WA'S PARKS, WILDLIFE AND CONSERVATION MAGAZINE

LANDSCOPE

Volume 38 Number 3 Autumn 2023 $7.95

COLOURFUL COAST
Francois Peron National Park

Sandalwood
The tree of Midas

Fantastic Flinders
Bald Head Walk Trail

Plastic-free Riverpark
Finding eco-alternatives

Nature's pin-ups
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ON THE COVER

Front cover Thorny devil (*Moloch horridus*), Shark Bay. Thorny devils are found throughout arid regions of Western Australia including Francois Peron National Park.
Photo – Jari Cornelis

Back cover Cape Peron, Francois Peron National Park.
Photo – David Bettini

In my 35 years in conservation management, never have I seen so many opportunities arrive at one point in time for a government department. Current initiatives include the expansion of conservation estate by some five million hectares, the formal joint vesting and management with Traditional Owner groups across the State, the continuation of Aboriginal ranger programs, a suite of COVID-19 recovery projects and substantial investments into visitor facilities and tourism opportunities.

In the South Coast region of Western Australia, projects include the proposed 1.3 million hectare marine park (the first for the WA south coast bioregions), $12 million improvements to visitor trails and associated visitor infrastructure in Torndirrup, Gull Rock and Porongurup national parks (see '*Adventuring the Great Southern*' on page 28), improvements to the iconic and increasingly popular Bald Head Walk Trail (see '*Adventure out*' on page 35) and the $3.3 million Torndirrup Redevelopment Project (Phase 2), which will see improvements made to The Gap visitor precinct.

There is always a 'fine line' in balancing ecological integrity and nature-based visitor activities. Trails project teams manage visitor use in a sustainable way, balancing environmental protection, product sustainability and improved visitor experience and safety, all while maintaining the intrinsic natural 'sense of place'. The premise for the Great Southern Adventure Trails project was not to build new trails until existing trail networks met appropriate environmental and trail standards.

Also, in this issue of *LANDSCOPE* is an article about the benefits of Aboriginal ranger programs for both the environment and Aboriginal people (see '*Caring for Country*' on page 12). These programs importantly serve to rekindle the connection to Country for Aboriginal peoples who in many instances have become alienated from the natural landscape.

I have experienced firsthand the value of two-way learning for conservation outcomes and Aboriginal ranger programs are important building blocks for the collective journey we are taking into the joint management paradigm.

Peter Hartley ***Regional Manager, South Coast***
Department of Biodiversity, Conservation and Attractions

Contributing

Sjanna Sandalova started with DBCA in November 2022 as a Communications Officer. She has previously worked as a regional journalist and media advisor and is a passionate storyteller. Sjanna loves the outdoors, often spending her weekends travelling Western Australia or at the beach. Sjanna is a keen contributor to *LANDSCOPE* and will never turn down an opportunity to write about WA's diverse landscape, wildlife, and environment.

Benjamin Sawyer is a Senior Policy and Project Officer with DBCA's Conservation and Ecosystem Management branch. After many years of studying and working in Western Australia's vast landscapes, Ben has developed an acute passion for all things sandalwood. From its ecological sustainability and improving regeneration in the wild; to working for sandalwood-generated social and economic outcomes for the Traditional Owners of the lands from where it originated.

Zoe Beeson is the Project Officer for the Plastic Free Riverpark program. Her love for the Swan Canning Riverpark stems from her family, and her passion for reuse was inspired in 2016 after stumbling across the zero-waste movement. In both her work and personal life, Zoe enjoys having conversations around low waste solutions to single use plastic.

Features

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This page *Banksia praemorsum* growing beside the Bald Head Walk Trail.
Photo – Damon Annison

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Snap shot

READER'S PIC

Rattle beak orchid (*Lyperanthus serratus*)

Photo and words by Lawreen McIver

"After a nine-week search for orchids, we saw many, but one thing that struck me was that the rattle beak orchids were alive and well wherever we went. They are very common, but are nevertheless quite attractive and pictures taken up-close show just how beautiful they are. They grow in thick bush and don't seem to be daunted by limited light, ants or lack of fire to induce flowering. They do die back annually and flower in a range of habitats. Their pollinators are not known."

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@dbca.wa.gov.au.

25 years of *Bush Rangers*

This year, the *Bush Rangers* program acknowledges 25 years of operation, which will be celebrated at the annual Cadets Conference held in Perth in March.

Bush Rangers unit coordinators from around the State alongside staff from DBCA and Department of Communities will come together to honour *Bush Rangers* and *River Rangers* programs that empower students to conserve the environment by making positive changes in their local area.

In partnership with the Department of Communities, these inclusive and diverse volunteer-run programs continue to achieve the highest rate of participation of students that are Aboriginal, female or have a disability across all *Cadets WA* programs in the State. Currently there are 2917 Bush Ranger cadets in 59 high schools across WA, and 809 River Ranger cadets in 16 primary schools.

"We look forward to celebrating the amazing people involved in the program that provides so many opportunities for kids to connect with nature," Acting Cadets Coordinator Marnie Giroud said.

"We are so passionate about this program and ensuring the schools are supported appropriately," said Brad Cusworth from the Department of Communities.

New parks added to Smartreka maps

Mount Augustus and D'Entrecasteaux national parks have been added to the growing list of free digital maps in the WA Parks Foundation's Smartreka series, enabling people to stay on track when off-line.

Smartreka maps use built-in GPS capabilities on a smartphone or tablet to plot real-time locations. If the maps are downloaded ahead of time using internet access, they will be able to be used to navigate in areas where there is no network connection and without roaming charges.

Developed with DBCA and in partnership with BHP, Smartreka maps are also available for Cape Le Grande, Cape Range, Fitzgerald River, Francois Peron, Kalbarri, Karijini, Leeuwin-Naturaliste, Millstream Chichester, Purnululu, Stirling Range, Walpole-Nornalup, Walyunga, and Yanchep national parks, bringing the total to 15.

The free, interactive Smartreka maps can be accessed via the free Avenza Map app from either Google Play or the Apple store.
For more details, visit: ourwaparks.org.au/smartreka/

Murujuga closer to World Heritage status

Above Member for Pilbara Kevin Michel MLA, Federal Environment Minister Hon Tanya Plibersek MP, WA Environment Minister Hon Reece Whitby MLA, A/Director General DBCA Peter Dans, CEO Murujuga Aboriginal Corporation Peter Jeffries.
Photo – DBCA

An historic step has been taken towards global recognition for the Murujuga cultural landscape, with a nomination for World Heritage status by the Australian Government.

Western Australia's first cultural heritage nomination to UNESCO's World Heritage Committee is led by the Murujuga Aboriginal Corporation.

Ceremonial certificates were signed in the Pilbara to mark the cooperation between Murujuga Aboriginal Corporation and the Australian and Western Australian governments in nominating the landscape for inscription to the UNESCO World Heritage List.

Parks and Wildlife Service staff in the Pilbara joined Aboriginal Elders and custodians, the Murujuga Aboriginal Corporation, the Federal and State Environment Ministers, DBCA executives, regional and local representatives at the signing ceremony.

If accepted, Murujuga would be the second site in Australia listed for World Heritage Status for First Nations cultural heritage.

Director General retires

Mark Webb PSM officially retired from the public service at the end of 2022 as Director General of the Department of Biodiversity, Conservation and Attractions as well as his role as Chief Executive Officer of the Botanic Gardens and Parks Authority, Zoological Gardens Authority and Rottnest Island Authority.

Mark Webb has worked in public service for more than 40 years after beginning his career in 1979 as an advisor with the then Department of Agriculture. Peter Dans will act as the department's Director General and CEO of the three statutory authorities during the recruitment process.

Left Mark Webb PSM.
Photo – Peter Nicholas/DBCA

Guest column

Roger Underwood AM

My career coincided with the years from about 1960 to 2000 that saw a terrible low point for native forest fauna in WA, but also the great flowering of wildlife research that led to its magnificent recovery.

Up until the early1970s, there was little interest in forest fauna. Most small mammals were nocturnal and rarely seen, but we knew they were there, and were happy enough. For example, when mapping wandoo in the early 1960s, we would see numbats almost daily. Then, all of a sudden, right across the south-west, there was a dramatic population crash. Extinction of several species seemed to be imminent. Many explanations for the crash were mooted, but none was satisfactory.

Work in the Perup forest by Dr Per Christensen provided the breakthrough. Per made the connection between (i) cessation of baiting of rabbits using 1080 poison and spread of myxomatosis; and (ii) an explosion in fox numbers in the forest. When rabbits (especially those that had ingested 1080) were no longer available, foxes switched their diet to native fauna.

Having pointed the blame at the fox, Christensen turned his attention to controlling them, and soon realised that 1080 remained the answer. While 1080 was lethal to foxes, native animals were more tolerant; they had co-evolved with native poison plants, the toxic ingredient of which was, essentially, 1080. Then followed three lovely bits of research—Dr Christensen working on woylies in the Perup area, Dr Jack Kinnear working on rock wallabies in the Wheatbelt, and Dr Tony Friend working on numbats at Dryandra. These studies showed conclusively that native fauna recovered in the wake of fox control.

The story did not end there. Managing feral cats, and provision of *Gastrolobium* poison bush thickets (for refuge), were also necessary. However, identifying the fox as the root cause was the watershed moment, the key discovery. This initial step has since evolved into a comprehensive wildlife conservation strategy, adopted in all WA forests and in many conservation reserves across Australia.

Nowhere is this better demonstrated than at Dryandra where I have been working lately. A combination of sanctuaries (enclosed by predator-proof fences), routine baiting for foxes and feral cats, 'habitat burning' to regenerate *Gastrolobium* thickets, and collaborative arrangements with farmer neighbours, demonstrates the winning strategy—and its outcomes: the forest is heaving with native animals.

I am proud to have been, even if mostly only as an observer, part of this wonderful achievement.

Roger Underwood AM worked as a forester with the WA Forests Department for 25 years and is now a writer and historian. He is currently working on a history of Dryandra forest.

Francois Peron National Park

Francois Peron National Park spans some 52,500 hectares of the Peron Peninsula in the Shark Bay World Heritage Area of Western Australia. The park lies to the north of Denham and its colourful coastal landscapes and diverse wildlife habitats are among the many values that contribute to the area's World Heritage listing.

Francois Peron National Park is the traditional Country of the Malgana people. Malgana language speakers have occupied much of the Shark Bay area, including the Peron Peninsula, for about 25,000 years. Wulyibidi is the Malgana name for Peron Peninsula and Gathaagudu, meaning 'two bays', is the name for Shark Bay. French explorers were the first Europeans to provide reports of the Malgana people early in the 19th century.

French explorer François Peron meticulously documented anthropology, oceanography, meteorology and zoology during Nicholas Baudin's 1801 and 1803 expeditions. The park bears Peron's name in recognition of his contribution to recording Australia's natural and social history. The national park has undergone significant ecological restoration, which has seen the return of bilbies (*Macrotis lagotis*) and malleefowl (*Leipoa ocellata*). Restoring the park's natural habitats continues to be an important management goal.

Above Big Lagoon Campground and day-use site within Francois Peron National Park. *Photo – Shem Bisluk/DBCA*

ACCESSING THE PARK

Access to the park is off Monkey Mia Road about four kilometres north-east of Denham. The Peron Heritage Precinct is two-wheel drive accessible. High-clearance four-wheel drive is needed to access the rest of the park. Information on track conditions is available at the entry station and should be checked before driving into the park. The four-wheel drive tracks are mostly single-lane in soft sand and require a high-clearance 4WD vehicle. They are not suitable for caravans or large boat trailers. Reduce tyre pressure to 20psi (or less) at the tyre pressure station to avoid getting bogged or damaging tracks. Be aware of oncoming traffic, drive to the conditions and please stay on designated tracks. Some sections traverse large birridas (gypsum claypans) which can be slippery and boggy when wet.

WHERE TO STAY

The national park is known for its coastal camping, giving visitors a truly

Discover more about Francois Peron National Park

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

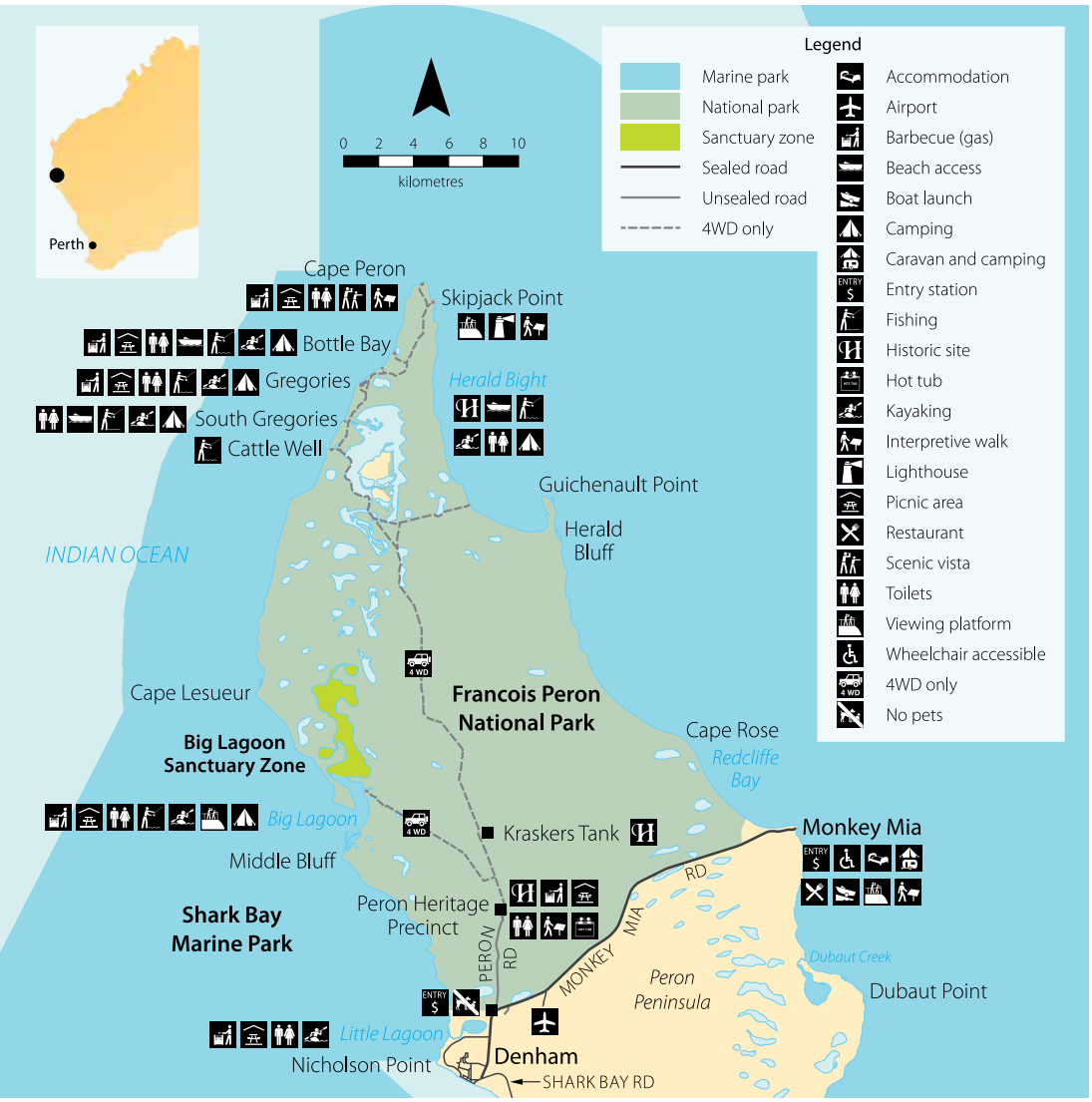
spectacular experience of camping by the beach. Redeveloped in 2017, the Big Lagoon camping area and day-use site has well-spaced camp sites and sheltered decking, toilets and barbecue facilities near the shoreline.

THINGS TO DO AND SEE

In September 2022 there was also a brand-new boardwalk and lookout built at the high point of the site providing incredible views. You are welcome to fish in the lagoon south of the camping area but fishing and crabbing are prohibited in Big Lagoon's northern waters (an important fish nursery area). These are protected within a sanctuary zone in the Shark Bay Marine Park. Drop nets for crabs are allowed but set netting and spearfishing are not permitted. To protect dolphins and dugongs, waterskiing and freestyle jet skiing are not permitted. Besides the Big Lagoon, there's also beachside camping available at Bottle Bay, Herald Bight, South Gregories and Gregories campgrounds.

Francois Peron National Park was once a pastoral station, and you can visit the Peron Heritage Precinct to experience how life was on a remote sheep station. Explore the history of the area around the self-guided walk and see how the shearers worked and lived. Enjoy a dip in the hot tub, a popular place to soak in artesian waters. Make sure to check out the world-class views at Skipjack Point Lookout. The lookout is perched on the cliff edge where you can enjoy the spectacular Cape Peron coastline and wildlife. It can be accessed from the Wanamalu Walk Trail. Be sure to look towards the ocean along the way for a chance to see marine life such as dolphins, sharks, rays, dugongs, turtles or schools

Clockwise from top Cliffs near South Gregories. *Photo – Janine Guenther;* Visitors can enjoy a relaxing soak in the artesian waters hot tub at Peron Heritage Precinct; Variegated fairy-wren (*Malurus lamberti*). *Photos – Sallyanne Cousans;* Clay pan birrida. *Photo – Jiri Lochman;* Pied cormorants (*Phalacrocorax varius*) at Skipjack Point; Shark Bay daisy south of Big Lagoon (*Pembertonia latisquamea*); Thorny devil (*Moloch horridus*) on 4WD track. *Photos – Janine Guenther*



of fish—remember your binoculars! The Wanamalu Walk Trail stretches for 1.5 kilometres along the cliff edge between Cape Peron and Skipjack Point. Spectacular red sand cliffs extend in either direction, offering fantastic photo opportunities. The 45-minute (one-way) walk provides excellent views of the coastline and it is common to see marine wildlife such as rays, sharks, dolphins, schools of fish and flocks of cormorants.

PLAN AHEAD AND BE SAFE

As with all remote parks and reserves, visitors are advised to ensure they undertake appropriate planning. As there are no water, food, fuel or vehicle services in the park and mobile phone coverage is limited, be sure to pack enough food, water, fuel and first aid supplies to last for the duration of your stay. When boating, fishing, snorkelling or diving be sure to follow all the 'know before you go' safety precautions at exploreparks.dbca.wa.gov.au.

The Department of Biodiversity, Conservation and Attractions (DBCA) is working together with the Malgana Aboriginal Corporation about the potential establishment of joint management. Francois Peron National Park is part of this negotiation as is the establishment of additional reserve areas in the Shark Bay area.

This page from top Big Lagoon. *Photo – David Bettini;* Wild rose (*Diplolaena grandiflora*). *Photo – Sallyanne Cousans;* Echidna (*Tachyglossus aculeatus*). *Photo – Janine Guenther;* Tyre pressure station. *Photo – Tiffany Taylor*

Do it yourself

Where is it? 4 kilometres from Denham, 340 kilometres from Carnarvon and 410 kilometres from Geraldton. Entry fees apply.

Total area 52,529 hectares

Recreational activities Walking, picnicking, swimming, four-wheel-driving, fishing, bush camping

Must see sites Cape Peron, Big Lagoon

Nearest Parks and Wildlife Service Office Knight Terrace, Denham (08) 9948 2226

FIRE, FOXES AND FERAL CATS – DISCOVERIES AND ADVENTURES OF A WILDLIFE SCIENTIST IN WESTERN AUSTRALIA

BOOK

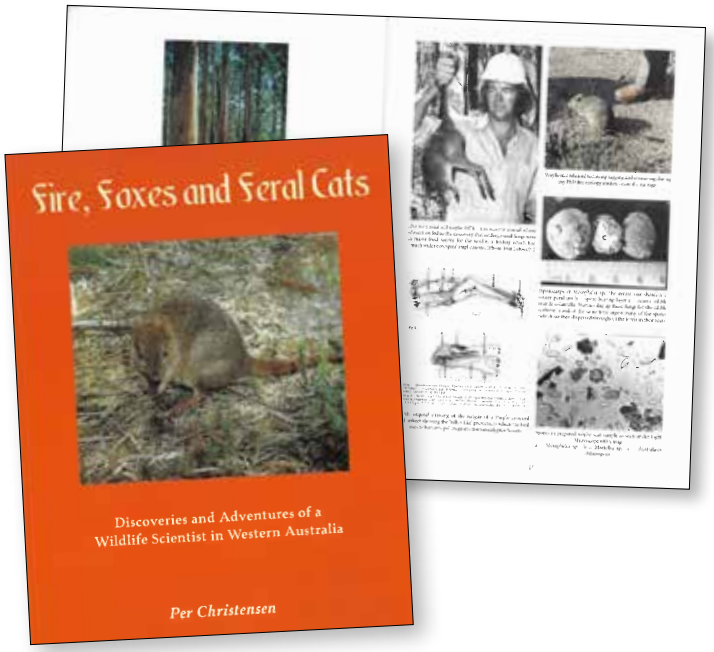
Ecologist Per Christensen's *Fire, Foxes and Feral Cats* is part memoir, part scientific analysis of the factors causing the demise of many native Australian plants and animals since European settlement.

Having spent the earlier parts of his life in Kenya, Denmark and Africa, Christensen moved to Manjimup, Western Australia, in the 1960s to study the area's forests.

The book is written from a first-person perspective and includes many interesting observations from a newcomer in a strange land, and anecdotes about negotiating science and politics around the often divisive topics of bushfire management and feral animal control over his extensive career.

Christensen's obvious passion for and knowledge of wildlife science and wry humour make for an interesting and enjoyable read.

Fire, Foxes and Feral Cats – Discoveries and Adventures of a Wildlife Scientist in Western Australia *can be purchased from the Hesperian Press website: www.hesperianpress.com*



ISLAND JEWELS: THE NATURAL HISTORY OF WESTERN AUSTRALIA'S ISLANDS

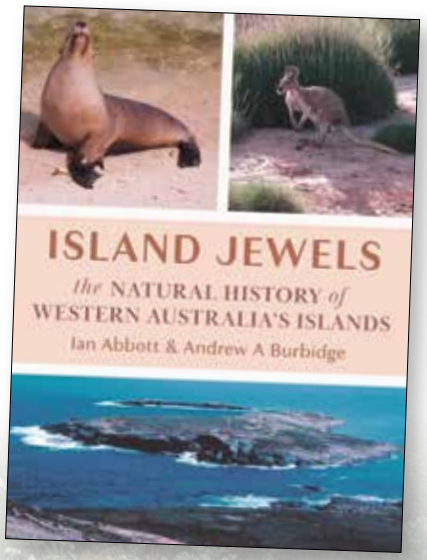
BOOK

Western Australia has more than 3500 islands–more than any other Australian state or territory.

In *Island Jewels*, experienced wildlife scientists Ian Abbott and Andrew A Burbidge share their vast knowledge and enthusiasm for Western Australia's diverse islands in the first book to comprehensively cover their biodiversity and natural history.

The islands are grouped geographically starting in the Kimberley then travelling down and around the south coast. The geography, discovery and naming, and physical and biological characteristics of each island or group of islands are covered, as well as factors impacting biota.

The book includes reference material, maps and many colour photos of landscapes, vegetation and animals and should delight those with an interest in natural history and the environment.



Island Jewels: The natural history of Western Australia's islands *is available from most online bookstores.*

MUNDA BIDDI TRAIL GUIDE

APP

Guest review by Corrin Everitt

The *Munda Biddi Trail Guide* app is a must-have to help you confidently navigate the stunning Munda Biddi off-road cycling trail.

Several times on my recent five-day journey I was thankful to have this app on my phone, including when I'd taken a wrong turn after leaving Wellington National Park and when I was wanting to avoid yet another hill and instead find my way along the beautiful creekside trails leading into Manjimup.

Using your phone's GPS, the app can locate you on and offline, meaning you always know where you are and what's coming up. The app also provides information on accommodation options in each town, hut locations and their distance from you, information about each section of the ride, and planning tips and pointers.

The app was extremely helpful for me in the lead-up to my trip and the app allowed me to plan my ride as I went using the app to find water and food stops along the way each day.

The Munda Biddi Trail Guide *app is available for $21.99 from the Apple Store and Google Play and is well worth the investment.*


THOMAS

Caring for Country

Environmental benefits from the Aboriginal Ranger Program

by Dr Kate Rodger and Dr Amanda Smith

Traditional Owners have been caring for Country for millennia. After colonisation, their connection to country and ability to care for Country was sometimes forcibly removed but the Aboriginal Ranger Program is playing a part in restoring that connection, with benefits for the rangers themselves, the community and, importantly, the environment.

Previous page
Left Ngurrara Rangers on Country.
Right Bardi Jawi Country, Dampier Peninsula.
Photos – Shem Bisluk/DBCA

Above Nyul Nyul rangers at controlled burn.
Photo – Sophie Henderson/DBCA

Working on and caring for Country is a significant part of Aboriginal culture. Aboriginal people were disempowered across Australia after colonisation. Being forced off their Country resulted in reduced access to their traditional way of life and ability to care for Country. They also lost their legal control, coinciding with the loss of some of the key components of their culture including language, Law/Lore, spirituality and family.

"A lot of people have lost that connection," a Ranger Coordinator said. "What happened in the early days, people were taken away from their Country and were told you had to be educated and act like a white person otherwise you won't be considered a citizen."

However, connection to Country is not necessarily achieved just by living or working on Country, instead it requires the ability to access, use and learn about Country.

In 2017, a state-wide Aboriginal Ranger Program (ARP) commenced in Western Australia as a five-year, $20 million initiative for Aboriginal organisations to manage Country and protect the environment with support from the Department of Biodiversity, Conservation and Attractions (DBCA). Through the ARP, rangers are able to spend time on Country, learning about and caring for Country.

"So much knowledge comes from just being on Country," a Land and Sea Manager said. "The drive in to where we are going can be just as important because the old people tell me about all these things. If you don't know the landscape, it can look quite similar as you are driving through but as you get told about everything you begin to understand about Country."

By spending time on Country rangers are able to learn how to care for Country.

"People used to know when they could hunt and catch things from what was flowering or what was happening in the environment," a Ranger Coordinator said. "So, through the ranger program they have got that opportunity to develop that understanding of how it all works."

WA's Aboriginal Ranger Program has funded more than 30 different ranger programs from 2017 to December 2021, with more than 800 people being employed across the State and almost 50 percent of those roles being filled by women.

A unique approach was taken of funding ranger groups on and off tenure, with on-tenure referring to DBCA-managed lands and water. Across the suite of different projects, rangers have been undertaking environmental work on Country including fire management, biodiversity monitoring and research, feral animal and weed management,

Hear directly from Aboriginal rangers about their experiences

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

To end of June 2022 there has been:

More than 7200 hectares actively managed

More than 2000 kilometres of track managed

More than 270 threatened flora and fauna surveys

More than 1,350,000 hectares managed for feral animals

More than 2000 hectares managed for weeds

traditional knowledge transfer, cultural site management and management of visitors or tourism and tourism assets. All of these are helping to deliver a range of environmental and cultural benefits.

TANGIBLE OUTCOMES

The fundamental outcome of the program is the increased capacity within the Aboriginal community to undertake land and sea management. This caring for Country encompasses conservation and maintenance of tangible aspects including the flora and fauna.

A number of environmental outcomes have enhanced the protection of cultural and biodiversity values through management activities undertaken by Aboriginal rangers.

"We do heaps of stuff from feral animals, biodiversity surveys, fire management, water monitoring and looking after Country and most importantly is the knowledge transfer with our Elders," a Woman Ranger Coordinator said. "We want to keep our language and culture alive and in doing so the transfer of knowledge is the key."

A number of environmental benefits were identified and include the removal of feral animals, weeds, biodiversity surveys, fire management as well as protecting cultural sites.

"Aboriginal people have a special connection with land," said the CEO of an Aboriginal Corporation. "There are elements of Aboriginal culture that have been suppressed for hundreds of years that they can bring to the forefront on how to care for Country, but also mixed with modern science. There is a great complementary relationship between Traditional Owners and non-Indigenous people coming together as a collective to care for Country."

TWO-WAY LEARNING

Working together and the sharing of knowledge, often referred to as two-way learning, draws upon western science as well as indigenous cultural knowledge

Top Esperance Tjaltjraak Country.

Inset Karajarri Ranger showing a native plant.
Photos – Shem Bisluk/DBCA

Above Bardi Jawi Oorany rangers in a greenhouse.
Photo – Amanda Smith/DBCA

"[The] Gouldian finch is important because it is rare and not seen for ages. Now can see it due to the management they have put in place. Seeing them coming back is amazing, all coming back now. Community mob don't know about [the] bird, so we have to teach them about the bird. They start to value them more as well and get excited about it as well."
(ARP Ranger)

to care for Country. This approach encourages collaboration and sharing of knowledge between all those managing the land and sea as Aboriginal people undertake traditional practices when caring for Country whilst incorporating scientific research.

Two-way learning has a positive impact, not just on looking after Country but also for non-Aboriginal managers, funding partners and the broader community who gain a greater exposure and appreciation of traditional knowledge.

"They [Aboriginal people] get an opportunity to learn and share their culture," a key project partner said. "When the department [DBCA] is lucky enough to be in collaboration with Traditional Owners, not only do we get to talk about the western science and monitoring, but we get to learn some of that traditional ecological knowledge."

"The combination of those two things is really powerful when we are working with Traditional Owners managing Country."

A good example of this is Traditional Owners working with DBCA on and off tenure in helping to share and gain knowledge of cultural fire practices and how these principles can assist in guiding the use of fire in today's landscapes

As Traditional Owners, Aboriginal people have a cultural responsibility to care for Country using fire as a key management tool. Traditional Aboriginal burning practices have been severely disrupted with many of WA's landscapes changing significantly due to the establishment of permanent communities, infrastructure, agriculture and other industries.

Through the program, Aboriginal Rangers have undertaken prescribed burning and bushfire suppression over more than four million hectares of land.

"We do right way fire," said the CEO of an Aboriginal Corporation. "So, we get traditional knowledge of burning and for fire and then we get the scientific knowledge, like lot of machines and stuff. We go by two things—traditional way and scientific way."

HEALTHY COUNTRY

Conserving the natural environment, or caring for Country, is a key focus of the ranger groups.

"We have a healthy Country plan that was developed and articulates our priorities" an Indigenous Protected Area Coordinator said.

Above Bardi Jawi Oorany rangers and DBCA staff spotting Gouldian finches.
Photo – Shem Bisluk/DBCA

"Looking after plants and animals and knowledge, indigenous knowledge transfer, cultural sites, wetlands and springs (no rivers) and the coastline, which is quite pristine."

The Aboriginal Ranger Program provided resources for biodiversity monitoring and management to better protect the environment.

"We do lot water monitoring and lot of jila [water] sites and we do lot of camera trapping, bilby monitoring, reptiles, night parrots," an Aboriginal ranger said.

"We also do trapping of feral animals like cats that are our main big problem out here, getting rid of them. It is really important for us to be out here to try and manage and protect and look after."

With the support of key funding partners, several of the ranger groups are involved with the collection, storage and propagation of native seeds. Rangers

are spending time collecting seeds from culturally significant plants, as well as rare and endangered species to contribute to seed banking and the production of bush medicines.

"It is good learning that on Country and seeing the different bush plants and looking after them," an Aboriginal ranger said. "Get some seeds and start growing some of them. We have been growing some bush plants at the ranger base. Have been doing bush medicine with lip balms, ointment foot balms."

Rangers are trained and learning skills in propagation and regeneration of vegetation.

"I like doing the seed collection, I find that interesting," an Aboriginal ranger said. "Working out when to pick them and how to store them. I like learning on Country. Actually, going out and finding and seeing it for yourself. I didn't know much…but by just going out I'm learning about Country, I'm learning the scientific names for all the plants."

CARING FOR COUNTRY

The outcome of being back on Country, caring for Country is a healthy Country (see 'Connection to Boodja: A healing process' *LANDSCOPE* Spring 2021).

"If you have got a healthy Country, it means that you are going to be healthier in yourself mentally and physically," an Aboriginal ranger said. "Looking after it [Country] and taking care of it makes Country healthy."

The environmental outcomes and benefits identified from the Aboriginal Ranger Program are extensive. In March 2021, the State Government acknowledged the success of the program and committed $66.5 million in additional funding to continue and expand the program from 2021 to 2026.

This has been well received by Aboriginal communities because as they have identified, if there were no Aboriginal rangers on Country then the "…impact would be not only on the people but also the conservation and protection of Country, 'cause if we don't have rangers then we can't look after Country," an Aboriginal ranger said.

"The government…they need somebody out here looking after Country, nobody else can do it," a Ranger Coordinator said. "They need Aboriginal people."

Top left Esperance Tjaltjraak rangers marking trails.

Top right Ngurrara rangers spending time out on Country.

Above left Esperance Tjaltjraak rangers learning about macroinvertebrate sampling.
Photos – Amanda Smith/DBCA

Above Ngurrara Ranger explaining bush medicines.
Photo – Shem Bisluk/DBCA

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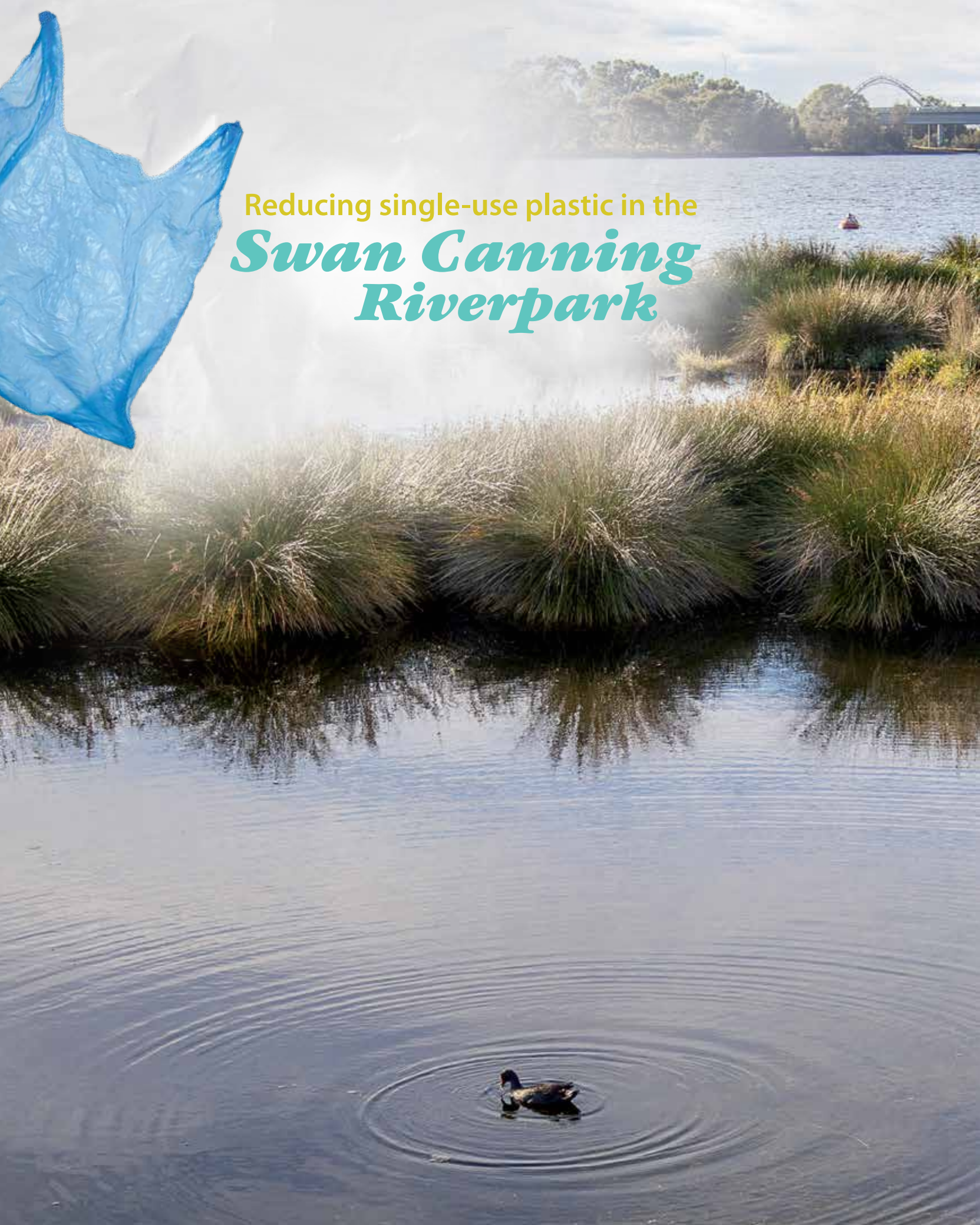
Editor's note: names throughout this article have been withheld for cultural and best practice research purposes.

The authors acknowledge and thank the ranger groups, their representatives particularly the Bardi Jawi Oorany Rangers, Nyul Nyul Rangers, Ngurrara Rangers, Karajarri Rangers, Esperance Tjaltjraak Rangers, associated Aboriginal Corporations and all Key Project Partners for contributing to this research, sharing their knowledge and taking us out on Country.



Reducing single-use plastic in the

Swan Canning Riverpark

Derbal Yerrigan (Swan River) and Djarlgarra or Dyarlgarro (Canning River) are known and loved by many. Home to more than 80 bird species, more than 200 recorded species of fish and around 24 Indo-Pacific bottlenose dolphins, the Swan Canning Riverpark is an ecologically and culturally significant attraction. However, the river faces a variety of stressors from contaminants, including plastic pollution.

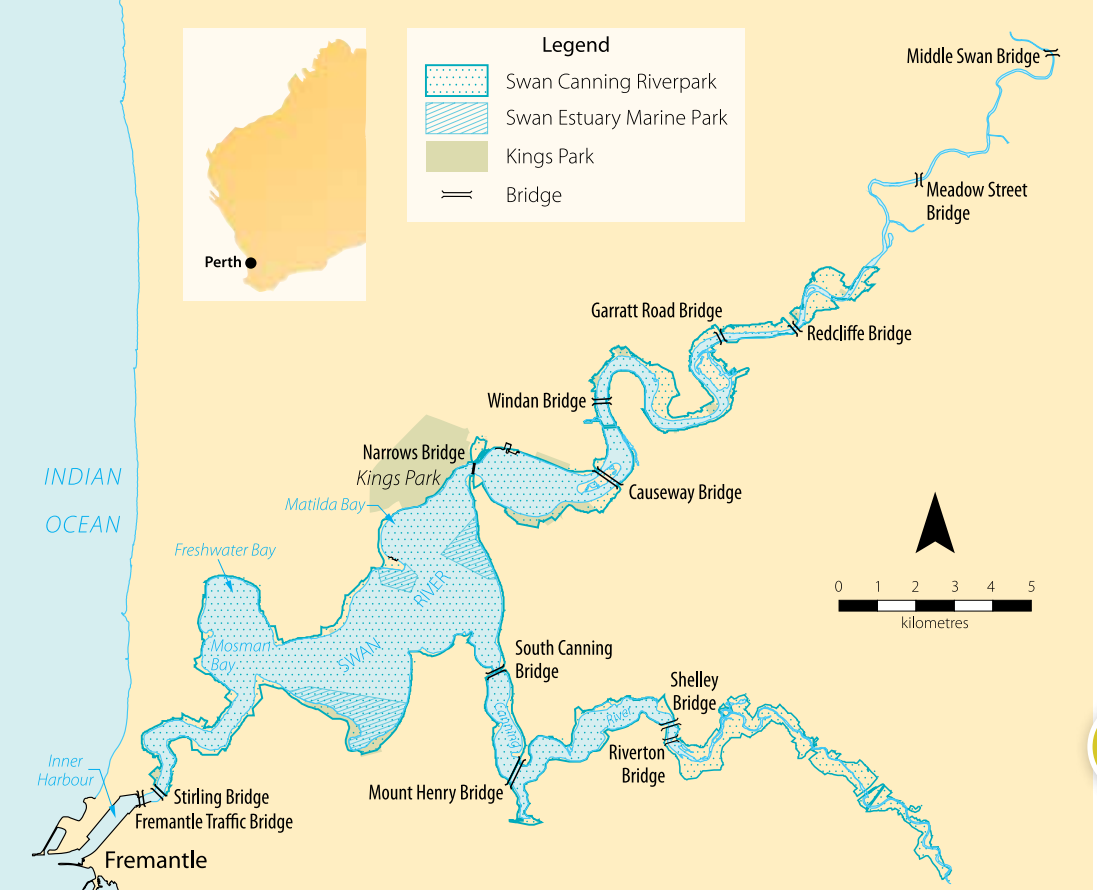
by Zoe Beeson

Awareness around plastic pollution is increasing, as are community efforts to reduce single-use plastic. Now with *Western Australia's Plan for Plastics* banning the sale and supply of selected single-use plastic items, business and industry have begun a major transition.

Through the Plastic Free Riverpark program, it is anticipated more than $95,000 in grant funding will support projects that reduce single-use plastic packaging within cafés, restaurants, bars, charter operator vessels, sporting organisations and at major foreshore events in and around the Swan Canning Riverpark. In many cases reusable alternatives have been adopted to help reduce the amount of waste generated.

In 2022, the Plastic Free Riverpark program supported 46 projects to reduce single-use plastic packaging. From cafés introducing reusable cup exchange programs to events providing reusable serve-ware, Perth's riverfront businesses trialled initiatives to reduce single-use plastic waste.

From 2021 to 2025, it is expected that funding from the Plastic Free Riverpark program will support more than 100 Riverpark venues and 20 major foreshore events. The program is delivered by the Department of Biodiversity, Conservation



Hear more about the impact of plastics in our waterways

Scan this QR code or visit Parks and Wildlife Service's podcast.

and Attractions (DBCA) in partnership with the Department of Water and Environmental Regulation (DWER), Boomerang Alliance's WA Plastic Free program and Perth's riverfront local governments and is on track to remove over 500,000 single-use plastic items from Riverpark venues and organisations as part of the program.

REDUCING PLASTIC USE

Since joining the Plastic Free Riverpark program in May 2021, the team at Royal Perth Yacht Club has worked with its members, the restaurant and function centre to eliminate single-use plastic packaging.

Previous page
Main Dusky moorhen (*Gallinula tenebrosa*) at Claisebrook, Swan Canning Riverpark.
Photo – Cliff Winfield
Insets Single-use plastics.
Photos – Adobe Photostock

Above Map showing Swan Canning Riverpark.

Above right Dr Peter Novak works with Curtin University students to analyse plastic samples collected in a net.
Photo – Zoe Beeson/DBCA

"A few years ago, we installed a water refill station and have already avoided more than 18,000 plastic bottles thanks to members bringing their own refillable bottles," Marketing Manager Kelly Scott said.

"Using reusable serve-ware instead of single-use alternatives for events, even with cleaning cost, will save money, reduce waste, and decrease the risk of contamination across recycling and landfill bins and reduce waste near the Riverpark."

"The grant we received from the Plastic Free Riverpark program allowed us to supply members with collapsible bins for their boats. Due to lack of storage, a boat may only have one bin for general waste where everything, including valuable recyclables, is collected and sent to landfill."

"Now our members are collecting recycling including Containers for Change. It's been hugely popular, and we're looking forward to making our first donation to charity from containers collected. We're also encouraging members to reduce the plastic they use on board their boats and ensure it's secured so it doesn't come off the vessel."

"Making changes was easier than I anticipated," café owner Nigel Warne said.

"At La Patisserie South Perth, we're eliminating all plastic beverage containers in our fridge and are trialling reusable cup exchange programs such as Green Cafeen and Renome with our customers,"

"COVID meant a lot of our customers stopped bringing their own reusable cups. I hope with community education and more businesses joining this program that we can see that reusable culture come back even stronger."

Stephanie Ross, lessee for the DBCA Kensington Café, wanted to lead by example and has hosted some noteworthy behaviour change initiatives.

"Earlier in 2022, around 70 per cent of the hot drinks we sold were in single-use cups," Stephanie said.

"We then introduced a mug library and cup exchange program and started asking DBCA staff if they really wanted their drink in a single-use cup."

"In October 2022, we hosted a reusable cup day in the café and were amazed at the result. In 2023, we have completely eliminated single-use cups—a reduction in 350 cups and lids per week.

"COVID meant a lot of our customers stopped bringing their own reusable cups. I hope with community education and more businesses joining this program that we can see that reusable culture come back even stronger."
(*Nigel Warne*)

Above DBCA staff member borrows a mug library cup for coffee at Stephanie's Café.

Top right Plastic straws, lids, plastic resin pellets and fishing line collected at Jenalup Beach.

Above right La Patisserie South Perth owner, Nigel, with plastic-free alternatives.
Photos – Zoe Beeson/DBCA

Above far right Royal Perth Yacht Club member Mark collects Containers for Change.
Photo – Royal Perth Yacht Club

Inset right Alternatives to single-use plastic.
Photos – Adobe Photostock

Reducing plastic waste in the Riverpark

- More than $95,000 in grant funding has supported projects reducing single-use plastic packaging across Riverpark businesses and events.
- 163,065 pieces of single-use plastic were avoided across Riverpark businesses and events in 2022.
- 98 per cent of Western Australians surveyed by DWER in 2019 supported further action to reduce single-use plastics.
- 2500 pieces of plastic per square metre were found at some of the 38 shorelines sites surveyed by DBCA in 2021.
- Fragments of soft and hard plastic appeared in more than 90 per cent of the 152 surveys conducted.
- In May 2022, Keep Australia Beautiful WA found food packaging to be within the top three highest items by volume collected in Australian litter measure surveys.
- In 2022, nine of the top 10 items collected in clean ups and recorded in the Australian Marine Debris Initiative database were comprised of plastic. *Source: Tangaroa Blue Foundation*

An individual can avoid hundreds of single-use items per year by choosing to reuse.

Plastic prevalent in the Swan Canning Riverpark

In 2021, DBCA scientist Dr Peter Novak led a collaborative project with DWER to survey plastic in the Swan Canning Riverpark. Thirty-eight shoreline sites were sampled four times each, with counts at some sites exceeding 2500 pieces of plastic per square metre.

Of the 152 surveys conducted, fragments of soft and hard plastic appeared more than 90 per cent of the time, expanded polystyrene was found more than 80 per cent of the time. These items could have begun life in a variety of ways, including as packaging for food and beverage purposes. Plastic resin pellets used in the manufacture of plastic products were also found in large quantities across the Riverpark. This work has provided baseline data on plastic pollution in the Riverpark. The method can be repeated to measure the effectiveness of mitigation measures in the future.

Single-use items are designed to be used only once before they are thrown into landfill or end up as litter in the environment. Their take, make, dispose nature is wasteful, and plastic debris that is not captured through waste systems can have life-threatening impacts on wildlife including entanglement and ingestion.

Dr Peter Novak is an Environmental Officer with DBCA's Biodiversity and Conservation Science and can be contacted for more information at peter.novak@dbca.wa.gov.au

The reduction of waste and cost is significant, and we have continued making changes to reduce our plastic use."

Lucky Shag Waterfront Bar is a venue directly over the Swan River so staff often see wildlife.

"Thanks to staff support, we got rid of plastic straws and paper coasters for drinks, which were falling through the boardwalk," said Venue Manager, Conor Heaney.

"Now we've joined the program to reduce single-use plastic containers and plastic wrap used in the kitchen. We're also asking our staff to use reusable containers for leftover food, rather than taking single-use compostable options home that may not end up in the right bin."

MAJOR FORESHORE EVENTS

During 2022, local governments and event managers with support from DBCA, have helped showcase reuse in action at four major foreshore events. Nearly 45,000 pieces of single-use plastic was avoided as 21,815 reusable cups, 14,040 reusable dishes, and 7570 pieces of reusable cutlery were provided to vendors and attendees.

The Plastic Free Riverpark program supported Fremantle Ports' Maritime Day, the Rotary Club of Applecross and City of Melville's Jacaranda Festival, City of Canning's Muddy Hands Festival, and Town of East Fremantle's George Street Festival with grants to provide reusable serve-ware, water refill stations, and waste education for attendees.

CHOOSE TO REUSE

In 2019, 98 per cent of Western Australians surveyed by DWER supported further actions to reduce single-use plastics in WA. Community support continues to be an integral part of the solution.

Perth residents and Riverpark visitors can choose reusable items such as a cloth bag or reusable bottle or cup. Keep items near the front door or in the car. It's good to support local businesses that accept or offer reusable items (if you bring your own, always make sure your cup or container is clean before handing it over).

Daily actions, no matter how small they may seem, can make a big difference. Together we can help reduce single-use plastic in and around the Swan Canning Riverpark, ensuring healthy and beautiful rivers for generations to come.

Above left Plastic litter found washed up on the shore at Point Fraser Reserve.

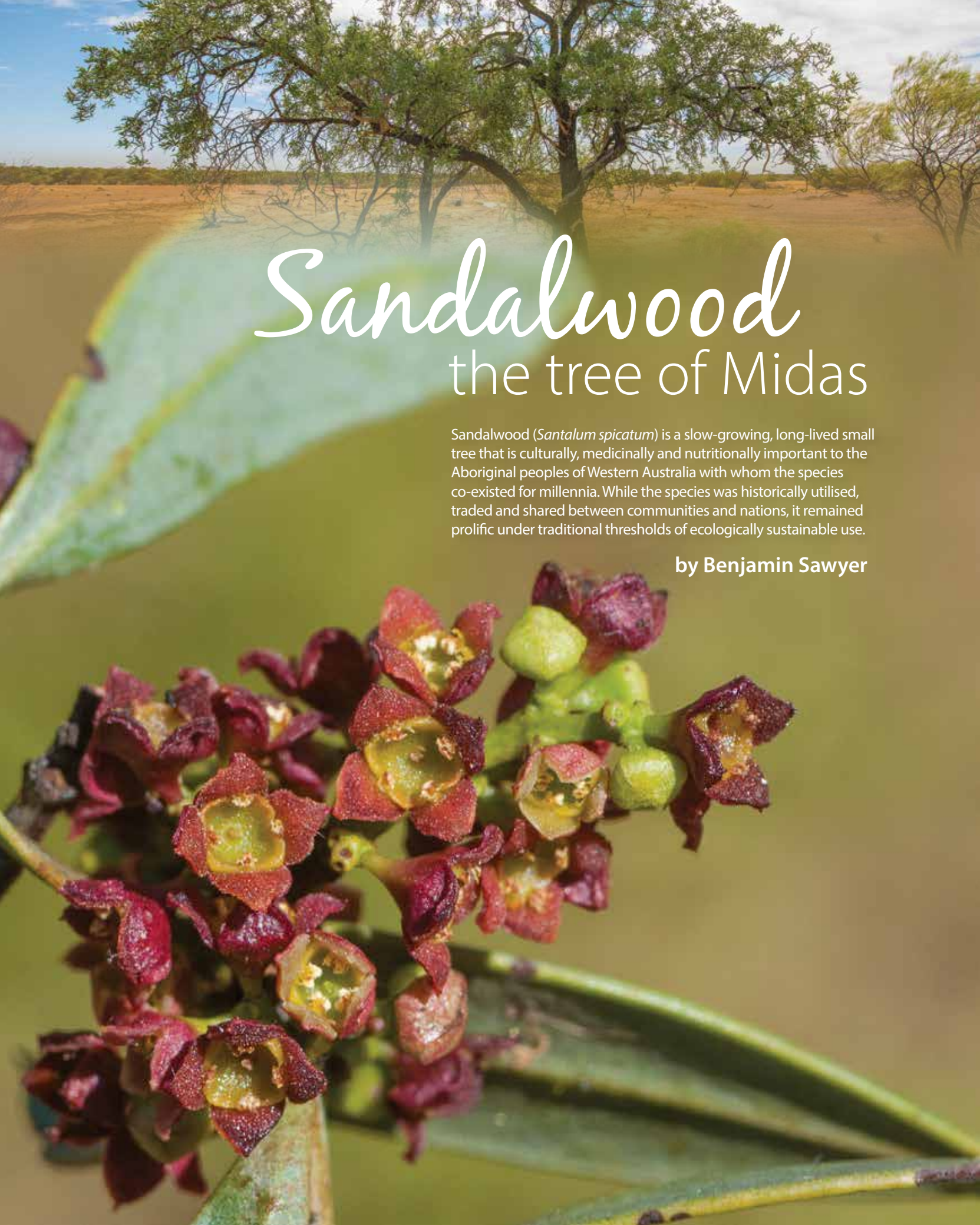
Top Stephanie from Go2Cup collects serve-ware at the Jacaranda Festival to be washed and re-used again.

Above Devashish from Juice Station sells a mango smoothie in a reusable cup.
Photos – Zoe Beeson/DBCA

Zoe Beeson is the Project Officer for DBCA's Plastic Free Riverpark program. She can be contacted on (08) 9278 0985 or by email plasticfreeriverpark@dbca.wa.gov.au

For the latest Riverpark news including updates on the Dolphin Watch program, Reel It In fishing line bins and Riverwise Gardening workshops, visit the River Guardians website riverguardians.com

And if you'd like to volunteer to keep your patch clean, why not Adopt a Spot with Keep Australia Beautiful Council?



Sandalwood
the tree of Midas

Sandalwood (*Santalum spicatum*) is a slow-growing, long-lived small tree that is culturally, medicinally and nutritionally important to the Aboriginal peoples of Western Australia with whom the species co-existed for millennia. While the species was historically utilised, traded and shared between communities and nations, it remained prolific under traditional thresholds of ecologically sustainable use.

by Benjamin Sawyer

Sandalwood (*Santalum spicatum*) is many things to many people and known by many names including birdilyba, kirti, munyunpa, parnjal, pikarra, tarrtjanpa, tatjan, tujan(pa), thumbuny, uilarac, walarda, walku, warlka, wirawayin, uilarac, waang, willarak, wolgol, wollgat poilyenum, native sandalwood or Western Australian sandalwood.

One of 25 known species of the *Santalum* genus, sandalwood is one of four species that is indigenous to Western Australia. In arid and semi-arid regions, sandalwood typically grows up to four metres in height with a stem diameter of 200 millimetres (measured at 150 millimetres above the ground). An occasional sandalwood specimen growing in the Wheatbelt region may be observed to be more than ten metres in height.

Sandalwood reproduces through production of fruits consisting of a leathery tan-brown outer skin (epicarp) and a smooth round inner nut (endocarp). The endocarp may be 10-25 millimetres in diameter and weigh two-to-three grams. Fruits are dispersed by the seed caching (scatter hoarding) behaviours of ground-dwelling marsupials including woylies (*Bettongia penicillata*) and boodies (*Bettongia lesueur*). Water flow across and through the landscape is also an important seed dispersal and recruitment vector.

A hemi-parasite is a plant that gains part of its resources through connections with another plant while also photosynthesising. Sandalwood is a root hemi-parasite that requires nitrogen-fixing host plants (particularly of the genus Acacia) from soon after germination through to maturity. Sandalwood roots connect to host roots through structures called haustoria. Each haustorium can be up to 20 millimetres in length and an individual sandalwood tree can have hundreds of connections. The haustoria function is to supply the sandalwood tree with water and nutrients from its host.

Within Western Australia, sandalwood is distributed across 173 million hectares of the Wheatbelt, Goldfields, Murchison, Gascoyne and southern Pilbara regions. These lands are the Country of 80 or more Aboriginal groups that, while increasingly considered for Native Title remain largely managed for pastoralism, cropping, conservation, and mineral exploration and extraction.

Previous page
Main Sandalwood flower.
Photo – Jiri Lochman
Inset Sandalwood.
Photo – Marie Lochman

Top left 13-year-old 'planted wild' sandalwood tree producing fruit.

Top right Gnarled stems of an old wild sandalwood tree.

Right A DBCA staff member collecting sandalwood population health data.
Photos – Benjamin Sawyer/DBCA

SPECIES IN DEMAND

The international economic value of sandalwood was recognised by early non-Indigenous settlers who began harvesting and exporting the species in the 1840s. By the 1890s, the economic value of sandalwood to the Western Australian colony (and later State) prompted extensive and ongoing research and inventory that has informed regeneration processes, conservation prescriptions, take limits and resource yield forecasts.

Sandalwood remains economically valuable and is commercially harvested under licence for the aromatic oils contained in its golden heartwood. As the heartwood extends throughout the tree, the whole tree including its roots is removed (taken) and processed.

The combination of environmental and land use changes of the last 200 years has impacted sandalwood occurrence at varying levels across WA's biogeographic regions. The most apparent declines in sandalwood populations are throughout the Avon, Wheatbelt and Mallee regions

Top left Sandalwood tree.
Photo – Marie Lochman

Top Woylie (*Bettongia penicillata*).

Above left Sandalwood fruit.

Above Feral camel.
Photos – Jiri Lochman

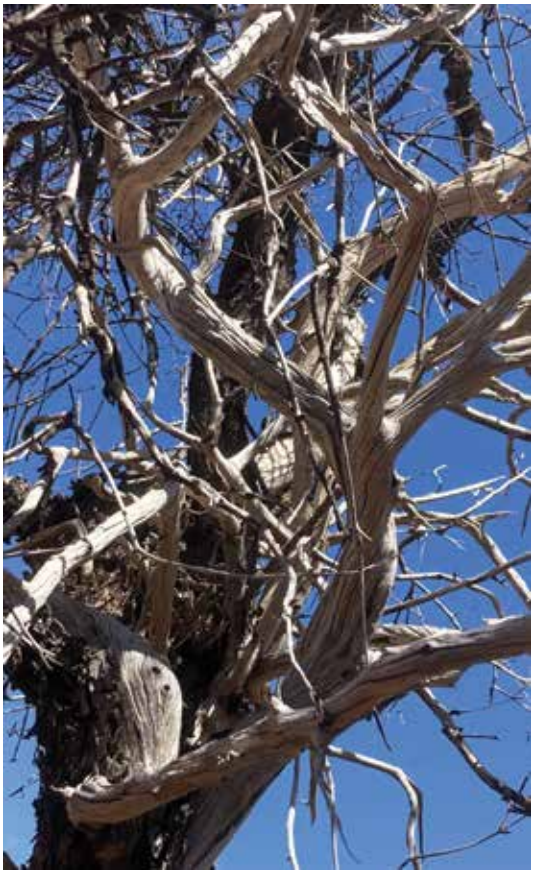
where extensive agricultural clearing has reduced wild sandalwood occurrence to fragmented populations within conservation reserves and remnant native vegetation on private property.

While sandalwood still broadly occurs across the Coolgardie, Murchison, Gascoyne and Yalgoo biogeographic regions, population numbers and plant condition vary considerably due to cumulative impacts associated with domestic ungulates, pest and feral species, lawful and unlawful take, altered fire regimes, deterioration of soil and water quality, and climate change.

These threats, particularly the broad extinction of woylies and boodies across mainland regions, give rise to strong concern for whether the current cohort of young sandalwood plants is sufficient in number to replace the projected decline of senescent sandalwood over the next 50 to 100 years. Sandalwood is listed as Vulnerable on the International Union for Conservation of Nature Red List and included on the Commonwealth Threatened Species Scientific Committee's Proposed Priority Assessment List. The assessment process is intended to be completed in October 2024.

KEEPING IT WILD

Whether sandalwood qualifies as a threatened species or otherwise, it is clear that the species requires active management to limit its decline and promote population recovery. Without intervention, the species' wild distribution may become confined to Wheatbelt nature reserves, the Great Western



Woodlands and watercourses in the northern and eastern rangelands and deserts.

It is critical that management of the species considers environmental, social and economic sustainability pillars including the potential for sandalwood to contribute to Aboriginal economic development for better social, health and cultural outcomes.

As such, this juncture may be the crossroads in which to align species management with opportunities for Aboriginal people, particularly those of the Central Deserts and Southern Rangelands. Now is the time for innovation and cooperation between Traditional Owners and the wider community.

TRADITIONAL KNOWLEDGE

Traditional Owner knowledge that has developed and been sustained through innumerable generations being connected with Country has intrinsic importance to biodiversity conservation, ecological processes, sustainable resource use and management. Traditional knowledge systems are complex, holistic and interdisciplinary.

> "Traditional sandalwood knowledge and western science working together respectfully can produce positive and innovative outcomes."

For example, Aboriginal peoples have always known the healing properties of the sandalwood seed kernel in the treatment of conditions such as rheumatoid arthritis and skin lesions and sores. Western science glimpsed this understanding in the early 2000s with the laboratory discovery of high concentrations of oleic acid and the rare ximenynic acid in the kernel. These constituents have high anti-inflammatory properties and regulate unsaturated fatty acids in human tissues.

Traditional sandalwood knowledge and western science working together respectfully can produce positive and innovative outcomes.

A TREE FOR THE FUTURE

Understanding that the drivers of sandalwood decline are multi-faceted enables the formulation of detailed, locally-specific sandalwood management plans that prescribe processes to establish and nurture seedlings and determine ecologically sustainable levels of use. Plans in some locations may deal with threats such as the increasing incursion of camels while other locations may focus on innovative seedling establishment processes attuned to the changing climate. There is also real opportunity for sandalwood management works to also benefit the wider environment through measures such as investment in Traditional Owner on-Country programs for fencing, fire management and fauna reintroduction.

Currently, 11 per cent of lands within the distribution area of sandalwood are managed for conservation by the Department of Biodiversity, Conservation and Attractions (DBCA). This land area

is dwarfed by the area subject to Native Title. Traditional Owners that decide sandalwood management is within their Country and community objectives may significantly contribute to its management at a far greater scale than is possible by State or Commonwealth government agencies alone.

DBCA is currently finalising a *Sandalwood* (Santalum spicatum) *Biodiversity Management Programme (Sandalwood BMP*) to provide for the conservation, protection, and management of wild sandalwood. This process involves considering and incorporating submissions provided by Traditional Owners, conservation interests, industry and the wider community. The Sandalwood BMP seeks to establish meaningful objectives, strategies and actions to stabilise wild populations through conservation and ecologically sustainable use criteria.

Midas of Greek mythology was rewarded by the god Dionysus with the magic of turning whatever he might touch to gold. After being initially overjoyed, Midas soon learned the curse in the powers that he had coveted. Will the wonder of sandalwood filling its cells with golden oil be its ultimate curse or saviour?

Opposite page
Left Historic sandalwood cutters' camp.
Photo – Jiri Lochman
Right Twisted branches of a dead sandalwood tree.
Photo – Benjamin Sawyer/DBCA

Above left Sandalwood seedling.
Photo – Jiri Lochman

Above right Ripe sandalwood fruit.
Photo – Ann Storrie

Right Mature sandalwood leaves.
Photo – Benjamin Sawyer/DBCA

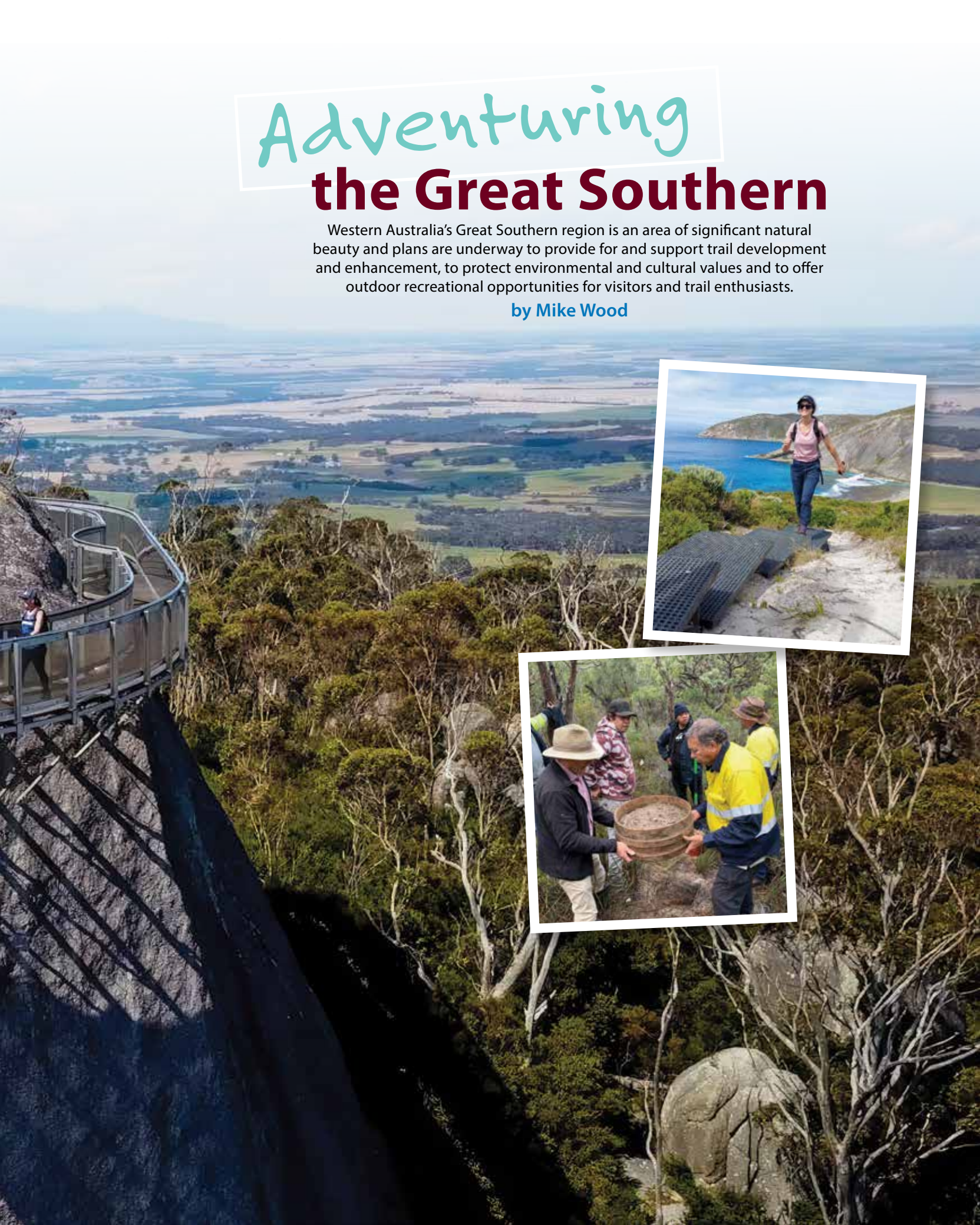
Below right Vibrant healthy sandalwood with maturing fruit.
Photo – Jiri Lochman

Benjamin Sawyer is the Senior Policy and Project Officer for sandalwood with DBCA's Parks and Wildlife Service. He can be contacted at ben.sawyer@dbca.wa.gov.au

Adventuring the Great Southern

Western Australia's Great Southern region is an area of significant natural beauty and plans are underway to provide for and support trail development and enhancement, to protect environmental and cultural values and to offer outdoor recreational opportunities for visitors and trail enthusiasts.

by Mike Wood



The Great Southern region of Western Australia is known for its tall forests in the west, spectacular Southern Ocean vistas, protected inlets and waterways, and bright white beaches. The region stretches from near Walpole in the west to beyond Bremer Bay in the east and inland to the broad-acre farming area around Nyabing.

It has a rich cultural heritage and strong connections for the Traditional Owners, the Menang people. The area also has a rich colonial history as Albany is nationally and regionally significant as the site of Western Australia's first European settlement and has a strong military heritage as the departing port for the ANZAC fleet.

The Great Southern Adventure Trails (GSAT) project began in 2020 focusing on the unique forests and coastal landscapes of the Great Southern and is working towards developing the area as a paddle, trail running, walking and cycling adventure destination, with significant progress already made.

Porongurup National Park

The granite outcrops of the Porongurup National Park rise 670 metres above see level and about 500 metres above the surrounding farmlands. The Range has an undulating terrain like huge, grey towers that have emerged out of the ground.

As you draw close to the peaks that dominate the skyline, and the 12 kilometres of distinctive granite domes, it is easy to imagine how the Traditional Owners of the land, the Menang people of the Noongar nation, viewed them as a place of great spirituality filled with important stories.

In Noongar language, Porongurup means 'totem'. The rocks and hills here are home to all totem spirits, sacred for all time. The Menang people never named individual peaks, they saw them as a collective, one stone. The Porongurups is a sacred and holy place, the place of the totemic sprits.

The Porongurup National Park is part of the south west biodiversity hotspot and is listed on the Commonwealth National Heritage List under the Australian Government's *Environment Protection and Biodiversity Conservation Act (1999)*, which protects Australia's most valued natural, indigenous and historic heritage sites.

To help people appreciate and enjoy the park, and to protect park values from increasing popularity, the existing walk trails in the Porongurups have been receiving significant upgrades over the past year, as part of the WA Recovery Plan delivered by the Department of Biodiversity, Conservation and Attractions (DBCA).

Stakeholders from local businesses, Traditional Owners, the Shire of Plantagenet, Friends groups, trail users, and DBCA staff, identified opportunities to improve trails and public amenities and all contributed to the development the Porongurup National Park Trail Master Plan.

"In Noongar language, Porongurup means 'totem'. The rocks and hills here are home to all totem spirits, sacred for all time. The Menang people never named individual peaks, they saw them as a collective, one stone."

Discover more about improvements at Castle Rock

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

Previous page
Main Castle Rock Skywalk, Porongurup National Park.
Inset centre Cultural engagement days were held onsite with the Traditional Owners.
Inset right Bald Head Walk Trail, Torndirrup National Park.
Photos – Samille Mitchell/DBCA

Above View to Nancy and Hayward Peaks from Devil's Slide, Porongurup National Park.
Photo – Marie Lochman

Above New steps at Castle Rock.
Photo – Cliff Winfield

Right New balustrading and platform at the base of the ladder, Castle Rock.
Photo – Samille Mitchell/DBCA

CASTLE ROCK

The very popular 4.7-kilometre-return Castle Rock Trail is at the north-eastern end of Porongurup National Park. With its impressive, suspended steel walkway, the Granite Skywalk and Lookout, Castle Rock Trail was the first project to receive attention.

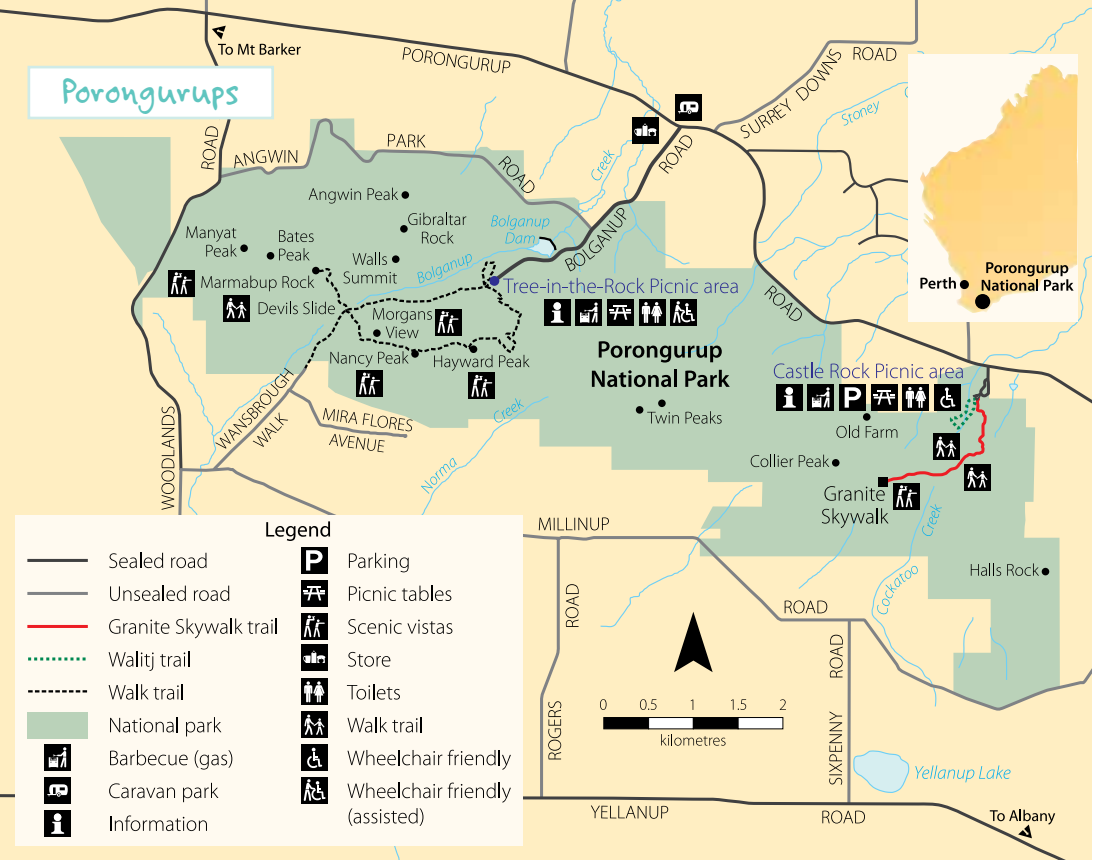
The impressive 736 new stone steps created by Kim Taylor and his team from KMT Contracting are complemented by more than 150 additional drains that were installed along the trail to improve the drainage and get water off the trail surface. The steps have been skillfully built, using locally sourced stone, giving the impression they have been in place for decades.

Starting at the Castle Rock picnic area, walkers climb through jarrah, marri and karri forest, past the fascinating Balancing Rock to the base of Castle Rock and the lower lookout.

The Castle Rock trail is now so popular that queues form to climb to the Granite Skywalk during peak times like school holidays. The six-metre steel ladder ascending to the upper Granite Skywalk has proved very popular with agile visitors. The addition of balustrading and a platform at the base of the ladder has improved the safety for waiting climbers and offers additional views past the rock and of the Stirling Range to the north.

Those not wishing to squeeze up the ladder can walk around to a similar, but lower lookout for panoramic views over the surrounding countryside and of the Skywalk above.

DBCA's landscape architects were tasked with improving the flow of foot traffic to the entrance to the Granite



Above Trail through cut karri.

Above right Helicopters are used to access challenging areas.
Photos – Jarred Pedro/DBCA

Skywalk and to improve the safety of those waiting to ascend the Skywalk.

In addition to the new platform structure at the top of Castle Rock, their designs also included an increase in car parking at the picnic area. There have also been upgrades and improvements to the interpretive signage, particularly recognising the Traditional Owners of the area and improved linkages to the trails.

TREE IN THE ROCK, NANCY PEAK AND DEVILS SLIDE

Work has now begun on trails at the western end of Porongurup National Park, focusing on the Tree in the Rock day-use area and the trails that are accessed from there.

Cultural engagement days have been held onsite with the Traditional Owners so that regional land managers can better understand how to celebrate and protect the cultural values of the site. This knowledge guides the design of facilities for visitors and encourages better communication and engagement with the community. Upgrading and improvement of the site includes increased car parking capacity and picnic facilities in the Tree in the Rock area, improved trail alignments to reduce walking on the slippery granite, and improved trail sustainability. These improvements will encourage more visitors to this part of the park, reducing pressure on the popular Castle Rock area.

DBCA's landscape architects have also prepared plans to refurbish the existing toilet block, providing accessibility and improving circulation and ventilation. New barbecue shelters and picnic facilities, including signage and interpretation, will be constructed as well as an accessible pathway network within the site. The designs have been developed considering the proximity to the Water Corporation's water protection requirements and Traditional Owner feedback and stories.

Work on the Nancy Peak trail began in June 2022, with approximately 630 stone steps being completed by the team at KMT Contracting. The steps are built in a way that reduces the width of the trail footprint and prevents widening from walkers using the sides of the trail. There have also been some small realignments to take the trail off steep granite outcrops to better protect the delicate mosses and lichens.

The bridge and boardwalk to Devils Slide will receive some maintenance with an upgrade to the existing timber structure and improved fixings. There will

Far left Footings and tools, Bald Head Walk Trail.

Left Fibreglass-reinforced panels.

Above Timber duckboards being installed at Bald Head Walk Trail.
Photos – Jarred Pedro/DBCA

also be erosion control work undertaken on the trail.

It is a very exciting time for those who like to walk in this unique part of the world. With these improvements to the trails in the Porongurups it will mean more people will be able to appreciate the beauty and tranquillity of the forest and understand its environmental and cultural significance.

Torndirrup National Park

BALD HEAD WALK TRAIL

The Bald Head Walk Trail is a 12.5 kilometre return trail and the premier trail experience within the Torndirrup National Park that experienced over 509,000 visits in 2021-22 (see *Adventure Out* on page 35).

Funding from the WA Recovery Plan has enabled DBCA's Parks and Wildlife Service to complete extensive trail renewal and coastal protection works on the Bald Head Walk Trail.

Work completed earlier in 2022 included the stabilisation of sand dunes, erosion control measures and surface treatments to timber duckboards on the first sections of the trail between the car park and Isthmus Hill.

Additional rehabilitation and erosion control work to the trail were undertaken following the construction of fibreglass-reinforced stairs, walkways and boardwalks. The trail remained open to the Isthmus Hill lookout while work was underway with some short, half day closures to ensure public safety during helicopter lifts for materials delivery.

The bulk of the work on the Bald Head Walk Trail was the construction of the new steps, walkways and boardwalks on the existing alignment, undertaken by Terpstra Construction and overseen and managed by DBCA Project Manager, Jarred Pedro.

After months of planning, packaging up helicopter sling bags full of construction materials including fibreglass-reinforced panels and stringers, timber sleepers, fastenings and construction tools, the helicopter operations started in March 2022 from the nearby Jimmy Newell's carpark with 80 airlifts completed.

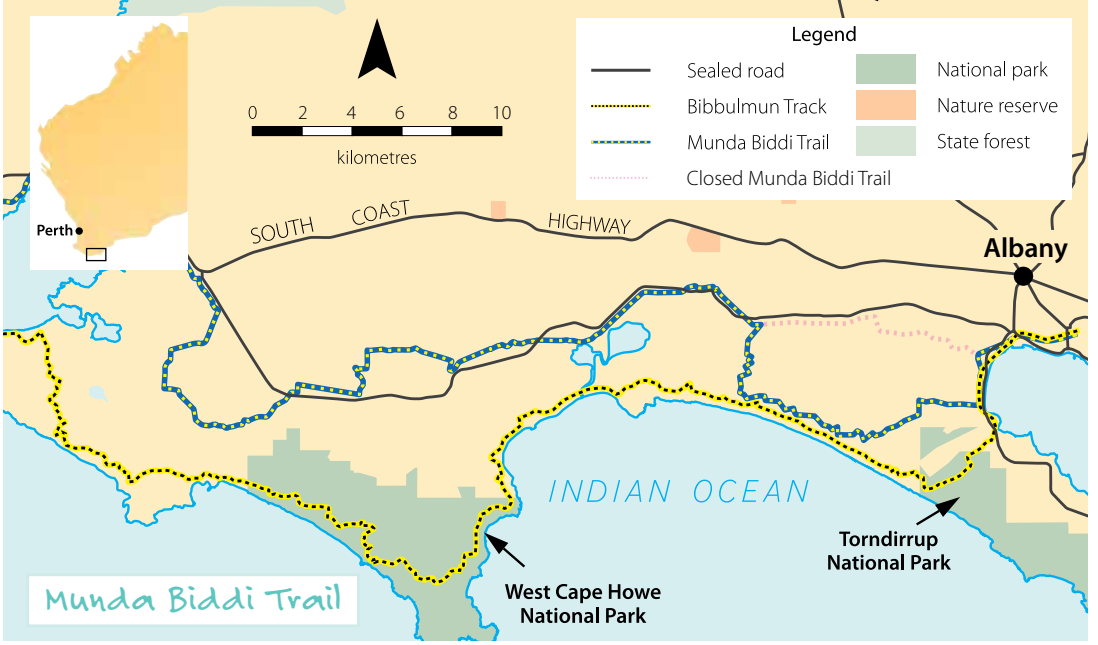
The Terpstra Construction team that included two local Menang men, began to prepare the footings with good weather allowing the team to drop more loads onto the track. Approximately 290 lifts were completed by Goodwin McCarthy Helicopters, including 40 loads for erosion control works at the end of the trail.

One of the main issues the team needed to repair were the depressions and cuttings that had been created over time as walkers trudged over fragile sand dunes, carving the trail surface so deep that it was sometimes up to shoulder height.

The upgraded Bald Head Walk Trail is proving to be popular with almost 3000 people enjoying the walk in the first month since re-opening in mid-December 2022. Work has focussed on ensuring the sustainability of the trail and surrounding environment. The improvement works now encourage walkers to stay on the trail and not walk off the side, creating braided and widening trails that damage the fragile vegetation. The new steps and boardwalks will reduce erosion and deepening of the trail surface.

Walkers will notice the use of coir matting, which is made from sustainable coconut fibre under and surrounding the trail. The coir matting prevents erosion of the sand from water and wind and helps to retain soil moisture, facilitates seed retention and helps to reduce foot traffic on the fragile sides of the trail.

The pins that pierce the coir matting and hold it to the earth are bio-gripper,



biodegradable pins made from potato starch.

The construction of a new toilet and the development of a new asphalt car park are also underway in 2023.

Visitors to nearby Misery Beach, voted the 'best beach in Australia' in 2021 by Tourism Australia, will also notice that the beach access and pathway have been improved. New roadworks will further improve access and parking, including sealing the Misery Beach car park.

Munda Biddi Trail

ALBANY WINDFARM REALIGNMENT

Cycle trails on the south coast have also received some attention. The William Bay cycle trail was completed last year, planning work continues for the Wilderness Ocean Walk (WOW) stage 2 trail near Denmark and the realignment of the Munda Biddi Trail, past the Albany Windfarm, was completed just before Christmas 2022.

The new 21-kilometre Munda Biddi Trail realignment through the Windfarm provides sweeping views over the coastline as well as the spectacle of the massive wind turbines. It required construction of 4.1 kilometres of new, surfaced, single track within the Sandpatch Reserve and construction of an elevated platform to traverse a wetland section.

The new alignment takes riders off the Lower Denmark Road, and was built with minimal disturbance and protects the habitat of the vulnerable Main's assassin spider and a water production bore zone.

The next time you are in Albany make the time to ride your bike along this new section of the Munda Biddi Trail past the massive wind turbines and enjoy the spectacular coastal views.

The trails work being undertaken in the Great Southern will encourage more visitors to spend time and invest in the region and help to better protect the fragile south coast environment. Aboriginal culture and stories will be a feature of trail interpretation to enrich visitors' experience when they explore the amazing South Coast.

Above left Albany windfarm.

Below left Boardwalk over fragile wetlands on the Munda Biddi Trail.

Below Castle Rock stone stairs.
Photos – Clinton Hull/DBCA

Mike Wood is a Communications and Community Engagement officer within DBCA's Parks and Wildlife Service. He is the former Chair of the Bibbulmun Track Foundation, a current Board Member of the Foundation and a keen trail user. Mike can be contacted at (08) 9219 8254 or mike.wood@dbca.wa.gov.au

Up to date information on trail projects in WA can be found at projects.trailswa.com.au or exploreparks.dbca.wa.gov.au/connect.

Bald Head Walk Trail

by Charlie Pierce

Charlie Pierce has been walking the length of the Flinders Peninsula for almost five decades. Recently, joined by his wife, children and grandchildren, he enjoyed the spectacular scenery of the Bald Head Walk Trail along the pristine southern coast of Western Australia.

I set off on the Bald Head Walk Trail with the usual sense of anticipation for perhaps the thirty-first time! I've been experiencing the delights of this 13-kilometre round trip walk along the Flinders Peninsula in Torndirrup National Park for almost five decades—initially just my wife and myself, then later with our two sons as they grew from infancy to adulthood, and now with their wives and children whenever they come down to Albany.

The joy of being at one with the natural world has passed from generation to generation. Our six grandchildren race off along the track, vying with each other to be the leader, and cries of "awesome" fill the air!

Previous page
Main top *Banksia praemorsum* and *Isopogon* sp. at Bald Head.
Photo – Damon Annison
Main below Bald Head trailside boulders.
Photo – Cliff Winfield
Inset Three generations reach the final cairn at Bald Head.
Photo – Charlie Pierce

Clockwise from top left Bald Head Walk Trail; Heath Lechenaultia (*Lechenaultia tubiflora*). *Photos – Damon Annison;* Photo opportunities along Bald Head Walk Trail. *Photo – Samille Mitchell/DBCA*

Discover more about Bald Head Walk Trail

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

"The joy of being at one with the natural world has passed from generation to generation."

REWARDING CHALLENGE

The walk, officially termed 'strenuous' by the City of Albany, takes walkers over spectacular landforms shaped from ancient granites and gneisses as well as more recent limestones and sandstones, mostly covered in low heath dominated by banksia, woolly bush, mallee and creepers, with rare orchids flourishing in spring and early summer.

There are several challenging climbs, offset by flatter sections along the top of granite domes and around Limestone Head. In recent years, steeper sections of the track have been severely eroded through heavy use and extreme weather events, resulting in an uneven, sandy surface scarred by roots and boulders, particularly in the limestone areas.

Yet, during 2022, new sections of pathway—either fibre-reinforced polymer or jarrah duckboarding—have been painstakingly constructed over these sections, and now the trail is both environment- and user-friendly.

OFF WE GO

The trek starts at a carpark at the base of Isthmus Hill, but just as I am lulled by the comfort of gentle slopes and the fascinating flora around me, the gradient suddenly increases and, somewhat breathlessly, I reach the bare granite surface at the top, marvelling at how safely this primeval rock holds me in its grasp.

I look back to Salmon Holes, where intrepid fishermen are but dots on shining sands, and absorb the last signs of human influence that I'll see on the walk—Goode Beach, where we now live, Albany's

Trail grading

Parks and Wildlife Service walk trails are assigned a 'class' to indicate degree of difficulty.

Class 3 indicates a moderate walk trail with clear directional signage. You may encounter minor natural hazards such as short, steep sections; steps; shallow water crossings; and unstable or slippery surfaces. A reasonable level of fitness is recommended.

Class 4 indicates a walk trail with limited directional signage and difficult sections. You may encounter natural hazards such as long steep sections; water crossings; and unstable or slippery surfaces. A good level of fitness and bushwalking experience is recommended.

historic whaling station and Discovery Bay Wildlife Park.

Then, unexpectedly, I turn a corner to find the vista of the whole Flinders Peninsula before me, with Bald Head resplendent at the end. Descending into the isthmus, I'm struck by the contrast between the churning seas of the Southern Ocean on my right and the relative calm of King George Sound, with its azure water and alluring inlets, on my left.

Another steep climb through rugged limestone topography takes me to the high plateau leading to Limestone Head—the highest peak in the Albany area. In the middle of the path is a huge, fossilised coral polyp; a reminder that once this plateau was an underwater reef.

Soon I'm at the col, a dip in the profile of Limestone Head that always provides an excuse for a refreshment stop. From here, Bald Head looks tantalisingly close and there are spectacular views of Seal, Breaksea and Michaelmas islands in the Sound, and beyond of mountains. Manypeaks and Gardner, as well as the Porongurups and if clear, the Stirling Range. In winter months, it's exciting to glimpse dolphins and whales.

Onward from the col, our path traces the north side of the peninsula, passing through leafy glades and always with breathtaking views of the sea, islands and mountains beyond. On one previous occasion, a massive kangaroo hopped out directly in front of me and proceeded to jump jauntily along the path into the

Top Fibreglass-reinforced walkways minimise erosion.
Photo – Cliff Winfield

Below Walkers of all ages enjoy the trail.
Photo – Damon Annison

distance. Over another granite outcrop there is no defined track, but we move from one cairn to another, and finally to the highest point on our route that lies adjacent to the rounded summit of Limestone Head.

Abruptly, we descend through a lunar-like landscape of desert sand and jagged rocks, with Bald Head luring us forward, and then stride over another glorious windswept outcrop of granite and granodiorite etched in sinuous patterns of pink, orange and black. To the right, the relentless Southern Ocean has carved dramatic patterns along the coast over hundreds of millions of years, and I am humbled by the natural forces at work.

UNBROKEN OCEAN

Soon it is time to traverse a steep scarp that leads down to the final approach to Bald Head. On previous visits, erosion of the sandy track into a deep gully meant that it was easier to descend by sliding down on one's backside, but now there is the new fibre-reinforced polymer staircase to use! At the bottom, I continue along the root-strewn trail past weathered boulders and silicified branches until I climb again on to the huge granite dome that is Bald Head itself.

Finally, we approach the cairn marking the end of our outward trek. Again, there is that sense of wonder. Before us is unbroken ocean until Antarctica. Behind is the magnificent scenery that will accompany our return. Oh, to linger! But time is passing, and it will take another three hours' walk to get back to the finishing point.

As we head westwards towards the setting sun, I reflect that despite tired limbs and sore feet, the exhilaration of this amazing walk means that I'll do it again and again until infirmity sets in. The beauty, grandeur and challenge of the adventure has an appeal that reaches across the generations.

Clockwise from top Stunning coastline and cliffs. *Photo – Samille Mitchell/DBCA;* Expansive views along the trail*;* Showy Dryandra (*Banksia formosa*). *Photos – Damon Annison;* Happy faces at the conclusion of the walk. *Photo – Charlie Pierce*

Do it yourself

Where is it? Bald Head Walk Trail is in Torndirrup National Park off Murray Road, 10 kilometres south of Albany or 430 kilometres south-east of Perth.

How long is it? 12.5 kilometre return walk, taking on average five to seven hours to complete.

Safety information: Bushwalking experience is recommended. Directional signage may be limited. Terrain is steep and difficult in sections. Do not attempt to return via the beaches due to unseen hazards. Be careful on the granite sections and around the edges as the cliffs are quite steep, instead please stay on the trail. Be prepared for changing weather conditions and ensure you are appropriately prepared with sufficient food, water, first aid.

Nearest Parks and Wildlife Service office: Albany office, 120 Albany Highway, Centennial Park, WA 6330 (08) 9842 4500

Charlie Pierce is an avid bush walker, living for many years in Vanuatu and now in Albany. He can be contacted at charliepierce19@gmail.com

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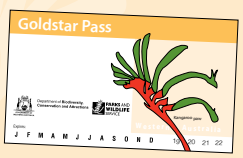

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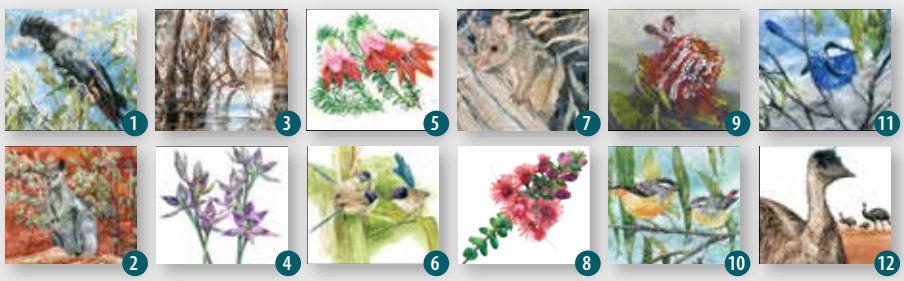

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Department of **Biodiversity, Conservation and Attractions**

Naturally invading toadlets

Above *Uperoleia borealis.*
Photo – Paul Doughty/Western Australian Museum

How individual species form and maintain themselves has long captured the attention of humans with many cultures gravitating towards invoking deities that formed them as part of a master plan to make the modern world. Such creationist ideas dominated until the theory of natural selection—perhaps the greatest scientific discovery of all time—was developed and promoted by the English naturalist Charles Darwin (1809–1882) after voyaging across the world and noting differences between populations on the various islands that form the Galápagos Archipelago, an isolated chain of volcanic mountains in the Pacific Ocean. His revolutionary 1859 book 'On the Origin of Species by Means of Natural Selection' led critics to decry the outrageous nature of his claims, denouncing it as antithetical to a Creator with the assertion that humans were simply intelligent animals derived from apes. Numerous challenges to the nascent theory of natural selection were overcome, especially with the discovery that the genetic material of cells transferred mutations to the parent's offspring.

A recent study by Australian scientists examined a group of native toadlets belonging to the genus *Uperoleia*. These small frogs occur over northern and eastern Australia, as well as southern New Guinea, and have bumpy, rough skin (hence the Australian name of 'toadlet', although they are not related to the cane toad). The 30 or so species are often hard to identify in the field, with some species having been discovered by their unique advertisement calls and molecular sequences rather than any distinctive characters. The study examined a complex of three closely-related species—*U. borealis*, *U. crassa* and *U. inundata*—that occur in the Kimberley and the Top End of the Northern Territory. Each was described in 1981 before the advent of molecular techniques and relied on differences between their advertisement calls, the webbing between their toes and subtle differences in body colouration. Using sophisticated genetic methods including single nucleotide polymorphisms (SNPs) and more standard DNA data, the authors of the new study found an interesting and perhaps unexpected story of invading toadlets.

Instead of three species, they found clear evidence for only two species, with *U. borealis* in the Kimberley, and a combined *U. crassa* + *U. inundata* taxon in the Kimberley and the Top End (they used the name *U. crassa*, and abandoned *U. inundata*). They surmised that *U. borealis* originated in the Kimberley and *U. crassa* in the Northern Territory about 1.8 million years ago when the climate replaced many woodlands with grasslands, thus forming an isolating barrier that ultimately led to speciation.

They had strong genetic evidence that a population of *U. crassa* had later moved into the Kimberley from the Northern Territory, and disrupted mating patterns within each species. Wherever both species occurred, the calls of invading *U. crassa* males developed fewer pulses so that *U. crassa* females could distinguish them from the more abundant *U. borealis* males. Occasional hybrids occur but their calls aren't accepted by either species. This phenomenon of female mate choice is a relatively new discipline and has been often overlooked by researchers. But it makes sense that males have to adapt—often quickly—to keep pace with whatever it takes to be accepted by a female.

Migration is a common phenomenon in all biological systems with 'invaders' trying to establish themselves to form viable populations in new areas and among the original inhabitants. The Galápagos islands that were made famous by Darwin are only 20 million years old and all terrestrial organisms living there today are the result of immigration from another landmass. Not all had to contend with a very recent relative as in the Australian toadlets, but many altered their lifestyles to fit in with their new neighbours and the local environment. The invading Australian toadlets also had to compete for acoustic space, and the males changed their calls accordingly. Biological immigrants don't always survive in their new homes, but those that did contribute to the astounding diversity we see around us.

It's not easy being green

The life and times of green turtles at Ningaloo

The name Ningaloo conjures images of whale sharks, or perhaps snorkelling in clear waters gazing at colourful corals and fishes. But for those who are not Exmouth locals or haven't endured the blazing heat of its summer, turtles are not the first thing that comes to mind. Yet, Ningaloo has some of the largest populations of sea turtles in the world.

by Mat Vanderklift and Richard Pillans

Of the seven species of sea turtles that swim in the world's oceans, three call Ningaloo home—green, hawksbill and loggerhead turtles (three other species visit occasionally). Most of the individuals that inhabit the clear lagoons of Ningaloo are green turtles (*Chelonia mydas*). CSIRO scientists have been studying these fascinating creatures for the last ten years, complementing efforts by other organisations, including the Department of Biodiversity, Conservation and Attractions (DBCA), which runs an annual survey of nesting tracks on the beaches of North West Cape.

Previous page
Main Female green turtle returning to the water after nesting.

This page
Above Green turtle resting on the shore after a big night of nesting.

Inset right Green turtle hatchling.
Photos – Craig Duncan

Inset left Satellite tagged green turtle after release.
Photo – Richard Pillans

As part of this research, many turtles have had tags attached to them and biological samples collected from them. More than 80 turtles have had acoustic tags attached that transmit a 'ping' detected by an array of devices installed on the seafloor. The 'ping' of each tag has a unique code so that individual turtles can be distinguished. More than 40 turtles have been equipped with satellite tags that transmit signals to satellites orbiting Earth. The chemical signatures of samples from hundreds of turtles have also been analysed. The discoveries made from combining the tagging and sampling techniques, as well as other scientific techniques during this decade of research, have unveiled multiple features of the green turtles' life history.

GROWING UP IN THE LAGOON

Green turtles, like other sea turtles, lay their eggs on sandy beaches, including the beaches of Ningaloo. After an incubation of eight weeks or so, the hatchlings run a gauntlet of predators on the beach to get to the sea, where more predators await. Those that survive swim directly to the open ocean far from shore, where they spend the first few years of their

life. At around seven years old, they start to appear in the lagoons of Ningaloo as juveniles. Thus begins their life at Ningaloo.

After they arrive, these small juveniles stay in shallow habitats close to the shoreline; so close that they need to move offshore whenever the tide drops. Their roaming is also restricted, and they tend to stay within home ranges that are typically not much more than a square kilometre. Some individuals appear particularly unadventurous—one has been captured four times in eight years, never more than a few hundred metres away from where it was first found.

During their time in the shallows, they eat a variety of the foods that are available, like the macroalgae (seaweed)

which is abundant, and seagrass which grows more sparsely. As small juveniles, they are vulnerable to predators (like the tiger sharks that roam the lagoons of Ningaloo), so this strategy makes sense.

The turtles stay in this shallow habitat close to the shore for several years. Eventually, they grow to a size where their life begins to change. At around 60 centimetres, they have moved slightly further offshore where they establish a new home range and are eating less macroalgae. They are still eating lots of seagrass, and other foods, like jellyfish, have become a more important part of their diet.

These changes continue, and by the time they have grown to 80 centimetres long (double the size they were when they arrived, but not yet a mature adult), they have home ranges that encompass four or more square kilometres, located a kilometre from the shore in the deeper areas of the lagoon. There, they seem to no longer eat much macroalgae, but seagrass and jellyfish dominate their diet. Occasionally, one might be tempted to explore further afield, and forays to deeper water outside the lagoon are not uncommon, but mostly they tend to stay in constrained home ranges within the lagoon.

ADULTHOOD

These overall patterns don't seem to change much as the turtles become sexually mature, which at Ningaloo happens from around 88 centimetres or so (it varies between individuals). However, come mating season, other patterns appear.

Mating season for green turtles at Ningaloo begins around October. During this time, adult males that had remained within their home range make rapid migrations to areas where mating aggregations occur. One 91-centimetre male (named 'Jeff' after a naming competition with the Exmouth community) had remained in a very consistent area since he had a satellite tag attached in May 2015. Jeff suddenly moved to a known mating aggregation further up the coast at the end of September. He stayed there, just off the beach, for three weeks before leaving, just as suddenly, returning to his home range where he remained until May 2016, when the tag stopped transmitting.

Females have a more arduous journey. Their migration can stretch for hundreds or even thousands of kilometres, and last for months. To be able to do this they need to be in prime condition, with fat reserves that not only nourish them for the journey, but also nourish the hundreds of eggs that they will lay, which means eating a lot of seagrass. Understandably, they don't do this every year, or even every other year. According to scientists' best estimates, female green turtles nest every five years or so.

While green turtles nest on the beaches of Ningaloo, most of those females are not actually from Ningaloo. Satellite tagging of female green turtles revealed they come from as far afield as the Kimberley in the north, and Shark

Above left Green turtle covering her nest in the early hours of the morning.
Photo – Craig Duncan

Above right Green turtles aggregating in the shallows to mate.
Photo – David Bettini

20 years and tracking

By Craig Duncan,
***Ningaloo Turtle Program* intern**

One of Australia's most comprehensive turtle monitoring programs, the *Ningaloo Turtle Program,* is now celebrating its 20th anniversary of researching the nesting habits of sea turtles. Volunteers have come from across the world and have walked more than 20,000 kilometres, explored 237,448 turtle tracks and identified 67,157 nests. The program plays an important role in understanding the world's marine turtle species, and their nesting habits by monitoring the Ningaloo coastline.

Originally developed in 2002, the program began as a collaboration between the local Cape Conservation Group, the Department of Biodiversity, Conservation and Attractions (DBCA), Murdoch University and the World Wide Fund for Nature.

Today, the program is run by DBCA's Exmouth District.

Each year local and external volunteers survey the beaches, identifying turtle tracks and nests. These surveys build on several decades of research and contribute to understanding nesting turtles and the threats they might face along the Ningaloo Coast.

Throughout Exmouth, the program has developed a culture of understanding within the community around the importance of the marine park and coastal reserves, its conservation and one of its most magnificent inhabitants, the turtles.

Beyond tracking turtles, the *Ningaloo Turtle Program* has rescued over 345 turtles in its time. Some turtles have tracked too far and become lost within dunes or trapped within the rocky coast.

TRIAL FOR TURTLES

Along the 25 kilometres of the Ningaloo Coast surveyed by the program, three turtle species appear most frequently—the green, hawksbill and loggerhead turtles.

Living the majority of their lives in the ocean, these turtles only return to land to lay their eggs. Estimates state only one in 1000 hatchlings will reach sexual maturity. For some species, this won't be until they are around 30 years old.

ON THE BEACHES

The work of a volunteer can best be described as detective work. Beginning a march along a section of pristine beach, piecing together the mysteries of the night with little more than tracks in the sand, arriving at a beach decorated with an intricate sprawl of turtle tracks, they begin by finding the track that leads to the ocean, identifying the unique pattern of ridges and lines that show the direction of travel.

Each species of turtle can be identified by its unique track. The symmetrical crawl of a green turtle creates a pattern similar to a tractor tyre, carved deep into the sand. Loggerheads move in alternating thrusts, leaving behind a broad flat path in their wake. The most petite of the three, the hawksbill also climbs in an alternating motion, leaving muchnarrower tracks, with a distinct tail wiggle to be followed.

Finally, the volunteers climb the sand to identify the turtle's last known action, be it a nest, an empty pit, or a seemingly pointless walk around the beach.

The process is recorded digitally and collated into a database illustrating the past 20 years.

The very fact these turtles live such lengthy lives and take so long to reach maturity means we may not know the full impact of threats on turtle populations for another 10 years.

Nests that were recorded at the beginning of the program have birthed hatchlings that are still yet to nest on the Ningaloo Coast to repeat their cycle anew.

Inset above Volunteers assist in a green turtle rescue.

Below Turtle tracks from a green turtle.

Inset right *Ningaloo Turtle Program* volunteers.
Photos – Craig Duncan

Bay in the south. Most of these voyagers to the Ningaloo nesting beaches travel at least a hundred kilometres, leaving Ningaloo Marine Park entirely.

So, if the turtles that nest on the beaches of Ningaloo don't originate from Ningaloo, where do the turtles that call Ningaloo home go to nest? The scientists had found a few clues, such as the presence of flipper tags that had been attached on nesting beaches at Barrow Island on adult female turtles captured in the lagoon at Ningaloo. But, to investigate this further, the scientists needed to tag the turtles before they departed on their migrations. This in turn meant there needed to be a way of telling which turtles were going to migrate—no easy task. To do this, the scientists turned to ultrasound.

PRENATAL SCANS FOR TURTLES

Ultrasound machines are often associated with pristine white rooms in medical practices, which isn't so practical on a beach. So, scientists turned to a small ultrasound that ran from a laptop, easily packed into a rugged case. Armed with this equipment, the scientists were able to identify female green turtles with vitellogenic oocytes—undeveloped eggs with yolk beginning to form. To date scientists have been able to tag and follow six females all the way through their nesting migration, from departure from the lagoon, to mating, and finally to the nesting beaches. All females tagged so far have left the waters of Ningaloo and travelled to Barrow and Montebello islands, more than 200 kilometres away.

At these offshore islands, individual turtles laid between four and eight clutches of eggs, each separated by about 10 days. After the last clutch had been laid, almost all of them returned directly to their home range back in the lagoon at Ningaloo. One female did not return to Ningaloo, but instead went to the Dampier Archipelago, where she remained until the satellite tag stopped transmitting.

And the eggs? After an incubation of eight weeks or so, the hatchlings emerged, ran the gauntlet of predators to get to the sea, and it began all over again.

Top T-Bone Bay, Ningaloo.

Above right Green turtles mating, Ningaloo.
Photos – David Bettini

Above left Green turtle.
Photo – Jiri Lochman

Right Researchers release a green turtle.
Photo – Violeta Brosig

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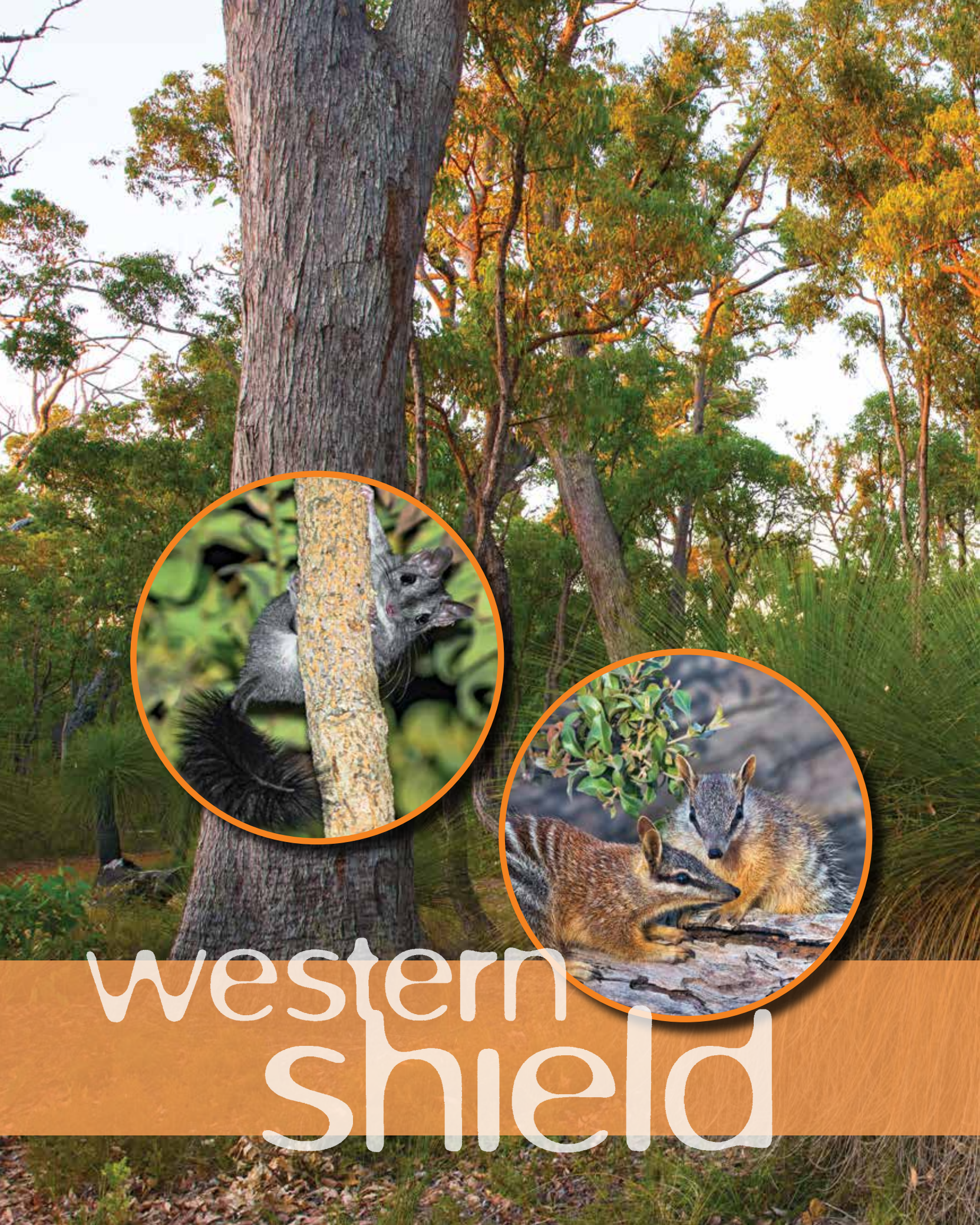


western shield

Fresh hope for forest dwellers

by Jenna Oliver

Western Australia's northern jarrah forest spans a 250-kilometre belt across the Darling Scarp from north of Toodyay to just south of Collie. It is home to a beautiful, rich and diverse ecosystem, but the variety of treasured native species that call the forest home are under threat.

For many years, the threatened species that live in Western Australia's northern jarrah forest have been given protection under the Department of Biodiversity, Conservation and Attractions' (DBCA) *Western Shield* predator control program, and, more recently in partnership with the Alcoa Foundation. Funding from the partnership provides improved protection for 14 threatened species including the numbat, woylie, chuditch and quokka.

PROBLEM PREDATORS

A major threat to WA's native wildlife is from introduced predators. Similar to other ecosystems on mainland Australia, both foxes and feral cats are established throughout the northern jarrah forest and pose a threat to native species. While fox management has occurred in the forest since the early 1990s, research has demonstrated that more intensive management of foxes is required to provide long-term protection for the forest's most vulnerable species in a changing environment.

"Looking at previous research conducted in the south-west of the State, it has been found that fox baiting was able to reduce the density of foxes by up to 80 percent compared with non-baited reserves," *Western Shield* Coordinator Ashley Millar said.

Research also suggests that more intensive predator control is needed to maximise the recovery potential for species such as the woylie and numbat.

In 2021, under the partnership with the Alcoa Foundation, the frequency of aerial fox baiting was increased to six times per year within identified sections of Avon, Perth Hills, Lane Poole and Wellington areas.

To assess the impact of the increased baiting, remote cameras were deployed to monitor fox populations and native fauna populations in areas of the forest with active fox management as well as areas with no fox management.

Fox management has long been a priority in the northern jarrah forest but there is now also a need to focus efforts on integrating management of feral cats.

"Feral cats can have a devastating impact on native fauna including numbats, chuditch and quokka," Dr Michelle Drew, *Western Shield* Zoologist said.

"It is vital for the long-term conservation of these species that we

Previous page
Main Northern jarrah (*Eucalyptus marginata)* forest.
Photo – Marie Lochman
Inset left Wambenger or brush-tailed phascogale (*Phascogale tapoatafa*).
Photo – Anne Storrie
Inset right Numbats (*Myrmecobius fasciatus*).

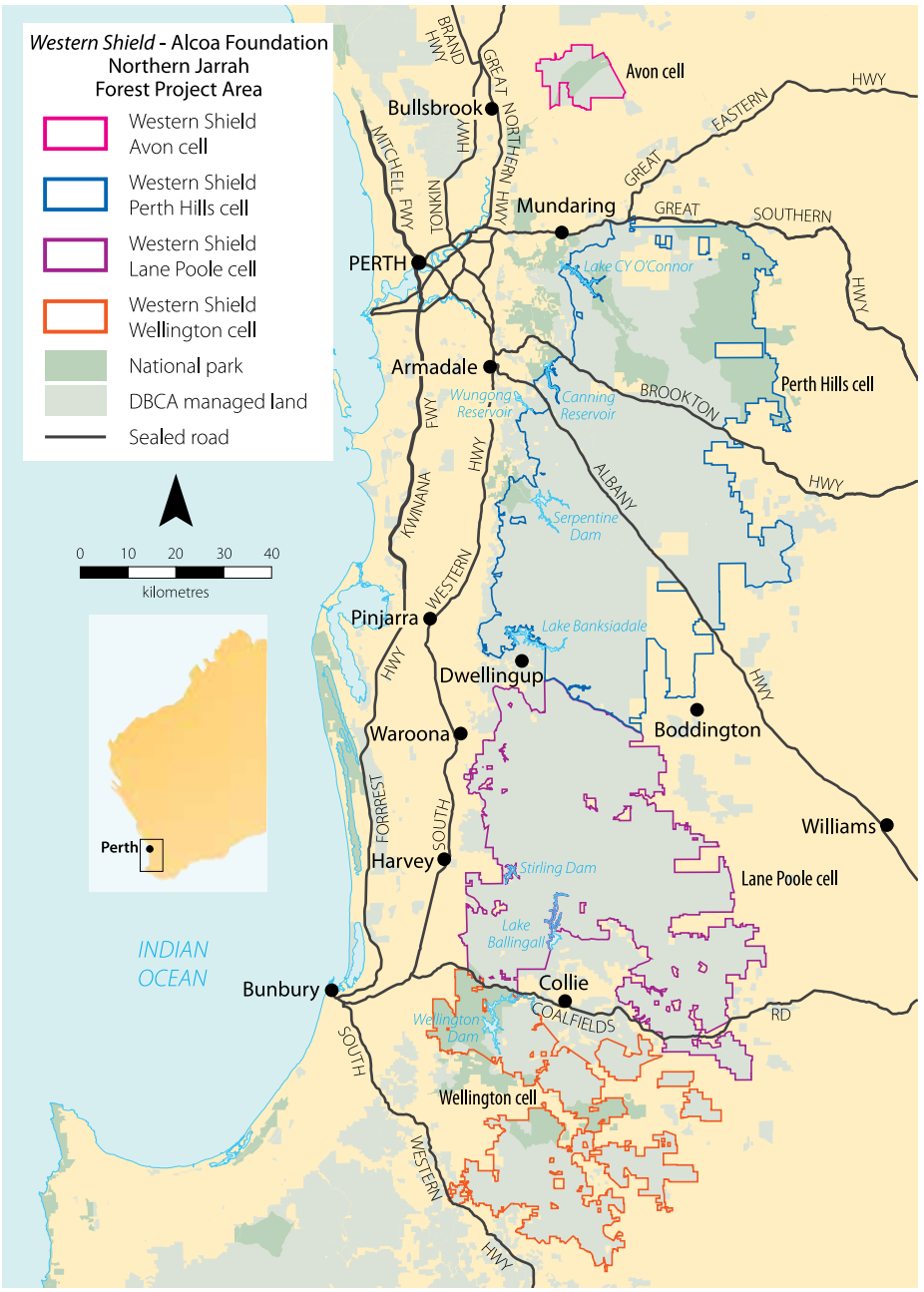
This page
Above left Chuditch (*Dasyurus geoffroii*).
Photos – David Bettini

Above right Quokka (*Setonix brachyurus*).
Photo – Jiri Lochman

Right Woylie (*Bettongia penicillata*).
Photo – David Bettini

Above Numbat (*Myrmecobius fasciatus*).
Photo – Jiri Lochman

Below Per Christensen with road-kill woylie in 1974.
Photo – Tom Leftwich



begin to actively manage predator-impacted areas across Western Australia."

As fox numbers decline, there is also the potential for feral cats to become more prevalent in these environments as the top order predator in the ecosystem. In ecology, a phenomenon known as mesopredator release occurs, in which populations of medium-sized predators rapidly increase in ecosystems after the removal of larger, top carnivores.

Dr Per Christensen's legacy

"It was Dr Per Christensen who first advanced the hypothesis that fox predation was the key factor in the decline of many small forest-dwelling animals, for example woylies and numbats. I can still remember reading his seminal presentation to the then WA Wildlife Authority in which he outlined his theory, and demonstrated how it provided a logical explanation for what was going on. Better still, it identified a way forward: once the threatening process was known, its abatement could be tackled.

"I was also fortunate enough to be working at Manjimup in the Forests Department in the 1970s when Dr Christensen moved on from theory to practice, and was able to demonstrate at Perup and at Dryandra, that populations recovered when foxes were eliminated."

- Roger Underwood, retired forester and LANDSCOPE *contributor.*

Fifty years ago, Dr Christensen was at the forefront of mammal conservation in Western Australia, and today his legacy continues to influence current *Western Shield* operations including this project in the northern jarrah forest. Look out for a feature on Dr Per Christensen in an upcoming issue of *LANDSCOPE*.

Above Mardo (*Antechinus flavipes*) release.

Below Woylie (*Bettongia penicillata*).
Photos – Peter Nicholas/DBCA

The partnership with the Alcoa Foundation will provide an opportunity for *Western Shield* to trial Eradicat® feral cat bait for the first time in the northern jarrah forest, as part of an integrated approach to managing both foxes and cats.

"In areas where more intensive feral predator management is occurring, including at Dryandra Woodland National Park and Perup in the southern jarrah forest, we are seeing signs of recovery of woylie and numbat populations," said Ashley.

"Our hope is that we will see a similar response in the northern jarrah forest with the integration of feral cat management on top of fox management activities."

AN EYE ON THE GROUND

On-ground surveillance using remote cameras allows for visual intelligence to be gathered on threatened wildlife, while also improving knowledge regarding the activity of introduced predators. Importantly, it allows the *Western Shield* team to use this data to adapt and improve management strategies over time.

Predator monitoring has occurred at four sites in the northern jarrah forest in 2022. While image classification is still underway, a number of species sensitive to introduced predators were detected in the Muja State Forest including the critically endangered woylie, vulnerable chuditch, conservation dependent wambenger or brush-tailed phascogale and quenda.

In addition, remote cameras were deployed at two sites with the intent of monitoring for largely arboreal (tree-dwelling) species including the red-tailed phascogale (kengoor), to provide a more comprehensive understanding of their distribution.

CATCH AND RELEASE

Marking animals with unique tags is another effective way the *Western Shield* zoologists observe how populations of different species are responding to changes in predator pressure. Monitoring was expanded to two new sites in the northern jarrah forest in 2022, increasing the number of actively monitored sites within the forest from 11 sites to 13.

Targeted chuditch trapping was also conducted at four sites in 2022. Individuals were captured at all four sites, and tissue samples for genetic analysis were collected. This work will further existing knowledge of the species' biology, distribution, and abundance within the northern jarrah forest.

Western Shield zoologists will continue to monitor native fauna to assess mammal population size, distribution and density alongside Aboriginal rangers.

Two Aboriginal trainee rangers from DBCA's Wellington district were engaged to assist with chuditch monitoring within the Collie State Forest and continue to be involved in a range of monitoring projects, providing opportunities to experience different field-based monitoring approaches.

QUARTER CENTURY OF SUPPORT

Protecting biodiversity in the northern jarrah forest builds on more than 25 years of support for *Western Shield* from Alcoa.

"We appreciate the support of the Alcoa Foundation, which is enabling us to bolster the management of feral predators in the northern jarrah forest and protect WA's precious and vulnerable native wildlife—such as the quokka and numbat—boosting their chances to thrive in their native environment," Ashley said.

"Australia has experienced devastating losses of native fauna since European arrival," Michelle said. "The key driver of these losses has been predation by foxes and feral cats. This is an Australia-wide problem so we can't manage this alone. Partnerships such as this are giving our native wildlife the protection they need."

Jenna Oliver is a Communications Officer with DBCA's Public Information and Corporate Affairs Branch. She can be contacted at (08) 9219 9902 or jenna.oliver@dbca.wa.gov.au

by Lauren Cabrera

kaleidoscope
kids exploring nature

Make your own **nature crown**!

In autumn, the leaves start to change colour and fall from the trees. So while you're out in the bush or at a park, it's the best time to collect some leaves and make your very own nature crown!

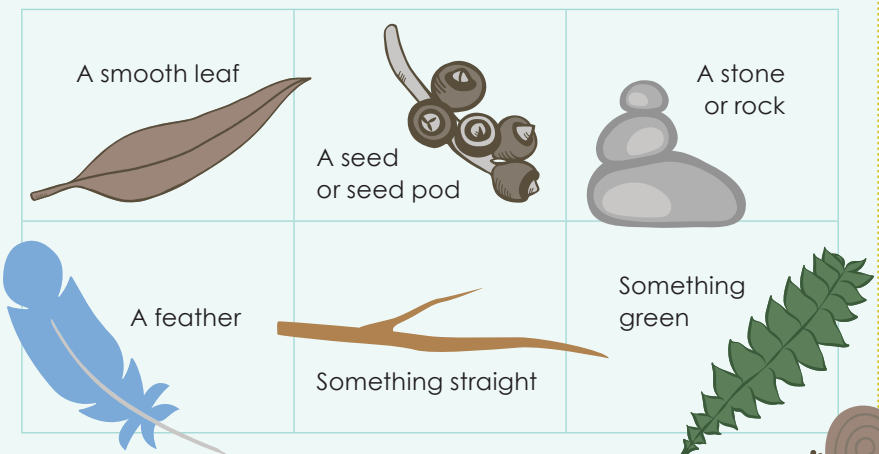
Step 1: Collect fallen leaves of different sizes.

Step 2: Glue or staple your leaves to a strip of paper.

Step 3: Ask a grown up to staple your crown together.

Autumn treasure hunt

While you're out on your nature walk, you can also do a treasure hunt! Find and collect these treasures:



DID YOU KNOW?

Some trees stay green all year long, they are called 'evergreens'. Trees that lose their leaves every year are called 'deciduous'.

These autumn activities come from our friends at Nature Play WA. Discover more fun, free nature-based family activities on their website natureplaywa.org.au/resources-for-families/

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

Wambenger (*Phascogale tapoatafa wambenger*)

Wambenger, also known as the brush-tailed phascogale is a small carnivorous marsupial found in south-western Western Australia. These squirrel-like athletes are very agile and active and boast one of the most flexible ankle joints in the mammal world (they can nearly rotate a remarkable 180 degrees), which makes them well suited for life in the trees. Wambenger tap their toes on the bark and wood of trees when alarmed, to warn their predators that they have been spotted. Wambenger mostly eat insects but may also feast on some flowers and nectar. After the winter breeding, all males die, making the ultimate sacrifice to allow more food to be available to the mothers and their young. Wambenger create well-insulated nests in small tree hollows and cavities.

Illustration by Gooitzen van der Meer

Reference photo by Jiri Lochman

Nature's pin-ups
PRINT COLLECTION

Artwork featured in *LANDSCOPE* magazine

Artwork by Gooitzen van der Meer and Gwendolen Monteiro, as featured in *Nature's pin-ups* on page 54 in each issue of *LANDSCOPE*, is now available for purchase.

Using a watercolour technique or acrylics, the pieces depict species featured in the magazine.

Prints of these beautiful pieces of artwork can now be purchased in A3 size ($35), A4 size ($25) or A5 size ($15) plus $3.30 postage for domestic large letters up to 250g. Printed on high quality art paper and delivered to your door, ready to be framed and hung somewhere special.

Proceeds from your purchase go towards managing and conserving WA's plants, animals and natural environment.

To see the collection visit **shop.dbca.wa.gov.au/collections/prints**

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