NEW LOOK
NEW FEATURES

WA'S PARKS, WILDLIFE AND CONSERVATION MAGAZINE

LANDSCOPE

Volume 29 Number 3 Autumn 2014 $7.95

KIMBERLEY ADVENTURE
Trekking the Gibb

Perup
A woylie haven

Epic ride
Munda Biddi Trail

Barrow Island
A resource and conservation gem

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Welcome to the new-look *LANDSCOPE*. For 29 years, this magazine has been providing readers with an insight into Western Australia's beautiful natural areas, the fascinating plants and the animals that live there, and the opportunities available for people to experience national parks, marine parks and other reserves.

The magazine will continue to deliver the fascinating articles and stunning photos readers are used to, with the addition of fresh interesting features. These changes are designed to reflect the creation of the new Department of Parks and Wildlife and its commitment to managing WA's outstanding network of conservation areas as parks for people, where they can enjoy and appreciate this extraordinary natural environment.

LANDSCOPE will also continue to profile people who have played significant roles in shaping park management and wildlife conservation and, of course, bring you stories about new environmental discoveries and the best-practice science that underpins our work. We anticipate that our younger readers will enjoy the new 'kaleidoscope – kids exploring nature' feature.

In this jam-packed edition, we detail two families' experiences travelling the iconic Gibb River Road in the Kimberley region—listed as number two in the Lonely Planet's 'Top 10 Regions' in the world for 2014. Another story takes us on a ride along the Munda Biddi Trail, which winds its way between Mundaring on Perth's outskirts to Albany on the south coast. Readers can also learn about recovery actions being undertaken for the woylie and management actions planned for the resource and conservation-rich Barrow Island.

I hope you enjoy the new-look *LANDSCOPE* and thank you for your continued support.

Jim Sharp, *Acting Director General*
Department of Parks and Wildlife

ON THE COVER

Front cover Exploring the spectacular Tunnel Creek cave—the oldest cave system in Western Australia—in Tunnel Creek National Park (see 'Trekking the Gibb' on page 40 for more information).
Photo – David Bettini

Back cover Restless flycatchers (*Myiagra inquieta nana*) can be found throughout much of Australia, especially northern Australia, and New Guinea.
Photo – Alice Gillam/Sallyanne Cousans Photography

Contributing

Michelle Rumball works in the Department of Parks and Wildlife's Planning Branch preparing management plans, including for the Barrow group nature reserves. Michelle is particularly interested in marine, island and fauna conservation, having volunteered with a bilby captive breeding program and worked with the local vezo people to monitor benthic and fish species in Madagascar's south-west.

John Huisman is a contract seaweed specialist at the Western Australian Herbarium and a research fellow at Murdoch University. He is a regular contributor to *LANDSCOPE* and has authored several books. His research encompasses the taxonomy of marine algae worldwide, but his current focus is writing a book documenting the seaweeds of north-western Australia where he has recorded several hundred species, including more than 50 species and five genera new to science.

Samille Mitchell was *LANDSCOPE*'s coordinating editor for seven years and has written and edited many books and articles for the department, including *Exploring Western Australia's natural wonders*, *Rediscover Perth outdoors* and *Kalbarri*. Samille relished the opportunity to learn and write about the state's incredible nature, and spread the word on the passion and dedication behind the work to conserve it. She is focusing on her freelance writing career.

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Department of Parks and Wildlife

Features

Regulars

This page The Soho Hills lookout is the start of the Caldyanup Trail at Mount Frankland—one of the sites in the Walpole Wilderness Discovery Centre (see page 6).
Photo – Cliff Winfield

Snap shot

READER'SPIC

Hellfire Bay, Cape Le Grand National Park

Tiffany Taylor

"Hellfire Bay is a stunningly beautiful location, much enjoyed on a recent family holiday. Be careful taking photos on the rocks though, as dropping an iPhone while taking a self portrait with your son is not good for the screen, as my husband found out!"

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 landscope@dpaw.wa.gov.au for a chance to win a $25 gift voucher to use towards *WA Naturally* publications.

Walpole Wilderness Discovery Centre wins award

The Walpole Wilderness Discovery Centre has been awarded gold in the New Tourism Development category of the Western Australian Tourism Awards. The awards recognise outstanding customer service, innovation and ongoing business excellence in the WA tourism industry.

The Walpole Wilderness Discovery Centre is a nature-based precinct incorporating three sites. It aims to give visitors an understanding of the cultural heritage and natural wonders of the Walpole Wilderness Area—a remarkable area containing old-growth forest, wetlands and threatened endemic flora and fauna. The three sites that make up the centre are the renowned Valley of the Giants Tree Top Walk, Swarbrick Art Loop and the recently completed Mount Frankland Wilderness Lookout, also known by its Noongar name Caldyanup Jinnung.

The lookout consists of an 80-metre-long, 2.5-metre-wide walkway to a viewing platform on the edge of a north-facing granite rock. Nearby, an arrival shelter with impressive stonework was built as a gathering place for visitors. The shelter is the gateway to the Mount Frankland summit, lookout and surrounding walk trails, and has already been used as a venue for a wedding ceremony.

Visit Explore Parks WA at www.parks.dpaw.wa.gov.au.

Below Mount Frankland Wilderness Lookout offers impressive vistas across the Walpole Wilderness Area.
Photo – Tim Foley/DPaW

Above Cloudy stone gecko.
Photo – Brad Maryan

NEW KNOWLEDGE

New gecko species discovered

A rare new species of gecko has been discovered in the state's midwest region. Western Australian Museum reptile curator Dr Paul Doughty said the cloudy stone gecko (*Diplodactylus nebulosus*) was a new species of gecko lizard endemic to the Geraldton area.

"The species only occurs from Mount Lesueur in the south of the region, in the hills to the east of Geraldton and up to the Hutt River," Paul said. "The new gecko is a stone gecko, meaning it prefers the harder surfaces of the ranges behind the coast over more sandy surfaces."

Paul and his University of Melbourne colleague Paul Oliver used specimens and genetics at the museum's Collection and Research Centre in Welshpool to identify the species as unique.

"The gecko differs from other species in that it has a pattern on its back resembling a cloud, or nebula, instead of a straight line like its Wheatbelt relatives," Paul said. "The toes have grippy surfaces, but it can't climb walls like other geckos—instead pretending to hide under slabs of rock or logs during the day. It can, however, climb low shrubs to forage for spiders and cockroaches."

mailbox

Dear editor

When my wife started working at Murdoch University many years ago she brought home *LANDSCOPE* thinking I might like it, having worked on Barrow Island in the early 1980s, fresh from New Zealand, then up and down the Dampier–Bunbury pipeline. Since then I have bought every issue and, amongst many memorable experiences, have *LANDSCOPE* to thank for introducing me to the world of Philippa Nikulinsky and her botanical art. We have all her books at home and I have one with me in South Korea where I work at present, six weeks here then two weeks home, just near Fremantle. The Spring 2013 issue is my constant companion, in my rucksack for reading on the bus to and from work at Hyundai, the world's biggest offshore construction yard. Your wonderful magazine and its diverse articles by accomplished scientists and contributors and its rich, almost three-dimensional photographs, keeps me so connected to Western Australia.

Thank you again for your most wonderful magazine produced in what are probably difficult conditions—being an active Bibbulmun Track Foundation member I'm only too aware of how you have to make every dollar go further these days. I look forward to many more issues.

Kind regards, Mark Davidson

Please send your letters to landscope@dpaw.wa.gov.au. They should be no longer than 150 words and the editorial team reserves the right to edit them for readability and length.

APP

New app to track marine pests

The Department of Fisheries has released a new smartphone application as part of its work to protect Western Australia's marine and riverine environment from aquatic pests.

WA PestWatch helps the public report pests they see in our rivers and oceans and enables people to track pests reported by other users. It provides information about common marine and freshwater pests. Aquatic pests and diseases are a significant threat to WA's precious oceans and rivers, with the potential to devastate ecosystems.

WA PestWatch can be used on a smartphone or tablet device and can be downloaded for free from the iTunes app store and Google Play store. A web-based version is also available from the Department of Fisheries website at www.fish.wa.gov.au/biosecurity.

WA PestWatch

Dr David Suzuki – Guest columnist

One hundred years is not a long time. But if we look at the past century, we see unimaginable change. The human population has grown exponentially, from about one and a half billion to seven billion. People have shifted from rural to urban, and now more than half of us live in cities—up to 80 per cent in developed countries. Automobiles and other amazing technological advances have allowed us to live in a very different way. But we're so enthralled with our technology that we've designed many of our cities for cars instead of people. Our knowledge and inventions have kept pace with population growth, but that only means they've sometimes sped ahead of our ability to plan more rationally for their use and application. And so we're consuming more, wasting more, polluting more, and using up more of the Earth's resources.

Many people are understandably afraid of what we've gotten ourselves into. But we'll never get out of a jam by plugging our fingers in our ears and going "lalala" or pretending everything's fine. The great scientist Albert Einstein once said, "We cannot solve our problems with the same thinking we used when we created them". Humans are creative and adaptable. We must imagine a brighter future if we are to create it. And we can. But we must apply new ways of thinking and seeing.

Our species' great evolutionary advantage over the rest of nature was foresight, the ability to look ahead and draw on our experience and insights, take action to avoid dangers and exploit opportunities. Change in the past has often come in the wake of catastrophic wars or revolutions or arms races or space races. But, in the end, it has always involved people sitting down and talking about the problems and the best ways to overcome them. Our hope is to start thinking and talking before catastrophe strikes. Surely we've evolved to the point we can do that.

With pollution and climate change, species extinction, and destruction of ocean and land ecosystems, we are nearing catastrophe.

Solutions exist. We have the science and technology. We have the many intelligent and dedicated people trying to steer us on course. But we need the will and the imagination to change and, as Einstein said, we need to think in new ways. The problem is more social than technological. We need to commit to adopting ways to live in balance with the natural systems that keep us alive, and with each other.

But we need more ideas—your ideas. We need to be creative. We need to use our imaginations. We need to talk to each other.

See 'In review' on page 11 for a review of Dr Suzuki's book *Everything Under the Sun: Towards a brighter future on a small blue planet*.

A group of riders set out to complete the 1,000-kilometre Munda Biddi Trail. The event provided the opportunity to look back at the trail's beginnings and its path to completion.

by Stuart Harrison

MASTERING THE MUNDA BIDDI

Above The Munda Biddi Epic 1000 riders rode from Albany to Mundaring as the first end-to-end users of the completed Munda Biddi Trail. *Photo – Geoff Snell*

Opposite page
Different terrains make the trail interesting and challenging.
Photo – Karen Rose

In early autumn 2013, with the heat of a long summer fading, a group of 26 eager adventurers set out on their mountain bikes from Albany on the south-coast. These intrepid riders from across Australia were aiming to be the first 'Trailblazers', setting themselves the challenge of riding 1,000 kilometres to Mundaring on the outskirts of Perth and being the first to ride end-to-end on the Munda Biddi Trail.

During the next three weeks, as part of the Munda Biddi Trail Foundation's first Munda Biddi Epic 1000, the riders experienced all the south-west has to offer, from rugged rocky coastline and remote wilderness to spectacular forest and river valleys, while battling it out against heat, sunshine and rain. The continually changing trail and infamous pea gravel caught a few by surprise, with plenty of hills and descents to keep their hearts and pedals pumping.

The riders spent their nights camping out on the trail or in small country communities where they gratefully accepted comfortable accommodation and opportunities to dine on the local produce and drink the world-famous wines.

A VISION IS BORN

The development of the Munda Biddi has taken more than 12 years, and many people have asked how the Munda Biddi came to be. Since the 1980s there has been a steady increase in recreational mountain biking, with

the first mountain bikes virtually just road bikes with knobbly tyres. Since then, both the activity and the bikes have significantly changed, evolving into different disciplines including downhill and cross country, which became an Olympic sport in 1996. (See also 'Munda Biddi: Pathway through the forest', *LANDSCOPE*, Summer 2002–03.)

Back in 1998, the then Department of Conservation and Land Management (CALM) had just completed the redevelopment and extension of the world-famous Bibbulmun Track. The redevelopment saw the trail re-aligned off the old forestry tracks, with large sections of dedicated walking trail built. It was this dedicated walking trail that was unwittingly attracting a growing number of mountain bikers searching for the thrill of tight, twisty, single-track riding. At the time, the demand for dedicated mountain bike trails outstripped the supply, and the increasing numbers of walkers using the new trail started to encounter more and more mountain bikers. It was this narrow walking trail that spawned the initial concept for the Munda Biddi.

In 2000, CALM, other state government agencies and businesses combined with the fledgling Western Australian Mountain Bike Association to develop the concept further, aiming to build a long-distance off-road cycle touring trail. As the first stages of trail planning and construction began, the project became known as the Munda Biddi Trail,

Do it yourself

Where is it? The Munda Biddi starts in Mundaring and stretches 1,068 kilometres to Albany.

Camp sites Twelve camp sites are positioned along the way.

Ride yourself Different sections of the trail are ranked according to their difficulty and vary in length, from short day rides to several-week cycling adventures. Check out the 'Trip planning' tab at www.mundabiddi.org.au.

Get involved Volunteering and event participation is possible by contacting the Munda Biddi Trail Foundation.

Find out more Visit the Munda Biddi Trail Foundation website at www.mundabiddi.org.au.

which translates from the local Noongar language as 'path through the forest'. The Munda Biddi Trail Foundation was also born, a not-for-profit community organisation that assists the now Department of Parks and Wildlife to manage the trail.

FROM DREAM TO REALITY

The first major section of the trail was opened in 2004, stretching more than 300 kilometres between Mundaring and Collie. Further sections of trail were planned and built as funds became available. In 2009, in partnership with Munda Biddi Trail Foundation, the then Department of Environment and Conservation successfully made an application to the Royalties for Regions program for funds to complete the trail. The considerable funding changed the project's pace, with additional staff and contractors employed throughout the south-west, all working towards completing the trail within a challenging three-year timeframe.

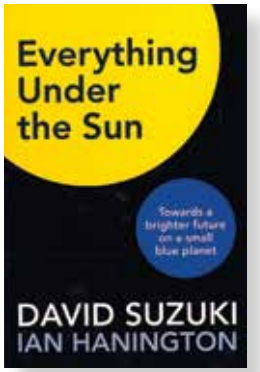
The department consulted with the community and stakeholders, planned alignments, sought approvals, and construction of the trail started. During the next few years, the trail began to unfold over the landscape, weaving its way through south-west towns and forests, farmland and wilderness, down to the spectacular southern coastline.

While the Epic 1000, or an end-to-end ride might not be your cup of tea, the Munda Biddi Trail offers a spectrum of different opportunities that cater to a range of people, be it a simple morning ride, a challenging expedition, or a chance to volunteer and help maintain the trail. Is there an opportunity waiting there for you?

Right Whether a short ride or an epic adventure, the Munda Biddi has options that suit a range of ages and abilities.
Photo – *Andrew McGregor*

Stuart Harrison is the Department of Parks and Wildlife's Recreation and Trails unit coordinator. He can be contacted on (08) 9334 0599 or by email (stuart.harrison@dpaw.wa.gov.au).

EVERYTHING UNDER THE SUN
Towards a brighter future on a small planet



"An invitation to join the most important conversation of our time." David Suzuki

Penned in his 75th year, *Everything Under The Sun* reads like a retrospective collection of the thoughts and conclusions David Suzuki has come to during his life. Written in a conversational style with personal and pop culture anecdotes thrown in, *Everything Under The Sun* covers a huge spectrum of topics, including extinction, making urban areas sustainable, energy sources, the challenges modern science is facing and, of course, climate change.

Suzuki keeps the tone of the book positive and says he aims not to provide all the answers to the world's environmental problems but to contribute to a dialogue on how they have been created and how they could be resolved. Fans of the renowned scientist's prolific work won't be disappointed—this is a book everyone should read.

Everything Under the Sun (ISBN: 978 1 74331 189 9) *was written with Ian Hannington and published by Allen & Unwin (www.allenandunwin.com). The 278-page soft-cover book is available for $29.99 from online retailers and local bookshops.*

EVERYTRAIL
Travel guide

EveryTrail (www.everytrail.com) is a free global travel website and smart phone app that offers access to millions of trails and guides created by users. One of the great benefits of the *EveryTrail* app is that wherever you are on holiday (provided you have internet access), you can search for guides and walking trails in your local area, and see photos the publisher has snapped along the way. DPaW has created a collection of guides that are free to download and there is an excellent series of guides for the Ningaloo Coast World Heritage Area, including 'Lakeside snorkel'. This guide provides a trail laid out on a Google Earth map, with points of interest marked out along the way and images of what to look for on the reef.

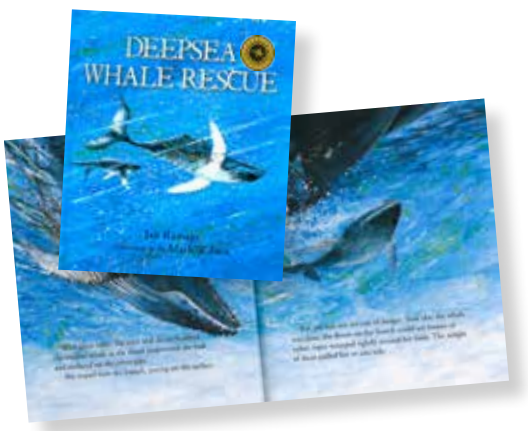
The free EveryTrail guide *is available for download from app stores.*

DEEPSEA WHALE RESCUE
Children's picture book

Based on a true account of a whale rescue off the Ningaloo coast, *Deepsea Whale Rescue* by Jan Ramage follows the story of a humpback whale and her calf. After a close escape from a pod of killer whales it becomes clear that the mother whale has another problem—she is entangled in nylon rope.

Deepsea Whale Rescue picked up the national Whitley Award for the best overall children's book in 2013 and offers a great Western Australian-based environmental story for kids. Mark Wilson's illustrations bring depth to the tale with rich textured brush strokes and deep blue hues of the ocean and mammals.

Published by the Department of Parks and Wildlife (DPaW), Deepsea Whale Rescue *is available in hardcover for $26.95 from the department's online bookshop at www.dpaw.wa.gov.au and from good bookshops.*



SHARING THE DREAMING
Cultural application

The DPaW's free *Sharing the Dreaming* application provides an informative introduction to the Noongar culture and language originating from Western Australia's south-west. It is simple to navigate, provides users with a great audio and visual experience, and features dreamtime stories that can be read or listened to, that will entertain and inform adults and children alike.

You can learn some Noongar words and their meanings and explore the guide to interpreting the symbols used in Noongar painting. It also covers the Noongar six seasons and where they fall in relation to the more standard calendar.

Sharing the Dreaming *was authored by Greg Richards and Les Hall for DPaW and is available for download from app stores.*


Perup

The woylie is in trouble, but a 423-hectare fenced enclosure at Perup is helping safeguard the native marsupial, which has experienced a staggering population decline in the wild. Woylies are now successfully breeding in Perup Sanctuary, providing new hope.

by Adrian Wayne

Sanctuary

INSURING WOYLIES AGAINST EXTINCTION

Previous page
Main Perup forest.
Photo – Marie Lochman
Inset left A juvenile woylie.
Inset right Department staff and volunteers line up to herd out kangaroos, wallabies and emus.
Photos – Adrian Wayne/DPaW

Above left A pair of woylies foraging for food.

Top A woylie carrying nest material.

Above A woylie nest.
Photos – Jiri Lochman

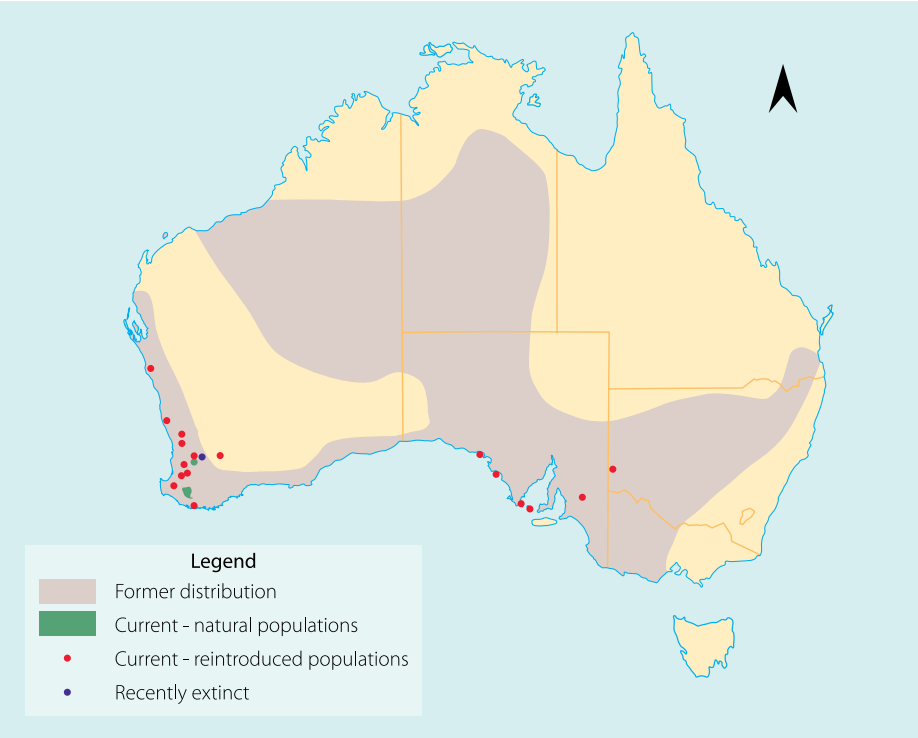
In 2010 the situation was dire: woylie (*Bettongia penicillata*), or brush-tailed bettong, populations had crashed by about 90 per cent in just seven years. In one of just three areas where natural woylie populations had persisted, Tutanning, the population was disappearing altogether. By 2011 it was gone. While scientists worked hard to determine the cause for the decline, something had to be done to protect the remaining populations. And it had to be done fast. Enter Perup Sanctuary. The then Department of Environment and Conservation (DEC) opened this 423-hectare predator-free enclosure in December 2010 to provide an 'insurance population' of woylies should the worst-case scenario happen: the total extinction of woylies in the wild. In just three years, Perup Sanctuary has experienced a 1,000 per cent return on investment as the insurance population grows from strength to strength. While buying valuable time to work out what had gone wrong in the woylie world, this population is now being used to help kick start the recovery of populations in the wild.

A POPULATION IN FLUX

Woylies once covered more than half of Australia but, due to land clearing and introduced predators, by the 1960s they were numbered in the hundreds, restricted to just three areas in south-west Western Australia—Dryandra, Tutanning and Upper Warren. By the 1970s some populations had started to increase in response to fox control and woylie translocations—a trend that escalated with the launch of the department's *Western Shield* fauna recovery campaign in 1996, which targeted foxes and resulted in more woylie translocations. Such was the success of this work that the woylie was de-listed from state and commonwealth threatened species lists in 1996—the first Australian species to be de-listed due to the success of conservation efforts. By 2000 there were about 200,000 woylies in the wild but the largest and most important woylie populations were starting to rapidly decline. Such was the extent of the decline that in 2008 the woylie was re-listed as critically endangered (see 'Down but not out: solving the mystery of the woylie population crash', *LANDSCOPE*, Winter 2008).

WHAT WENT WRONG?

Efforts are still underway to work out what caused the more recent population decline, which appears to be different to past decreases. By understanding the causes, conservation managers can directly target the problem to help conserve the species now and in the long term. So far it is clear that predation, particularly by feral cats (*Felis catus*) but also the European red fox (*Vulpes vulpes*), has had a major role in the recent decline of the woylie. But woylies also appear to have become more vulnerable to predation due to other critical factors, probably some form of disease yet to be verified. Evidence of this includes a strong pattern for the woylie decline in the Upper Warren over space and time, in which something, possibly a disease, is initiating the population crash at one point and then spreading out like a wave to impact neighbouring areas at a rate of about four kilometres a year. Characteristic changes in the demographics of the woylie population associated with the decline include a deterioration in skin and fur condition, elevated immune system responses and more woylies



"While scientists worked hard to determine the cause for the decline, something had to be done to protect the remaining populations. And it had to be done fast. Enter Perup Sanctuary."

were being infected with parasites and the parasitic infection levels were also higher.

BUILDING A SAFE-HAVEN

The 423-hectare Perup Sanctuary is located within Tone-Perup Nature Reserve, 40 kilometres from and between Manjimup and Boyup Brook. Work to build the enclosure began in 2009 with the construction of an 8.5-kilometre fully enclosed electric fence using 1,700 2.4-metre galvanised star pickets with 33 kilometres of netting and 52 kilometres of standard tensile wire.

In September 2010, before the four corners of the fence were closed, 180 volunteers and department staff mustered out the kangaroos, wallabies and emus by walking from one end of the sanctuary to the other (2.5 kilometres) and back again, in a coordinated line of people spaced 10 metres apart and spanning the full width (1.5 kilometres) of the sanctuary. This was necessary to prevent entrapping these wide-ranging species and avoid any potential future management problems, including a build-up of their numbers inside the sanctuary.

DPaW staff then had to ensure the enclosure was free from cats and foxes using a combination of targeted baiting, trapping, sand track surveys, remote sensor camera surveillance and active searches. The only two chuditch (*Dasyurus geoffroii*) trapped were also liberated from inside the sanctuary to immediately outside, because their home ranges are much bigger than the size of the sanctuary.

In early November 2010 the enclosure was complete and declared free from cats and foxes. Next began the task of translocating woylies to the safe-haven. In November and December 2010, 210 kilometres of transects across the Upper Warren region involving 1,050 trap points, each surveyed for four nights, resulted in 41 woylies (21 males and 20 females) being carefully selected to represent the genetic diversity across the Perup and Kingston populations. Thirteen additional woylies were also sourced from the Upper Warren to establish smaller captive colonies at Perth Zoo and Native Animal Rescue facility in Malaga.

The woylies in Perup Sanctuary survived in greater numbers in the first year after the translocation compared to woylies in the wild populations of the Upper Warren. Foxes and cats were responsible for most of the deaths outside Perup Sanctuary, whereas no predation was observed inside the sanctuary.

Monitoring in Perup Sanctuary by trapping has shown that at least 34 of the 41 original founders released by December 2010 were still alive in 2013. All adult female woylies captured have been breeding and one female has been repeatedly observed with twin pouch young, which is extremely rare. While woylie numbers have grown strongly in Perup Sanctuary, the capture rates of wild woylies in the Upper Warren have remained very low.

Recent research, led by Carlo Pacioni at Murdoch University, has shown that the genetic diversity of the remaining natural wild populations of woylies was still high at the time of the decline, and that the differences observed between these populations was the result of recent fragmentation due to modern human-induced land-clearing and habitat change. Historically, woylies throughout the southern half of Western Australia belonged to one large interconnected population. This genetic research has helped guide plans to help conserve the woylie population as a whole, rather than as separate populations in isolation. To increase the genetic diversity of the insurance population in Perup Sanctuary and thus better reflect the genetic diversity of the species as a whole, another 36 woylies (23 males, 13 females) from Dryandra were introduced to Perup Sanctuary in July 2013. The independent offspring from the last remaining six woylies from Tutanning, being bred in captivity at Kanyana Wildlife Rehabilitation Centre, also have been released into Perup Sanctuary; two in August and three in October 2013. More young woylies from Tutanning parents will be released as they become available. Remote sensor cameras and cage trapping will continue to monitor their progress in Perup Sanctuary.

WHAT HAVE WE GAINED?

The number of woylies in Perup Sanctuary has grown from an initial 41 to more than 400 woylies in the first three years. In the next couple of years the numbers could double again until the woylies reach their natural carrying capacity, at

Above A woylie in Perup Sanctuary.
Photo – Sallyanne Cousans

Right Perup woodlands.
Photo – Bron Anderson/DPaW

which time their numbers are expected to stabilise as they have done elsewhere such as at Karakamia Sanctuary (see 'Karakamia Sanctuary', *LANDSCOPE*, Summer 1997–98). The Perup colony will not only help conserve the woylies' genetic diversity to maximise its long-term prospects but it also provides a source for genetic augmentation of existing woylie populations and a source for translocations of woylies elsewhere, some of which have already occurred (see 'Kick starting wild population recovery, below).

In addition, the long-term and extensive monitoring involved in the program has provided an unrivalled resource for conservation managers and researchers. It indicates that, having declined by 95 per cent, woylie numbers in the Upper Warren have remained low but relatively stable since 2006. Subregional patterns are also evident. There are no signs yet of a population recovery in central Perup (including no woylies found in Yackelup since 2005), but potentially the beginnings of a modest recovery in southern Perup. There appears to be some recovery in northern Perup and, in Greater Kingston where the declines first began, the first and only substantial recovery was recorded. However, this recovery did not last, with the population later declining to new record lows.

The monitoring currently provides some of the strongest evidence available for and against the possible causes of the woylie decline and the barriers to a recovery. It represents an excellent resource to provide wildlife conservation managers with up-to-date information on population changes and potential issues. For instance, the monitoring has revealed that a drop in the breeding rates of female woylies coincides with the start of declines. Also, samples collected from woylies during the monitoring and examined by expert and student collaborators at universities and other institutions have helped to narrow the possible suspects at play in the declines. They have resulted in many discoveries new to science including new parasites, viruses, bacteria, a tick and several new native truffle (fungi) species.

KICK STARTING WILD POPULATION RECOVERY

Eighty-seven woylies (51 males and 36 females) were translocated from Perup Sanctuary to nearby Yendicup in July 2013. The translocation area was subject to weekly ground-based fox baiting for three months, beginning just before the release

Where to see woylies

You may see woylies in the Perup region by staying at Perup-Nature's Guesthouse in the heart of Tone-Perup Nature Reserve. Choose from a range of accommodation types and set out on one of the many walk trails at night with a spotlight in hand for a chance to observe woylies and other native animals in their natural habitat. For more information contact the Department of Parks and Wildlife's Donnelly District office on (08) 9776 1207 or email donnelly.district@dpaw.wa.gov.au.

You can also see woylies at Barna Mia animal sanctuary at Dryandra Woodland and Karakamia Sanctuary in Chidlow.

Top The 2013 monitoring team at Perup Sanctuary.

Above Releasing a woylie.
Photos – Adrian Wayne/DPaW

A collaborative effort

Many collaborations and partnerships have been involved with the woylie conservation actions in Perup Sanctuary and the Upper Warren region, most involving student projects and experts at Murdoch University, Perth Zoo and The University of Western Australia. Much of this work is focused on better understanding the nature of the woylie declines, the possible causes of these declines and the ecology and biology of the woylie relevant to its conservation and, in some cases, native wildlife more broadly.

Warren Catchments Council (WCC) has been a key partner, particularly in helping with invasive species control, woylie and predator monitoring and involving the community. Volunteers have also been a substantial and critical component to the successes of this project. The Caring for our Country federal government-funded components of this project alone, led by WCC, involved 159 individuals contributing an average 6.2 days each—a total of 984 days and 9,889 volunteer hours, worth at least $250,000 of labour. These calculations do not include the involvement of Bush Ranger cadets, primary, secondary and university student experiences, landholder involvement in vertebrate pest animal control, volunteers assisting at public information display booths at public events or the work of wildlife rehabilitators looking after orphaned young such as Leslie Harrison and Maroo Wildlife Refuge.

The Department of Parks and Wildlife and its predecessors, WA State NRM, the Caring for our Country federal government program and the Perth Zoo funded the establishment of the Perup Sanctuary. Other aspects of woylie conservation and research efforts have been funded by the Australian Research Council, South West Catchments Council, Wildlife Conservation Action, Australian Academy of Science, South Coast NRM, World Wildlife Fund, and the Environment Division of the United Nations Association of Australia (WA) Incorporated. Other collaborators include Kanyana Wildlife Rehabilitation Centre, Whiteman Park, Australian Wildlife Conservancy, South Australian Government Department of Environment, Water and Natural Resources, and the University of Adelaide.

of woylies into the area. Monitoring using 50 remote sensor cameras within a three-kilometre radius of the centre of the release site occurred for four months and follow-up monitoring by trapping continues. Early results indicate that many of the translocated woylies are doing well and the capture of many new individuals indicates that their numbers are growing significantly.

Provided the key threats to woylie populations can be reliably identified and managed, from now on Perup Sanctuary can provide a source of up to hundreds of woylies a year to help enrich the genetics and kick start the recovery of other existing woylie populations, establish new woylie populations and perhaps create other insurance populations across Australia if needed.

BIGGER PICTURE

As well as providing unrivalled data on woylie populations, the work at Perup Sanctuary has revealed much information about other species that occur there. Surveys indicate that at least 13 mammal, 19 reptile and 10 frog species are found in and immediately adjacent to Perup Sanctuary. The sanctuary provides refuge for many of these species that are also vulnerable to introduced predators. Ongoing monitoring inside Perup Sanctuary, in conjunction with monitoring at comparative sites on the outside, will help to understand what other effects a predator-free enclosure may have on the plants, animals and ecosystems within.

The strong increase in woylie numbers in Perup Sanctuary provides an opportunity to measure their actual breeding potential and survival in the absence of introduced predators, which helps population modelling—an important tool for managing the conservation and recovery of populations. It also demonstrates that, given a chance, woylies have an enormous capacity to recover strongly and that foxes and cats are likely to play a critical role in limiting the recovery of populations in the wild. Close monitoring of the numbers and health of the woylies will also help efforts to understand the possible roles of disease.

The monitoring and associated research across the Upper Warren region also provides insights into the biology and ecology of several other native mammal species. For example, we now have a clearer understanding of broader and recent patterns of population changes in other animals including similar rates and magnitudes of decline that occurred before the woylie, including the wambenger, or brush-tailed phascogale (*Phascogale tapoatafa* ssp. WAM M434); dunnarts (*Sminthopsis* spp.); quenda, or southern brown bandicoot (*Isoodon obesulus fusciventer*); and ngwayir or western ringtail possum (*Pseudocheirus occidentalis*); and the subsequent substantial increases in koomal, or common brushtail possum (*Trichosurus vulpecula hypoleucus*) and chuditch.

Adrian Wayne is the Department of Parks and Wildlife (DPaW's) forest fauna ecology research scientist. Based in Manjimup, he researches the ecology of forest vertebrate fauna (frogs, reptiles and mammals), focusing on work relevant to the conservation and management of threatened species and fauna responses to management activities such as timber harvesting, fox control and prescribed burning. He can be contacted on (08) 9771 7985 or by email (adrian.wayne@dpaw.wa.gov.au).

The whale shark is Western Australia's new marine faunal emblem.

by Dani Rob

GENTLE **GIANTS**

Officially an icon

On 12 November 2013 the state government named the whale shark (*Rhincodon typus*) as Western Australia's new marine faunal emblem. The whale shark was chosen following a statewide competition between primary schools that encouraged students to nominate their preferred marine emblem, and learn more about the field of marine science. The whale shark will join the red and green kangaroo paw (floral emblem), the black swan (faunal bird emblem), the numbat (faunal terrestrial emblem) and the gogo fish (fossil emblem).

Ningaloo Marine Park is an excellent location to view these magnificent animals, typically from mid-March to early August each year, generating a world-class ecotourism industry.

GIANTS OF THE DEEP

The world's largest fish—the whale shark—grows 15 to 18 metres long and visits Ningaloo in large numbers to feed on zooplankton and phytoplankton blooms caused by the annual coral spawn. This event usually occurs seven to 10 days after the full moons in March and April. The reef comes alive during this time and the whole food chain is affected; coral spawns lead to plankton blooms, which attract birds as well as schools of baitfish, tuna and whale sharks. Whale shark diets can vary across the world, but at Ningaloo their preferred food is tropical krill (*Pseudeuphausia latifrons*), copepods and other zooplankton such as gastropod larvae.

Passive feeding is where the shark cruises through the water with its mouth slightly agape, relying on the forward motion to pass water through its gills. Plankton is collected on gill rakers before being funnelled down into the stomach. Active feeding involves the shark pumping high volumes of water through its gills at speed, often gulping, causing the gills to flair out. The shark employs a suction filter-feeding method where it draws water into its mouth and can often open its mouth to a width greater than one metre while doing this. Vertical feeding is where the shark hangs vertically in the water and feeds by sucking in prey-rich water.

Although whale sharks can grow to 18 metres, those at Ningaloo are generally between three and 12 metres with the average length being 5.5 metres. About 80 to 85 per cent of the whale sharks that visit Ningaloo are juvenile males.

STILL A MYSTERY

There is still plenty to learn about whale sharks, with many questions to be answered about where and how they mate, birthing numbers and areas, as well as population size and migration patterns.

Researchers have been tagging whale sharks for many years and are refining their methods and equipment. By deploying a combination of acoustic, archival and satellite tags, researchers hope to track whale shark migrations and discover information about shark movements. More summer sightings

Previous page
Main The majestic whale shark.
Photo – Hayley Versace/OceanwideImages.com
Inset A painting of the state marine faunal emblem by DPaW's Gooitzen van der Meer.

Below Photos of the left-hand side of a whale shark can help researchers profile individuals.
Photo – Axel Passeck

How you can help

Whale sharks have a unique pattern of spots and stripes, much like our human fingerprint. This pattern can be used to identify individuals and track their movements. To help us identify them you can submit photos of the left hand side of the shark (including the gill slits and pectoral fin) online at www.whaleshark.org.

One of the threats to whale sharks is boat strike and injuries caused by propellers. DPaW encourages skippers to become familiar with the whale shark vessel and swimmer codes of conduct, available on the DPaW website (www.dpaw.wa.gov.au). You can also help by reducing the speed of your boat in marine parks, and keeping a lookout for these most gentle of giants.

To report statewide whale shark sightings, contact DPaW's whale shark conservation officer Dani Rob. Dani can be contacted on (08)9947 8006 or by email (whaleshark@dpaw.wa.gov.au).

"The world's largest fish —the whale shark—grows 15 to 18 metres long and visits Ningaloo in large numbers to feed on zooplankton and phytoplankton blooms caused by the annual coral spawn..."

are being reported, posing yet another question—are whale sharks possibly at Ningaloo all year round?

CONSERVING THE SPECIES

The whale shark is a protected species within all Western Australian state waters. They have recently been listed as 'other specially protected fauna' under the *Wildlife Conservation Act 1950*. Nationally, they are listed as 'vulnerable' under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*, and internationally they have been recognised as 'vulnerable' on the International Union for the Conservation of Nature's 'Red List', which means they have declining populations worldwide and a threat of extinction in the medium-term future.

The Department of Parks and Wildlife (DPaW) has recently completed an updated whale shark management program, which outlines the direction the department will take for the next 10 years to work to conserve the species. The plan outlines management, research, monitoring techniques and education strategies needed to ensure that whale sharks continue to visit Ningaloo now and into the future.

Right Snorkellers are required to stay three metres away from the whale shark's body and four metres from its tail.
Photo – Cameron Skirving

Below Whale shark from below.
Photo – Axel Passeck

Dani Rob is the Department of Parks and Wildlife's whale shark conservation officer based out of the Exmouth District Office. She can be contacted on (08) 9947 8006 or by email (whaleshark@dpaw.wa.gov.au).

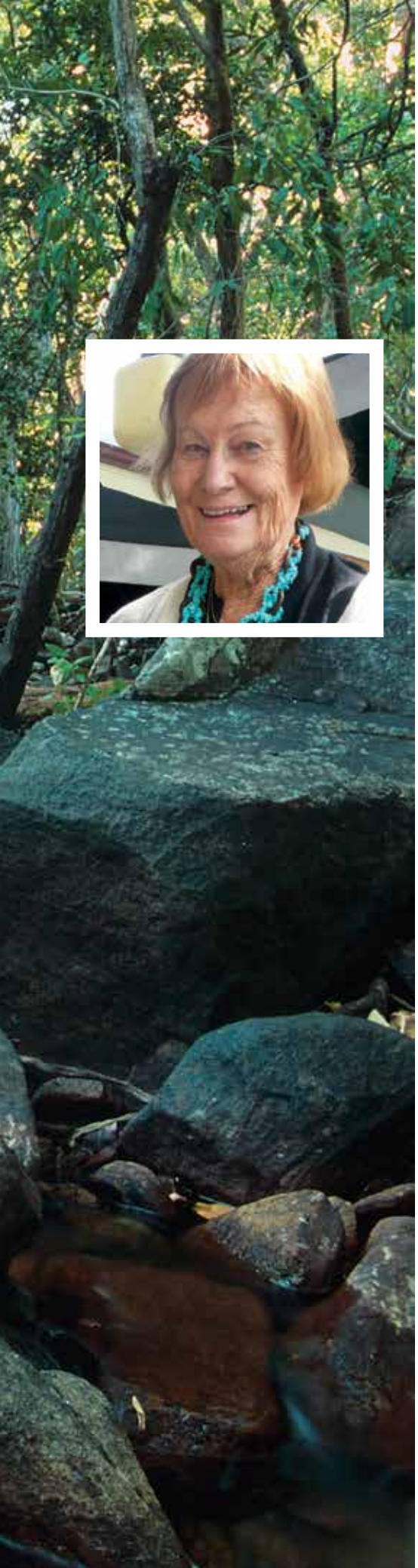
Picturing an icon

DPaW senior graphic designer and *LANDSCOPE* veteran Gooitzen van der Meer was charged with the task of painting the whale shark for use as the state's official emblem. Gooitzen used water colours to achieve the whale shark's intricate spots and stripes and the look of water shimmering on the fish's body.

"The key was getting the light and shading correct to show that the whale shark was underwater, with light streaming in from above," he said.

Right Gooitzen van der Meer at work on the painting.
Photo – Emma van der Meer

Below The whale shark joins the other WA emblems—numbat, red and green kangaroo paw, black swan and the gogo fish.



Pat Barblett AM

by Samille Mitchell and Tracy Shea

This remarkably energetic woman has dedicated a lifetime's work as a volunteer to advocating the benefits of 'parks for people'. She firmly believes that both can benefit from mutual interaction.

Pat Barblett is sitting on a rock, near a gorge in Millstream-Chichester National Park, talking to an Aboriginal elder about country. The woman is sharing her deep connection to the land here, weaving tales of her totems, whispers of her spiritual beliefs. Pat leans forward to take in her words, struggling to hear against the scream of hundreds of white cockatoos squabbling in the treetops nearby. Pat feels alive, at one with the world and utterly privileged to be in this magical place learning its secrets from one of the elders who guard over it. For Pat, this is what life is all about—being amid nature, sharing stories and nurturing the soul's desire for connection, both with people and the land.

It's a scene that reflects Pat's life's calling. For Pat has dedicated her life to promoting 'interpretation' to help visitors learn the stories of the places they are visiting, while also advocating the 'healthy parks, healthy people' message. And despite the level of dedication, Pat simply thrived on following her passion.

"People need natural places, particularly today," she says. "It's a different world with people spending their days in front of computers or TV screens. We're losing our spiritual connection with nature, but we need it to sustain our life and soul. And parks need us too. Once we learn a park's stories, people realise how valuable they are and we need good management to help people spend time in parks without damaging them."

Providing guidance on such management became Pat's career, albeit an unpaid one. Her work spans decades, first on the Rottnest Island Board, which later became the Rottnest Island Authority, then with the National Parks and Nature Conservation Authority, which later became the Conservation Commission of Western Australia. Pat also dedicated time to the Forum Advocating Cultural Eco Tourism, not to mention various others.

Main The rainforests of Mitchell River National Park are just some of the areas protected by the management planning process that Pat was involved in streamlining.
Photo – Jiri Lochman

Inset Pat Barblett.
Photo – Courtesy of Pat Barblett

THE BEGINNINGS

But it wasn't always this way. Born and raised in Melbourne, Pat first came to Western Australia as part of a netball team trip. Fresh out of university, where she'd studied physical education, she noticed an advertisement for a job as a physical education teacher at St Hilda's Anglican College, applied for the job on a whim, got it and moved west.

Later, married and in the midst of rearing five children, she found "study fitted in with her lifestyle" and embarked on further education, eventually adding a Graduate Diploma of Recreation, Post Graduate Diploma of Public History, Diploma of Environmental Interpretation, Diploma of Photography and Certificate of Archival Administration to her existing Bachelor of Education and Diploma of Physical Education qualifications. Oh yes, and she's part way through a research degree in Master of Arts in History too.

It was while studying for her Graduate Diploma of Recreation that she had her first significant contact with government. A former minister seeking to have more women on government boards had heard of Pat through written university work on Rottnest. The minister asked if she could put Pat's name forward for a position on the Rottnest Island Board and, much to Pat's surprise, she was appointed as the first woman to the board. "I think at first they didn't know what to do with me to be quite honest," she says.

Pat used the position to champion what was then an unheard of tool in recreational management in WA—interpretation. She could see the way that informative signs and other interpretive methods could enhance a visitor's experience of a place, how they could reveal the secrets of an area's past or its natural wonders. Interpretation could bring even the seemingly dullest area to life when people learned of its relevance.

During Pat's 17 years on the Rottnest Island Board and Authority, including the last three as chair, she founded the Rottnest Island Voluntary Guides (and is now their patron), the Rottnest Island Museum and transformed the Kingstown Barracks into an environmental education centre for school groups and teachers. Her work also provided experience in managing recreational areas, which stood her in great stead for her next role on the National Parks and Nature Conservation Authority, predecessor to the Conservation Commission of WA. Integral to the authority's work was the development of management plans to guide how natural areas, particularly national parks, would be managed—a balancing act of conserving the environment, providing recreation and protecting cultural and historical sites.

And this is where Pat hit her stride.

Above left Pat examining the Rabbit Proof Fence.
Photo – Conservation Commission of WA

Above Receiving the Sir David Brand Medal in 2003 from Lady Brand.

Right The Rottnest Island Authority honoured Pat by naming a cabin after her in the Thomson Bay settlement.
Photos – Courtesy of Pat Barblett

Above Pat (far right) on a Conservation Commission of WA field trip in 2008.
Photo – Conservation Commission of WA

"I've been fortunate to see so much of the state in such a special way... I've made so many friends and been very privileged."

A PASSION FOUND

What followed was a whirlwind of travel, debate, planning and policy development. Pat became renowned for rolling up her sleeves, cutting through the red tape and getting the job done. Long-time associate and Department of Parks and Wildlife assistant director for policy and planning Tracy Shea says Pat is an inspiration.

"Pat has passion, innovation, is very practical and likes to see results," Tracy says. "She is able to cut through unnecessary detail and has led a process in recent years to simplify and streamline the management planning process. Even after going to so many meetings over the years she is still as passionate as ever. Passion like that is a very rare thing."

Pat's work on management plans took her to every corner of the state—from the pockets of rainforest in the Kimberley's Mitchell Plateau, to the woodlands of the Goldfields and the tree-cloaked expanses of the south. "I've been fortunate to see so much of the state in such a special way," she says. "I've made so many friends and been very privileged."

Such travel also put her in contact with many Aboriginal people. "Their connection to the land is something that is part of them," she says. "We can learn so much about land management from them. To me it made sense that they be involved in the management planning process." And Pat worked to make that happen. In particular, she was an enthusiastic supporter of the Yoorrooyang Dawang proposed conservation park's draft management plan, which is part of the Miriuwung and Gajerrong people's country.

Another major management plan that Pat worked on was for the Leeuwin-Naturaliste capes area, both as a member of the Conservation Commission and as an observer on the Capes Community Advisory Committee. Her local knowledge and contacts in the community enabled her to make an invaluable contribution to the plan.

In addition to this work, Pat strove to raise awareness of the state's conservation estate through her work with the Conservation Commission. Tracy says Pat's selfless dedication to the job was astounding. "Her passion for promoting sustainable tourism and the value of a healthy parks system to community health has shone through in every position she has held, and has inspired so many people," Tracy says.

"Pat has an amazing ability to connect people and make things happen, and has been a mentor to so many people in government and the tourism industry. She works tirelessly to promote parks and the community's connection to them. She has made a huge contribution to the parks industry during her lifetime".

PROMOTER OF CULTURAL TOURISM

Through her work on Rottnest Island and with the National Parks and Nature Conservation Authority, Pat became committed to the idea of cultural heritage tourism and, at a conference on the subject, realised that many people were working in the area in isolation. She founded the Forum Advocating Cultural and Eco Tourism (FACET) to help bring them together. What began as an informal gathering has grown to become a major player in Western Australian tourism development today, 22 years later.

After 17 years with the Conservation Commission of Western Australia, Pat resigned but her workload has barely lessened. She continues to be an advocate for Aboriginal heritage and culture through FACET and any other way she can.

Pat also founded the Rottnest Foundation in 1993 to raise money for improvements to the island. The foundation's current focus is raising funds for a walk trail around the island. It is also working on providing recognition of an Aboriginal burial ground on the island that is home to 400 unmarked graves.

Pat also serves on the board of the WA Maritime Museum. Such dedication earned her a Sir David Brand Medal in 2003, a Western Australian Tourism Award in 2003, a Member of the Order of Australia, AM, in 2004, a Prime Minister's Medal in 2004, the Sir Edmund Hillary Parks Award in 2012 and the inaugural FACET Medal in 2012.

How does she maintain the enthusiasm after all this time? "I love what I'm doing," she says. "I think something guides me. I go from one thing to the next and it all just opens up before me. I love it. I just love it. I'm so grateful to have been given the opportunity."

Above Pat founded the Rottnest Foundation to raise money and advocate for improvements to the island.
Photo – Marie Lochman

Below Pat (third from the left) with members of the Conservation Commission of WA at Mount Meharry in Karijini National Park in 2005.
Photo – Conservation Commission of WA

Samille Mitchell was a Department of Parks and Wildlife (DPaW) features writer and editor at the time of writing this article. She can be contacted on 0407 998 721 or by email (samille@wn.com.au).

Tracy Shea is an assistant director in the Parks and Visitor Services Division of DPaW driving policy and planning, as well as partnerships in cultural and nature-based tourism and Aboriginal heritage programs. Tracy is also an executive member of FACET. She can be contacted on (08) 9219 8755 or by email (tracy.shea@dpaw.wa.gov.au).

People in profile *is one of* LANDSCOPE'S *many regular features. It profiles eminent and interesting people who play a role in conservation.*

Cochlospermum macnamarae

When the first specimens of an interesting and usual plant turned up at the Western Australian Herbarium in late 2012, it created considerable excitement among the botanists. The specimens were clearly of a species of kapok (*Cochlospermum*)—a distinctive genus of small trees characteristic of areas in northern Australia, from the Kimberley to Cape York, with distinct wet and dry seasons. Kapoks are spectacular in their flowering habits—they lose all their leaves during the dry season, then flower gloriously on bare stems before the arrival of the first wet-season rains. Their flowers are very beautiful, large and golden yellow, often with a contrasting centre of red stamens.

But the new specimens came from a very odd place—a dry, semi-arid granite ridge in the Pilbara, south of Port Hedland, nearly a thousand kilometres from the only other *Cochlospermum* known from Western Australia, a species thought to be restricted to the Kimberley. Close study of the specimens and comparison with all other Australian species of *Cochlospermum* showed that it was a new and remarkable species.

One of the many great things about discovering and then naming a new species is the opportunity to choose a suitable name. Under international rules for naming organisms, the name must be formed from Latin or latinised words. Within that constraint, a taxonomist tries to choose a name that is euphonious, appropriate and relevant. By convention, names either describe some distinctive feature of the new species or honour a significant individual who is either associated with the new species in some way or is worthy of honour for other reasons. Naming after an individual gives taxonomists a unique way of acknowledging people who have made significant contributions to science, conservation or taxonomy.

In this case, it was decided to name the new species in honour of Keiran McNamara, then Director General of the Department of Environment and Conservation. Keiran was a very appropriate recipient of such an honour—he had provided funding to the herbarium over the previous decade that had resulted directly or indirectly in the discovery, study, naming and description of more than 150 new Western Australian plant species. Few other government officers can claim such a direct impact on taxonomy, and of course discovering and naming a new species has a direct impact on its conservation.

"Close study of the specimens and comparison with all other Australian species of *Cochlospermum* showed that it was a new and remarkable species."

The new species was named *Cochlospermum macnamarae* in record time, less than 18 months after its first discovery. Sadly Keiran passed away after a brief illness a few days after the species was formally named. His legacy is many-faceted, ranging from an inspiring network of nature reserves and national parks throughout WA to a world-class system for protecting all Western Australia's natural areas and native species. And one rare, fascinating and very beautiful plant in the Pilbara quietly bears his name and honours his achievements.

Above *Cochlospermum macnamarae* in full flower.
Photo – Daniel Brassington

Discovered is a regular series prepared by scientists at the Western Australian Museum (Department of Culture and the Arts) and Western Australian Herbarium (Department of Parks and Wildlife). Each article highlights new and noteworthy discoveries of plants and animals in Western Australia, and offer insights into the work of the scientists whose jobs involve discovering, naming and describing Western Australia's marvellous living riches.

Home of the Gorgon Project off the state's northwest, Western Australia's second largest island is also recognised as one of the most important areas for native fauna conservation in Australia. The first management plan has been released for Barrow Island Nature Reserve, and for the nearby Boodie, Double and Middle Islands Nature Reserve, which together comprise the Barrow group nature reserves.

MY ISLAND HOME

Barrow Island

by Michelle Rumball, Joanna Adele, Kim Onton and Paul Connolly

Barrow Island lies approximately 1,250 kilometres north of Perth and 56 kilometres west of the mainland, between Onslow and Dampier. The island was first gazetted in 1908 as a Class 'C' reserve and upgraded to Class 'A' in 1910 in recognition of the need to protect the island's unique plants and animals. In 1979 the 23,483-hectare island was classified as a nature reserve, set aside for the purpose of 'conservation of flora and fauna'.

The island has been host to petroleum and gas extraction operations since 1967 and, in 2009, construction of the Gorgon Project started (see 'Giant steps: industry and conservation make history through Gorgon', *LANDSCOPE*, Winter 2010). Chevron Australia is the operator of all petroleum operations on Barrow Island. The Department of Parks and Wildlife (DPaW), which has staff based on Barrow Island on a fly-in, fly-out roster, works closely with Chevron Australia and other government agencies to ensure the island's unique environment is protected and conserved.

Barrow's neighbouring islands, Boodie and Middle to the south, and Double to the east, cover 586.7 hectares in total. They were gazetted as a nature reserve in 1984 and, together with Barrow Island, are referred to as the Barrow group nature reserves.

LANDSCAPE FEATURES

The landscapes of the Barrow group nature reserves are characterised by spinifex grasslands dotted with large brown termite mounds, limestone coastal cliffs and caves, dry creek beds, white dunes and sandy beaches, mangroves, claypans and intertidal flats. The flora of Barrow Island Nature Reserve is, for the most part, typical of the nearby Pilbara and Carnarvon bioregions. Some 377 known flora species occur on the reserves, dominated by families such as Poaceae (grasses), Chenopodiaceae (goosefoots), Fabaceae (legumes, peas and wattles), Malvaceae (mallows) and Asteraceae (daisies) and in particular by the genera *Triodia* (hummock grasses) and *Acacia* (wattles).

The nature reserves contain several plant species of conservation significance, including the endemic species *Cucumis* sp. Barrow Island, and 12 species that have a restricted distribution in the area and are at, or near, the geographical limits of their range. *Cucumis* sp. Barrow Island, *Helichrysum oligochaetum* and *Corchorus congener* are also listed as priority species (meaning they are poorly known, could be rare or near threatened but are in need of further survey work, or in need of monitoring). Additionally, tangling melaleuca (*Melaleuca cardiophylla*) is important because it is one of the key habitat types for restricted fauna species, including the Barrow Island population of the conservation-significant black and white fairy-wren (*Malurus leucopterus edouardi*). Two plant communities are listed as priority ecological communities in recognition of their significance.

The Barrow group nature reserves extend to the low water mark, and include the intertidal zone. This zone is rich with macroalgae, interspersed with seagrass meadows, both of which provide a food source for green turtles (*Chelonia mydas*), as well as shelter and food for a large variety of benthic species (animals and plants which live on the sea floor). These benthic species, in turn, are a food source for other marine turtle species such as the flatback (*Natator depressus*) and hawksbill (*Eretmochelys imbricata*), and both resident and migratory shorebirds.

ISLAND REFUGE

Due to their geographic isolation and the absence or scarcity of established non-indigenous species, the Barrow group nature reserves are an important refuge for many species that have either declined in number or become extinct on the mainland. The array of conservation-significant fauna species and populations includes species that are threatened, listed as priority species, endemic, short-range endemic, relictual (characteristic

Previous page
Main Obe's Beach, Barrow Island.
Photo – Marie Lochman

Left Mangroves (*Avicennia marina*) in Bandicoot Bay Conservation Area.
Photo – Michelle Rumball/DPaW

"... the Barrow group nature reserves are an important refuge for many species that have either declined in number or become extinct on the mainland."

of an earlier period in evolutionary or ecological history) or disjunct (geographically separated from other population occurrences of that species). These species include the black-footed rock-wallaby (*Petrogale lateralis lateralis*) and populations of the Barrow Island boodie (*Bettongia lesueur* ssp.), Barrow Island spectacled hare-wallaby (*Lagorchestes conspicillatus conspicillatus*), Barrow Island euro (*Macropus robustus isabellinus*) and Barrow Island golden bandicoot (*Isoodon auratus barrowensis*). There are 23 threatened fauna species known to occur in the reserves.

Barrow Island's significance as a fauna refuge provides an important reservoir from which founder populations can be sourced for fauna reconstruction programs on other islands and the mainland. For example, a number of species have been translocated by DPaW from the island to Lorna Glen—a former pastoral station and proposed conservation park in WA's rangelands. Translocations of golden bandicoots and boodies from Barrow Island to Lorna Glen occurred in 2010 and 2011 as part of the department's *Operation Rangelands Restoration*, one of the world's largest wildlife reconstruction programs (see also 'Going nuts for boodies' on page 37 and 'Into the wild: restoring rangelands fauna', *LANDSCOPE*, Winter 2009). Golden bandicoots, spectacled hare-wallabies, boodies, black and white fairy-wrens and spinifex birds were also moved to Hermite and Alpha islands in the nearby Montebello Islands group as part of the *Montebello Renewal* project (see 'Montebello Renewal', *LANDSCOPE*, Summer 1996-97).

Above The Barrow group nature reserves provide a haven for Barrow Island euros.
Photo – Jiri Lochman

Right Barrow Island boodies are endemic to Barrow and Boodie islands.
Photo – Marie Lochman

Below right Bat's wing coral tree (*Erythrina vespertilio*) has a restricted distribution on Barrow Island Nature Reserve.
Photo – Kevin Crane/DPaW

Above Flatback turtles are hatched in rookery sites on the Barrow group nature reserves.
Photo – Kevin Crane/DPaW

Left Marine turtle tracks can be seen on nesting beaches.
Photo – Michelle Rumball/DPaW

Thirteen mammal species, 43 terrestrial reptile species, one species of frog, four species of marine turtle and three subterranean vertebrate species have been recorded on Barrow Island Nature Reserve. More than 2,000 taxa of invertebrates, including 34 subterranean invertebrates, have also been recorded on the island. An unknown diversity of fish and marine invertebrates inhabit intertidal areas. The reserves are also home to 119 migratory and resident bird species.

TURTLES AND BIRDS

The sandy beaches of the Barrow group nature reserves are important rookery sites for marine turtles, particularly green and flatback females that arrive early each summer to undertake the arduous process of nesting. Intertidal habitats are important for nesting female turtles, as well as for foraging juveniles, and some resident adults. It is thought that the Barrow group nature reserves provide habitat critical to the survival of these species. These reserves are close to the south-west limit for nesting flatbacks. Hawksbill turtles are also regular visitors to the reserves for nesting, with loggerhead turtles (*Caretta caretta*) visiting and nesting occasionally.

Thousands of shorebirds also inhabit the islands, with these coastlines recognised for their regional, national and international significance to shorebirds, including migratory birds that both use the area as a staging site (where they feed and rest along their epic flights) and a destination (where they spend most of their non-breeding season). In particular, Barrow Island Nature Reserve is designated as an Important Bird Area by Birdlife International because of its importance to shorebirds. It is equal tenth among the 147 important sites for seven species of migratory shorebird in Australia, and is the fourth and fifth most important site in Australia for the ruddy turnstone (*Arenaria interprens*) and grey-tailed tattler (*Tringa brevipes*) respectively.

Tidal mudflats are a feature of the southern parts of Barrow Island Nature Reserve, providing habitat and feeding sites for many shorebirds. The mudflat habitat of Bandicoot Bay in the south of the reserve supports many of these bird species and, in recognition of this, has been designated a conservation area for benthic fauna and seabird protection within the Barrow Island Marine Management Area. The nature reserve is also regionally significant for the threatened fairy tern (*Sterna nereis*) and the resident sooty oystercatcher (*Haematopus fuliginosus opthalmicus*). Double Island is considered a regionally significant site for breeding wedge-tailed shearwaters (*Ardenna pacificus*). Other species such as the bridled

Right Ruddy turnstones are species of shorebird that frequents Barrow Island Nature Reserve. *Photo – Rob Drummond/Lochman Transparencies*

tern (*Onychoprion anaethetus*) and white-bellied sea eagle (*Haliaeetus leucogaster*) also breed on the reserves. In total, the Barrow group nature reserves provide habitat to 68 bird species protected under the Commonwealth Environment Protection and Biodiversity Conservation Act, which include 40 species listed under international agreements and two threatened species.

MYSTERIES DISCOVERED UNDERGROUND

Barrow Island Nature Reserve is well recognised for its important, species-rich subterranean collection of creatures. It contains a priority ecological community known as 'Barrow Island subterranean fauna', which includes threatened and priority species as well as several species previously undescribed, not known from other locations, or only known from one or two specimens.

Particularly special are the three known subterranean vertebrate species, including a blind snake, which is the first truly troglobitic reptile to be described globally. This species was discovered from an oil well casing on the island. It lacks pigment, has very reduced eyes and an extremely long and slender worm-like morphology. Underground waters are also home to a species of eel, likely to belong to the genus *Ophisternon* (also known from Cape Range and from near Pannawonica), which has been observed, but no specimen so far retained. These intriguing species are all restricted, or likely to be restricted, to the Barrow group nature reserves. Much more remains to be discovered about these strange creatures and their environments in the future.

What's in a name?

'Troglobitic' refers to terrestrial species that live entirely underground in air-filled caves, cavities or interstices in the karst above the watertable. 'Stygobitic' refers to aquatic species that live entirely in water-filled cavities and interstices in the karst, which include the blind gudgeon (*Milyeringa justitia*), a small, pale, eyeless fish that is similar to *Milyeringa veritas* from Cape Range.

"Barrow Island Nature Reserve is well recognised for its important, species-rich subterranean collection of creatures."

It is thought that subterranean ecosystems on Barrow Island Nature Reserve may be at least partially dependent on food chains based upon chemoautotrophic bacterial systems that metabolise naturally occurring petroleum chemical products rising upward from the hydrocarbon reserves far below. The bacteria which support this food chain may be considered a keystone species.

Above ground, termite mounds are a distinct feature of Barrow Island Nature Reserve, rising like pinnacles from the arid landscape. Much more than just homes to small insects, they make a significant contribution to ecological processes by providing habitat and a food resource for other species (including many vertebrates such as Stimson's python (*Antaresia stimsoni*)), as well as mobilising nutrients within the ecosystem (see 'Termite mounds: more than just termites', *LANDSCOPE*, Spring 2013).

HISTORICAL SIGNIFICANCE

Barrow Island Nature Reserve has a significant fossil record, including the remains of many species that are now locally extinct. It also has a significant pre-historic human record, with many Aboriginal cultural heritage sites including artefacts discovered from when Aboriginal people were held on the island against their will by pearlers. While the Barrow group nature reserves are not claimed under native title, Aboriginal groups have expressed an interest in the heritage of the islands. Indigenous and colonial heritage on Barrow Island are the subject of a major Australian Research Council-funded program being led by The University of Western Australia.

The reserves and their surrounds have a long history rich with exploration, whaling, barracoon and slave markets, pearling, turtle hunting, fishing, oil and gas extraction, and nature conservation, with interests in quarantine, pastoralism and phosphate mining.

Barrow Island was the site of some major pearling camps in the late 1800s. There is also considerable data established from long-term ecological research since the early 1900s, and particularly since the mid-1960s, when petroleum exploration and operations first started. This information has informed present-day management planning and practices for the area.

CAREFUL MANAGEMENT REQUIRED

The many and varied values of the Barrow group nature reserves mean good management of the reserves is critical to their conservation. One of the major

Above left DPaW staff discuss rehabilitation of a site on Barrow Island Nature Reserve.
Photo – Wesley Manson/DPaW

Above Ecosystem rehabilitation is already progressing over some cleared and unused areas of Barrow Island Nature Reserve.
Photo – Michelle Rumball/DPaW

threats to biodiversity is the introduction of non-indigenous species, such as weeds and non-native animals including rodents, ants, geckoes and frogs. Non-indigenous species can be introduced in a number of ways, including via floating debris, birds, strong winds and vessels or aircraft carrying contaminated goods. Black rats were introduced to Barrow, Middle, Boodie and Double islands by the pearlers in the late 1890s. They were successfully eradicated from 1984–1992.

Before the construction phase of the Gorgon Project, a 2009 vegetation survey established the presence of 12 non-native plant species on Barrow Island, three species on Boodie Island, and one on Middle Island. Buffel grass (*Cenchrus ciliaris*), which occurs on Barrow and Boodie islands, is one of the species of highest concern as it is known to significantly impact island vegetation communities. Kapok (*Aerva javanica*) is another high priority species for surveillance. Chevron Australia has made a commitment to control the spread of these existing weed species and eradicating any new non-indigenous plants and animals. These weed management measures are an important contribution to the long-term conservation security of these islands.

The risk of introduction and spread of non-indigenous species increases with human activity. During the construction phase of the Gorgon Project, Chevron Australia developed and implemented a government-approved quarantine management system to prevent introduction of non-indigenous species to the island, to avoid proliferation of existing non-indigenous species and to detect and eradicate non-indigenous terrestrial plants and animals and marine pests that may be introduced as a result of project activities. DPaW staff review and monitor quarantine activities on the islands as part of their management role on Barrow Island, as well as at mainland Gorgon Project sites in WA.

Protecting the many values of the Barrow group nature reserves is a multifaceted challenge, especially in the context of the strict environmental management requirements associated with the Gorgon Project. From threatened mammals, marine turtles and migratory shorebirds, extensive karst systems and the subterranean species they support, to important pre-historical and colonial historical sites, the new management plan for the reserves outlines the actions the department will take to manage this significant area.

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The authors would like to acknowledge the many DPaW staff who assisted with the preparation of the Barrow group nature reserves management plan, in addition to the many external individuals, industry bodies and agencies that made valuable contributions, particularly the Conservation Commission of Western Australia, Chevron Australia Pty Ltd, Department of Mines and Petroleum and Department of State Development.

The Gorgon Project is operated by an Australian subsidiary of Chevron and is a joint venture of the Australian subsidiaries of Chevron, ExxonMobil, Shell, Osaka Gas, Tokyo Gas and Chubu Electric Power. The Barrow Island oil field is operated by an Australian subsidiary of Chevron and is a joint venture between Chevron, Santos Offshore and Mobil Australia Resources.

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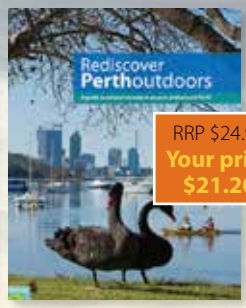

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Department of Parks and Wildlife

Going nuts for boodies

Once widespread across Australia, the boodie, or burrowing bettong, is being helped by a significant conservation project. And scientists are hopeful that its recovery will aid another declining species too.

By Tamra Chapman and Rhianna King

The boodie (*Bettongia lesueur*), or burrowing bettong, is the only member of the macropod (kangaroo and wallaby) family that digs and inhabits burrows. Boodies are gregarious, highly social and live in a complex warren system with numerous entrances and interconnecting passages. Some warrens can have as many as 90 entrances and can house 20 to 40 boodies. Boodies have a short gestation period and, while they only produce one joey at a time, they may raise up to three young in a year.

Boodies once had one of the largest distributions of any native mammal in Australia. However, they were considered an agricultural pest and fell victim to hunting and poisoning as well as predation by introduced European foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) until they became completely extinct on the mainland by the early 1940s. They are now confined to less that 0.01 per cent of their historical range on six Shark Bay and Pilbara islands, and some mainland fenced enclosures.

Thankfully, an important conservation project at Lorna Glen—a 244,000-hectare former pastoral lease acquired by the Western Australian government in 2000 for conservation—is providing a safe, predator-free haven for boodies, and a number of other mammal species (see 'Into the wild: restoring rangelands fauna', *LANDSCOPE*, Winter 2009). It is also giving scientists from the Department of Parks and Wildlife (DPaW) opportunities to study the reintroduced animals and some of their associated ecological processes. As we know, the decline of a species can never be viewed in isolation and can often have landscape-scale repercussions. One of the boodies' most important ecosystem functions is digging and seed dispersal, and their population decline might explain the decline of another species too.

SANDALWOOD DECLINE

Oil from the sandalwood tree (*Santalum spicatum*) has long been used by aromatherapists and perfumers. During the 1940s, sandalwood earned up to 45 per cent of the colony's export income and today about 2,000 tonnes is harvested in Western Australia each year, under the management of the Forest Products Commission.

Although widely distributed from Shark Bay through the Wheatbelt and arid Goldfields to the south coast, sandalwood has declined due to clearing for agriculture, and remaining stands have low rates of natural recruitment. The reasons for this include grazing, fire, low rainfall and poor seed dispersal and germination, due to the loss of diggers and seed dispersers like boodies.

Sandalwood has smooth, round fruits that are about 15–25 millimetres in diameter with a reddish-brown, leather-like skin which covers a hard, woody nut. The kernels inside the nuts are thought to be one of the boodies' favourite foods and they regularly visit sandalwood trees to check for fallen nuts. Sometimes the boodies eat the nuts where they find them, but most often they take the nuts away (up to 360 metres from the tree) and bury them. To the boodies, they're probably just saving the buried nuts for a rainy day, safe from other hungry animals. To the tree, they're performing a valuable service that plays an important role in the species' propagation.

Previous page
Main A boodie.
Inset Nuts of the sandalwood tree.
Photos – Jiri Lochman

Above A boodie at Lorna Glen.
Photo – Judy Dunlop/DPaW

Right Volunteers John and Heather Richardson radio tracking the sandalwood nuts.
Photo – Tamra Chapman/DPaW

GOING NUTS

In order to test the theory that sandalwood distribution could be improved by reintroducing boodies into sandalwood habitats, DPaW research scientist Tamra Chapman attached radio transmitters—or 'nut tags'—onto a number of sandalwood nuts. Getting the 'best' attachment was a process of trial and error (and involved a few blisters). It was necessary to ensure the distance between the nut and the transmitter

"Boodies are gregarious, highly social and live in a complex warren system with numerous entrances and interconnecting passages."

was long enough that when the boodie picked it up, the weight of the transmitter would be supported by the ground so the boodie wouldn't be deterred by the extra baggage. Tamra wanted to determine whether the boodies ate the nuts *in situ* or whether they moved them and buried them away from the parent plant, thereby potentially helping to propagate new trees. So, she attached the radio transmitters, using tiny screw-in eyelets and fishing swivels, to a number of nuts, and placed them under the canopies of sandalwood trees growing on the edge of an active boodie warren inside the 1,100-hectare predator fenced enclosure at Lorna Glen, and a nearby relic warren outside the enclosure (where there were no boodies). She also set up movement-sensing cameras to record activity at the nuts, and, together with volunteers, visited the trees for six mornings to record whether the nuts had been removed, eaten or remained where they were. If the nuts had been moved, she located them with a radio receiver, recorded their positions using a GPS and put another tagged nut in its place.

The results provided some interesting insights. Tamra had expected that because there were no 'non-tagged' nuts underneath the tree canopies (the experiment was conducted in April, outside the October to December fruiting season), that the boodies would eat the nuts *in situ*. But, instead, all the nuts left near the active warren were moved. Some were buried up to four centimetres deep, and some only superficially, but all represented a chance for a sandalwood tree to germinate and thrive as it's unlikely the seeds would have established while lying on the surface under the host tree. The nuts left near the disused boodie warren outside the fenced enclosure were not touched, further suggesting that sandalwood trees and boodies do, in fact, have an important symbiotic relationship.

Based on these results, more detailed investigations of sandalwood use by boodies will be carried out. But there is a definite possibility that sandalwood propagation can be improved by reintroducing boodies into sandalwood habitats and the future health and abundance of sandalwood in Australia's arid rangelands can be improved, along with the conservation status of boodies. These results reinforce that by returning our native animals to their natural habitat we are restoring important natural processes, many of which we are yet to discover.

Above Fishing tackle and picture frame screws were used to attach the radio transmitter to the nut.

Above right Boodies live in complex warren systems that can house as many as 20 to 40 animals.
Photos – Tamra Chapman/DPaW

Right Nuts of the sandalwood tree.
Photo – Jiri Lochman

Tamra Chapman is a Department of Parks and Wildlife research scientist and can be contacted on (08) 9334 0198 or by email (tamra.chapman@dpaw.wa.gov.au).
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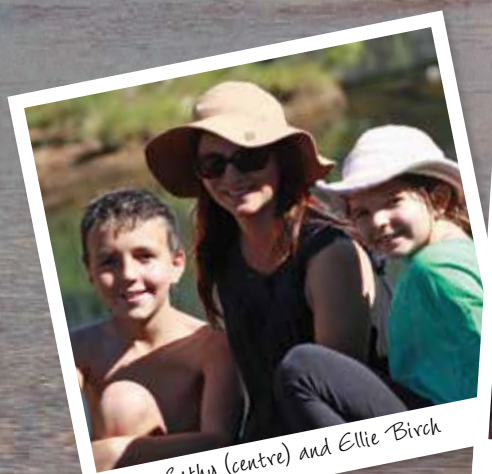
In symbiosis *is one of* LANDSCOPE*'s many regular features. It showcases some of the fascinating relationships that have evolved between different species.*

Trekking the Gibb



Jack, Cathy (centre) and Ellie Birch

Tammie Ried

The rich history of one of Australia's great wilderness drive tracks promised the adventure of a lifetime for two families. Here are their personal accounts about their Kimberley experience winding their way along the iconic Gibb River Road and its surrounds in Western Australia's far north.

by Cathy Birch and Tammie Reid

The 668-kilometre Gibb River Road was originally a stock route pioneered for central Kimberley pastoral stations to drove their cattle to the ports of Derby and Wyndham. It later became a road transport route across the Kimberley plateau linking King Sound at Derby to the Cambridge Gulf at Wyndham. The Wyndham meat works closed in 1985 and the road is now more of a tourist route than a beef transport road. It traverses the rugged King Leopold Ranges, snaking through red granite folded ranges and the headwaters of the Fitzroy River, negotiating steep jump ups. These breakaways must have rung loud with curses when the droving teams pushed their mobs through and over the very dry tableland country. The Gibb River Road is a growing and popular four-wheel drive tourist experience, linking many stations, parks and reserves, gorges and Aboriginal communities.

One thing is for sure, the Gibb River Road is not for the faint hearted. And for Department of Parks and Wildlife (DPaW) senior project officer Tammie Reid and marketing manager Cathy Birch, months of planning, and high expectations for an ambitious adventure were all worth it.

THE TRAVEL PLANS

Tammie set off with backpacks and lightweight camping gear, maps, reference books and guides, first aid gear, recovery and safety communications equipment, and a rooftop tent on her four-wheel drive for a month's journey along the Gibb River Road. This was something she and her husband Ian had looked forward to for a long time and at last, with three months long service leave up their sleeves and their children all now adults, it became a reality.

Meanwhile, Cathy, together with husband Dan and two children Jack (11) and Ellie (7) set off after much preparation and excitement to discover Western Australia's vast north-west and the somewhat infamous Gibb River Road four-wheel drive track.

WINDJANA GORGE NATIONAL PARK

This place is steeped in history and highly populated with freshwater crocodiles (*Crocodylus johnsoni*). The water-streaked walls of the gorge are incredible and there are a variety of different walks, including the seven-kilometre return Gorge Walk, which takes you along the full length of the gorge and back. The walk provides an up-close look at the park's resident fruit bats and corellas which, together with a number of waterbirds, take shelter in the tall broad-leaved leichardt pines, native figs and paper-barked cadjeputs. It's a great place to take photos of crocodiles without getting too close. *Cathy*

TUNNEL CREEK NATIONAL PARK

We had a great experience walking through the cool caves of Tunnel Creek—Western Australia's oldest cave system. The walk is quite dark so it is neccessary to have a torch. Other walkers recported seeing a freshwater crocodile in the water partly hidden by a small waterfall, but we had already walked past it. The walk experience was amazing with stalactites throughout the cave and interpretive references to the Bunuba Aboriginal leader known as Jandamarra being shot at Tunnel Creek in 1897. *Cathy*

BELL GORGE – KING LEOPOLD RANGES CONSERVATION PARK

We were welcomed by DPaW campground hosts, a retired bank manager and his wife, from the eastern states who volunteer their time each year. They provided us with information about the park, camping sites, facilities and the walk to the spectacular waterfalls at Bell Creek Gorge. The walk is reasonably challenging but certainly worth it with a beautiful waterfall and Aboriginal artwork to discover. There are more than 200 bird species in the park, including the spectacular rainbow bee-eater (*Merops ornatus*), which darts around giving flashes of its brilliant colour, while the sticky kurrajong (*Brachychiton viscidulus*) brightens the gorges with its stunning pink flowers. *Tammie*

DIMOND GORGE ON OLD MORNINGTON STATION

Dalalnger, also referred to as Dimond Gorge, is on the Australian Wildlife Conservancy's Mornington property and is the final cut through the King Leopold Ranges before the Fitzroy River flows onto the plains. It's spectacular and holds great cultural significance for the local Aboriginal community. There is a radio phone in a shed at the turn off so camp site availability can be checked before committing to the drive. There are various walks, other spectacular gorges and water holes, an abundance of birds to spot and regular evening presentations from the researchers based at the property. We also enjoyed the 'library' at reception—an open enclave complete with comfy couches and all the information and field guides you could ever need about the plants, animals and people of the Kimberley. *Tammie*

Previous page
Main Crossing the Pentecost River ahead of the impressive Cockburn Ranges.
Photo – Marie Lochman

All other photos – Colin Ingram, Cathy Birch and Tammie Reid/DPaW unless otherwise indicated.

Bell Creek Gorge

Dimond Gorge

Rainbow bee-eater. Photo — L-A Shibish

Silent Grove campground. Photo — L-A Shibish

MANNING RIVER GORGE

The walk here was fantastic. We first swam across to the other side of the Manning River. You can take a boat to pull yourself across, but we chose to swim and cool off before the walk. The track to the gorge is a fair hike but, like all the walks in the Kimberley, is well worth it. We spotted an olive python (*Liasas olivaceus*) making its way into the water as well as water monitors. Once we reached the gorge we took in the scenic views. Cathy

MCGOWAN ISLAND

The road into Kalumburu and out to McGowan Island was quite hard on our vehicle so we were glad to experience the island and take a break from the heavy corrugations. As this was a no swimming area, the kids spent hours building sandcastles for crazy crabs (*Coenibita variabilis*). That night we camped under beautiful boab trees (*Adasonia gregorii*) and watched an amazing sunset, which was vivid red due to a distant fire. We were treated to fireworks and delicious salmon courtesy of other visitors. Cathy

McGowan Island

POINT WARRENDER

The drive into Point Warrender is not for the faint-hearted (like me). However, once we finally got down the track we were rewarded with an amazing view of this stunning coastline and had a fairly secluded place to camp and fish. Though we didn't have any luck fishing from the rocks, we did catch quite a few fish including threadfin salmon, skip jacks and two mud crabs after much time spent in a dinghy. Some friendly black kites and a dingo (*Canis lupus dingo*) scavenged around our camp site hoping to share our catch with us. Cathy

PUNAMII-UNPUU – MITCHELL FALLS, MITCHELL RIVER NATIONAL PARK

This part of the drive was enjoyed by all with a few river crossings and amazing scenery of fan palms (*Livistona eastoni*); it was like driving into a tropical oasis. The walk to Mitchell Falls was a trip highlight and, aside from being beautiful, the fan palm forest is one of the most biologically important areas in the state. Up to 50 mammal species, 220 bird species and 86 kinds of reptiles and amphibians may occur in the area. There are two smaller falls (Little Mertens and Big Mertens Gorge) along this challenging and reasonably long walk and at the end are the beautiful cascading Mitchell Falls. We stayed for hours enjoying the magnificent view and swimming at the very top of the falls. We walked both ways, visitors can instead opt to take a helicopter flight over the falls and back to the camp site. Cathy

Mitchell Falls. Photo — David Bettini

"The walk to Mitchell Falls was a trip highlight and, aside from being beautiful, the fan palm forest is one of the most biologically important areas in the state." Cathy

NGAUWUDU – MITCHELL PLATEAU

This several-day diversion into the Mitchell Plateau was well worth it. We hiked through this country and experienced rock art, gorges, palms, rainforest patches and water lilies and listened to and watched for the elusive scuttling Dalal or black grass wren (*Amytornis housei*). An evening campground presentation by the DPaW ranger John Hayward included images of the park in the wet, transformed with water raging and completely washing out all four tiers of the Mitchell Falls, giving an insight into the breathtaking forces at work in this part of the country. Surveyors Pool/Aunayu is another enjoyable walk into a place known by the Wunambal people as a powerful place for their Wanjina-Wungurr law. The white rocks at the base of these falls are said to be the eggs of the Rainbow serpent. *Tammie*

KING EDWARD RIVER – WANDJINA ROCK ART SITES

There are two accessible rock art areas near Munurru, the newly redeveloped camp site at King Edward River which is managed by DPaW through an MOU with Kandiwal Aboriginal Corporation. One site is accessed by a gravel road after crossing King Edward River, and the second is accessed several kilometres after the camping area.

These sites have been developed and protected under the direction of the Wnambal Gaamberra traditional owners and convey the deep respect and age-long connection they have with the land. The traditional owners welcome visitors to these sites and ask that visitors respect the land and stop for a moment to think about where they are. It was late afternoon when we visited, with a golden glow reflecting on the rock art and surrounding savanna grasslands, making these breathtaking and emotional visits for me. *Tammie*

MINERS POOL AT DRYSDALE RIVER STATION

Drysdale River Station offers bookable facilities for overnight stays and has great outdoor dining. We opted to camp at Miners Pool, just out from the main station, where we could swim in the Drysdale River. The campsite offers basic toilet facilities here and a large area for setting up tents. *Cathy*

ELLENBRAE STATION

This shady, garden homestead was established by the original station owners to welcome weary Gibb River Road travellers. It's a nice spot for a morning tea of scones, jam and cream. Some beautiful double-barred finches (*Taeniopygia bichenovii*) joined us. *Cathy*

PENTECOST RIVER

We spent a couple of nights camping along the Pentecost River, which rises below the Durack Range and flows north through El Questro Station. This is a great place for watching other travellers cross the river, croc spotting and taking in the incredible sight of the Cockburn Ranges. *Cathy*

Miners Pool

Surveyors Pool

Pentecost River

Mitchell River. Photo – Tourism WA

"The stunning scenery of the Kimberley was of course the absolute highlight of this trip. However, sharing the trip with our children was really special." *Cathy*

Cathy

"Much to our delight we had a wonderful, safe holiday and an experience none of us will forget. The stunning scenery of the Kimberley was, of course, the absolute highlight of this trip. However, sharing the trip with our children was really special. They didn't have any electronic gadgets so they spent their time in the car writing stories, reading, mapping the journey, helping out on the two-way by letting the four-wheel drive behind us know when another vehicle was coming the other way, taking photographs (until the batteries went flat), drawing pictures, telling jokes and enjoying the scenery. I hope we, as a family, have the opportunity to do the trip again and visit some of the places we didn't fit in this time and revisit some of the places we loved. The trip is a wonderful chance to step away from the hustle and bustle of everyday life and enjoy spectacular Western Australia at its best. I, for one, looked at life a little differently when I returned from the trip."

Tammie

"Travelling the Gibb was a lot easier than we had anticipated. There are hot showers, fuel and food supplies, information, tours, camping and accommodation options all the way along, even scones and cold drinks at the occasional station run bars. The good road conditions surprised us too; apparently a grader had passed just before our trip after some heavy rains had closed sections of the road for a number of days. But we still managed to rattle off our front number plate by the time we arrived at Wyndham!

What surprised us during our trip was the immense scale and impact of the geology and how easy it was to read the land and understand the huge forces that had created the Kimberley. You can literally see the impact of land masses colliding and buckling into the continent as well as the Fitzroy River relentlessly eroding the different granite and basalt rock types and cutting its way through to drain vast amounts of wet season rainfall through to the plains and eventually the ocean.

We enjoyed learning more about Aboriginal custodianship of the Kimberley, one of the oldest continuous living cultures in the world. There are still more than 30 different language groups in the Kimberley region alone. We combined our bush walks, community art gallery visits, station tours and gorge explorations with always keeping an eye out for signs of past habitation and investigating rock art that was thousands of years old. One rock art site depicted a thylacine (Tasmanian tiger), a marsupial that has been extinct for at least 2,000–3,000 years, so one wonders just how old this site is.

During our month-long trip, we lived among spectacular scenery, walked and swam in beautiful landscapes and built our knowledge of dry season Kimberley plants and animals. We met fellow travellers, interacted with many campground hosts and DPaW staff who care for the parks and reserves along the way.

The trip was everything we had hoped for and more—a refreshing and invigorating experience, and one that makes me proud to be Western Australian. We also began to truly understand what Aboriginal people have lived by for millennia: if you care for the land, the land will care for you."

Doing up the Gibb

Western Australia's Kimberley region has been recognised as one of the 'must-see' destinations in the world by international travel publisher Lonely Planet. The Kimberley is number two in the world's 'Top 10 Regions' for 2014, and the only Australian region on the list.

The state government is working to conserve the Kimberley's immense nature and culture through the Kimberley Science and Conservation Strategy. The centrepiece of the strategy is the creation of the Kimberley Wilderness Parks, which will form the state's largest interconnected system of marine and terrestrial parks, covering about 50,000 square kilometers or five million hectares. The Kimberley Wilderness Parks include the Great Kimberley Marine Park (three million hectares) and Australia's largest national park, at two million hectares (naming of this park is still being finalised). Works to improve the Gibb River Road and Kalumburu Road for visitors, and to better protect the natural environment, include new toilet facilities at the junction of the Gibb River and Kalumburu roads, a rubbish cage at Drysdale River Station (for travellers returning from Mitchell Falls, as no rubbish collection is available there) and a redeveloped campground at King Edward River. Future plans include the development of new camping and visitor facilities at Carson River Station—a collaboration between DPaW, the Kalumburu Aboriginal Corporation and the Balanggarra Traditional Owners. Work on the facilities will start in 2014.

Heaven sent?

A stroll through a suburban regional park uncovered a cyanobacterium that has been romanticised in mythology as the remains of fallen stars, is eaten in salads in some countries and has been brought back to life after 87 years of dormancy.

by John Huisman and Catherine Prideaux

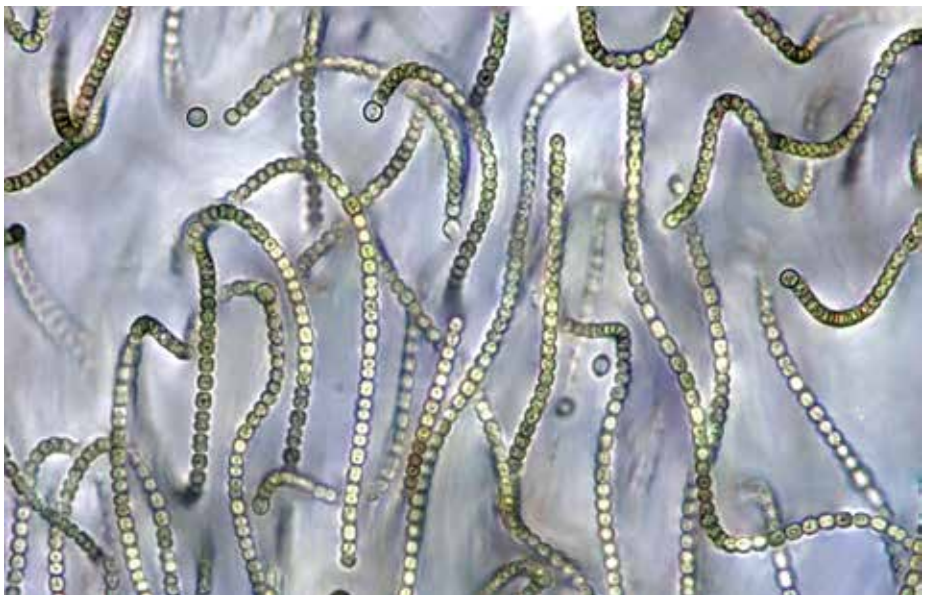
Department of Parks and Wildlife (DPaW) biologists are a fortunate bunch, often finding themselves in remote and wild locations, places only a few ever get the opportunity to visit, and where you might expect to observe rare and unusual plants and animals. However, such things are not restricted to these areas, and occasionally the weird and wonderful can be encountered along a suburban pathway.

DPaW's Swan Region planning officer Catherine Prideaux recently had such an experience. During a site visit along the northern end of Lake Coogee, part of Beeliar Regional Park, south of Perth, Catherine noticed a strange growth among the grass next to the path, something that she had not seen before despite many visits to the area. This growth looked like a dark green jelly, spreading for many centimetres, sort of globular in shape but without any distinct form. She was understandably curious and took a photo, hoping that she might show it to someone able to identify the unusual organism. Catherine guessed that it might be a cyanobacterium (or 'blue-green alga'), and once back at work she sent the photo to the herbarium's phycologist John Huisman, who agreed that it was indeed a cyanobacterium, but he needed a specimen to confirm the identity. This was collected and the organism identified as *Nostoc commune*, a species seemingly with a worldwide distribution, but one rarely reported in Western Australia.

CRYPTIC GENETICS

Cyanobacteria, although traditionally called blue-green algae, are not algae, but are more accurately described as photosynthetic bacteria. While they do photosynthesise like plants and algae, they do not have the same cellular complexity and are more closely related to bacteria. They are found in virtually all habitats and are often toxic, perhaps the most well known in WA being *Anabaena* and *Microcystis*, which often bloom in the Swan-Canning Estuary.

Nostoc commune has been reported worldwide, from arid to polar regions, and is found in a wide range of habitats. In truth, this distribution pattern is misleading, as specimens from different countries, while looking identical to one another, have dissimilar genetics. Therefore *Nostoc*



Previous page
Main North Lake, Beeliar Regional Park.
Photo – Jiri Lochman
Inset *Nostic commune* growing by the path.
Photo – John Huisman

Top Blue-green algal bloom at Matilda Bay Reserve.
Photo – Dennis Sarson/Lochman Transparencies

Above The gelatinous colonies of *Nostoc commune* among the grass.

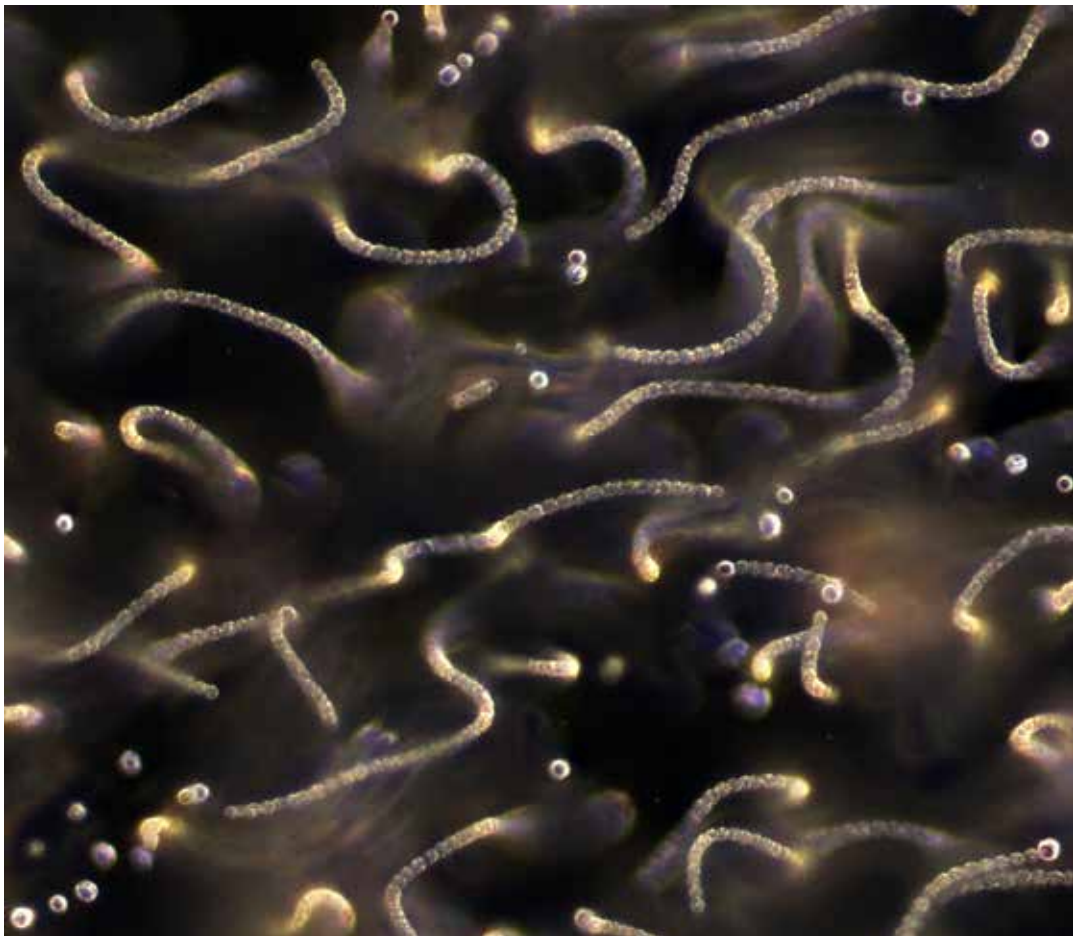
Above right *Nostoc* trichomes as seen under the microscope; the slightly larger spherical cells are nitrogen-fixing heterocytes.
Photos – John Huisman

commune is regarded as a 'form species', one that probably represents different genetic species that cannot be distinguished by their appearance.

EVOCATIVE NAMING

Unusually for a cyanobacterium, *Nostoc commune* has several common names, including star-slime, star jelly, witch's butter, and mare's eggs, although these names are also used for several other gelatinous cyanobacteria and fungi with a similar appearance. The celestial names arose from the common belief in the British Isles that *Nostoc* was the remains of shooting stars, and dates back to the 15th Century. Early accounts describe quarry workers who, upon sighting a shooting star, "went to the spot near which they supposed it to fall, and they generally found a hatful of this mucus". This belief was still held in some areas until at least the early part of the 20th Century. Similar names have been recorded from Belgium, Denmark, Germany and Holland. 'Witch's butter' is based on the belief that witches would milk cows at night, then scatter the unappetizing butter in the fields, while 'mare's eggs' is generally applied to spherical forms that appear as clusters of eggs, perhaps thought to have come from nearby horses. The scientific name '*Nostoc*' had an equally unusual genesis. It was based on 'Nostoch', a name coined by German philosopher Paracelsus (1493–1541 AD), and is thought to be an amalgamation of two words, both describing the human nostrils: the old

"Nostoc commune is eaten as a salad in several Asian countries, including the Philippines, Indonesia, Japan and Taiwan, where it is known as 'yu-lai gu' (meaning post-rain mushroom). One variety is also eaten in China, where it is known as 'facai' and is traditionally served at the Lunar New Year."



English 'Nosthryl' and German 'Nasenloch'. Paracelsus observed that *Nostoch* might be "excrement blown from the nostrils of some rheumatick planet". Thus one other common name also used is: 'snot'!

TASTY SALAD

Nostoc commune is eaten as a salad in several Asian countries, including the Philippines, Indonesia, Japan and Taiwan, where it is known as 'yu-lai gu' (meaning post-rain mushroom). One variety is also eaten in China, where it is known as 'facai' and is traditionally served at the Lunar New Year.

In the mountains of Peru *Nostoc* is collected from highland lakes and is called 'llullucha'; it is eaten as a salad or added to stews and thought to be highly nutritious. Unfortunately eating cyanobacteria can be sometimes risky, as many species produce toxins. *Nostoc commune* is thought to be non-toxic, but a recent analysis of specimens bought from a Peruvian market showed them to contain beta-N-methylamino-L-alanine (BMAA), a neurotoxic amino acid linked to neurodegenerative illness (such as Alzheimer's). Given that there are seemingly many genetically distinct strains of *Nostoc commune*, whose toxicity is unknown, it would be prudent to avoid their consumption.

NATURE'S SURVIVORS

What Catherine observed in the grass is actually a colonial organism. Short strings of cells form filaments (known as trichomes), which are embedded in a gelatinous mass that is highly resistant to drying out. Within the trichomes are larger, specialised cells known as heterocytes, which can fix atmospheric nitrogen and the *Nostoc* can then grow in areas where no nitrogenous compounds are available in the soil. It is often found associated with limestone gravel. Following rain the colonies appear rapidly, seemingly out of nowhere, and are typically a dark green colour. When they dry out they turn brown and appear as a crust on the surface of the soil, described by one author as looking like "dried dog faeces". This does not mean they are dead, far from it, they are merely dormant, and will pop back to life following the next rainfall. They can remain viable in this dormant phase for extremely long periods and are resistant to heat and repeated freezing and thawing. In one study a specimen dried onto a herbarium sheet was successfully revived 87 years after it was first collected; they are certainly one of nature's survivors! Unfortunately this means they can also be a pest, popping up in gardens and on pathways after rainfall, and are very difficult to deter. In WA our dry climate probably means this is unlikely and it was probably our unusually high mid-2013 rainfall that promoted the colonies that Catherine saw. The colonies have since dried and now do indeed resemble something unsavoury, but we will certainly pay a visit to Lake Coogee after next winter's rain and see how they are faring. Or if we happen to see a shooting star.

Above Dark-field photography highlights the *Nostoc* trichomes embedded in a gelatinous mass. *Photo – John Huisman*

John Huisman is a contract seaweed specialist at the WA Herbarium and research fellow at Murdoch University. He can be contacted by email (john.huisman@dpaw.wa.gov.au).
Catherine Prideaux is a Department of Parks and Wildlife planning officer.

Canoeing Kalbarri National Park

Samille Mitchell discovers a canoe tour is an excellent way to experience the beauty of Kalbarri National Park's river gorges, and gain access to little-visited parts of the park.

We're on the move, trekking down a scrambly path through dry shrubland bush. Ahead, a family banters about their lack of fitness, the girls teasing their dad for being too slow and their brother for wearing thongs on a hike, and behind I hear a kid whine, "how much further?" But, as we take a turn and the river gorges of Kalbarri National Park open up before us, we all fall momentarily quiet. Struck by the beauty, we take a collective gasp. For out of the scrub an expanse of gorge appears before us, a rust-red cliff looming skyward, the Murchison River flowing along its base and gnarled gums overhanging the waters.

Our guide beckons us further on, across sun-bleached boulders and, finally, we reach a beach more typical of the tropics than the semi-arid environs of Kalbarri National Park. Nearby a stand of river gums shade picnic tables, and fresh water seeps through the cliff overhang above creating a deliciously cool micro-climate. It has the feel of an oasis in the desert. And it's where we'll base ourselves for our canoe tour of the Murchison River gorge.

NATURE'S BOUNTY

Kalbarri Adventure Tours has been in the game for 16 years, transferring participants to Kalbarri National Park in a four-wheel drive bus well designed for the bone-jarring track off the main gorge route to the canoe site. Stopping the bus seemingly nowhere, our guide Helen Waite leads us on foot down a track to the hidden gorge. Here, we team up into pairs and climb aboard the canoes to set off on a three-kilometre paddle up and back. It's when the canoes begin to spread out that we begin to fully appreciate the beauty around us: the silence, the way the breeze occasionally ruffles the otherwise mirror-like water, a pair of eagles floating on the warm air above. Helen says canoeists are often treated to the sight of up to 50 black swans that visit every year, and she points out where whistling kites have built a nest in a tree overhanging the water. But it's the gorge walls that are most captivating. You only need to look at them to guess that they're old—really old. They have been worn and weathered by the storms of time in a process spanning 420 million years (see 'Captivating Kalbarri', *LANDSCOPE*, Autumn 2010).

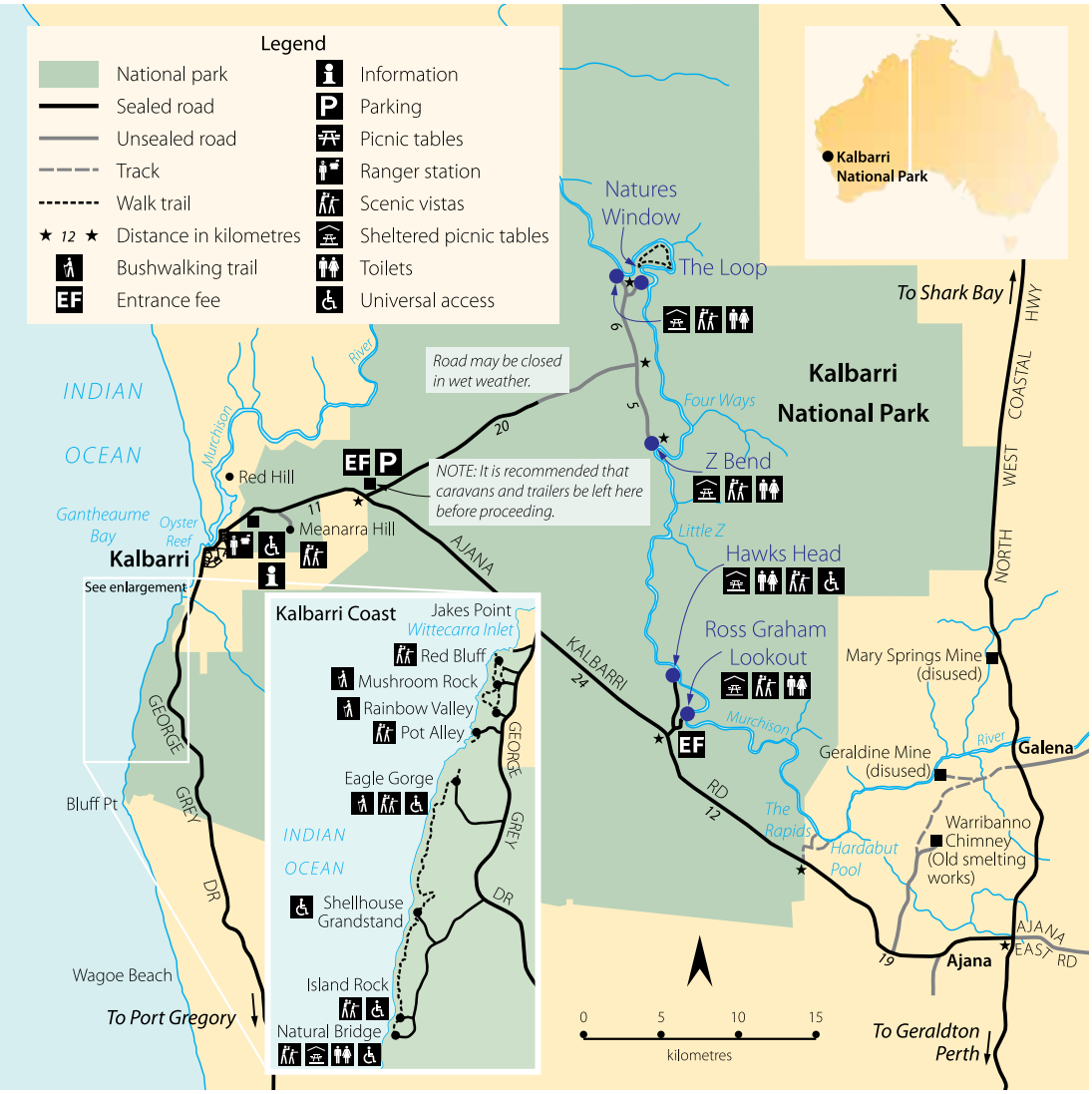
AN ANCIENT LANDSCAPE

Apparently this process began when the area that is now Kalbarri was part of a gigantic river system that discharged into a shallow sea. Then, more than 200 million

Above Trekking down to the Murchison River.
Photo – Samille Mitchell
Above left Whistling kites can be seen in trees overhanging the water.
Photo – Jiri Lochman

Opposite page
Top The Murchison River gorge provides a picturesque location for canoeing.
Left Taking in the tranquil surrounds.
Right Canoeists are dwarfed by the ancient gorge walls.
Photos – Samille Mitchell

"... as we take a turn and the river gorges of Kalbarri National Park open up before us, we all fall momentarily quiet. Struck by the beauty, we take a collective gasp."



Above Cooling down in the Murchison River. *Photo – Samille Mitchell*

years ago, wind and floodwater shifted sand from an area known as the Yilgarn Block into the Kalbarri area. More recently, between 65 million and 1.6 million years ago, the Murchison River began to flow through the landscape carving out a path that revealed the sedimentary formation lain here all those years ago and sculpting the spectacular gorges of today.

While it's fascinating to learn of the geology, you can still appreciate the gorge's ancient nature without this knowledge. It's almost as if the gorge itself speaks to you, in its stark outlines, crumbling rock and even, perhaps, through the whisper of the wind. I'm getting a little lost in whimsy when a hoot of laughter sounds out nearby and someone leaps from their canoe into the water. Jerked out of my daydream, we pull the canoes onto the beach and join the swimmer. It's the ideal refresher before lunch—we bring our own—and cake, a scrumptious creation from a tour guide who is just as well known in Kalbarri for her baking prowess as her tour-guiding abilities.

Still wet from the swim we pack up and head out on a different route—up a crevice that has us huffing and puffing and using the excuse to stop and admire the view. While enough to make you sweat, the climb out is not too strenuous. Helen says she's had people of all ages—from toddlers to 80 years—on the tour. She says anyone with a sense of adventure enjoys the experience.

"They love being outdoors, in this amazingly beautiful area, doing some exercise, learning a bit about nature, and just taking in the scenery," she says. "And we usually find we have a good laugh while we're at it."

Do it yourself

Where is it? River gorge recreation sites in Kalbarri National Park are about 35 kilometres east of Kalbarri. Kalbarri is about 650 kilometres north of Perth.

When to visit? The gorge can be extremely hot in summer so time your visit for autumn, winter or spring.

Please note, drinking water is not available in the park. To avoid dehydration drink three to four litres when walking.

For more information, and to make bookings, contact the Kalbarri Visitor Centre on (08) 9937 1104 or visit www.kalbarri.org.au/tours.

Park fees apply at Kalbarri National Park. To purchase a national parks pass, visit the Kalbarri Department of Parks and Wildlife (DPaW) office, DPaW's online shop at www.shop.dpaw.wa.gov.au or the Kalbarri Visitor Centre. You can find more information about Kalbarri National Park in the department's stunning publication *Kalbarri*, sold where you can buy park passes and from good bookshops.

Parks for people *is one of* LANDSCOPE*'s many regular features. It features information about some of WA's great national parks and other reserves and the amazing ways to experience them.*

kaleidoscope
kids exploring nature

Kids in the **field**

The recent summer months saw a number of kids enjoying the 'Cocky Capers' activity with Nearer to Nature. After meeting Chasey, the Carnaby's cockatoo, and learning about his special features, it was great fun to dress up as a cockatoo and hunt for food in the forest! Nearer to Nature engages the community to learn about and get involved in conserving our environment by providing opportunities for adults and children to take part in fun, hands-on experiential learning in the natural environment.

Find out more about Nearer to Nature at dpaw.wa.gov.au/n2n.

Bush **Rangers**

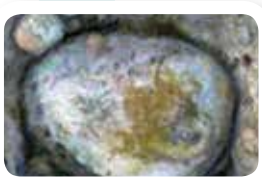
Derby Bush Rangers took on the significant problem of discarded fishing line and bait bags from recreational fishers, which endanger aquatic life through entanglement or ingestion. Through the Recfishwest Grant Scheme with the support of the Shire of Derby/West Kimberley, Indigenous ranger groups, Mary Island Fishing Club and Community Radio 6DBY, the Derby Bush Ranger Cadet Unit and school community have replaced missing fishing line recovery bins along the jetty and boat ramp and have installedsignage at popular fishing spots around Derby and Willare.

Focus on... animals on the limestone reef

Every issue, *kaleidoscope* focuses on interesting habitats and some of the animals that live in them.

MUSSELS attach themselves to the rocks by a net of anchor threads called a 'byssus'. They feed at high tide by opening up and filtering the water for microscopic plants and animals.

SEA ANEMONES look like flowers, but are really animals. A sea anemone's mouth is surrounded by a ring of stinging tentacles which are used to catch and paralyse small sea creatures.



ABALONE The large muscular foot with which abalone move and cling to the rocks, is also highly prized as food. These molluscs feed on drifting algae and seagrass.

BARNACLES are often found in large colonies on the rocks. When the tide is in, their feathery tentacles filter out plankton from the water.

SEA STARS have hundreds of tiny tube feet on the underside of each arm that enable them to move. If an arm is broken off, a whole new animal can grow from the severed arm.

SEA URCHINS have an external shell, known as a test, that is often found washed up on the beach after the animal has died and the spines have been broken off. Sea urchins are from a group known as echinoderms, a word meaning 'spiny skins'.

Remember, some marine animals can be dangerous, so if in doubt keep your distance and be careful what you touch.
Find out more at marineparks.dpaw.wa.gov.au.

This information was adapted from the *Exploring Western Australia's marine parks* teachers' guide. This guide has been designed for years 3 to 7 by the Department of Parks and Wildlife with financial support from ExxonMobil Australia.

Photos of Limestone Reef animals – Gilbert Stokman, John Huisman, Mark Westera, Kevin Crane.

Red-capped parrot (*Purpureicephalus spurius*)

Red-capped parrots (*Purpureicephalus spurius*) are endemic to Western Australia, occurring in eucalypt forests and woodlands from Dandaragan, north of Perth, to just west of Esperance. They grow to about 36 centimetres long and the males are characterised by their scarlet crowns and brilliantly coloured plumage. Female and immature males are duller and have larger areas of green.

Illustration by Gooitzen van der Meer

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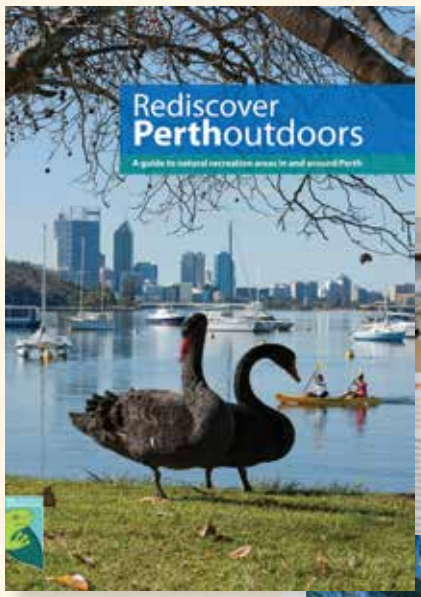

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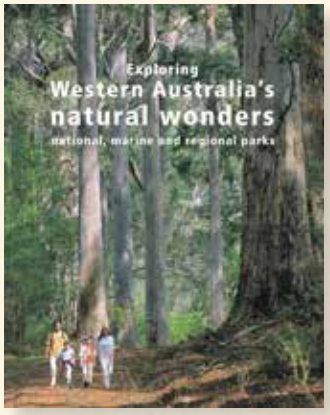

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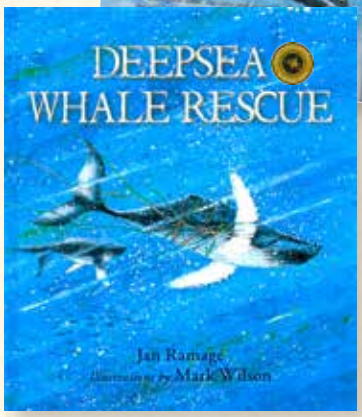

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