful rippling movements.

BAT CALLS IN THE NIGHT

The Pilbara leaf-nosed bat is the region's form of the orange leaf-nosed bat, a species that is found across northern Australia within the Kimberley, Northern Territory and Queensland. The Pilbara form is found only in the Pilbara and Upper Gascoyne bioregions and is currently listed as 'vulnerable' with few known roost sites across its distribution. Due to its selective and precise habitat requirements, this microbat is highly susceptible to both the direct and indirect impacts of activities, such as mining, that disturb their caves and foraging habitat.



Above Pilbara leaf-nosed bat.
Photo – Mark Cowan/Parks and Wildlife

Left Wildlife research centre manager John Augus recording northern quoll habitat on Dolphin Island.
Photo – Kelly Rayner/Parks and Wildlife

Pilbara leaf-nosed bats use warm, humid caves and gorge crevices as roost sites. They also take advantage of old mine shafts and adits to roost due to the dark and humid environment caused by seeping groundwater. Researchers most often detect the presence of these bats through recordings of their echolocation calls. But it is possible to see these agile and darting flyers along with many other bat species while they are out foraging for insects at night over waterholes or pools in gorges, or when they exit their roosts for the night.

The Pilbara leaf-nosed bat is distinguished by its diamond-shaped nose leaf and usually brightly coloured orange fur, although there is variability in the colour of this species with paler fawn, silver or golden individuals having been recorded. These animals are small, with adults reaching a maximum body length of only 43 millimetres. They make calls that cannot be heard by humans and live in unstable cave and mine systems that are typically not safe for people to enter. The combination of these factors makes sighting this species very unlikely but an event that any lucky observer should value highly.

GATHERING CITIZEN SCIENCE

If you are fortunate enough to encounter one of these threatened species, your information is valuable for increasing

understanding of their distribution. You don't need to be an ecologist to contribute information, thanks to Parks and Wildlife's Pilbara Threatened Fauna Project theme, which can be accessed through the department's online web portal NatureMap (<https://naturemap.dpaw.wa.gov.au/>). The portal has been designed to enable people to check observations against photographs and descriptions of the Pilbara's threatened species. Users can also access information about work currently being conducted by Parks and Wildlife to conserve and manage these species. The website also provides links to further information for those who would like to learn more about these threatened species. Importantly, the portal provides contact information so people can share their observations to help increase our knowledge of these species and contribute to their conservation.

Contributions do not have to be recent sightings; all records are important, including those that may have occurred in the past. The most essential part of collecting species records is making sure the information is as accurate as possible. Information required for any sightings and/or signs of species presence includes the location, date, type of record collected and the observer's contact details, in case the department requires further clarification of the information

provided. Photos of what you have found and the type of habitat at the location are extremely useful and can also be forwarded with the record to threatenedfauna@dpaw.wa.gov.au. Photographs are an important tool for researchers to verify your information and a great way for you to keep a personal record of your encounter with a threatened species. The extensive use of smartphones these days enables observers to record both GPS coordinates and digital photos of observations. All the information gathered helps to build knowledge about the fascinating plants and animals that occur throughout the Pilbara, and indeed the state, aiding their conservation.



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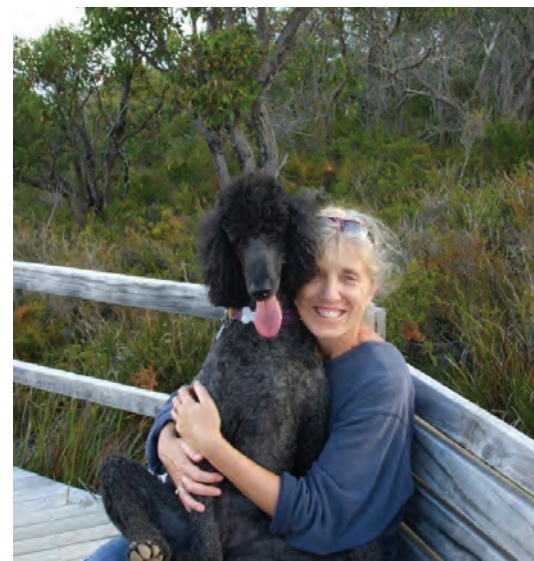
Touched by nature

Home to Cape Arid

Jacqueline Pemberton has spent much of her adult life sharing her love of the natural environment with others – first as a ranger's wife, working in the tourism industry and now through her beautiful botanical art.

by Tracy Shea





It's 6am and Jacqueline is following a narrow track through coastal sandheath over a dune and rocks to her favourite place on Earth – the beach where the Southern Ocean waves meet the dunes of the majestic Yokinup Bay. With her sketchbook and camera in hand, salt air in her nose and the sweet aromas of the herbaceous plants she has just walked through on her clothes, she knows she is truly 'home'.

This is Cape Arid National Park on Western Australia's south coast – a rugged and beautiful wilderness which, together with Nuytsland Nature Reserve and Eucla National Park to the east, forms an almost continuous nature conservation corridor area to the South Australian border.

MATTERS OF THE HEART

Jacqueline first came to Cape Arid National Park as a young ranger's wife in the 1980s. Alongside her husband Richard Pemberton, a national park ranger for 15 years, she cared for the park and its incredible biodiversity. It was important to them both that visitors took away marvellous memories and a love of being immersed in nature. Although Richard's work took them to many national parks along the south coast of the state, including West Cape Howe, Porongurup, Torndirrup, Fitzgerald River and Cape Le Grand, it was the magic of Cape Arid



that got under Jacqueline's skin, and is the place she and Richard return to whenever they can.

Greatly inspired by her friend and art mentor – local pioneer, naturalist and artist Mrs Amy Crocker (nee Baesjou), who grew up in the area – Cape Arid is the place that provided the inspiration for Jacqueline to start on a lifetime journey as a botanical artist. Today, her love of the natural environment is evident in her detailed botanical works, which capture the very essence of her subjects through coloured pencil, graphite and watercolour.

Jacqueline spends as much time as she can each year returning to the south coast collecting inspiration and drawing sketches from which she produces finished botanical paintings from her home studio in Mandurah. She also teaches botanical art when she has time.

Previous page

Main The beautiful, and inspiring, Cape Arid National Park.

Inset Jacqueline and Richard Pemberton on Christmas Day at Cape Arid National Park in the 1980s.

Above left Yokinup Bay, Cape Arid National Park.

Above Jacqueline Pemberton and her beloved poodle, Miss Molly.

Photos and artwork – Jacqueline and Richard Pemberton

GETTING OUT THERE

Currently, time is a rare commodity as her passion for nature and the outdoors has seen Jacqueline complete her Commercial Coxswain's ticket. She now skips boats and provides tour guide commentary for Mandurah Cruises, bringing smiles to the faces of locals and international visitors alike, who delight in the antics of the bottlenose dolphins and amazing birdlife in the Ramsar-listed Creery Islands wetlands and canals around Mandurah.

Although Jacqueline 'graduated' from a qualified tour guide to being the Captain of boats, she still revels in the interaction with people that comes from tour guiding. In the early 2000s, while Richard was studying aquaculture in the north-west of WA, Jacqueline worked as a tour guide and manager at Willie Creek Pearl Farm in Broome, which saw her nominated

for the Forum Advocating Cultural and Eco-Tourism (FACET) Golden Guide Award in 2003.

In 2012, Jacqueline was awarded a Diploma of Botanical Illustration (with distinction) from the Society of Botanical Artists in the UK and has exhibited and sold works in England, at the Royal Botanic Gardens in Melbourne, as well as at galleries in NSW and WA. Her artwork has appeared in *Flora of the South West*, which was published by the then Department of Conservation and Land Management (CALM) in 2002, and *The Handbook of Plant Forms for Botanical Artists* by Margaret Stevens. She has also published a DVD on the techniques of botanical illustration and is a member of the Botanical Art Society of Australia, Friends of Royal Botanic Gardens Melbourne and Botanical Artistry.

GIVING BACK

Jacqueline and Richard's contribution to the environment has not all been through paid employment or professional association. Before embarking on his 15-year career as a national park ranger in CALM, Richard was a volunteer with the National Parks Authority in the 1980s. During and since then, both he and Jacqueline have continued to volunteer in various roles throughout the State. As an original 'end to ender' – completing her journey in 1979 – Jacqueline was a voluntary volunteer coordinator in the Albany district for the Bibbulmun Track Foundation. Richard volunteered on voyages for *STS Leeuwin II*, as natural history advisor, while Jacqueline regularly acted as a volunteer crew member on deck.

In 2008, Richard and Jacqueline took on the challenging role of volunteer wardens at Eyre Bird Observatory, and during regular visits back to their beloved Cape Arid National Park they have remained registered volunteers.

FOLLOWING A CALLING AND BACK AGAIN

Jacqueline says that she's a lifelong naturalist who loves sharing her passion for the environment with others.

"I'm so fortunate to have had the opportunity to experience first-hand the beauty of nature at its finest. Translating that to my art and tour guiding has enabled me to share it with others and hopefully has helped other people discover a love of nature along the way," she said.

In quoting Albert Einstein who said "Look deep into nature and then you will understand everything better", Jacqueline says: "Through art and interaction with people, my aim is to leave a legacy for future generations in the hope they too will understand everything better". And – 30 years after she first settled in Cape Arid National Park – as her pencil glides across the pages of her sketchbook and her hand and eyes follow the contours of the flower before her, Jacqueline feels as at home in this unique spot as anywhere on Earth.

.....
This page
 Jacqueline's beautiful botanical art.
 Artwork – Jacqueline Pemberton



Tracy Shea is Parks and Wildlife's assistant director of policy and planning. She can be contacted on (08) 9219 8755 or by email (tracy.shea@dpaw.wa.gov.au). For more information about Jacqueline Pemberton, visit www.jacquelinepembertonartist.com. 'Touched by nature' is a new feature that tells the stories of people who have used their experiences in nature to enrich the lives of others.





Now you see me...

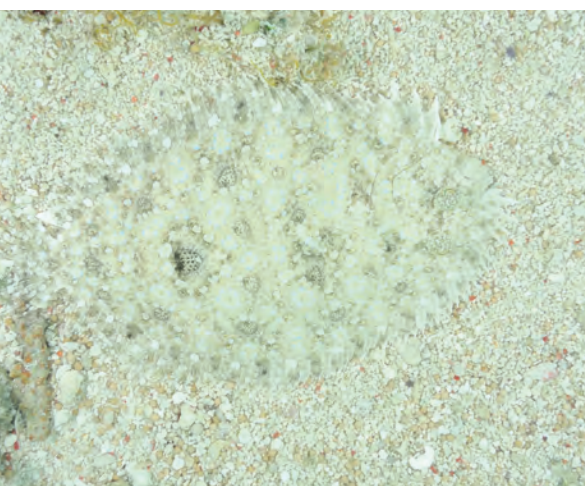
For all marine creatures, sustenance is a driving force in their daily lives. The seaweeds require light and nutrients, the herbivores suitable vegetation to graze, and the carnivores are almost constantly on the hunt for prey. For most, the need to eat and avoid being eaten have been major evolutionary pressures, influencing not only where they live and the way they behave, but also the way they look. The latter can be expressed in a variety of ways, including some that would seem to be totally at odds with what might be expected.

by John Huisman
and Alan Kendrick
Photos by John Huisman

A healthy ecosystem with a diverse range of species is a joy to behold. But essential to this is a balance between the primary producers, the herbivores and the carnivores. Too many, or too few, of one group can impact on the others, upsetting the equilibrium and potentially causing the entire ecosystem to undergo sometimes quite dramatic changes in structure and function. To maintain this fine ecological balance, species have evolved numerous survival strategies, both to keep themselves fed and to avoid being eaten. Here we look at just a few of the myriad ways that marine species have achieved this.

NOW YOU SEE ME ... NOW YOU DON'T

The most obvious strategy to elude predators is to be inconspicuous – in shape, colour, or both – to blend imperceptibly with the surroundings and remain unseen by any potential predator looking for a meal. One of the best practitioners of this strategy is the flounder, a bottom-dwelling fish, which has undergone a massive rearrangement of body parts. Evolution in the flounder has resulted in a flat body that can lie snug against the sea floor, while at the same time one eye has shifted so that both sit on the upper side. Interestingly, the eyes of larval flounder are on both sides of their head and this remarkable change occurs as they grow into juveniles on the seabed. The pale, mottled colour



“The most obvious strategy to elude predators is to be inconspicuous – in shape, colour, or both – to blend imperceptibly with the surroundings and remain unseen by any potential predator looking for a meal.”

of the tropical leopard flounder (*Bothus pantherinus*) almost precisely matches the colours of the sandy seabed where it most commonly occurs. Such cryptic colouration, or crypsis, is common among marine organisms. Of course, this strategy will only work if the animal remains still, as any movement will usually draw attention.

Cryptic colouration can also be very effective for predators, as they can remain hidden and lie in wait for unsuspecting prey. The tasselled wobbegong shark (*Eucrossorhinus dasypogon*) is found in northern Australia and can grow up to 1.8 metres in length. During the day the shark often settles in caves, where its strongly patterned camouflage blends effectively with the rocky seabed and its

colourful mosaic of algae and encrusting invertebrates. The wobbegong’s dangerous mouth is even obscured by the presence of branched, seaweed-like skin extensions around the front of its head, which soften its outline and enables it to blend in smoothly with the natural surroundings. The shark remains perfectly still, other than sometimes waving its tail to lure smaller fish, before launching a fast and unexpected ambush on prey that stray too close.

Numerous other species of marine fish and invertebrates have evolved cryptic colouration. The prickly leatherjacket (*Chaetodermis penicilligerus*) merges almost imperceptibly with the background and has a few seaweed-like frills to complete the effect. The broadclub cuttlefish (*Sepia latimanus*), which is a cephalopod like octopuses and squid, has the ability to change its skin colour at will, blending instantly with its surroundings. When a cuttlefish swims from a reef to a sandy area, its colour will change to match the new background. It also uses evolving colour patterns to communicate with other cuttlefish, or as warning signals. Unsurprisingly, they are often called the ‘chameleons of the sea’.

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Main Hermit crabs use empty mollusc shells as their home.

Above A decorator crab (*Naxia* sp.) with its clever camouflage of seagrass and seaweed.

Left Leopard flounders (*Bothus pantherinus*) have both eyes on one side so they can lay undetected on the ocean floor.



Above Prickly leatherjackets (*Chaetodermis penicilligerus*) blend into their environment.

Right Broadclub cuttlefish (*Sepia latimanus*) change their colour to match their surrounds and to communicate.



NATURAL DISGUISES

Of course if changing colour or modifying body shape is not possible, you can always sequester parts of the surrounding vegetation to hide beneath. The decorator crab (*Naxia* sp.) is expert at attaching pieces of seaweed and even seagrass to its hard carapace, resulting in an almost perfect disguise. The crab selects suitable material from its surroundings, coats the ends with a gland secretion that hardens in seawater, and then attaches it to special hooks that cover its shell. The algae and seagrass even continue to grow, ensuring that the crab looks exactly like a small rock when it remains still.

Decorator crabs are remarkably attentive to the effectiveness of this protection. When moved to a different habitat, they rapidly shed the original camouflage and attach materials from the new home, ensuring that their disguise blends into the most recent surroundings. Similarly, other crabs can use anemones, sponges and an assortment of invertebrates as camouflage and protection. In another form of camouflage, hermit crabs adopt empty mollusc shells as

a home, providing the crab with a mobile protective casing that also hides it from potential predators.

EAT ME IF YOU DARE!

While camouflage and remaining inconspicuous are intuitively excellent strategies to avoid predators, there are numerous marine species that have evolved to be outstandingly bright and colourful. So how does being so obvious help to avoid predation? The answer lies in an unusual phenomenon, not unique to the marine environment, but certainly prevalent among marine creatures. Many species that are poisonous, or at least contain distasteful compounds, are also the most colourful. These bright colours warn potential predators that if you eat me you could die, or if you survive, it will have been a very unpleasant experience.

This strategy is perhaps best developed by the spectacularly colourful shell-less molluscs known as nudibranchs, which are much loved by underwater photographers. Many nudibranchs make no effort to hide, and their visibility is accentuated by bright colours and bold patterns. They embrace this seemingly carefree attitude because their colours signal to potential predators

that they are distasteful and not to be eaten. Fish, it seems, are fast learners, and an unpleasant encounter with a toxic nudibranch ensures they will no longer try them as food. Some nudibranchs produce their own toxins, but others store compounds derived from their own food, such as sponges. Such is the case of the spectacular nudibranch *Chromodoris kuniei*, which feeds on sponges and uses its toxic chemicals for its own defence.

This bright warning colouration, also known as aposematic colouration, is such an effective deterrent strategy that many other species have now evolved apparently vivid warning colours, but do not have the poisonous compounds that are so often advertised by such patterns. Why bother wasting valuable energy developing toxic defences, which can otherwise be spent on growth and reproduction, when you can get the desired outcome with a relatively simple disguise?

Looking like another species is known as mimicry, with the imitator known as the mimic and the species being mimicked known as the model. Mimicry of a toxic species by a non-toxic species is known as Batesian mimicry, after the English naturalist Henry Bates, who first



recognised the phenomenon in butterflies. Batesian mimicry can only be effective if the prevalence of the mimic species does not exceed that of the model, otherwise potential predators may encounter the non-toxic species more often, and not associate the warning colours with an unpleasant taste. In some cases both the mimic and model are toxic, which serves as a strong reinforcement of the warning to predators to stay away. This type of mimicry is known as Müllerian mimicry, after the German naturalist Fritz Müller, who, like Bates, worked with butterflies.

Batesian or Müllerian mimicry is often seen in polyclad flatworms, many of which display colours and patterns remarkably similar to those of nudibranchs. Flatworms are carnivorous members of the phylum Platyhelminthes and are common in the marine environment, where they are often conspicuous due to their bright colours. The flatworm *Pseudoceros imitatus* mimics the colour pattern of the unrelated *Phyllidiella pustulosa*, a tropical nudibranch that deters fish predators by secreting a milky substance containing noxious compounds. The flatworm has evolved an almost exact copy of the nudibranch's colour and patterns, undoubtedly reaping the benefits of looking like its

Above A Western Australian sea hare (*Aplysia gigantea*).

Right top and right Nudibranch (*Phyllidiella pustulosa*) and flatworm (*Pseudoceros imitatus*) look almost identical with the flatworm enjoying the protection brought by resembling a tropical nudibranch.

distasteful model. These two are not the only lookalikes; several other species of nudibranchs are mimicked by other organisms, including flatworms, juvenile holothurians (sea cucumbers) and even other nudibranchs.

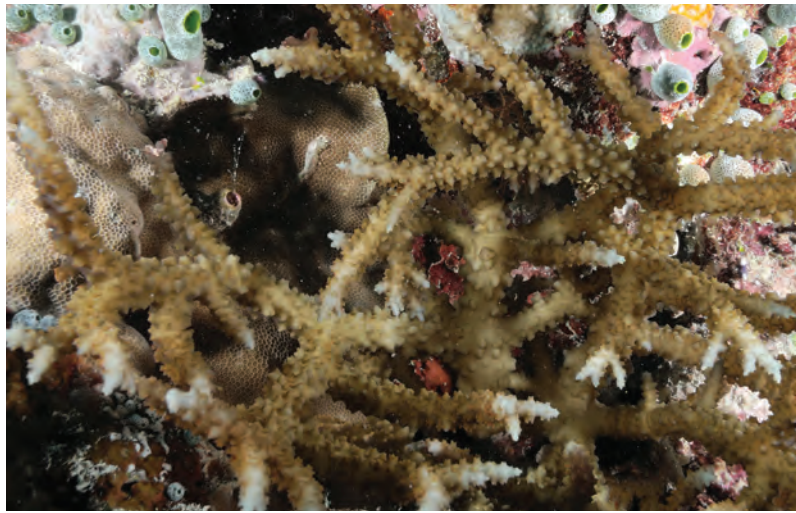
Not all toxic sea slugs flag their toxicity with bright colours. The Western Australian sea hare (*Aplysia gigantea*) has cryptic colours, but is also toxic. This species is short-lived and spawns in shallow water during summer and early autumn. They often wash up in large numbers on WA beaches, where they attract the interest of dogs. This has led to numerous poisonings, but fortunately most are treatable and the dog survives.

The toxic red-eyed rock crab (*Eriphia sebana*) seems to be hedging its bets. It has a fairly bland colour that merges well with the background, but also has vivid red eyes that stand out like beacons and presumably

warn off potential predators. Like many marine animals, the toxic compounds in crabs are not produced by the animals themselves but are derived from external sources, such as diet or possibly symbiotic bacteria.

SEAWEED MIMICS

Mimicry is most often associated with animals, but a few seaweeds are also excellent at hiding their true identity. In this case, rather than adopting the guise of a toxic species, the seaweeds take on the appearance of a less palatable organism. The red seaweed *Rhodogorgon* was named due to its uncanny resemblance to a gorgonian coral, and this mimicry deceived seaweed and coral biologists until very recently. Another red seaweed, *Eucheuma arnoldii*, has evolved to mimic the very common hard coral *Acropora*, presumably taking advantage of the fact



that herbivorous predators have little interest in eating the stony coral skeleton. This disguise is so perfectly rendered that the algae even has the distinctive bluish branch tips with a polyp-like structure, a distinguishing feature of *Acropora* corals and is in fact the source of its name (the Greek word *acro* means 'tip'). The alga in the photo was seen recently at Ashmore Reef, and actually went unnoticed by seaweed biologist and WA Herbarium curator John Huisman but was picked up by the WA Museum's coral biologist Zoe Richards, who was stunned to find that what she thought was a stony *Acropora* coral was actually flexible. The disguise clearly confuses more than just potential grazers!

Seaweeds can also be protected from grazing by producing a calcium carbonate skeleton. Numerous species do this, but it is most well-developed in the coralline red algae, many of which can be rock-hard and bear little resemblance to their more plant-like relatives. Coralline algae are not immune to grazing fishes and often bear teeth marks and scars, but the number of grazers is considerably reduced by their calcified structure. Other algae,

such as the rubbery *Titanophora pikeana*, can appear strikingly like coralline algae, presumably gaining protection from the similarity.

Several seaweeds, like animals, produce compounds that make them unpalatable to fish. The turtle weed (*Chlorodesmis fastigiata*) produces a cytotoxic terpene that deters grazing by fish, but surprisingly the chemical stimulates grazing by the aptly named turtle weed crab (*Caphyra rotundifrons*), which lives exclusively among the seaweed filaments and feeds on them. The crab benefits further by its association with the seaweed, as it experiences significantly reduced predation. There are several other examples of seaweeds that are chemically defended against grazing

by most species, but are eaten by a small number of specialists that can tolerate or sequester the active compound. These include the red seaweed *Asparagopsis*, which produces halogenated metabolite bromide as a chemical defence, but is grazed by the pygmy sea hare (*Aplysia parvula*). Perhaps surprisingly, *Asparagopsis* is highly prized in Hawaiian cuisine, where it is known as 'limu kohu' and is used to flavour raw fish and stews.

The struggle to survive could be described as an ongoing battle between species, each evolving novel ways to gain sustenance while avoiding being eaten. It's not surprising that this has resulted in a seemingly endless array of different strategies, many of which, undoubtedly, are yet to be discovered by biologists.

Above and above right Red seaweed (*Euclidean arnoldii*) has evolved to mimic a hard coral (*Acropora vaughani*).

Photo (right) – Zoe Richards/WA Museum

Right A red-eyed rock crab (*Eriphia sebana*).



John Huisman is the WA Herbarium's curator and is a specialist in seaweed taxonomy. He can be contacted at john.huisman@dpaw.wa.gov.au.

Alan Kendrick is the Marine Science program leader at Parks and Wildlife. He can be contacted at alan.kendrick@dpaw.wa.gov.au.

Eighty Mile Beach – a remarkable stretch of remote coastal country between Port Hedland and Broome – and its offshore waters provide food for a number of species, habitat for migratory birds and turtles, and is a significant place in the lives of the traditional owners of the area. And now, thanks to a partnership between Parks and Wildlife and the Karajarri, Nyangumarta and Ngarla people, it is providing employment for traditional rangers who are using their invaluable on-country knowledge to manage this special spot.

by Alan Byrne, Jesse Murdoch,
Leah Pearson, Matt Fossey
and Rhianna King



Eighty Mile

WHERE TRADITION



Beach

MEETS SCIENCE

Located in Western Australia's north-west, between Port Hedland and Broome, the beauty of Eighty Mile Beach Marine Park is significant on many levels. Its superb turquoise water and expansive blue sky contrasts against the rocky outcrops, mudflats and sandy beaches. Meanwhile every evening provides a different combination of hues and, when they're present, the silhouetted birds provide a point of reference to help you grasp the expanse of the scene before you. But the significance of this environment is much more than meets the eye.

For the Karajarri, Nyangumarta and Ngarla people – who have lived on and been connected to what is now the marine park and its plants, animals and spirits since the beginning of time – this area houses significant songlines and sites that are deeply embedded within their cultures. The area has a rich tapestry of family clans who speak for and care for specific areas of country. And while the groups speak for different areas, they share a strong and enduring responsibility to protect and manage the land and its sites, objects, plants and animals, as well as to preserve traditional knowledge and pass it onto younger generations through song, ceremonies and spending time on country. This connection is based on a simple but poignant premise: if you look after country, it will look after you. Today, thanks to a merging of traditional land management practices and contemporary science, via Indigenous Land Use Agreements and joint management arrangements, the future of this area is in good hands.

Left Traditional owners provide a wealth of insight into this spectacular country.

Photo – Colin Ingram/Parks and Wildlife

Opposite page

Left Dugongs are known to occur in the area.

Photo – Geoff Taylor/Lochman Transparencies

Centre The area is famed for its waterbirds, including terek sandpipers, great knots and bar-tailed godwits.

Photo – Cliff Winfield

Right Flatback turtles nest at Eighty Mile Beach Marine Park during November and December.

Photo – Jiri Lochman

NATURAL ABUNDANCE

In 2013, a 200,000-hectare area of water and shoreline was afforded protection for conservation as Eighty Mile Beach Marine Park. The area's mudflats provide a rich source of food for the thousands of migratory shorebirds that flock to the area between August and November as well as its permanent populations. Ninety-seven species of waterbirds have been recorded in the area, including 42 that are listed under international migratory agreements – the highest number for any site in Australia. Birds come from as far away as Asia and Alaska as well as from other parts of Australia and New Zealand. This has seen the area listed as a Ramsar site and it is particularly significant given the declines in numbers of some migratory species while elsewhere. Surveys have revealed that the most common species are the great knot, bar-tailed godwit, red-necked stint, red knot and the greater sand plover.

Eighty Mile Beach is also a major nesting site for flatback turtles, which gather to nest at the beach from November to December before their hatchlings emerge from January to March. Green, hawksbill, loggerhead, olive ridley and leatherback turtles are also known to frequent the marine park.

The marine park is a feeding and breeding ground for dugongs – which use the protected shallow bays and mangrove channels – while some species of dolphins, including the Indo-Pacific bottlenose, Australian snubfin and the Australian humpback, are more inconspicuous users of the marine park. Shark species in the area include 'whaler' sharks – pigeye, nervous, graceful, blacktip, spinner, hardnose and lemon sharks – as well as hammerheads. Stingrays and shovelnose rays can be found in the area too. Four of the world's five sawfish species – dwarf, largetooth, green and narrow – occur here, which may represent one of the last relatively healthy sawfish populations in the world. Whales also pass through the area. And the marine park supports a diverse range of tropical fish species with more than



“And while the groups speak for different areas, they share a strong and enduring responsibility to protect and manage the land and its sites, objects, plants and animals, as well as to preserve traditional knowledge and pass it onto younger generations ...”

350 species recorded in waters that range in depth from five to 30 metres.

Underpinning the natural abundance of the area is the thriving populations of marine invertebrates which provide food for the birds, fish and turtles that visit the area. This abundance of marine life has sustained the traditional owners of the area for eons. Women would weave large nets using spinifex grass to catch large fish and dugong from the ocean or drag the nets through the shallow water at the mouths of creeks and rivers to catch mullet, barramundi, mangrove jacks and eels. While men would travel on rafts made from mangrove trunks to offshore reefs to catch fish, shellfish and octopus. They also used spears to hunt for fish and catch stingrays. At low tide, they were able to collect pearl shells and oyster meat on foot. Today, species such as prawns, crabs, squid, octopus, oysters, rock lobsters, sea cucumbers and hermit crabs are sought after by recreational and commercial fishers.

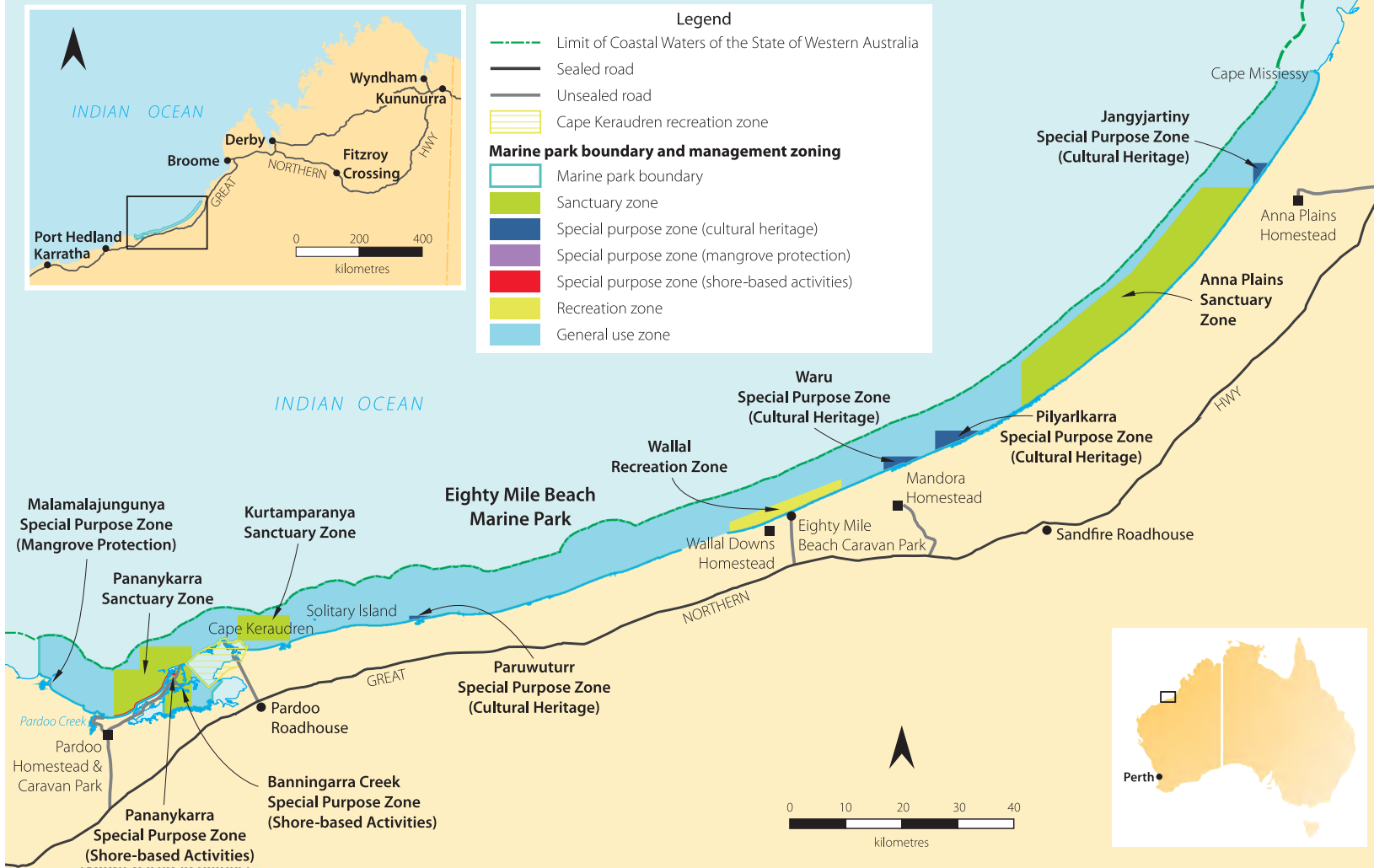
CULTURAL WEALTH

The State Government's *Kimberley Science and Conservation Strategy* was released in 2011 and committed to establishing a massive marine park network in the Kimberley, including Eighty Mile Beach Marine Park. The



strategy strongly acknowledges and respects the relationship the traditional owners have with the lands and waters of the region, and includes their valuable insight, skills and knowledge in the management of this special environment through joint management arrangements.

Over the last 10 years, Parks and Wildlife (and its predecessors) and traditional owners have worked collaboratively to develop meaningful relationships and manage these areas for the conservation of their cultural and natural values under joint management



Opposite page

Above left Bar-tailed godwit is one of the species that frequent the area.

Photo – Rob Drummond/Lochman Transparencies

Left Eighty Mile Beach Marine Park.

Photo – Dennis Sarson/Lochman Transparencies

Right Parks and Wildlife’s Eighty Mile Beach Marine Park Ngarla and Nyangumarta rangers (left to right) Augustine Badal, Jeffrey Brown, Nathan Hunter and Stephen Brown.

Photo – Miecha Bradshaw/Parks and Wildlife

arrangements. As part of this, a management plan for the area was released in 2014.

Recently, Parks and Wildlife staff and representatives from Greening Australia and BHP Billiton took part in a cultural awareness session with the Nyangumarta elders, who shared information about family trees, songlines, seasons, cultural sites, their stories and language. The group travelled to two culturally significant sites and talked about joint management, working together as family to protect the environment and discussing the way forward for land management in the area.

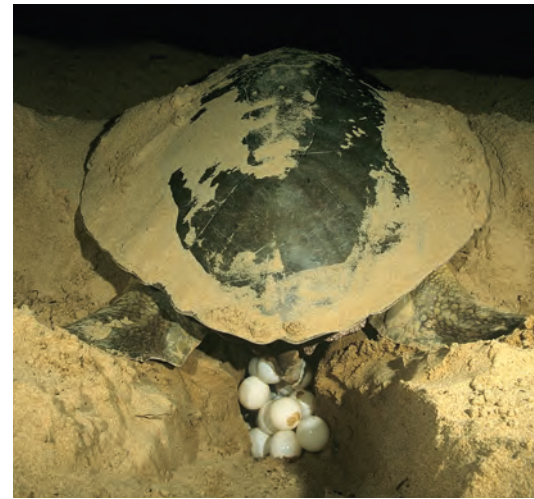




Above Stephen Brown watches a flatback turtle hatchling journey to the ocean.
Photo – Sara McAllister/Parks and Wildlife



Above centre Flatback turtles leave distinctive tracks to the water.



Above right A nesting female flatback turtle.
Photos – Jiri Lochman

Right The traditional rangers monitor turtles on Eighty Mile Beach Marine Park.
Photo – Sara McAllister//Parks and Wildlife



WORKING ON THE LAND

One of the most successful outcomes of this commitment has been the engagement of four traditional rangers who have joined Parks and Wildlife’s West Kimberley District Eighty Mile Beach Marine Park team as part of the department’s Mentored Aboriginal Training Employment Scheme. This scheme has been extremely successful in engaging Indigenous people in land management training across WA since it began in 2002, with 82 trainee staff completing one or more qualifications.

Augustine ‘Augie’ Badal and Nathan Hunter – Nyangumarta men – and Stephen Brown and Jeffrey Brown

Jnr – Ngarla men – started the program in 2015 and have brought a wealth of cultural knowledge and on-ground experience. They have already been involved in many aspects of management including flatback turtle monitoring where they attached satellite trackers to individual turtles, used cyber trackers to collect data from the turtle tracks and nests, and have taken visitors on night tours to watch the turtles nest while providing cultural and biological information about the species.

Augie and Nathan are from Bidyadanga, which is the largest remote Aboriginal community in WA. Bidyadanga has a population of about 750 people and is home to the Karajarri, Juwalinny, Mangala,

Nyungumarta and Yulpartja language groups. Since joining MATES, they have been involved in a biological survey of Mandora Marsh – a species-diverse and culturally significant wetland system inland of Eighty Mile Beach – where they assisted with animal surveys and water quality sampling. They also worked with elders and other traditional owners to share information about sites of cultural significance, including a sacred womens’ business site. Mandora Marsh will soon be protected by a new conservation park.

Meanwhile, Stephen and Jeffrey helped Bunuba Rangers with a freshwater crocodile survey at Windjana Gorge National Park, where they gained

“The past 10 years have delivered a range of insights into best practices for developing meaningful and successful partnerships with traditional owners on country.”



Above Augustine Badal with his boab nut artwork.

Right Nyangumarta elders sharing their knowledge of cultural sites within Eighty Mile Beach Marine Park.

Photos – Jesse Murdoch/Parks and Wildlife



experience in capturing the crocodiles and recording their length, weight and sex. For Stephen, he hopes his job will help him hand down knowledge and experience to the next generation and is optimistic that his position will open up other employment opportunities within his community when he eventually moves on.

The rangers are also completing units towards their Certificate II in Conservation and Land Management and have developed skills in welding, using power tools, fire-fighting practices, computers and radio communications. They have undertaken a range of training and workshops including bush survival, four-wheel driving and quad biking and a irukandji sting prevention and treatment workshop. Karajarri Rangers who are employed under the Commonwealth Indigenous Protected Area (IPA) program have been engaged on a fee-for-service arrangement to conduct similar conservation works, such as fencing of parts of the Eighty Mile Beach coastline, assisting with migratory bird surveys, and designing and installing interpretive signs that carry both cultural and scientific messages. This fee-for-service arrangement will remain given the strength of the existing IPA ranger program.

ROOM TO MOVE

To date, the engagement of the traditional owners and ultimately the rangers has proved a resounding success. The past 10 years have delivered a range of insights into best practices for developing meaningful and successful partnerships with traditional owners on country. In particular, Parks and Wildlife has worked to recognise the traditional owners as more than just stakeholders, but as co-managers who are strongly vested in all decisions and activities that affect their land. And significant time and effort has been invested in the interpersonal relationships that exist between Parks and Wildlife staff and the Ngarla, Nyangumarta and Karajarri people. Much of this relationship building has occurred on country, where the traditional owners often feel most comfortable to share knowledge and experiences. Joint management is based on the premise that the merging of traditional ecological knowledge and modern-day science will offer the best possible protection to this beautiful and spectacular landscape and all that inhabits it, while providing opportunities for traditional owners to share their ancient and proven practices.

Scan here to watch a video about the traditional owners and how to enjoy a turtle nesting experience at Eighty Mile Beach.

Scan this QR code or visit Parks and Wildlife's 'LANDSCOPE' playlist on YouTube.



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Rhianna King is a LANDSCOPE editor. She can be contacted on (08) 9219 9903 or by email (rhianna.king@dpaw.wa.gov.au).

Sponges are one of the most ancient life forms on Earth and represent the most basal lineages of all animals. They are one of the more simple multicellular organisms and use pores and channels to circulate water to obtain oxygen and food. In doing this, they perform an important function for the world's oceans by recycling nutrients and providing habitats for other animals and plants.

Sponges make up the phylum Porifera, and are divided into four distinct groups. Many species employ ingenious defensive methods to avoid predation, including spicules to ward off grazers (see also 'Now you see me ...' on page 22). They have a variety of chemical defensive secretions, with more than 5000 chemical compounds isolated from sponges so far, many with anti-inflammatory and anti-cancer properties.

A casual inspection of the intertidal zone on Western Australia's beaches will reveal a plethora of different species, with varying body forms and colour, ranging from dull yellow and brown, through to gaudy red, orange and purple. These are mainly classified in the group Demospongiae which are the most common group in shallow seas throughout the world. There has never been a full census of WA sponges, but research conducted by Dr Jane Fromont at the Western Australian Museum suggests that the number of species in WA is in the thousands – many of which have never been described and named. And studying sponges is not for the faint-hearted. Apart from body form and colour, sponge scientists need to closely examine the sponge's bits and pieces with a microscope. One of the more important characteristics, is the shape of the spicules which are inorganic structures made of calcium or silicon. The arrangement of their skeletons and how the spicules mesh together are critical for species identification. The demosponges have spicules made of silicon, while another group, the Calcarea, have spicules made of calcium carbonate.

A recent study by Jane and her colleagues Pedro Leocorny, Aline Alencar



Calcarean sponges

and Michelle Klautau from the Universidade Federal do Rio de Janeiro, Brazil has focused on the family *Leucettidae* in the Calcarea. Before this, only seven species in this family were known from Australia, so the description of four new species was a significant advance in our knowledge of these curious creatures. Calcareous sponges tend to be small (they range from two millimetres to about six centimetres in height) and are therefore sometimes overlooked by collectors, but Jane's team found four lovely new species thriving in WA. She made sure that they sampled fresh material to enable the team to obtain molecular sequence data, which has helped establish their closest relatives, and aid in separating them from each other.

One of the new species, *Leucetta purpurea* from Jurien Bay, is the only species of the genus that is purple in colour, and another, *Leucetta foliata*, from Cervantes and the Recherche Archipelago, resembles a simple folded flower. Hence the names they chose for these species. These species belong to the same genus as a sponge called *Leucetta prolifera* that has light-requiring symbionts and is consequently green; surprisingly this sponge turned out to be the dominant species in the Jurien area and was very abundant beneath the kelp.

The other two new species belong to the genus *Pericharax*, and are now named *Pericharax crypta* and *Pericharax vallii*. All four species have been described in a paper published in the journal *Zootaxa*.

Jane's research is shedding new light on the incredible diversity of sponges in our corner of the world, with many more discoveries to be made. WA's location on the edge of the Indian Ocean means that we are in a global biodiversity hotspot. But the discoveries are often hard fought. Before scientists can name a new species, they must ensure it hasn't been previously named. Many of the older taxonomic descriptions are rather poor and not sufficient to recognise the species, and this entails some rather intense taxonomic detective work that sometimes leads to examining the original specimens – the type material – that were used in the original description, to detect differences that characterise a new species. This might sound boring and tedious to some, but taxonomists love nothing more than solving a good mystery by closely examining all potential suspects before honing in on the prime target, then shouting "It's a new species!" I'm not sure if Jane shouted out loud, but her research is helping to shape our understanding of our unique marine ecosystems.



NEARER TO

Nature

A chilly morning spent *Nearer to Nature* provided a group of youngsters an opportunity to learn about Western Australia's possums, see them up-close and enjoy a trip to the Perth hills. And, for at least one discerning five-year-old, it was the highlight of the school holidays.

photos and words by Rhianna King

For those of us with school-aged children (or grandchildren), school holidays are a hotly anticipated time where we seek to balance fun and adventure with downtime to rest up before the school term starts again. For my kids, this usually involves spending as much time outside as possible, whether we're at home in the backyard or in a park, to capitalise on the benefits brought by kids exploring their natural surroundings, developing and refining gross and fine motor skills, fostering

independence and problem-solving. However, the July school holidays can be a bit trickier than other times of the year when the weather can play havoc with even the best-laid plans, and the kids can get a tad toy being stuck inside, regardless of how much Play-Doh, Lego and kinetic sand there is on offer. So when *LANDSCOPE* graphic designer Tiffany Taylor suggested we take our young ones to a Parks and Wildlife *Nearer to Nature* activity I jumped at the chance.



● Perth Hills Discovery Centre

A COMMUNITY FAVOURITE

Nearer to Nature is Parks and Wildlife's community outreach program which delivers unique nature-based activities to schools and members of the community at a number of locations throughout Perth and across the south-west in a range of ecosystems. School programs such as excursions, incursions, professional learning as well as the ever-popular *Bush Rangers* program meet requirements of the Australian Curriculum. Activities run during the school holidays offer less formal but still fun hands-on experiences that are designed to bring kids up-close and personal with WA's plants and animals and provide opportunities to learn about Aboriginal culture. On this occasion we journeyed up to the Perth Hills Discovery Centre in Beelu National Park near Mundaring on a particularly chilly Monday morning to take part in the 'Possums tails tale' activity.



THE TALE OF TWO TAILS

The premise of this activity, designed for four to seven-year-olds, is to help kids understand the similarities and differences between brushtail and western ringtail possums (*Trichosurus vulpecula* and *Pseudocheirus occidentalis*). Conservation messages were woven through a number of well-timed activities, including the animals' conservation status, the threats they face, and why it's important to

protect these precious animals into the future.

Nearer to Nature guide Bec Warner led the session with the support of three volunteers who were on site to help the kids during the activities – especially handy during the 'pin the tail on the possum' game where blindfolded kids were looking for any surface to pin their tails to!

The kids enjoyed a lovely hand-written and drawn story by *Nearer to Nature* that told the tale of two possums. This provided context for a bushwalk where the young explorers were tasked with the role of spotting 'possums' in

Possum tales

Western ringtail possums can be distinguished from larger brushtail possums by their smaller rounded ears, and tails with shorter fur. Their tail fur lies flat and ends in a white tip and is used for climbing. While, as their name suggests, brushtail possums' tails are bushy, and they have more pointed faces than ringtails. Adult brushtail possums are also generally bigger than ringtail possums (1.3 kilograms compared to one kilogram).

Brushtail possums have retained a wider distribution (throughout the south-west) than ringtail possums which are now limited to coastal areas with peppermint trees and isolated pockets of jarrah forest near Manjimup. The decline of both species has been attributed to clearing and fox predation.



Western ringtail possum



Brushtail possum

Previous page

Main *Nearer to Nature* participants took a walk through Beelu National Park looking for possums.

Inset top 'Pin the tail on the possum' was a hit among the kids.

Inset centre *Nearer to Nature* guide Bec Warner led the activities.

Inset below Sue Turner from Blue Gum Wildlife Rescue and Rehabilitation with 'Matilda'.

Above A hand-drawn and written story book captivated young participants.

Left Brushtail and ringtail possums.
Photos – Jiri Lochman



Volunteering

If you have a little spare time and enjoy the outdoors, there is a wide range of opportunities in assisting *Nearer to Nature* to run programs at venues all around the Perth metropolitan area. Phone our programs officer on (08) 9295 2244 for more information.



the trees. They were given clues to help them find the nocturnal animals – such as that ringtail possums live in nests called ‘dreys’, while brushtail possums inhabit hollows. They then worked as a group to identify the differences between the two species, including the shape and size of their ears and nose, colour of their fur and overall size, to complete a giant puzzle. This segued into an activity where the kids coloured in a picture on a puzzle that they were able to take home.

Then, the real stars of the show emerged and the kids met ‘Matilda’ the brushtail possum and ‘Pepe’ the western ringtail possum, which were both under the care of wildlife rehabilitator Sue Turner from Blue Gum Wildlife Rescue and Rehabilitation. The captivated audience of youngsters (no mean feat) listened attentively as Sue told them the stories of how the animals made it into her care (one involved a dog and the other a vehicle) – tales all too common among rescued native animals. She discussed the decline in numbers of both species and the reduction of available habitat caused by development and urbanisation of our bush as well as predation by foxes and feral cats. Then she shared information about Parks and Wildlife’s *Western Shield* program which aims to return the balance and mix of native animals in selected areas

Top left The kids worked in a group to complete a giant puzzle.

Above left Volunteering is a rewarding way to give something back and spend time in nature.

Above A take-home colour-in puzzle extended the fun of the activity well after it had ended.

of WA’s environment to levels comparable to pre-European settlement through feral cat and fox baiting, and other initiatives.

A GREAT MORNING OUT

Judging by the amount my kids chattered away in the car as we journeyed back ‘down the hill’ about all the things they’d learnt, the objective of the activity was well and truly met. The kids enjoyed doing something a bit different, and I loved seeing them having some wholesome fun in a natural setting. The lack of queues and crowds was an added bonus. And, at \$14 per child, it was great value for money.

In fact, we all enjoyed it so much that I’m already planning another activity for next holidays. We might even spend a night in the adjoining campground so we can explore more of the area. In the meantime, we’ll keep an eye out for possums in our local area, now we’re experts on what we’re looking for.

Do it yourself

Nearer to Nature runs programs at a number of sites in Perth as well as in the south-west. For more information and a copy of the activity program, phone (08) 9295 2244 or visit www.dpaw.wa.gov.au/get-involved/nearer-to-nature/community.

Contact us: *Nearer to Nature*, Perth Hills Discovery Centre, 380 Allen Road Mundaring, WA 6073.

Phone: (08) 9295 2244

Fax: (08) 9295 3247

Email: n2n@dpaw.wa.gov.au

To book activities in the south-west, phone: (08) 9725 4300

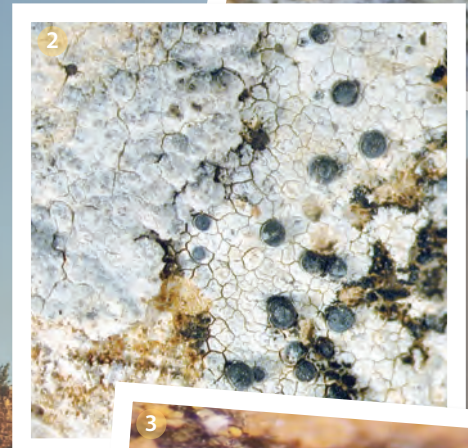
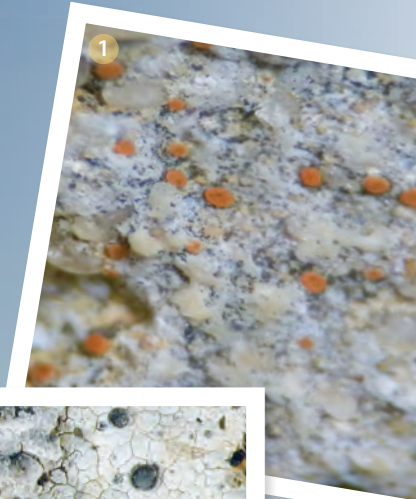
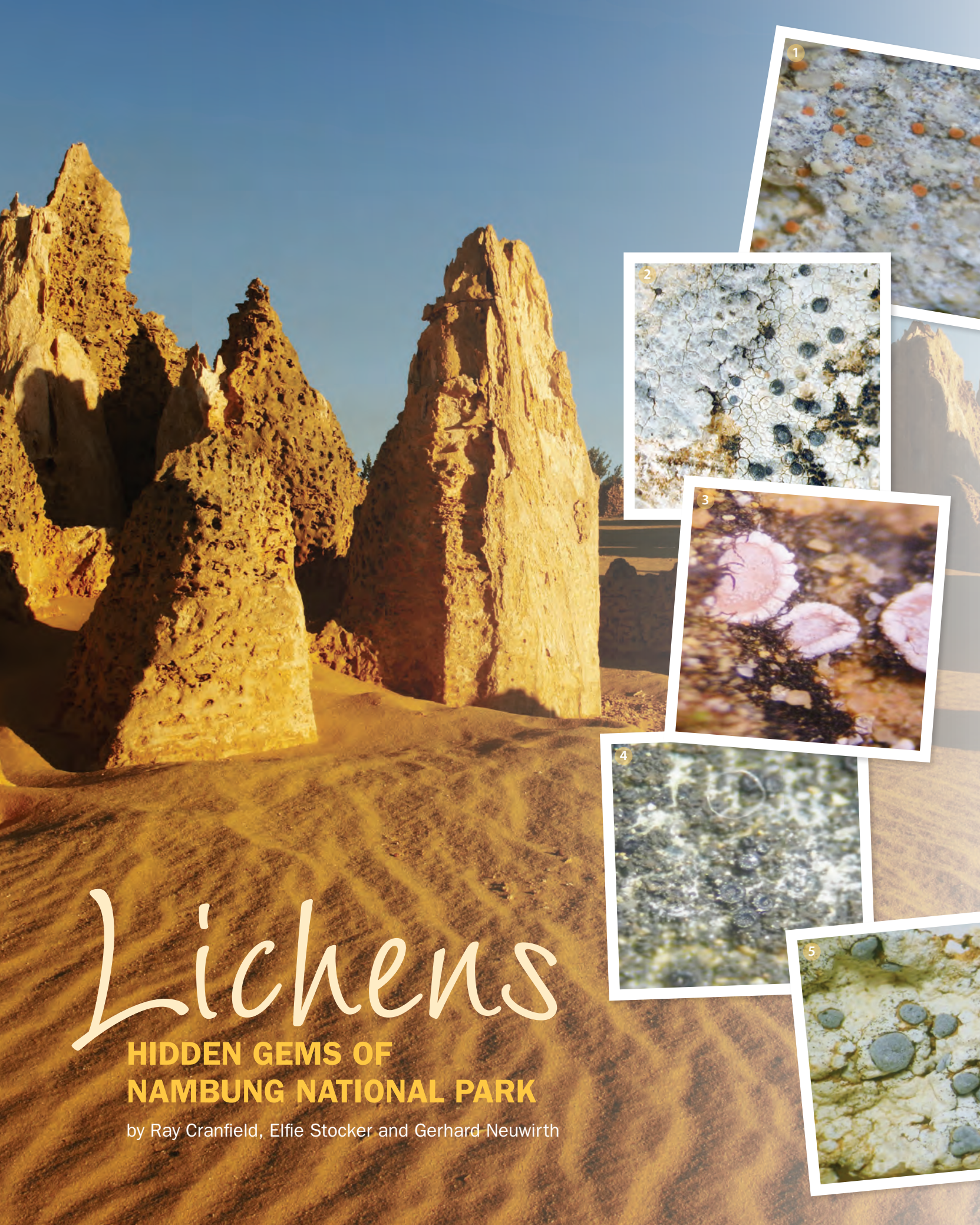


Scan here to get an overview of the *Nearer to Nature* program

Scan this QR code or visit Parks and Wildlife’s ‘LANDSCOPE’ playlist on YouTube.




Rhianna King is a *LANDSCOPE* editor. She can be contacted on (08) 9219 9903 or by email (rhianna.king@dpaw.wa.gov.au).



Lichens

**HIDDEN GEMS OF
NAMBUNG NATIONAL PARK**

by Ray Cranfield, Elfie Stocker and Gerhard Neuwirth




At first glance, the mysterious Pinnacles Desert in Nambung National Park is as sparse as it is vast – with tall limestone pillars jutting dramatically from the yellow sand and little obvious vegetation occurring throughout. But look a little closer and you may discover a whole microcosm of fascinating structures and forms that are often overlooked.

The spectacular Pinnacles Desert was first recorded in the 17th century by Dutch sailors as they passed along the WA coast. Today, Nambung National Park is one of the State's most visited national parks attracting more than 300,000 visits every year. It is probably safe to say that most people come to admire the expansive and intriguing scenery of the impressive limestone structures that rise from the sand. And it's probably even safer to speculate that few people pay attention to what is occurring at a microscopic level. But, if you take the time to have a closer look, you may spot dull-coloured patches that occur on the pillars that provide an insight into another feature of this rare landscape.

UNDER THE RADAR

These inconspicuous patches are actually a collection of unique organisms that, while often drab in appearance and void of showy flowers, contain interesting structures and forms. A search of the Pinnacles will reveal that they are not necessarily present on all pillars, but those that are may be different species and encompass many genera. This flora is made up of algae, moss, liverwort, fungi and lichens, and can be found naturally on several substrates.



Survival is no mean feat. This environment is hostile to many of these life forms and only a select few can thrive in this extreme coastal setting. Although tough, lichens (which are a symbiosis between a fungus and an alga or cyanobacterium) do not appreciate the sand blasting they receive from the prevailing winds, which are common in this exposed area. So you'll most often find them in sheltered crevices or edges where

the wind movement is reduced. Some species 'tough it out' and can be seen on upper surfaces of larger pillars. Most of these lichens have grey or white-coloured crust-thallus (or 'twigs') with disc or dome-shaped fruiting bodies. Some species have evolved a step further and have immersed their thallus into the stone surface with only their coloured fruiting bodies seen. Several lichens and one moss species have been identified on the bark or wood of mature shrubs and one moss species on the soil in the fringing vegetation areas around the Pinnacles Desert.

SEARCHING FOR RECORDS

An examination of WA Herbarium records in 2013 came up empty-handed with no recording of lichens or terrestrial algae in the Pinnacles Desert. As a result, a one-day excursion was carried out in 2014 when 52 samples were collected from the pillars and surrounding vegetation with an occasional sample collected from the soil.

Initial identification of the sampled material revealed that there were possibly several free-living algae that may be involved in symbiotic partnerships with fungi. These samples were sent to the University of Graz in Austria for identification of lichens and alga species. Tentative identification recognised 15 lichen, four alga and one moss species. Expert examination of the lichen samples in Salzburg has shown there to be at least 16 species at the Pinnacles, of which two are yet to be identified due to the immature development stage of these samples. The free-living algae and cyanobacteria specimens have been placed in cultures at the University of Graz for future identification.

Of the 16 lichens identified, two were only recognised in 2014 and are new to Western Australian lichenology. *Sarcogyne*



Previous page

Main The Pinnacles at Nambung National Park. Photo – Tourism WA

Insets 1 *Caloplaca lactea*. 2 *Buellia albula*. 3 *Psora decipiens*. 4 *Placynthium australiense*. 5 *Circinaria calcarea*.

Above *Rinodina bischoffii*. Photos – Ray Cranfield

meridionalis and *Placynthium australiense* both occur on stone substrates. The common showy taxa appears to be *Buellia albula* usually found on limestone. Other limestone species recorded are *Circinaria calcarea*, *Rinodina bischoffii*, *Lecania sylvestris* and *Caloplaca holocarpa*, *C. lactea* and *C. lithophila*. *Toninia* appears to be represented by two species – *T. australis* and *T. sedifolia* – but further study of this genus is required in Australia to reveal more answers. In the meantime, visitors to this fascinating park should be encouraged to refocus their gaze so they may see the area's interesting life at the macroscopic as well as landscape levels.

Scan here to get a unique view of Nambung National Park

Scan this QR code or visit Parks and Wildlife's 'LANDSCOPE' playlist on YouTube.



Ray Cranfield is a research associate with the WA Herbarium. He can be contacted by email (lichenswa@outlook.com).

AO Professor Elfie Stocker is lichenologist and alga taxonomist at the University of Graz, Institute of Plant Sciences.

Dr Gerhard Neuwirth is a retired lichen expert living in Tumeltsham Austria.

Island battleground: Toads versus native fauna



Kimberley islands are providing our native species with havens from the advancing and insidious cane toads. Or are they?

by David Pearson, Corrin Everitt, Jasper Kruse and Andrew Rethus



Introduced cane toads have spread across northern Australia since their release in Queensland in 1935. In 2009, they entered Western Australia's east Kimberley, marching westwards at a rate of about 50 kilometres per year. As part of the State Government's Cane Toad Strategy for Western Australia significant scientific research has been undertaken to understand and control this insidious pest. Cane toads are toxic to many Australian native species courtesy of the large parotid glands located on either side of their necks which exude white bufotoxin, a strong and complex poison that can kill very quickly. The most affected native species are larger predators such as northern quolls, goannas and venomous snakes, but also some smaller species such as northern bluetongue lizards. Toads at the front of the invasion tend to be large, efficient dispersers and are the first toads that naïve wildlife encounter. Their large size translates to large bufotoxin loads and so these pioneer toads have a devastating impact on the populations of species that attempt to eat them.

ALL DOOM AND GLOOM?

As cane toads have invaded various areas, there have been reports of the deaths of many species including frogs and predators, suggesting toads were having catastrophic effects. However, a laboratory study conducted by the University of Sydney with assistance from Parks and Wildlife found there was actually a range of responses to toads among mammals and reptiles. Many species ignored toads and did not try to eat them; others tentatively bit toads and received a non-lethal dose of bufotoxin



and were subsequently not tempted to try another; while in others a proportion of individuals were killed by toads. In some species, such as larger venomous snakes and several species of goannas, the majority of individuals found their first experience with a toad lethal – a great concern for the likely impacts on wild populations of these most susceptible species.

Recent work by a number of research groups has focused on developing ways to train quolls, bluetongue lizards and goannas not to eat toads. 'Taste aversion' sausages made from non-toxic parts of toads mixed with a strong salt have been used to train quolls to avoid toads. The idea developed by University of Sydney researchers Jonno Webb and Rick Shine, is that by eating one of these taste-aversion sausages, a quoll is immediately nauseous and as a result will not be tempted to eat a toad in the future, associating the ill feeling with the taste and smell of toads. Similarly, in a project between the University of Sydney, Parks and Wildlife and Kimberley Balangarra Corporation, goannas have been successfully trained to avoid large toads. Small dead toads

Previous page

Main The stunning Adolphus Island.

Photo – David Pearson/Parks and Wildlife

Inset left Cane toad.

Photo – Parks and Wildlife

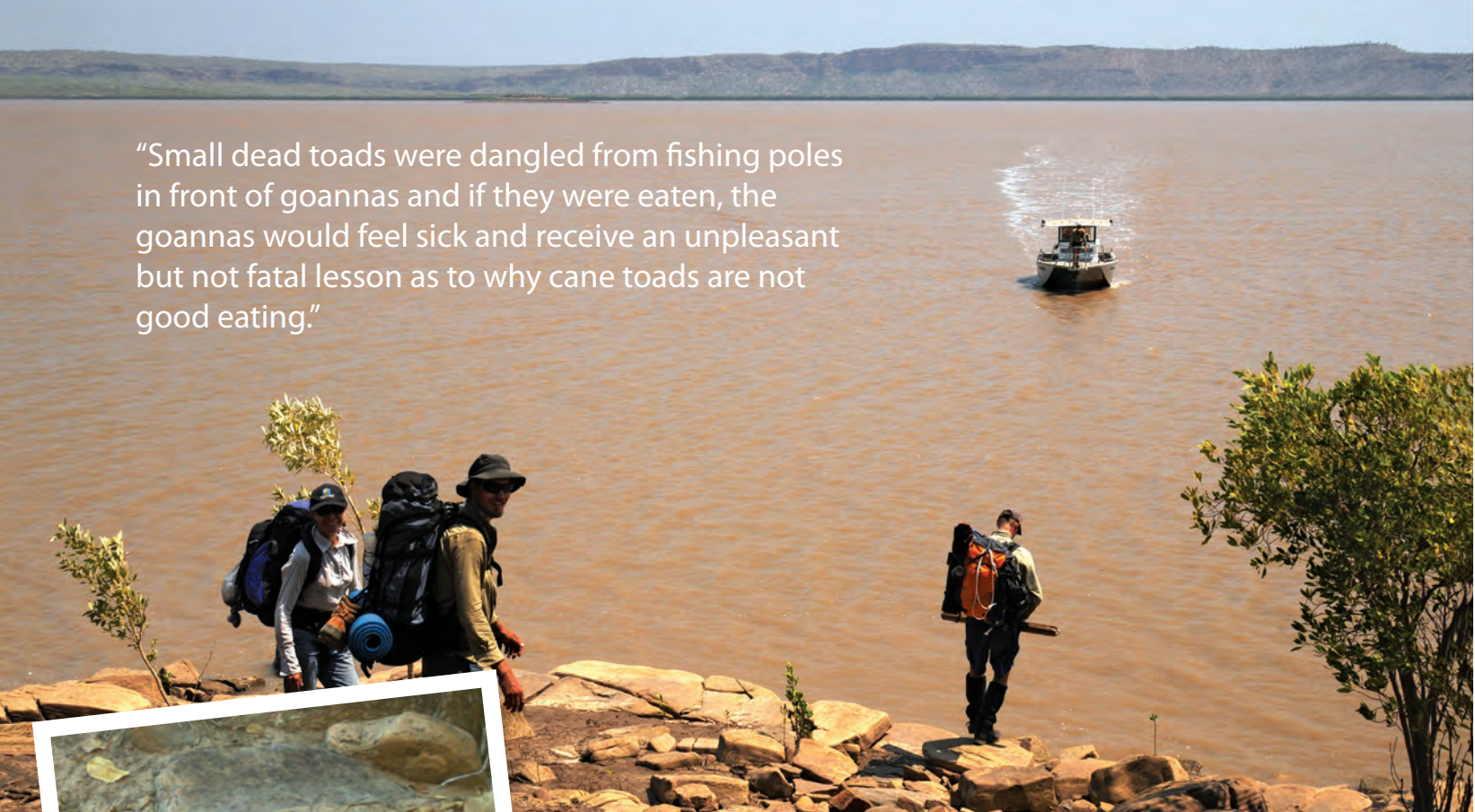
Inset right Brown tree snakes have learnt to avoid cane toads.

Photo – David Pearson/Parks and Wildlife

Above right Juvenile toads look different to adults, but they still have poison glands, which are visible here as the light brown lump behind the eye.

Photo – Jiri Lochman

“Small dead toads were dangled from fishing poles in front of goannas and if they were eaten, the goannas would feel sick and receive an unpleasant but not fatal lesson as to why cane toads are not good eating.”



Top The survey team scoured the island.
Photo – David Pearson/Parks and Wildlife

Above Camera traps captured images of quolls on the island.
Photo – Parks and Wildlife

were dangled from fishing poles in front of goannas and if they were eaten, the goannas would feel sick and receive an unpleasant but not fatal lesson as to why cane toads are not good eating.

ISLAND ARKS – SAFE FROM TOADS?

As toads continue their relentless occupation of the Kimberley, it was thought that islands along the coastline

might provide refuges for native fauna at risk from toad poisoning. More than 3500 islands are dotted along the Kimberley coast, but only the larger ones and those closer to the mainland tend to have large toad-sensitive predators such as quolls and goannas. Toads have already shown that they can reach offshore islands in the Northern Territory, presumably by rafting on vegetation or perhaps on plumes of freshwater that flow on top of the heavier saltwater when large tidal rivers flood.

The first major island in WA that the toad front reached was Adolphus Island, which lies in the channel of the Ord River, 40 kilometres from its mouth where it empties into the vast Joseph Bonaparte Gulf. Parks and Wildlife visited the island in 2008 during the Kimberley Island Survey and detected quolls and the large floodplain goanna (*Varanus panoptes*) – species particularly at risk from toads. A team from Parks and Wildlife, the University of Sydney and the Balangarra Corporation returned to the island in 2013 to study the quolls with the intention of trialling taste-aversion sausages. However, the quoll population proved to be too small and scattered at study sites, prompting the need for further exploration of the island

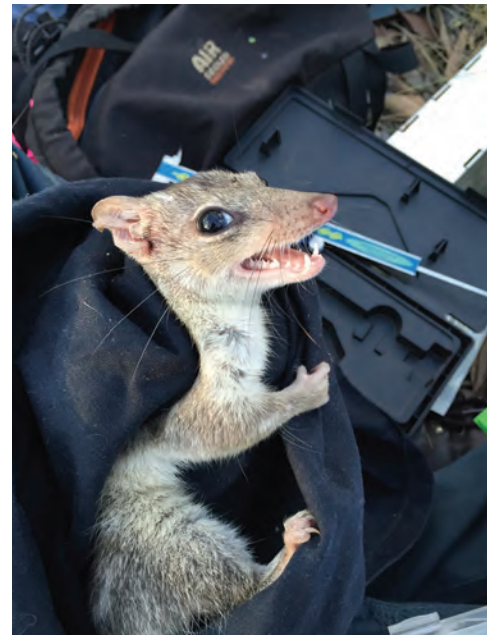
to see if other, and potentially larger, quoll populations could be located.

A SURPRISE ENCOUNTER CHANGES PLANS

In June 2014, Parks and Wildlife staff worked in two teams, walked around the entire island and explored suitable-looking quoll habitat identified from satellite imagery. Adolphus is steep and rocky with a 50-kilometre perimeter and encircled by saline mudflats and mangroves. There are no known water sources in the dry season, so a helicopter was used to drop water containers to use at each campsite. We searched rocky and creekline habitat looking for tracks and the distinctive droppings of quolls.

Unfortunately, and unexpectedly, on the first night a toad was found while we were putting up our mosquito nets. Toads were thought to have only recently reached the mainland adjacent to the island. Over subsequent days several more toads were located in a small seepage area and then along a seasonally dry creekline.

The lack of surface water on Adolphus Island during the dry season makes the island an unlikely habitat for cane toads. However, during our search around the



banks of the small creeklines some dead toads were discovered as well as live ones concealed under logs and, worryingly, in the burrows of the floodplain goannas. We also began to find dead goannas and snakes. It is difficult to ascertain whether these deaths were due to toads, but the position of their uneaten bodies in creeklines and in the open suggested that death was quick, not the result of a predator, but from rapid poisoning, typical of toads. Eventually during the search a fresh dead floodplain goanna was found with a dead toad alongside it. Clearly the fauna of Adolphus Island was already under assault from cane toads.

LEARNING FROM ADVERSITY

Even though it is a tragedy that cane toads have reached Adolphus Island, it is important to make the most of this unfortunate occurrence and learn as much as we can about how toads use the island, where they shelter, if it is possible to remove them and how native fauna are surviving – are they learning to avoid toads without our intervention?

At a number of sites where we knew or suspected quolls might persist, automatic motion-sensitive cameras were

Above Corrin Everitt checking a cage trap.
Photo – David Pearson/Parks and Wildlife

Above right A northern quoll being measured.
Photo – Jasper Kruse/Parks and Wildlife

Right A poisoned goanna lies near its burrow with a cane toad close by.
Photo – David Pearson/Parks and Wildlife

set up to detect them. The batteries on these units last many weeks so it was possible to get detailed surveillance of sites long after researchers returned home. Quolls were caught with Elliott traps with the intention of feeding captured individuals taste-aversion sausages to train them to avoid toads. We continued to explore the island both day and night with head torches to find out what native fauna persisted and to gauge the areas that toads were present. In some areas, tethered taste-aversion sausages were placed

in front of cameras to see if wild quolls consumed them and what other animals may eat them.

EARLY BUT ENCOURAGING DAYS

After observing many dead goannas in the first few months of our work on Adolphus Island, we were encouraged by still finding active burrows and tracks of goannas. It seems some goannas must have learnt to avoid toads. Presumably they were fortunate enough to encounter



Above The northern bluetongue lizard is one species affected by cane toads.

Above right Water and supplies were delivered to the island by helicopter.

Below Ongoing monitoring of the island will determine if native populations survive and recover.

Photos – David Pearson/Parks and Wildlife

a small toad rather than a lethal large one and had learnt themselves. Trapping indicated that quolls were still present although at reduced numbers compared to the pre-toad situation. In addition, the cameras detected quolls at other sites. Olive pythons, recorded anecdotally to be killed by toads, are still encountered at night often in close proximity to toads, so they too seem to have learnt to avoid toads.



Cameras are left on the island to provide longer-term surveillance. One unusual outcome of having cameras on the island was the detection of a rare bird, the Eurasian hoopoe (*Upupa epops*) that decided to inspect one of our cameras. This was only the fourth recording of the species in Australia.

Our hope is that the fauna of Adolphus Island is resilient and able to survive the arrival of cane toads. Eradication of toads from islands, even arid ones like Adolphus, is very difficult because toads are able to survive under logs, in rockpiles and goanna burrows, and they have the ability to build populations from small numbers. Taste aversion training of quolls provides a technique to preserve small pockets of quolls. However, the logistics of producing the taste-aversion sausages, dispersing them in remote places and their short longevity in the field means they have a

limited though potentially significant role in ensuring quolls persist in the landscape and can recolonise habitat after the main front of toads has passed through.

Even though cane toads have severely impacted a few reptile species and quolls, Adolphus Island remains an important sanctuary for a range of birds, small reptiles and several frogs, away from some of the threats prevalent on the mainland such as feral cats, habitat change due to grazing by cattle and frequent wildfires. Early indications are that toad-susceptible species on Adolphus have survived the initial invasion of cane toads and ongoing monitoring will determine if populations are able to remain viable and recover. This will provide valuable information to guide the management of wildlife on other islands likely to be invaded by cane toads.



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Recruitment processes **A TALE OF SURVIVAL**

The adult coral reef organisms that we usually see when we go for a dive are the survivors of a complex and often dangerous life cycle. Before they make it to adult life, released eggs and sperm have to find each other and be reproductively compatible for fertilisation, mature as larvae, all while running the gauntlet of hungry fish and other predators. Of the millions of eggs and sperm released into the open water, very few have a chance of surviving their journey as larvae before they are old or lucky enough to find a suitable place to live and thrive – a hard tale of survival.

by **Richard Evans,**
Tom Holmes and
George Shedrawi



Many marine organisms have what is known as a bi-partite life cycle, in which adults release eggs and sperm, also known as spawn, which fertilise to produce tiny larvae that disperse in the open oceans before returning to benthic habitats to continue their lives as juveniles and adults. While older individuals who move locations are often well adapted to the habitats they may find at their end point, larvae may find themselves in a scary new world when they reach their new home, one in which they have no prior experience. So what happens when these larvae arrive at their new homes?

The dispersal of larvae through the water column is important for the connectivity and survival of populations of marine species, but for the young (recruits), the conditions they find on the reefs when they arrive also affects their survival at the start of a new stage in their life cycle. Firstly, larval organisms need to survive the gauntlet from the water column past the 'wall of mouths' (predators typically in the form of fish) to the reef substrate. Many reef-based animals see naïve young larvae as a tasty mid-morning snack, so it pays to find ways to reduce or entirely avoid this threat from predators. Fish approach this challenge in three key ways. Firstly, they settle at night and generally around the new moon, when darkness is greatest and most potential predators are asleep. Secondly,

Previous page

Top *Acropora* recruit *in situ* with urchin.

Photo – Richard Evans/Parks and Wildlife

Bottom Coral spawning.

Photo – Geoff Taylor/Lochman Transparencies

Above Coral reef fish hiding among the busy coral reef landscape.

Right Young *Chromis viridis* hiding among the branches of an Acroporid coral.

Photos – Matt Kleczkowski

they settle in large numbers like waves of soldiers storming a beach, flooding the potential predators with choice and maximising the chance that some will survive. Thirdly, they generally remain transparent in colour until they reach protection, decreasing their visibility to watching eyes (see also 'Now you see me ...' on page 22).

Once there, they face a whole new set of challenges, including further predation, competition for space and access to an adequate food supply. For immobile organisms such as corals the list continues, and includes other threats such as smothering from sediment, abrasion and dislodgement, exposure and heat stress. For example, if coral larvae settle out of the water column onto a reef covered in sediment, they are probably not going to find a suitable place to attach successfully or if the competent larvae manage to,



they may be smothered before they can grow to maturity. Other challenges for organisms that attach to the bottom include competition for space by existing benthic organisms such as sponges, ascidians, bryozoans, other corals; and predation from other benthic organisms such as snails, slugs, boring worms or scraping and excavating herbivorous fish. They are also subject to environmental influences that may occur during the settlement period, such as heavy rainfall affecting salinity. Having no eyes and very little motility to find the sweet spot is a challenge and corals have to use other methods to increase their chance of survival. They time their spawning so that their eggs and sperm are released at night on a relatively dark moon phase, and more importantly they settle in complete darkness near the new moon a week later to decrease predators' ability to see them.



“It would not be a relaxing existence being a juvenile fish or coral on a big coral reef!”

Far left A thriving reefscape.
Photo – George Shedrawi/Parks and Wildlife

Left A juvenile coral trout.
Photo – David Williamson

Above Parks and Wildlife scientists installing coral settlement tiles in Shark Bay.
Photo – Michael Rule/Parks and Wildlife

Coral larvae use settlement cues, probably through chemical receptors to find a good place to settle on the reef, helping them distinguish ‘friend’ from ‘foe’ on suitable substrata. One such place is underneath existing reef structures where they hide from the torrent of pressures influencing their survival.

Coral reef fish typically have excellent swimming abilities and good senses of sight and smell, but they still have to find a place to hide that is not occupied by other creatures and is appropriate to the individual species’ dietary needs, body shape and behaviour. They must then duck out of this sanctuary to find food every day, always under the watchful eye of the bigger and faster predatory fish like coral trout, snappers and wrasses. Even during the night it is not safe due to the voracious nocturnal predators such as sharks, cephalopods (octopus and squid) and crabs.

It would not be a relaxing existence being a juvenile fish or coral on a big coral reef!

CORAL RECRUITMENT STUDIES

Since 2010, Parks and Wildlife marine scientists have travelled to some of WA’s most iconic coral reefs to gather settlement and recruitment data. This program extends from Shark Bay Marine Park in the south to the reefs off Onslow and Barrow and Montebello Islands marine reserves. Understanding rates of settlement, recruitment and shifts in the size-structure of corals can increase management effectiveness by describing the underlying patterns of declining or recovering coral communities in response to large-scale natural and human stresses. This information may then be used to make informed strategic management decisions which recognise resilient and susceptible areas under differing levels of

management. This is important because coral reef recovery can take years, as is currently the case in some Western Australian reefs, where corals have been impacted by dredging, bleaching, and cyclones in recent years.

To gain an understanding of how these events affect coral communities presently and into the future, terracotta tiles were deployed at various reefs throughout WA. Coral settlement tiles are a standard unit for measuring coral larval supply and are used in many science projects throughout the world. The 100x100-millimetre tiles attract various creatures settling to the reef and among those are young competent larvae, if they are able to find them among the vast coral reefs. The tiles are deployed during the peak reproductive times for corals, which are mainly during the autumn months of March and April.

Assessing early coral survival and coral recruitment on the actual reef is also being done in conjunction with counting the corals on settlement tiles. The tiles are a measure of supply to the reef but the juvenile corals counted on the reefs are a measure of survival. Corals that can be observed with the human eye are generally one to two-plus years old so there is a lag time comparing the tiles to the young corals on the reef. By combining these two methodologies we find the reefs that have had consistent settlement to tiles and high levels of early survival through the recent heat stress years, are more resilient and able to recover quicker from disturbance.

The research conducted within Ningaloo Marine Park during the past six years has shown us that settlement and recruitment survival is highly variable. Coral cover has been low at

Bundegi in the park's north-east, since the bleaching events of 2010-11, and has had consistently low settlement and recruitment rates and subsequently coral recovery is slower than other locations. The minimal amount of live reproductive adults, natural oceanographic factors or high sediment loads may hinder recruitment and survival of corals at this reef through time. What we've found at Bundegi is that after four years, recruitment of encrusting form corals, which are an important first step to recovery, are beginning to increase. However, settlement and recruitment of those large habitat-forming corals such as branching- and plate-shaped Acroporidae are still very low and Bundegi may take at least 12 to 15 years to return to its former glory. The abundance of recruits has also decreased around the Muiron



Islands but these are limited to young branching corals and it is expected that recruitment may not be as limited as that found at Bundegi due to the relatively smaller impact of the bleaching event in this area. In contrast, the north-western Ningaloo reefs (and Coral Bay in the southern part of the marine park) have maintained healthy adult corals and have had consistently high settlement rates even after the multiple disturbance events.

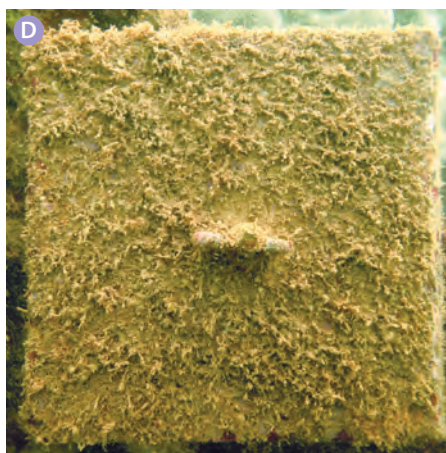
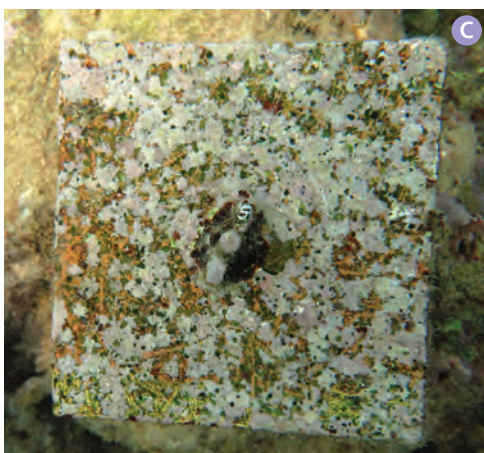
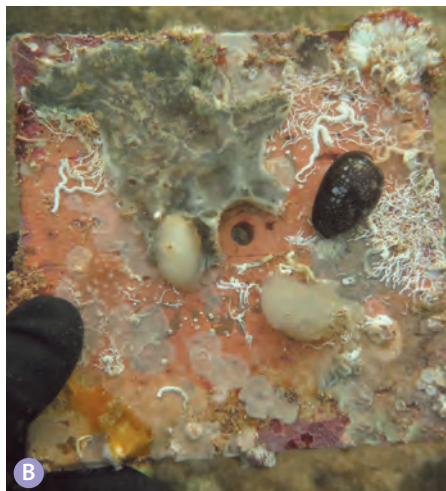
These are particularly important findings as these areas may become the supply for reefs in those affected areas of the marine park. Studies linking recruitment supply and abundance will help us to determine which reefs are likely to be source populations and which are likely to receive new recruits from other locations. Genetic connectivity studies can be done to further understand these links (see 'Understanding marine connectivity', *LANDSCOPE*, Winter 2016, for a detailed description of these processes).

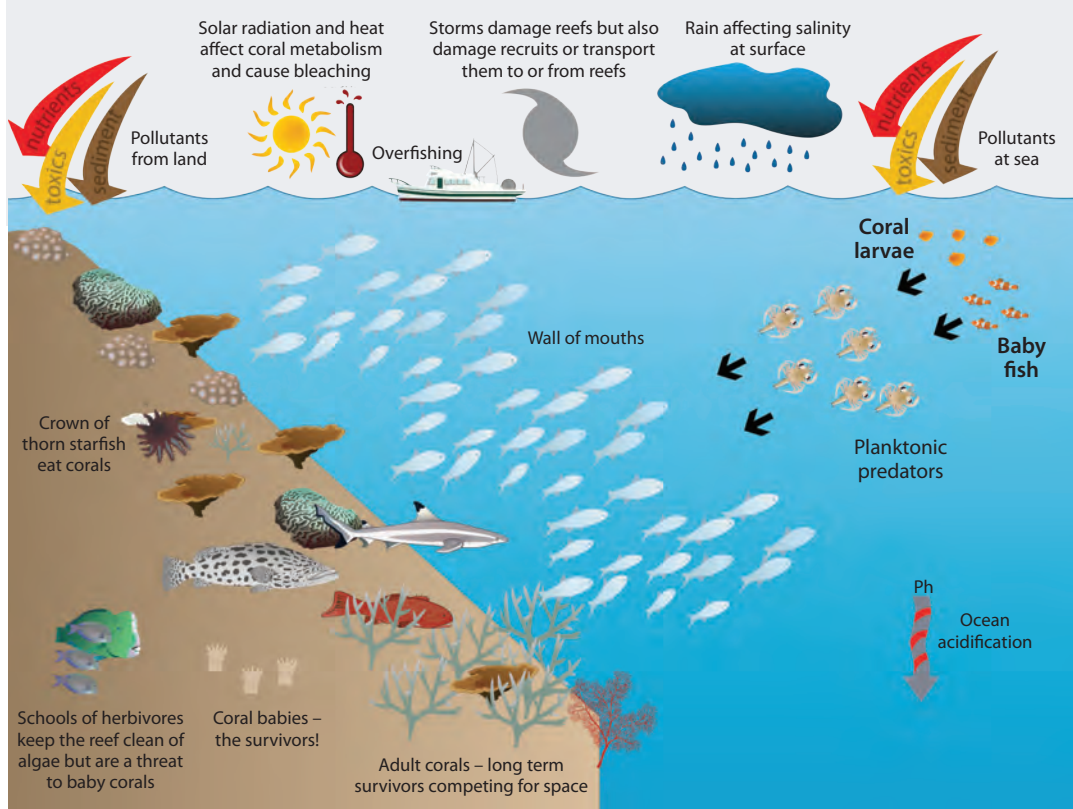
In a simultaneous study, the Chevron-funded Wheatstone offset project

.....
Above A 'wall of mouths' at Muiron Islands.
Photo – Matt Kleczkowski

Left When the tiles are deployed (A) they are clean. After three months on the reef, many critters settle on the underside of the tiles (B). The top of the tile is exposed to many interactions and are only covered in the critters that can survive. (C) shows parrotfish scrape marks through some coralline and turf algae. But at some locations sediment smothers all (D).

Photos – Richard Evans/Parks and Wildlife





investigates connectivity and the resilience of important habitat producers and associated animals. As part of this study, coral recruitment and survival has been investigated after several thermal stress events which reduced coral cover from approximately 50 per cent to as low as five per cent. The real challenge for the corals of this region is that they live in an area with high natural sediment regimes, which is not ideal for young corals. In addition to the bleaching that occurred in 2011 and 2012, a dredge operation off Onslow moved up to 46 million cubic metres of marine sediment from 2013–15. The purpose of this study is to identify potential stressors to the reefs and discover their influence on the recovery potential of western Pilbara reefs. This study had been conducted over the past three years and is still in progress.

FISH RECRUITMENT STUDIES

While corals have to decide on a single perfect home for the rest of their lives, fish are mobile and have the

opportunity to shift habitats as they grow, choosing different areas that are most appropriate to their changing size, diet and reproductive needs. Initially, many fish settle in nursery grounds that are low in predator numbers, provide a reliable supply of food appropriate for small fish and ample hiding spaces to survive until they are big and strong enough to move to more challenging environments. For some coral reef fish, this may simply be a specific type of coral that offers a complex array of hiding spaces for small individuals. However, for others this may involve settling in nearby seagrass, mangrove or macroalgal (seaweed) habitats that offer greater protection and food sources for

juvenile fish of certain species.

While much of the previous work on nursery habitats has focused on the importance of seagrass and mangrove communities, recent work by Parks and Wildlife scientists and their collaborators, highlights the significant role that macroalgae also plays. Often considered the ‘enemy’ of coral reefs due to the perception that they out-compete the more beautiful corals following disturbance events (such as cyclones and coral bleaching), macroalgae actually plays an important role in tropical reef ecosystems. This is particularly the case in the Gascoyne, Pilbara and wider north-west shelf regions of WA, where

Above right Some of the stressors and processes affecting the settlement and recruitment of baby coral and fish to adulthood on coral reefs.

Illustration – Richard Evans with symbols courtesy of Integration and Application Network, University of Maryland Centre for Environmental Science

Right Ribbon grass.

Photo – Clay Bryce/Lochman Transparencies



“... these areas provide essential nursery habitat for a range of ecologically and fishery important species in this region, including parrotfish, emperors, snappers and tuskfish.”



Left Blue spotted turkfish.
Photo – Clay Bryce/Lochman Transparencies

Below left Algal reef habitat acts as a nursery.
Photo – Matt Kleczkowski

Below A young turbinaria survivor.
Photo – Richard Evans/Parks and Wildlife



immediately adjacent to coral reefs were found to support an amazing diversity of juvenile fishes, many of which are known to live in coral habitats later in life. While the Montebello/Barrow Island work provided an excellent snapshot of how these patterns may extend into the wider Pilbara region, the Ningaloo research continues to provide insights into how these patterns change through time and why fish may recruit to certain areas.

The research has found recruitment to be a highly variable process, with some years producing extremely high numbers, and others next to none. While there is likely a high degree of natural inconsistency, the strength of fish recruitment appears to be closely related to ocean and weather conditions over the summer period (when reproduction and recruitment occur). In particular, the strength of the Leeuwin Current (the southward flowing warm water current along the Western Australian coast) seems to be particularly important, with years of stronger current flow resulting in higher recruitment.

Location also appears to play a role, with some areas along the Ningaloo coast consistently recording higher numbers of fish recruits than others. This appears to be closely related to both oceanic conditions and certain characteristics of the coral or algae in which they settle. For example, some commercially important species, such as the spangled emperor (*Lethrinus nebulosus*), prefer to settle in algal areas that are dense and have a high canopy height.

large areas of shallow inshore waters are covered by vast macroalgal fields. Researchers have found that these areas provide essential nursery habitat for a range of ecologically and fishery important species in this region, including parrotfish, emperors, snappers and tuskfish.

Initially focused on the Ningaloo region as a wider study of fish recruitment patterns within the marine park, the work was extended to the Montebello and Barrow Islands marine reserves in 2010 as part of the Gorgon gas development monitoring, evaluating and reporting program. In both cases, macroalgal fields

These studies are but a few focusing on recruitment as an important process to help WA coral reefs recover from natural and human influences. Marine science staff are involved in collaborative recruitment studies alongside The University of Western Australia, Australian Institute of Marine Science, CSIRO, Australian National University and University of Tasmania in various locations including the Dampier Archipelago, Montebello Islands, the Kimberley, Ningaloo reef and even the cold waters (for a coral) of Shark Bay, Jurien Bay and Perth.

If you would like more information about how the young marine animals run the gauntlet through the wall of mouths to start their lives on the busy metropolis of coral reefs contact the Marine Science Program.



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by Lauren Emmerson



kaleidoscope
kids exploring nature

Catch me if you can!

One hundred and fifty students in Years 4 to 6 from three City of Bayswater schools spent the day outdoors learning how catchments work and Aboriginal culture as part of a *Nearer to Nature* excursion. They learnt about all the wonderful plants and animals that live in catchments and the feral animals that threaten the local wildlife.



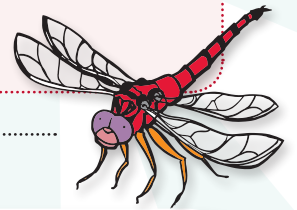
"My favourite station was learning about Aboriginal culture because Zac [*Nearer to Nature's* Gudathada 'Zac' Walker] was hilarious. I liked it when he painted our faces with symbols of native animals. I got a kangaroo." Ela, Year 4

Above St Columbus students learning how to throw spears with *Nearer to Nature's* Gudathada 'Zac' Walker. **Above right** St Columbus students learning how water flows through catchments. Photos – Jennifer Eliot/Parks and Wildlife



"My favourite part was when we found invertebrates. That means they don't have a backbone. We found two shrimps, an ant and a beetle." Lily, Year 4

The excursion was part of Parks and Wildlife's *Nearer to Nature* schools program. Excursions, incursions, professional learning and resources meet requirements of the Australian Curriculum and provide opportunities for students of all ages to take part in hands-on, experiential learning in the natural environment. The excursions build concepts, skills, values and the ability to make environmentally responsible decisions. Also provided are excursions and incursions in sustainability from an Aboriginal cultural perspective. For more information, phone (08) 9295 6149, email n2n@dpaw.wa.gov.au or visit nearertonature.dpaw.wa.gov.au.



Watch out for zoo poo!

There was no monkeying about when students from Leeming Senior High School helped clean up rubbish at Perth Zoo recently. Students also helped clean up marine debris near Shoalwater as part of the *Rio Tinto Earth Assist Program* with Conservation Volunteers Australia (CVA). Voin Zivkovic from the Leeming Senior High School Education Support Centre said that a bit of healthy competition emerged and saw the students competing for who could collect the most rubbish.

Rio Tinto Earth Assist is a hands-on conservation-focused partnership that gets students out of the classroom and into nature. The program is managed by CVA in partnership with Parks and Wildlife and Department of Education, with funding provided by Rio Tinto. For more information visit <http://earthassist.org.au>.

Right Leeming Senior High School students at Shoalwater Beach.

Far right Meeting a few of the Perth Zoo's residents. Photos – Leeming Senior High School



LANDSCOPE's **Kaleidoscope kids exploring nature** page is an exciting regular feature for kids.



Red-flowering gum (*Corymbia ficifolia*)

When it's flowering, the beautiful red flowers of the red-flowering gum transforms this otherwise unremarkable tree into a blaze of rich colour. They flower in summer to early autumn and can vary from a brilliant scarlet and crimson to orange and pink. Red-flowering gums are found only from near Mount Frankland to Walpole and east to Denmark with an isolated population near Albany and grow in eucalypt and banksia woodlands.

Illustration by Jacqueline Pemberton



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