

WA'S PARKS, WILDLIFE AND CONSERVATION MAGAZINE

# LANDSCOPE

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Feature  
pull-out  
map

## CAPE RANGE NATIONAL PARK

Ancient paradise

### **Back to the bush**

Nature-based camping

### **50-year fight**

Carnaby's cockatoo

### **Pink lakes**

Fascinating  
phenomenon



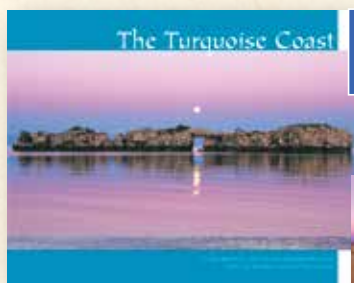


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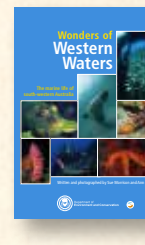
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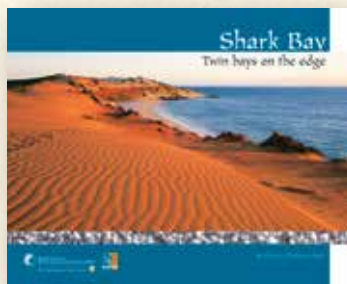
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Department of  
Parks and Wildlife





ON THE COVER

**Front cover** Known as one of Western Australia's best beaches, the stunning day-use Turquoise Bay in Cape Range National Park is an idyllic spot to spend the day relaxing on the beach in a sun shelter or snorkelling among the plethora of marine life in the waters of Ningaloo Marine Park (see 'Parks for People: Cape Range National Park', on page 8).

Photo – Alyssa Gilchrist, courtesy Exmouth Visitor Centre

**Back cover** Sturt's desert pea (*Swainsona formosa*) – one of the most well-known native plants of the Pilbara and one of the first plants ever collected in Australia.

Photo – Parks and Wildlife



There's nothing better than spending time in the great outdoors, especially in our amazing national parks. Research strongly indicates it's good for the mind and body, and thanks to the State Government's \$21.05 million *Parks for People* initiative, families and tourists have access to more affordable camping holidays and better facilities in our national parks. We hope the creation of 450 camp and caravanning sites will encourage more Western Australian families and tourists to reconnect with nature while getting active outdoors. You can read about some fantastic

camping opportunities in 'Under the stars: nature-based camping' on page 30.

One of the best parts of travelling around Australia's largest and most biodiverse State is the many and varied people you meet. There is often a strong sense of community among travellers, who exchange stories and tips over campfires and barbecues. You will no doubt also come across Parks and Wildlife staff and Campground Host volunteers who are often your first point of contact and can provide a wealth of information. In this issue of *LANDSCOPE* we are pleased to include a handy, pull-out map of Western Australia. The map highlights 128 of the State's most popular parks, reserves and attractions managed by the department. It also provides a snapshot of some of the people you may meet along the way.

Of course, there's a lot of work that goes on behind the scenes too. You can read about Dr Denis Saunders, whose career has spanned 50 years and has seen him tirelessly studying and working to conserve Carnaby's cockatoos, on page 36. And we take a look at how our State's mammals are faring on page 42. We also examine a fascinating natural phenomenon at Lake Warden (see 'And the rivers ran red' on page 19) and put algae under the microscope – literally – on page 23.

We trust you will enjoy this issue and hope you find time to explore and enjoy our beautiful State.

**Peter Sharp, Director of Parks and Visitor Services**  
Department of Parks and Wildlife

Contributing



**Dr Andrew Burbidge, AO** is a conservation biologist and Parks and Wildlife Research Associate who worked for 33 years for a series of Western Australian conservation agencies before retiring in 2002. Since then he has been involved in a variety of volunteer conservation roles as well as working part-time as a consultant. He is currently chair of the WA Threatened Species Scientific Committee.



**Steve Crawford** is Parks and Wildlife's Parks and Visitor Services Division visitor communications manager. His career in the tourism industry spans some 30 years with a special interest in nature-based tourism, destination development and marketing. His current focus is on camping in natural areas including visitor research, interpretation and e-media.



**Tania Durlik** is inspired by WA's natural environment and enjoys telling stories about Parks and Wildlife operations, from whale disentanglements through to fire management. Since starting at the department in 2008, she has engaged with a range of audiences in print and broadcast formats. When she's not writing about the achievements of acclaimed scientists and their work to protect black cockatoos (see page 36), she helps staff share their knowledge and expertise with media outlets and the community.

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**This page** Numbats (*Myrmecobius fasciatus*) have endured predation by feral cats and foxes (see page 42).

Photo – David Bettini



Department of  
Parks and Wildlife



**PARKS  
FOR  
PEOPLE**

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Turn to page 27 for *Explore WA: Feature pull-out map*  
Showcasing WA's favourite parks and reserves.



READERS' PIC

**Banksia hookeriana,  
Corey Road near Eneabba**  
Patrick Prett

"LANDSCOPE magazine has helped me identify wildflowers and interpret the sandplain landscape near Eneabba as demonstrated by this magnificent array of Hooker's banksia (*Banksia hookeriana*) at Corey Road near the Eneabba sandplain. I was able to identify this species having read researcher Vanessa Westcott's article in LANDSCOPE (Winter 2012) in which she explains how cone numbers help determine plant life cycle details and relationship to fire history of the area. In this roadside corridor the massed flowering catches the eye of Jennifer Prett."

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



A new way to explore  
Esperance lakes

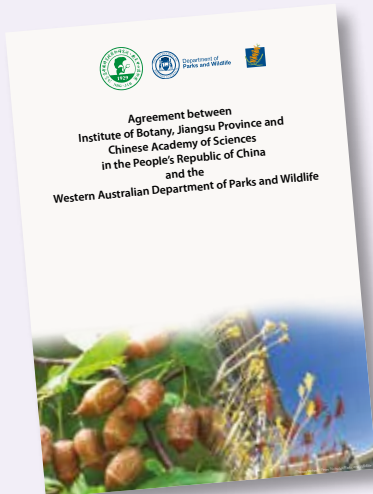
Visiting and local paddlers have a new way to explore the idyllic Esperance lakes system thanks to a new self-guided 5.5km canoeing trail.

The trail is fitted with information and traverses Woody Lake, Lake Windabout and Lake Wheatfield. Users can tailor the adventure to their experience level and it is suited to beginner, intermediate and experienced paddlers. Paddlers can launch at any of the three lakes and can choose whether to paddle from lake to lake or limit their trip to just one. Signs provide distance and time information and general tips on personal safety, while markers on the lakes guide paddlers across a pre-determined route and indicate water levels.

Esperance lakes provide a host of nature-based recreation activities including picnicking, bushwalking, birdwatching, fishing and waterskiing. Birdlife is prolific on the lakes and paddlers will be able to see egrets, pelicans, swans, a variety of ducks and summer visitors such as sanderlings and green-shanks. Sea eagles and ospreys have also been recorded on the lakes.

**Above** People of all ages can enjoy the new trail.  
Photo – Tanya Butler

**Chinese collaboration for WA park**



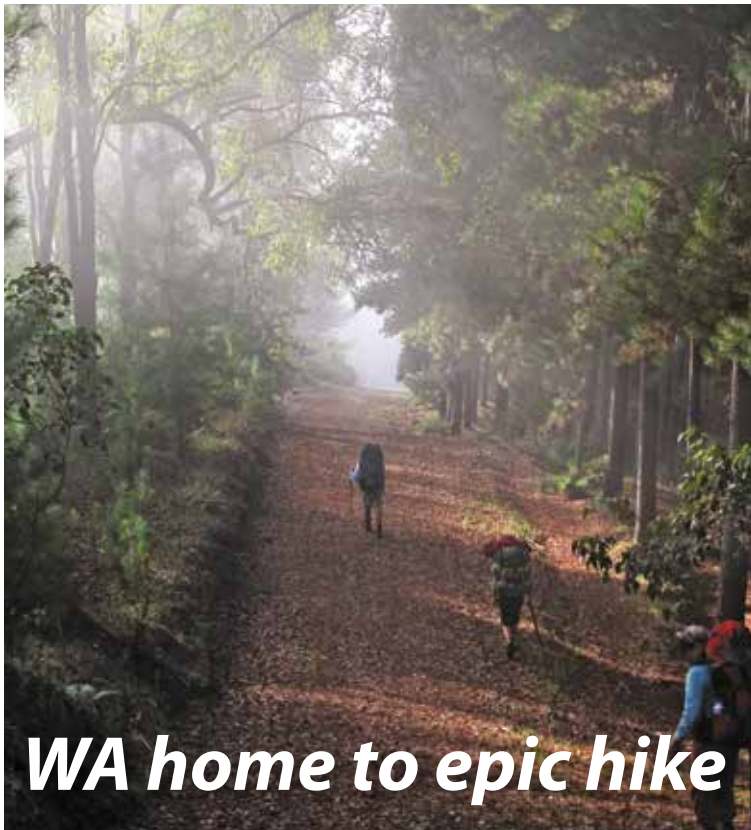
An agreement between the State Government and the People's Republic of China will help forge strong relationships in tourism, park management and plant conservation research for two iconic parks.

Purnululu National Park in Western Australia's north and China's Danxiashan National Park 290km north of Hong Kong are 'sister' parks, thanks to a new partnership which will see collaboration on joint activities and projects, sharing of information and staff training.

Both parks are World Heritage-listed and are major visitor attractions for scores of people each year who are attracted to the striking natural landscapes and plants and animals. Scientists also visit the areas to carry out surveys and learn more about the natural values.

Danxiashan is renowned for its cliff and stone inscriptions while Purnululu's Bungle Bungle Range, with its magnificent orange and grey sandstone formations, contains hundreds of archaeological sites highlighting ancient rock art, stone quarries and burial places.

A second cooperative agreement was signed between the Institute of Botany, Jiangsu Province and Chinese Academy of Sciences and Parks and Wildlife's Plant Science and Herbarium Program.



## WA home to epic hike

The State's premier walking track, the 1000km Bibbulmun Track, has been named one of *National Geographic's* Top 20 World's Best Epic Hikes.

The revered track leads walkers through diverse and spectacular scenery, and past numerous charming regional towns, on its way from Mundaring to Albany. Huts and other facilities are available along the way to cater to people who set out for an eight-week 'end-to-end'; those who prefer to do a shorter 'day walk' and everyone in between. The Bibbulmun Track Foundation also operates a number of events to cater to a range of adventures for people who are looking for a guided experience.

Being named as one of the world's top 20 best epic hikes, has put the Bibbulmun Track in esteemed company, with trails such as the GR20 in Corsica, the Continental Divide Trail in the USA and the Great Himalaya Trail in Nepal also on the list.

In its assessment of the track, *National Geographic* highlighted how the track showcased the "land of the original inhabitants" and Western Australia's unique plants and animals.

"Besides all the wildlife, though, it's the social aspect of the trail that makes it most Australian. At the camp sites you will meet hikers from around the globe as well as regular Australians who have fulfilled the original promise of the trail and are spending time simply walking for weeks to better understand themselves and the unique place where they live."

Visit Parks and Wildlife ([parks.dpaw.wa.gov.au](http://parks.dpaw.wa.gov.au)), Trails WA ([trails.wa.com.au](http://trails.wa.com.au)) and the Bibbulmun Track Foundation ([bibbulmuntrack.org.au](http://bibbulmuntrack.org.au)) for more information.

**Above** Walking through pine forest near Blackwood.  
Photo – Bibbulmun Track Foundation

## Esme Bowen – Guest columnist

*President, RAC*



As a member based organisation and a mutual serving more than 800,000 members, the RAC has proudly reinvested its profits to benefit members and the community for over a century.

The RAC was therefore proud to partner with the Department of Parks and Wildlife to help promote Western Australia's stunning natural attractions. With Western Australia's fast population growth the RAC is keen to encourage more people to learn about Western Australia and holiday at home.

RAC also works to ensure all Western Australians are able to travel around the State in the safest, most sustainable and efficient way possible.

*"Our message is simple, get out and enjoy all that Western Australia has to offer but be safe on the roads."*

Road crashes kill about 1400 Australians and hospitalise another 32,500 each year. The total estimated cost to the community is \$27 billion and the human impact is devastating. In Western Australia the total estimated cost is nearly \$6.6 billion each year.

While there has been a measurable decrease in death and serious injuries on Australian roads in the past decade, Western Australia has lagged behind other states.

Now is not the time to be complacent. The reality is in 2014 Western Australia remained above the national road fatality rate and one person, on average, was killed on our roads nearly every two days. In 2014, 56 per cent of all fatalities in Western Australia occurred on regional roads.

Our message is simple, get out and enjoy all that Western Australia has to offer but be safe on the roads.

If you are planning a trip remember to take regular breaks while on the road or share the driving with someone else, stick to the speed limit and always wear a seatbelt.





## Cape Range National Park

*From the glistening turquoise waters that house an abundance of marine life to the rugged ancient canyons, visitors to Cape Range National Park are spoilt for choice on how to spend their time and what to explore. On the right day, it comes pretty close to being paradise.*

Located adjacent to Ningaloo Marine Park, on Western Australia's Coral Coast, Cape Range National Park covers more than 50,000ha of spectacular scenery. Now celebrated as part of the Ningaloo Coast World Heritage area, the park has been known to local Aboriginal people for an estimated 35,000 years and there are 140 sites registered on the list of Aboriginal Site and other Heritage Places.

Burial grounds, examples of rock art and artefacts, including shell beads, provide an insight into Jinigudira, Baiyungu and Thalanji people who lived in the area. Nowadays, people come from across the world to see the unique combination of this rich heritage and the tropical reef and turquoise waters contrasting against the ancient gorges.

### WATER WONDERLAND

The magnificent Ningaloo Reef runs between 200m and 7km from the shoreline and encases the park's western side. Ningaloo Marine Park is one of the best places in the world to encounter the world's largest fish, the whale shark (*Rhincodon typus*), which visits the area from March to June. Weighing as much as 11 tonnes, with mouths more than 1m wide, they may live for 100 years, and only reach sexual maturity after 30 years. A number of daily tours operate in the marine park to guide

visitors to swim with these gentle giants. Opportunities such as whale watching between August and November and coral viewing from glass-bottom boats or taking a boat tour along the Yardie Creek are just some of the other incredible nature-based experiences that people can enjoy.

The waters are home to seven species of marine turtles, and visitors can learn about them at the Jurabi Turtle Centre, which provides displays and information about turtle biology and ecology. Here, visitors can access the turtle nesting beaches where they may see turtles laying eggs in the sand between November and February. The myriad of other marine life that populates the area can be discovered along the kayak and snorkel trails in the marine park, where people can moor their kayaks while they venture underwater (see 'Adventure out: Kayaking along Ningaloo Coast', *LANDSCOPE*, Winter 2014). Cuttlefish, squid and as many as 500 species of fish

**Above** Snorkelling at Turquoise Bay.

Photo – Tourism WA

**Above right** Shothole Canyon.

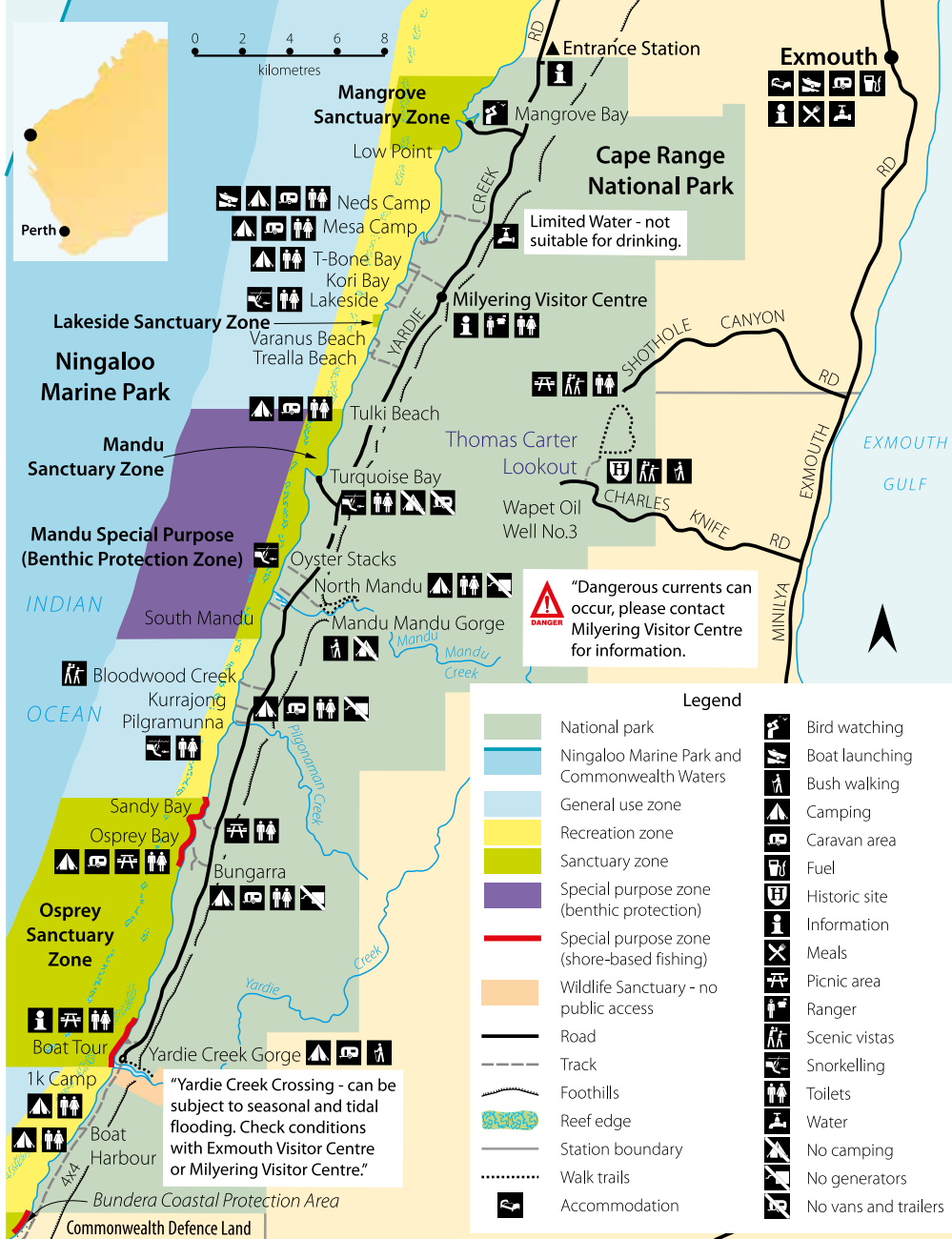
Photo – Parks and Wildlife

Opposite page

**Top** Yardie Creek.

**Above right** Emus can be found in Cape Range National Park.

Photos – Tourism WA



entertain snorkellers with their antics, while up to 200 species of coral dazzle with their varied colours and forms.

### HIKING GORGES

On dry land, Cape Range National Park amazes with its sweeping gorges and chasms, and rugged limestone range, which provide an insight into the area's rich geological history. The fascinating processes that have occurred here are the result of the ancient sea floor being thrust upwards by movements of the Earth's crust. This stunning landscape can be explored on a number of walks in the park – ranging from an easy 100m walk around the mangroves, to an 8km hike with views across Shothole Canyon and Exmouth Gulf.

“On dry land, Cape Range National Park amazes with its sweeping gorges and chasms, and rugged limestone range which provides an insight into the area’s rich geological history.”

Visitors may be lucky enough to spot some of the amazing animals that live in the park, including the shy black-flanked rock-wallaby (*Petrogale lateralis*) (see also ‘Nature’s pin-up’ on page 54), echidnas (*Tachyglossus aculeatus*) and a number of bird species, such as emus, Australian bustards, pied butcherbirds and ospreys. Meanwhile, an extensive karst system underground houses populations of as many as 38 species of cave-dwelling

invertebrates, of which 10 are endemic. In winter and spring the park erupts in colour as wildflowers bloom, transforming the otherwise dry landscape.

### STAY AWHILE

Cape Range National Park has long been popular among campers, and upgrades to existing facilities and the development of new ones offer visitors a better-than-ever camping experience.

## *Parks for People* Cape Range National Park



"What's there now is a rugged and beautiful wilderness. People come from all over the world to see it. After all, how many places can you go to where you can swim with a whale shark, a placid animal the size of a bus covered in brilliant dots like an Aboriginal painting. The same day you can be circled by manta rays that roll and swerve like enormous underwater birds. If you're lucky you'll see a dugong, the shy and vulnerable creature of the seagrass meadows. There'll be turtles, of course. I've seen them hatch and waddle down to the water with sky pink as the desert beyond. There'll be more coral than you've ever seen in your life. If you're keen enough you can see the coral spawn like a tropical blizzard. As you can see, I love the place. It has been left to us to experience, to look after, to pass on to our children and their children."

*Tim Winton (Ningaloo Reef Rally speech, Fremantle, December 2002)*

As part of the *Parks for People* initiative, the Kurrajong campground received a \$900,000 upgrade in 2012. There are now 36 camp sites nestled in between sand dunes to shelter campers from prevailing winds and are all a short walk to the beach. There are new toilets and a camp shelter as well as three paths and boardwalks that lead visitors to new viewing platforms and provide beach access. Here, visitors can relax and enjoy the stunning views or explore the shoreline by foot.

Upgrades have begun on Osprey campground, which is expected to be completed by Easter 2015, thanks to \$1.125 million of funding from *Royalties for Regions*. The campground will be expanded from 20 basic camp sites to a newly designed twin loop with 45 camp sites that will be accessible via a new road. A separate area for non-campers is also included in the new construction – providing visitors with direct access to the offshore kayak and snorkel trail and the beautiful beaches of Osprey Bay. Each site at Osprey Bay is designed to enhance the camping experience – with sites spaced 5m

apart and each with a view of the Ningaloo waters. New toilets, shade shelters, sunset viewing platforms and a connecting walk trail to the beautiful neighbouring Sandy Bay will also be built.

**Parks and Wildlife Campground**  
Host volunteers are present in the park's campgrounds and are only too happy to provide visitors with advice of where to go and what to explore. Whether you're just popping in for a day or planning on camping for a couple, there is plenty to do and see in this magnificent part of the world.

---

**Above** Swimming with a whale shark in Ningaloo Marine Park off Cape Range National Park.

*Photo – Violeta Jahnel Brosig, courtesy Exmouth Visitor Centre*

**Top right** Turtle hatchlings.

*Photo – Ningaloo Turtle Program*

**Above right** Some natives visiting the campground.

*Photo – Jed Newman, courtesy Exmouth Visitor Centre*



## Do it yourself

**Where is it?** The northern access point is 36km from Exmouth.

**Total area:** 50,581 ha.

**What to do:** Birdwatching, hiking, snorkelling, diving, tours, camping, fishing, surfing, boat tour.

**Facilities:** Milyering Visitor Centre and gift shop, Jurabi Turtle Centre, campgrounds and caravan area, toilets, picnic tables, boat launching facilities, bird hide at Mangrove Bay, Yardie Creek Boat Tour.

**Visitor fees:** For current visitor and camping fees and to book online, visit [parkstay.dpaw.wa.gov.au](http://parkstay.dpaw.wa.gov.au).

**Nearest Parks and Wildlife office:**

Exmouth District Office, 20 Nimitz Street, Exmouth, phone (08) 9947 8000. Rangers are based at Milyering Visitor Centre, phone (08) 9949 2808.

*Strong currents at Turquoise Bay mean inexperienced swimmers should not enter the water unless accompanied by an experienced swimmer or licensed tour operator.*



I'm writing this on the summit of Peak Charles, in Peak Charles National Park. It's mid-summer but a reasonably cool day, the wind that was a pleasant breeze down in the campground is here blowing a minor gale, and I'm delighted because my wife Suzanne and I have just found one of the rarest plants in Western Australia.

By anyone's standard, *Pilostyles* is extraordinary and peculiar. A handful of species, all parasites, are found in the USA, parts of Africa and the Middle East and south-west WA. But unlike normal parasites like mistletoes or dodder, *Pilostyles* live for most of the year completely inside their hosts, growing through their stems like strands of fungus. Only when their flowers erupt through the host's stems, like some awful botanical equivalent of the monster in *Aliens*, are they visible. To me the flowers are quite wonderful, but for the host it's probably not a pretty sight.

We're at Peak Charles in mid-summer because one of WA's three known species of *Pilostyles*, *P. collina*, was collected here at this time in 1982, growing on a species of poison pea (*Gastrolobium*). It hasn't been seen here since, until today. Only two other locations are known for the species – at the foot of Bluff Knoll (again, last seen in 1982), and near Hyden, where in previous summers I've found it in Dragon Rocks Nature Reserve.

And that's where a taxonomic conundrum starts. Bluff Knoll, Dragon Rocks and Peak Charles are hundreds of kilometres apart, and no-one has found it elsewhere in 30 years of collecting. So is *Pilostyles collina* one species or several? Unfortunately, herbarium specimens of *Pilostyles* look a lot like sticks with blackish bumps on them, and without leaves and stems and with flowers that are small and difficult to interpret, they don't help a taxonomist much. Nevertheless, I have a hunch that something is up, which is why I've searched long and hard over several years at Peak Charles and Bluff Knoll.

This year's scramble up Peak Charles was particularly slow (and painful), because yesterday we tried following up another lead, hiking a 16km round trip along a



## Life (for a taxonomist) was never meant to be easy

long-overgrown track to Ellison Rock, a small granite rock west of Peak Charles and another possible *Pilostyles* hiding place. Alas, we found no host and no *Pilostyles*, the only result being stiff legs and sore feet. But the ascent this time was worth it because finally, in a patch of poison peas growing just below the summit, we found pencil-thick stems of the host thickly clad with small, orange-brown *Pilostyles* flowers.

Finding it after so many unsuccessful attempts helps in many ways. We've confirmed that this very rare plant still grows here, so we can better ensure its conservation. I also now know that the Peak Charles and Dragon Rocks plants look the same. But, are they the same at Bluff Knoll? The fresh flowers also showed, rather alarmingly, that *Pilostyles collina* flowers appear almost identical to those of *Pilostyles coccoidea*, a species I described from around Eneabba, more than 500km away, on another pea genus. Could these be the same? That would be both embarrassing (no taxonomist likes to describe a species only to find that it's already been named), and confusing.

However these turn out, *Pilostyles collina* remains a fascinating and very odd plant. At all three places the rare and localised *Pilostyles* is only found parasitising a rare and localised *Gastrolobium*, apparently spurning (or unable to infect) common and widespread hosts. As well, no-one knows what pollinates *Pilostyles* flowers, how their seeds disperse, how they infect their hosts, or how they survive fires. One could easily spend a lifetime studying *Pilostyles*, and probably still not answer all the questions surrounding it.


*Pilostyles* is an ongoing taxonomic conundrum, one of the most fascinating (and, it must be said, obscure and rarely-seen) plants in WA. Having finally relocated it at Peak Charles, the focus of activity will now turn to climbing and scrambling around Bluff Knoll and the Stirling Ranges. Taxonomy is often not easy, but it's always a heap of fun.

---

**Above** Western Australian Herbarium Curator Kevin Thiele with a specimen of *Pilostyles* growing in its host plant.  
Photo – Peter Nicholas/Parks and Wildlife



RETURN TO *Millstream*



**T**he aged hands of the white woman grasp the broad hands of the Aboriginal man at her side. “Thank you so much for seeing us,” the 91-year-old woman murmurs, her voice thick with emotion. My grandmother Mildred Gordon is sitting on the verandah at the Yindjibarndi Aboriginal Corporation office in Roebourne in Western Australia’s Pilbara Region. She and her husband Doug are chatting to Yindjibarndi Aboriginal Corporation chief executive Michael Woodley recalling tales of pastoral life on Millstream Station. Michael is the grandson of the late Woodley ‘Old Woodley’ King, a station hand who worked alongside Doug and Mildred at Millstream about 100km south of here. Old Woodley was a Yindjibarndi man whose people originated from this part of the country. For the Gordons, Woodley was more than just a member of the Millstream staff, he was someone to rely on to help run the station when Doug was away, someone respected for his quiet and gentle nature and someone revered for his knowledge of this mystical land. Woodley’s wife Shirley helped run the household, his children were schooled alongside Doug and Mildred’s kids in the back room of the Millstream homestead. It was a relationship based on mutual respect. And one that lasted generations.

## MEMORY LANE

Doug, Mildred and two younger generations of their family met Michael on their return to the Pilbara last year. It had been 20 years since Doug and Mildred had last set foot in the Pilbara. And it had been 50 years since they moved from Doug’s childhood home to seek new opportunity in the south. Their return to what is now Millstream Chichester National Park was

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**Main** Millstream is revered for its freshwater pools.

**Inset** Mildred and Doug Gordon with Yindjibarndi Aboriginal Corporation chief executive Michael Woodley recalling tales of pastoral life on Millstream Station.

*Photos – Samille Mitchell*



A couple in their 90s return to Millstream Chichester National Park in Western Australia’s Pilbara to visit their former pastoral home. Joined by their granddaughter, Samille Mitchell, on their return they discovered that, while times change, a connection to a place can endure.

by Samille Mitchell

“Woodley was more than just a member of the Millstream staff, he was someone to rely on to help run the station when Doug was away, someone respected for his quiet and gentle nature and someone revered for his knowledge of this mystical land.”



Left The late Woodley King.

Above Millstream’s freshwater pools were a recreational playground for the Gordons and their friends, including Nell Gordon and Cecil Roberts pictured in 1916.

Photos – Courtesy Doug Gordon

about rekindling memories of their time here and realising that, while buildings crumble and life moves on, connections to places can endure.

Millstream Station was established in 1865 when Alexander McRae took up 100,000 acres of land. The station was later bought by the Cookson brothers, who in 1914 employed Doug’s grandparents Claude and Ella Irvine to manage the property. Aboriginal people had inhabited the area long before it became a pastoral station, with evidence of their occupation in the Pilbara stretching back 25,000 years. The people who lived at Millstream revered the area, which they call Nhanggangunha, meaning ‘home to the creation spirits’. These spirits rose from the earth here at Millstream, lifted the sky and the world from the sea and, together with the sky god and first men, moulded the landscape.

For countless years the Yindjibarndi camped by Millstream’s clear waters feasting on the area’s bounty, meeting for corroborees, and sharing Dreamtime tales. They’d tell stories of the mythological serpent, or Warlu, called ‘Barrimirndi’ who travelled across the land during the

Dreamtime adorning it with the many freshwater pools that characterise the region today. These people were Old Woodley’s forefathers and Old Woodley himself was born here – one of the many ‘Millstream boys’.

Doug says Aboriginal people of his time, spoke nothing to him of the Barrimirndi serpent, but he believes his grandfather Claude Irvine got on well with the Aboriginal people he employed.

Michael says the respect between the Gordons and their Aboriginal staff was mutual.

“My grandfather always spoke highly of the Gordons. I remember hearing the story of how (Les Gordon) died. Some of the Aboriginal ladies were there when he died and even much later, when one told me of the death, she still got really emotional,” he said

Like their father and grandfather before, and all the Pilbara pastoralists, Doug and his brother Stuart came to rely on the Yindjibarndi people for unveiling the secrets of the land, and for their labour. They paid their Aboriginal staff in food, tobacco, medical care and perhaps

some cash if they planned a trip to town. Michael says while this is unacceptable by today’s standards, his grandparents accepted those times without ill feelings. “That was the way the system worked then,” Michael says. “Most of them said, although it was hard, they were happy to still be on country.”

## REVISITING AN ANCIENT LANDSCAPE

Such an era is fresh in my grandparent’s memory as they leave Michael *en route* to Millstream. The drive is an opportunity to sit back and admire the beauty of this countryside. They travel amid the flat-topped plateaus of the Chichester Range – enormous jumbles of rust-red rock adorned in a cloak of golden spinifex that snakes towards the horizon. Inside Millstream Chichester National Park they visit Python Pool, a site grasped in the clutches of this harsh and ancient land. Here a towering red cliff face embraces the dark-green waters of a deep and permanent pool. Gums crowd the creek line and a breeze whispers through the leaves.



**Left** Mildred Gordon, in her younger days.

**Below left** Brothers Stuart and Doug Gordon as kids.

*Photos – Courtesy Doug Gordon*

**Below** Doug Gordon on his return to Millstream.

*Photo – Samille Mitchell*

homestead. The homestead was built in 1919 and was once the pride of the district. It was constructed by Doug’s grandparents Claude and Ella Irvine, who retired from Millstream in 1924, leaving their daughter and son-in-law Nellie and Les Gordon to take on as managers. The duo bought the property in 1950 and left it to their sons Stuart and Doug after Les died in 1954. Stuart and his family were based at the Millstream homestead while Doug and his family were at an outcamp called Kangiangi.

As they approach the Millstream homestead Doug and Mildred realise things are not as they were. Where today there is a green lawn and overgrown fields, they remember gardens brimming with blooming oleanders and palm, cotton, banana, fig and mulberry trees. Where today stands an aging homestead with visitor information they reminisce about a dining room with a long timber table adorned with silverware where family dinners were held. And where today grows unkempt bush they recall a tennis court fashioned from the dirt of termite mounds. Doug says it was a first-class court with “playing speed about midway between grass and clay”. And oh the gatherings they would have! People from across the district would descend on Millstream for these welcomed social outings. Fellow pastoralists and their

Doug and Mildred can’t manage the walk to the pool’s edge but the image of the still waters remains fresh in their memory. They remember a time when people from across the district would meet here for Road Board meetings. They point out where a blacksmith shop once stood, located here to service the horse-drawn wagons, the drovers and the

flocks of sheep that would trundle the stony trail through the ranges *en route* to market on the coast. No trace of those buildings remain, but you can still see the path through the stones that the sheep and stockmen once travelled. Visitors can hike 16km of this trail, today called the Chichester Range Camel Trail – a title that bemuses Doug as he claims camels never travelled it.

Revived by a cuppa at Python Pool, Doug and Mildred venture to Millstream





“These pools are what set Millstream apart – a fairytale world of clear waters adorned with ferns and lily pads and shaded by paperbarks, introduced date palms and Millstream palms, which occur nowhere else in the world.”

**Above left** An Aboriginal camp at Millstream in 1920. Doug’s grandfather Claude Irvine is pictured in the middle.

**Above** The bathhouse constructed of bull rushes at Millstream.  
Photos – Courtesy Doug Gordon

families would stay in the nearby shearing quarters, play tennis, dine together and bathe in the natural freshwater pools near the homestead. “Around 10 or 12 people would come and stay for the weekend,” Mildred says. “They were great parties.”

The station was abuzz with activity in those days. Aboriginal staff and their families lived on the grounds and worked as stockmen, gardeners, horse breakers, cooks, cleaners, childminders, fencers, builders, windmill fixers, well diggers and more. A governess lived at the homestead to school the Gordon children and some of the Aboriginal children. Tourists would visit to admire the station’s oasis-like nature. The gardens here were once lauded for their beauty. The Minister for the North West visited Millstream in 1920 and declared it “the garden of the north; it is a terrestrial paradise...” He wrote:

*“Bananas are in abundance, and in the Garden – which has been cultivated summer and winter for the past 38 years – all descriptions of vegetables flourish amazingly. In the pool and the streams are water lilies of many colours and great beauty. The streams Lose Themselves in*

*the Earth, about twelve miles from the homestead, and all along their course is this rich soil, thousands of acres of it – capable of growing almost anything.”*

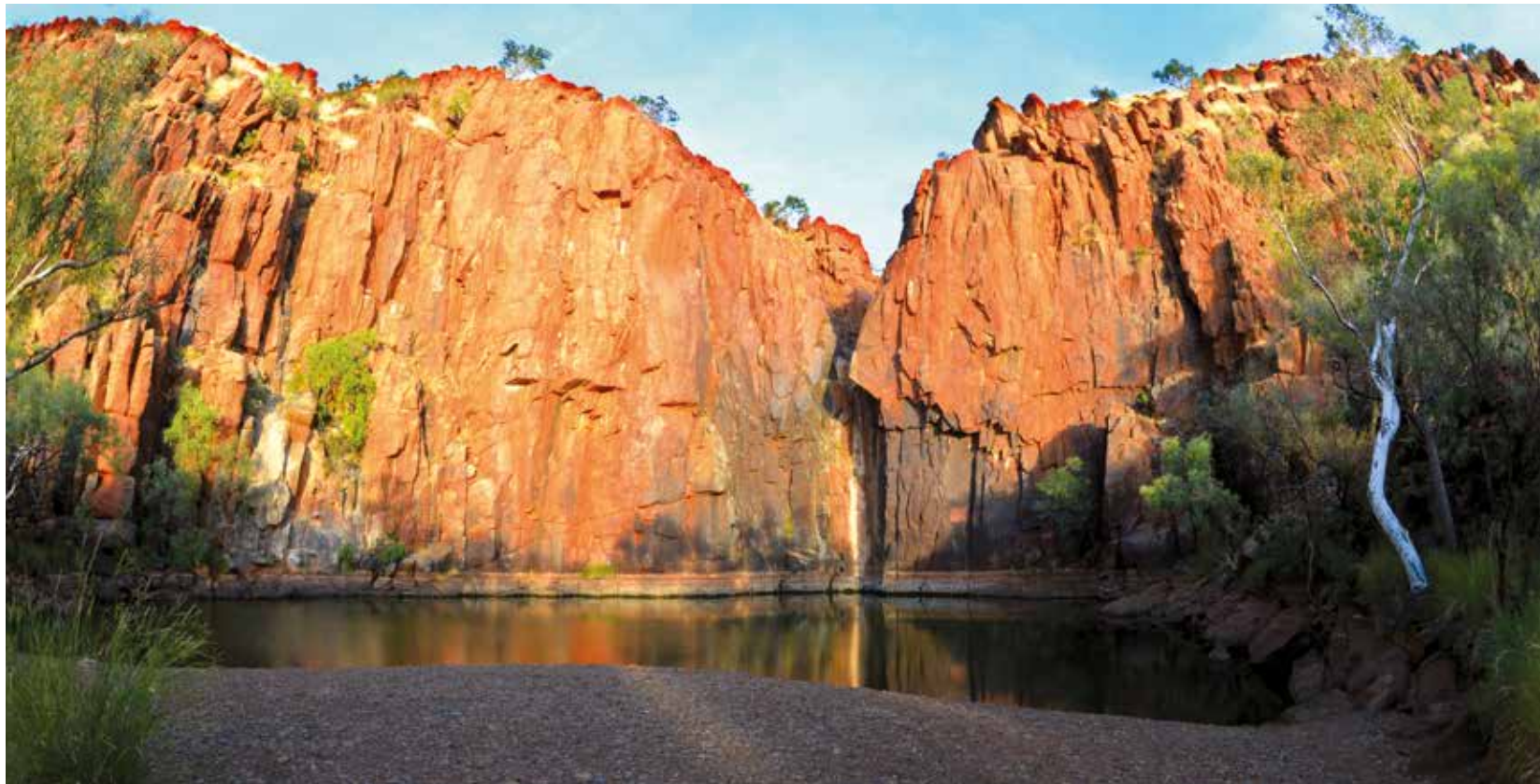
This “terrestrial paradise” is also home to Doug’s parents’ grave stones, which they visit on a hill behind the homestead. Doug’s dad Les was buried in 1954 after dying of a heart attack aged 63 and his mother Nellie’s ashes were buried alongside him after she died in 1983 aged 86. Some of Doug’s brother Stuart’s ashes also lay here now, buried alongside his parents’ gravestones in 2012 with the words “part of his heart never left Millstream...” etched on the gravestone. Mildred and her great grandchildren lay flowers on the gravestones before they head back to the homestead to set up camp for the night.

It’s here at the camp, among the staff, caretakers and researchers at Millstream, that Doug and Mildred learn more about modern-day Millstream. Under the hospitable care of caretakers James and Maureen Lindsay, who have whipped up the first of many cuppas, they launch into discussion. They also meet a PhD

student and her mother researching tiny marsupials called kalutas. They share a chat with members of a moth research team who think they’ve found about 1000 species of moth at Millstream during their field trip here, many new to science. They’ll know more when they send samples from their work here to Canada for DNA analysis. And they meet another of Old Woodley’s grandsons – Kingsley Woodley.

Kingsley strides up to introduce himself, offering his hand to shake and flashing a warming smile. He is one of 11 Aboriginal people from the Ngurrawaana Aboriginal Community who works as a ranger under a joint program run by Natural Resource Management’s Rangelands, Parks and Wildlife and Yindjibarndi Aboriginal Corporation. The rangers’ work on country is a critical element of park operations at Millstream.

Later, back near the homestead, Doug visits the freshwater pools alongside the homestead. These pools are what set Millstream apart – a fairytale world of clear waters adorned with ferns and lily pads and shaded by paperbarks, introduced date palms and Millstream palms. Signs from the



**Top** Python Pool, Millstream Chichester National Park.

**Above** Doug Gordon remembers both his parents and brother at Millstream.  
*Photos – Samille Mitchell*

homestead to the pool carry the words of Doug as a 12-year-old boy and give visitors an insight into what the area was like in the 1930s. They tell stories about life at Millstream – like dive-bombing into the clear pools on a summer afternoon (the pool is no longer used for swimming) and describe the tennis courts, the bathhouse and the old kitchen.

The bathhouse was particularly popular with residents and visitors. It stood over the shallow rushing waters with walls of dried bull rushes, a gable roof thatched with cane grass, concrete floors on each side, cattle troughs lining the sides of the stream and coloured slabs lining the stream floor. On his 1920 visit, the Minister for the North West described the bathhouse:

*“A glorious stream of water some twelve inches in depth, passes through the room, and the water is always at the same temperature, summer and winter. One can indulge in a bath at any time”.*

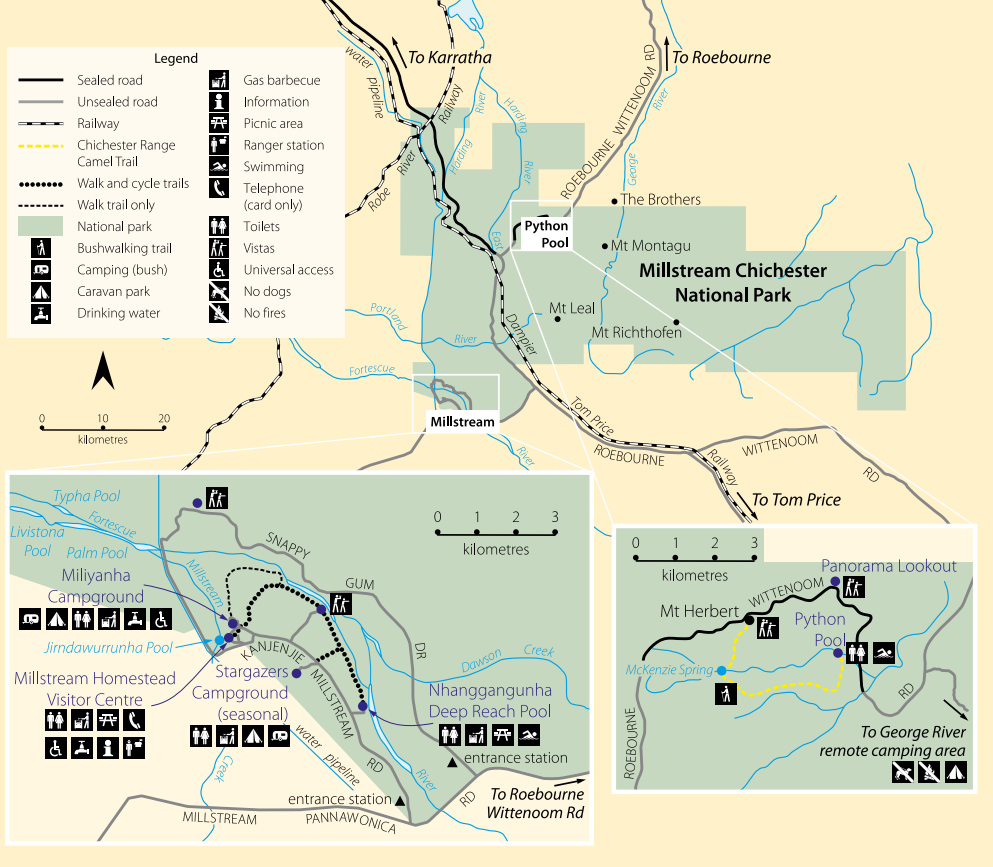
Doug’s eldest child Sue remembers galloping amid the paperbarks and date palms on her pony, the trampling hooves of her steed and the footsteps of the

children keeping the overgrowth down so the pools were like an extension of the garden. She remembers diving into the cooling pools, delighting in the fish you could see clearly through the water.

Doug also visits Deep Reach, a day-visit site along the mighty Fortescue River and is impressed with the work done there – the handrails and steps into the river waters, the lookout, the shaded picnic areas. Interpretive signage on the way tells the story of the sea serpent Barrimirndi who the Yindjibarndi people believe lurks here. Doug is unaware of this story.

He says, in his day the Aboriginal people avoided Deep Reach because once, long ago, it was site of a corroboree in which people’s frenzied stamping broke the crust of the river banks sending the revellers tumbling into the river. The steep broken banks meant they were unable to escape and they drowned in the dark waters.

Further downstream Doug visits the cliff-side lookout over Crossing Pool. He takes a seat on a picnic bench, his walking stick by his side and his great granddaughters racing along a walk trail kicking up red dust that shimmers in the



## Do it yourself

**Where is it?** Millstream Chichester National Park is 150km from Karratha.

**Total area:** 238,497ha.

**What to do:** Hiking, birdwatching, photography, nature observation, swimming.

**Facilities:** Visitor centre, campgrounds, toilets, camp kitchens, picnic tables, gas barbecues, walk trails.

**Camping:** Camping is available at Miliyanha (suitable for all vehicles) and Stargazers campgrounds. Campground Host volunteers are stationed in both campgrounds for most of the tourist season, between mid-April and early October, and can provide a wealth of information about the park and what you can do there, as well as collect your camping fees.

Entry fees apply.

**Nearest Parks and Wildlife office:** Pilbara Regional Office, Lot 3 Mardie and Anderson roads, Karratha, phone (08) 9182 2000.

Visit [parks.dpaw.wa.gov.au](http://parks.dpaw.wa.gov.au).



**Left** View across the plain with iconic royal mulla mulla.

*Photo – Rob Davies*

**Below** Four generations enjoy the sunset in Millstream Chichester National Park – Samille Mitchell with her daughter Charlie Harrison, grandparents Mildred and Doug Gordon and mother Sue Mitchell.

*Photo – Samille Mitchell*



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late afternoon sunlight. From here he can look out over the still waters, admire the gums crowding the river banks and reflect on the changes at Millstream. He left here to seek new opportunities for his four children, never imagining the fortune the next owners would make selling a licence to use the area's water to supply Karratha. He never envisaged they'd turn the homestead into a tavern, that the State Government would one day acquire the homestead and use it as a visitor centre in a national park. But Doug is not one for

regrets. He realises that things change, life goes on. And by the end of their trip he and Mildred had an appreciation of the work that goes on here. Reflecting on the trip after returning to their home in Northampton Mildred declares: "I thought it was excellent the work they are doing. They are bringing it up to modern times. It's such an environmentally significant spot – quite different to anything else in the area". They, like Old Woodley and his people, realise that while time marches on, the magic of Millstream endures.



And the *rivers*  
*ran red*

The story behind the shoreline of Lake Warden's sudden and spectacular transformation to a blood-like pool could be the plot of a Shakespeare play, but the reason behind this mysterious phenomenon is more fact than fiction.

by **John Huisman and Don Cater**

“Under high salinity conditions, *Dunaliella* accumulates very high quantities of  $\beta$ -carotene, and the cells take on a distinctly orange hue.”



Recent visitors to Western Australia’s Lake Warden, near Esperance, might have thought they’d witnessed a phenomenon of biblical proportions. Coating the lake’s shoreline was a vivid red liquid that could aptly be described as blood-like, the scene’s forebodingness heightened by a sputum-like froth contrasting with the deep crimson. What might have caused this morbid sight?

Thankfully a simple explanation was in reach. A short stroll from Lake Warden is Esperance’s famous Pink Lake, known worldwide for the tinted waters that give the lake its name. Surely whatever makes Pink Lake pink must also be behind the ominous scene at Lake Warden. Well, yes and no.

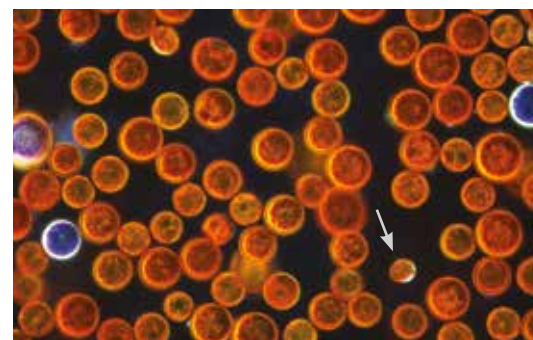
### WHAT MAKES ESPERANCE’S PINK LAKE PINK?

Pink lakes worldwide host several microscopic organisms that give them their colour. One of these, surprisingly, is a green alga, the single-celled, salt-loving *Dunaliella salina*. Like all green plants and algae, *Dunaliella* has several accessory pigments such as  $\beta$  (= beta)-carotene, the same pigment that gives carrots their orange colour. In green algae and plants, these are usually in low quantities and the colour is masked by the green chlorophyll pigments. Under high salinity conditions, *Dunaliella* accumulates very high quantities of  $\beta$ -carotene, and the cells take on a distinctly orange hue. *Dunaliella* also has one other competitive advantage, one that is shared by very few organisms: it is able to live in water with extremely



high salt concentrations, up to saturation when salt crystals form. Why is this ability an advantage? By living where little else can survive, *Dunaliella* has very few competitors and predators, and can form a virtual monoculture. Populations can reach very high densities, and even though individual cells are microscopic and invisible to the naked eye, when in high concentrations their great numbers colour the water noticeably.

How does *Dunaliella* cope with these high salinities? If you subject most plants to very salty water the results will be quick and grim; the difference between the high salt concentration in the water and that of the plant cells sucks all of the water from the plants, causing dehydration and a rapid demise. *Dunaliella*, however, has a neat trick. To combat the external salt, it accumulates glycerol in its cells and this serves to balance the salt concentration. This enables *Dunaliella salina* to be one of the most environmentally tolerant organisms known and it can handle a salinity range from seawater (three per cent salt) to saturation (31 per cent salt). It can also survive temperatures ranging from



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**Main** With the appearance of something more sinister, the shoreline of Lake Warden was coated with a crimson liquid.

Photo – Don Cater/Parks and Wildlife

**Above left** Lake Warden with its pink-tinged edges.

Photo – Mick Sonneman

**Top** The green, oval-shaped motile (swimming) cells of *Dunaliella viridis* amongst *Dunaliella salina* cysts.

**Above** *Dunaliella salina* cysts under a microscope. The slightly smaller, oval-shaped cell swimming in the clear space on the bottom right is a motile cells.

Photos – John Huisman/Parks and Wildlife

below 0°C to about 38°C, although its preferred temperature is above 20°C.

Esperance’s Pink Lake unfortunately does not always live up to its name. The pink colour waxes and wanes, which Parks and Wildlife monitoring suggests is a result of fluctuations in the lake’s salinity. During



"In WA, commercial production of *Dunaliella* is undertaken at Hutt Lagoon, near Port Gregory north of Geraldton. The algae are cultivated in water made up of salt-saturated brines obtained from the lagoon..."

periods of low salinity density of *Dunaliella salina* declines, its place taken by diatoms, ciliates, and the smaller green species *Dunaliella viridis*.

Despite its often high concentration, *Dunaliella* is not the sole cause of the pink colour in salt lakes. The unusual, salt-loving, bacteria-like organism *Halobacterium* also contributes. Although a prokaryote, like the bacteria, *Halobacterium* is classified in the separate domain Archaea, which also includes other organisms found in extreme environments such as hot springs. The colour of salt lakes has also been attributed to yet another tinted organism, the red bacterium *Salinibacter*, which is found worldwide. Undoubtedly these or similar organisms occur in WA's pink lakes, but how much they contribute to their colour is yet to be established.

## AND LAKE WARDEN?

As previously stated, the cause of Lake Warden's spectacular transformation is related to the cause of Pink Lake's colour, but there are differences. *Dunaliella salina* was responsible for the recent red colour of the Lake Warden shoreline, but in a slightly different form. In its normal, vegetative state, *Dunaliella* is a free-swimming, single cell, about 15µm long (=0.015mm), somewhat oval-shaped with two flagella emerging from one end. The cells usually divide by simply splitting in two along the long axis, but occasionally they can undergo sexual reproduction where the cells fuse by joining at their flagellated ends, the resulting cells then forming a smooth-walled spherical cyst known as a 'zygospore' which, after a time, will germinate to produce up to 32 cells.

Top left *Dunaliella* on the lake surface.

Above left Shorebirds feeding at Lake Warden.

Photos – Don Cater/Parks and Wildlife

Above Farming *Dunaliella* at Hutt Lagoon.

Photo – Steve Back

On occasions, cells can also form asexual cysts, which are known as 'aplanospores'. These are also spherical cysts, but in contrast to the zygospores they have rough walls. The formation of zygospores is thought to be a response to a drop in salinity. Unlike the motile cells of *Dunaliella*, the aplanospores contain canthaxanthin, a different carotenoid pigment that is usually a deeper red than β-carotene. When the Lake Warden shoreline water was analysed under a microscope, it was seen to contain millions of aplanospores, and virtually no motile cells. The blood-red water was the result of these high levels of aplanospores, probably pushed onto the shore by prevailing winds. Unfortunately



this spectacle was witnessed by only a few people, as the aplanospores were soon dispersed and Lake Warden returned to its more usual dirty-pink colour.

## OTHER PINK LAKES

Esperance's Pink Lake and Lake Warden are not the only tinted lakes in the region. Perhaps the most impressive of all, but unfortunately the least accessible, is Lake Hillier on Middle Island, the largest of the islands that make up the Recherche Archipelago off the coast of Esperance (see 'A visit to Middle Island', *LANDSCOPE*, Spring 2006). Lake Hillier is about 600m long and was first seen by the explorer Matthew Flinders in 1802, when he climbed the island's highest peak (now known as Flinders Peak) to survey the surrounding waters. Parks and Wildlife scientists have been monitoring the various lakes, and have shown that Lake Hillier also supports a population of *Dunaliella salina* and an as-yet unidentified bacterium, which in combination are probably the reason for the lake's spectacular hue.

## DUNALIELLA AS A CROP

The idea of using *Dunaliella salina* as a commercial source of  $\beta$ -carotene was first mooted in the 1960s. The species is characterised by its ability to accumulate very high levels of  $\beta$ -carotene, and concentrations of up to 14 per cent of dry weight have been reported.  $\beta$ -carotene is a valuable product, its uses include as a naturally derived food colouring, but it is

also promoted as a dietary supplement, where the claimed health benefits are many including boosting energy and vitality, supporting the immune system, and promoting healthy skin and eyes. Levels found in commercial products are much less (about two per cent dry weight), and promotional literature often compares this favourably to the levels in raw carrots (about 0.008 per cent; or 0.12 per cent dry weight). Australia is the largest producer of *Dunaliella salina* in the world, but commercial scale production also occurs in the USA and Israel.

In WA, commercial production of *Dunaliella* is undertaken at Hutt Lagoon, near Port Gregory north of Geraldton. The algae are cultivated in water made up of salt-saturated brines obtained from the lagoon, with the salinity controlled by the addition of seawater and nutrients added as required. When the ponds have reached the appropriate  $\beta$ -carotene content, the water is pumped to a specially designed facility and the *Dunaliella* harvested, after which the remaining water is returned to the ponds and the salinity and nutrient content adjusted.

Whether colouring a lake or as a source of valuable pigments, *Dunaliella* is an impressive beast, especially when you consider its microscopic size (about 12,000 individuals would fit on the head of a pin). WA abounds with unique plants and animals, but this minuscule alga must surely qualify among the more unusual, and as one of the many miracles that nature has bestowed us.

## Visiting the Pink Lakes

Each of WA's pink lakes has its own particular character. Easily the best known and most accessible is Pink Lake, near the town of Esperance on the south coast. This lake is only a short 7km drive west of the town and a great way to see it is as part of the 40km Great Ocean Drive, a loop that includes Esperance's spectacular coastal scenery. The remarkable Lake Hillier is located in a pristine wilderness on Middle Island in the Recherche Archipelago and can only be seen from the air, either by helicopter or light plane from Esperance. You can also explore the islands and abundant wildlife of the Recherche Archipelago on a cruise. A third lake, also called Pink Lake, is near the town of Port Gregory, north of Geraldton on the central west coast. At this site one can also see the only commercial operation harvesting *Dunaliella* for  $\beta$ -carotene, and vast ponds have been established that are carefully managed for optimum pigment production.

**Above left** The spectacular Lake Hillier on Middle Island.

Photo – Jiri Lochman

**Below** Sputum-like froth atop blood-red coloured water.

Photo – Don Cater/Parks and Wildlife



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*Often misunderstood and overlooked, algae can be fascinating if you know what to look for. Here is a glimpse of this hidden world from an entirely different perspective.*

**photos and words by John Huisman**

# A hidden world

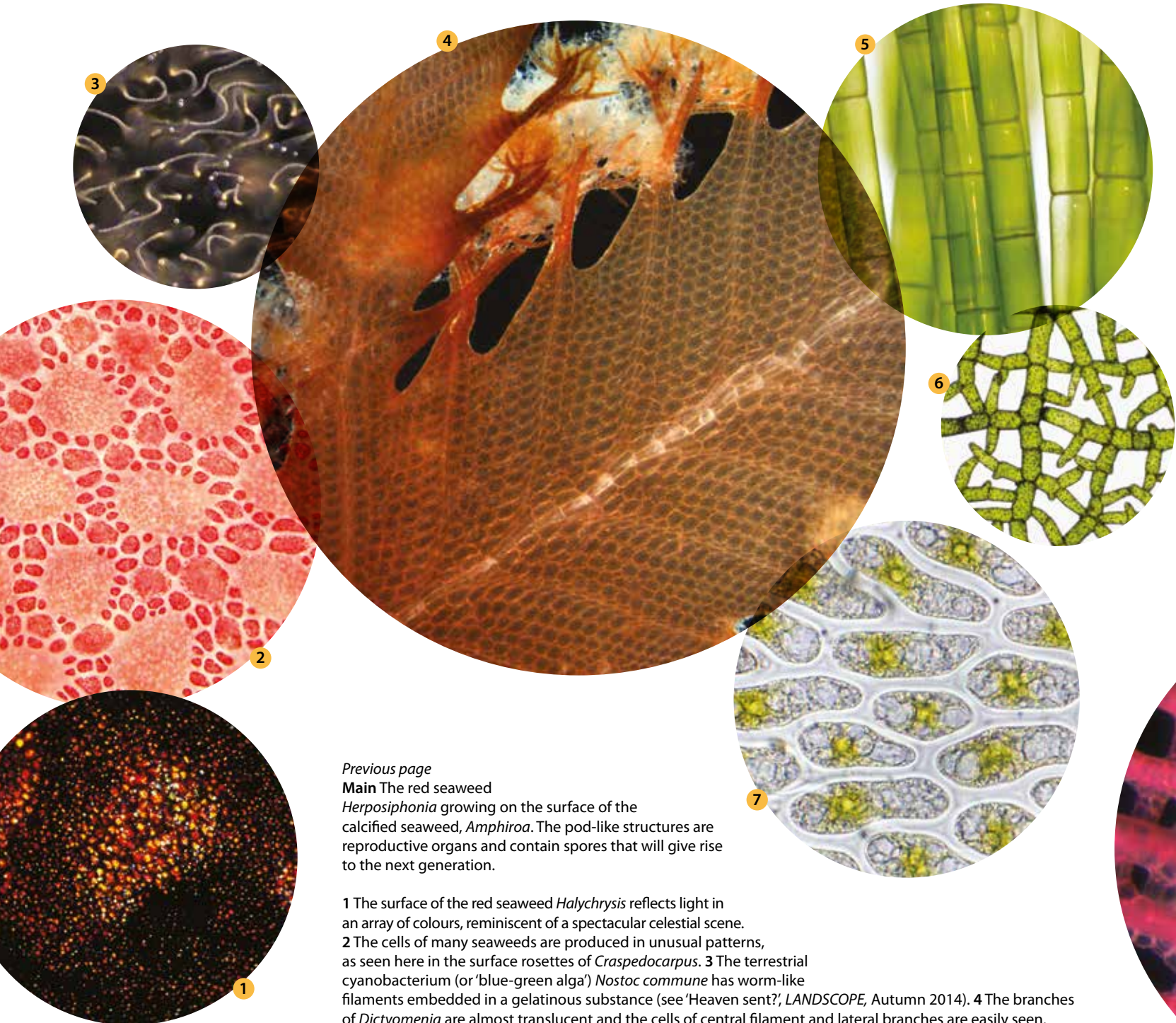


There's no question that seaweeds and freshwater algae have a bad reputation; whether they're piled high on the beach, forcing a careful navigation before you can reach the water and emitting a stench so powerful that it can drive down property values, or forming blooms in lakes and rivers that effectively poison the water, it is perhaps

understandable that a positive appreciation of these plants is not widely held.

But take a closer look. These are not 'weeds' in the true sense of the word, but a diverse assortment of unusual plants whose only connection with one another is, in many cases, that they have evolved in a watery environment, which presents a unique suite of evolutionary pressures.

The end result is that the algae have evolved with unique, and often strikingly beautiful set of colours, shapes and patterns, many of which do not have a terrestrial counterpart. Sometimes this beauty is only discovered in close-up, where the intricate patterns of cells and reproductive structures are revealed.



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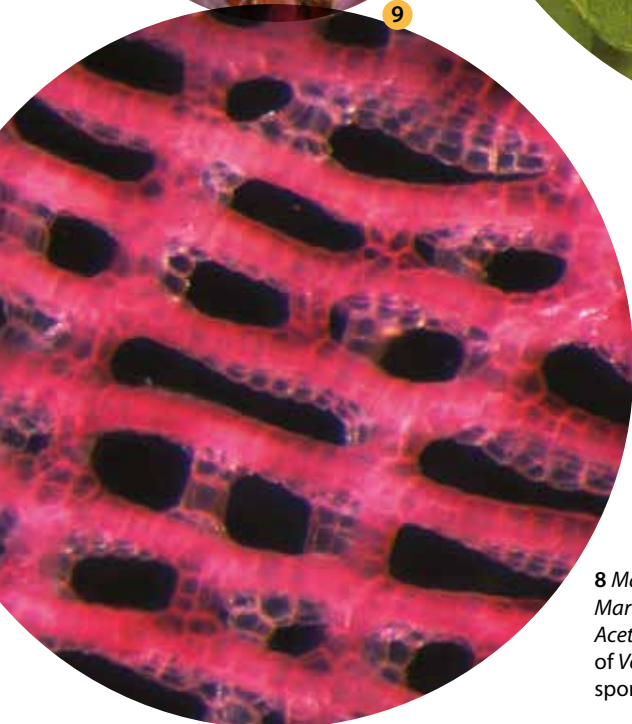
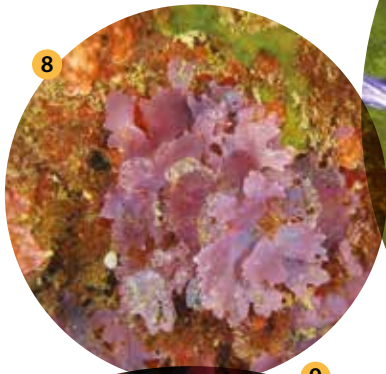
**Main** The red seaweed *Herposiphonia* growing on the surface of the calcified seaweed, *Amphiroa*. The pod-like structures are reproductive organs and contain spores that will give rise to the next generation.

- 1 The surface of the red seaweed *Halychrysis* reflects light in an array of colours, reminiscent of a spectacular celestial scene.
- 2 The cells of many seaweeds are produced in unusual patterns, as seen here in the surface rosettes of *Craspedocarpus*.
- 3 The terrestrial cyanobacterium (or 'blue-green alga') *Nostoc commune* has worm-like filaments embedded in a gelatinous substance (see 'Heaven sent?', *LANDSCOPE*, Autumn 2014).
- 4 The branches of *Dictyomenia* are almost translucent and the cells of central filament and lateral branches are easily seen.
- 5 When magnified, the green seaweed *Chaetomorpha* has a bamboo-like appearance with emerald green cells.
- 6 Cells of *Microdictyon* fuse with one another to form a delicate net.
- 7 The membranous blades of *Porphyr*a (also known as nori) are only one-cell thick, seen here in surface view.

## MARTENSIA (Photos 8 and 9)

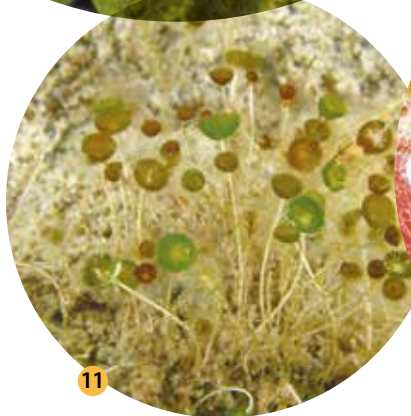
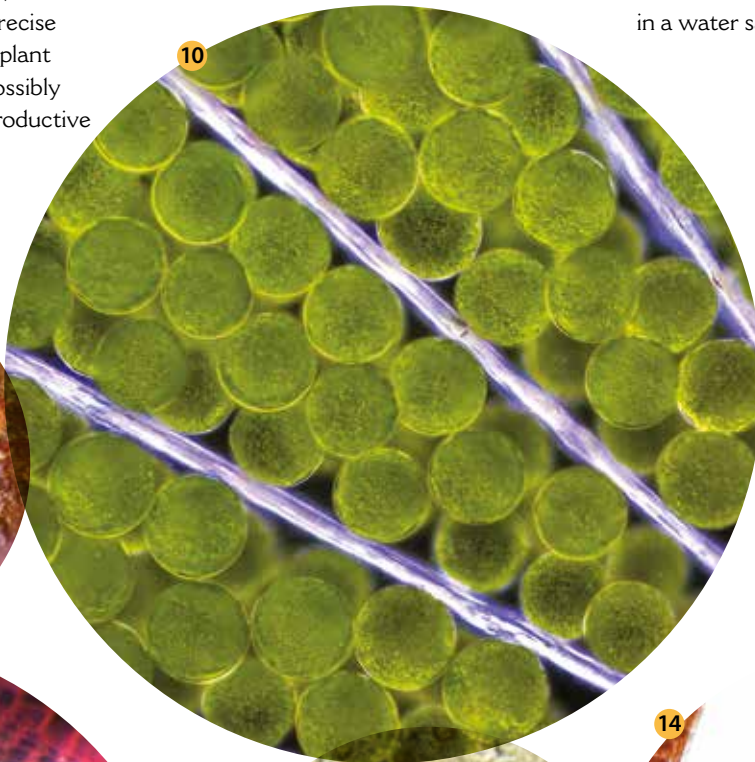
In 1854 Irish botanist William Henry Harvey commented that “among the marine algae, perhaps none are more curious and few more beautiful” in relation to the net-like red algae that include *Martensia*.

Of the seaweeds, *Martensia* is certainly the most unusual. It has light pink, very delicate fronds that are thin and membranous, only a few cells thick. Lower down the fronds are whole, but at the margins a striking transformation occurs. The cells change their orientation and grow as a series of filaments, which are then cross-linked in a very precise pattern to form a net. Why the plant does this is unknown, but it is possibly related to the production of reproductive structures, which form on the net portion of the plant.



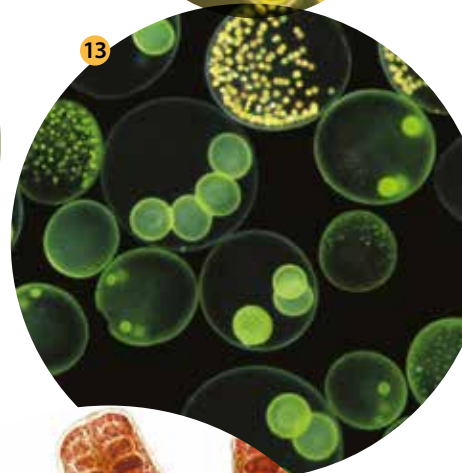
## ACETABULARIA (Photos 10 and 11)

The name *Acetabularia* is taken from Latin and means ‘saucer’, and refers to the circular, green, cup-like structure that sits at the apex of the plant. This structure is actually composed of several reproductive pods, which each contain numerous cysts that in turn will release the plant’s gametes. *Acetabularia* is commonly found in shallow sandy habitats, where it often grows in clusters on old bivalve shells. The genus sometimes goes by the common name ‘mermaid’s wineglass’.



## VOLVOX (Photos 12 and 13)

Not a seaweed, but a colonial freshwater green alga. The individual cells of *Volvox* all have two flagella and are joined laterally into a spherical colony with their flagella directed outwards. Occasionally these cells transform into male and female gametes, and once fertilisation has occurred a spiny, thick-walled cyst is formed that is a bright orange colour. The spherical colonies of *Volvox* can be common in lakes and larger colonies can be a couple of millimetres broad, so just visible to the naked eye in a water sample.



8 *Martensia* growing on a reef at Rottneest Island. 9 A magnified view of the net-like margin of *Martensia*. 10 The green reproductive cysts of *Acetabularia* form in radial pods. 11 A cluster of *Acetabularia* plants growing on an old shell at Shoalwater Bay. 12 The bright orange, spiny cysts of *Volvox*. 13 Several *Volvox* colonies, some forming smaller daughter colonies. 14 Reproductive spores of *Amansia* are borne in specially modified lateral branches.





# Under the stars

## NATURE-BASED CAMPING

Visitors to campgrounds around Western Australia are enjoying new facilities and experiences, thanks to a State-wide initiative designed to encourage and facilitate people to camp in our beautiful natural areas. *by Steve Crawford*

**T**here's nothing quite like waking up to the sound of nature. Whether it's the chatter of birds busying themselves with their daily routines, the noise of rustling leaves in the surrounding trees, or the soothing sounds of water lapping at a river's edge or rolling in waves onto shore, it sure beats the sound of an alarm clock.

Each year, many thousands of Western Australians, interstate and international visitors venture to the many campgrounds throughout the State to enjoy time with family and friends. These experiences form treasured childhood memories and often become urban legends – stories of adventure and fun told long after the trip, usually embellished with every telling. On the flipside, some people venture out to seek solitude – a break from the busy and cluttered modern-day world. Whatever the motivation to get out, or the company taken, camping in WA is entering on a whole new era with an emphasis on accessibility and affordability.

## A MAJOR INVESTMENT

The State Government's \$21.05 million *Parks for People* initiative, funded over four years by the *Royalties for Regions* program aims to improve and expand camping, and associated visitor experiences in national parks and conservation reserves throughout WA. It is delivering new facilities and



services including affordable camping and caravan accommodation through the development of eight new campgrounds and the expansion of at least nine existing campgrounds, resulting in 450 new camp sites. It includes the creation and upgrade of existing and new walk, bike and drive trails, and the development of interpretative information including mobile and desktop applications to help guide visitors to parks and camp sites, as well as wi-fi connectivity in some campgrounds. Important partnerships with key recreation and tourism industry stakeholder groups are also being forged to help encourage families to connect with nature while having fun and getting active. The initiative provides for improvements to commercial leasehold caravan park accommodation, and visitor facilities in State forest recreation areas and former pastoral lease areas.

## NEW CAMPING FACILITIES

Western Australians are spoilt for choice, and Perthites don't need to travel far to find a well-equipped and beautiful setting in which to camp. A new campground has been opened at Martins Tank Lake in Yalgorup National Park, a short drive south of Mandurah (see '*Parks for People: Yalgorup National Park*', *LANDSCOPE*, Summer 2014–15), while Baden Powell campground in Lane Poole Reserve in the Perth Hills provides camping among the jarrah forest (see '*Parks for People: Lane Poole Reserve*', *LANDSCOPE*, Winter 2014). Further south, on the spectacular rugged South Coast at Fitzgerald River National Park, two new campgrounds have been opened along with road improvements, new walk trails and additional recreational facilities (see '*Rediscovering Fitzgerald River National Park*', *LANDSCOPE*, Winter 2014). Travelling north, the new Kurradjong campground at Cape Range National Park near Exmouth (see '*Parks for People: Cape Range National Park*' on page 8) has been

## Go camping

For details about campgrounds and bookings visit [parkstay.dpaw.wa.gov.au](http://parkstay.dpaw.wa.gov.au). Or for more general information about parks and recreational areas visit [parks.dpaw.wa.gov.au](http://parks.dpaw.wa.gov.au). Share your experiences, photos and camping tips on Facebook at Explore Parks WA or hashtag your photos on social media with #exploreparkswa. To find out more about WA Wilderness Glamping or book a site visit [www.wawilderness.com.au](http://www.wawilderness.com.au).

Where camping fees are charged these can vary from \$7.50 to \$19 per adult per night. Discount rates for children and concessions apply.



*Previous page*

**Main** Camping under the stars on Ningaloo Coast.

*Photo – Paul Bester, courtesy Exmouth Visitor Centre*

**Above** Fishing at Blackwood River.

*Photo – Tourism WA*

“These experiences form treasured childhood memories and often become urban legends – stories of adventure and fun told long after the trip, usually embellished with every telling.”



expanded with new camp sites, toilets, walking paths and scenic lookouts.

Additional camping facilities are planned and under construction at Leeuwin-Naturaliste (see ‘Our south-west escape: Leeuwin-Naturaliste capes’, *LANDSCOPE*, Summer 2014–15), Wellington, Cape Le Grand, D’Entrecasteaux and Shannon national parks and many other parks and reserves. Camp site improvements cater for the full range of camping from basic tents to campervans and towed caravans.

Complementing these new camping facilities, Parks and Wildlife has recently upgraded and improved visitor facilities at a number of parks. The Granite Skywalk at Castle Rock in Porongurup National Park and the Wilderness View Lookout at Mount Frankland National Park are two new facilities that have been designed to deliver awe-inspiring visitor experiences. Coupled with the award-winning Valley of the Giants Tree Top

Walk and the redevelopment of the Gap Lookout at Torndirrup National Park, regional tourism bodies now have the opportunity to package and market new visitor experiences to a broader tourism audience.

In addition to new and improved infrastructure and facilities, Parks and Wildlife is improving its campground information and booking systems. Through the new Park Stay WA website ([parkstay.dpaw.wa.gov.au](http://parkstay.dpaw.wa.gov.au)), campers can get information on more than 100 campgrounds managed by the department

with 14 campgrounds bookable online, with plans to expand this number in the coming years.

## COMMUNITY AND BUSINESS PARTNERSHIPS

While many campers are seeking a traditional low-key camping experience in a natural setting, Parks and Wildlife is meeting the growing demand for alternative forms of camping, such as ‘glamping’ (short for ‘glamorous camping’). Through a community partnership initiative with Pemberton

.....  
**Above** Remote camping at Karlamilyi National Park.

*Photo – Judy Dunlop/Parks and Wildlife*

**Right** A ‘glamping’ tent for a couple.

*Photo – Parks and Wildlife*





**Left** Camping in the Perth Hills.

**Below left** Enjoying a barbecue at a pre-set up tent.

*Photos – Parks and Wildlife*

**Below** Pilgramunna camp site at Cape Range National Park.

*Photo – Steve Bryant*



In partnership with Nature Play WA and Outdoors WA, Parks and Wildlife conducted its first ‘Camping 101’ event at Yanchep National Park. Part of the Great Aussie Camp Out in October 2014, the event aimed to give first-time campers an opportunity to camp with support in the beautiful Yanchep National Park. More than 100 adults and children took part in the event and there are more planned for the future.

The provision of new and upgraded facilities has also created opportunities for Parks and Wildlife to work collaboratively in on-ground interpretative activities and experiences. Josh Whiteland of Koomal Dreaming recently conducted a Noongar bush barbecue experience, providing campers with an opportunity to experience Noongar culture. Josh demonstrated cooking with Noongar herbs and spices, provided tastings of emu and kangaroo, and gave an uplifting didgeridoo performance and story-telling session. The camping experience included guided nature walks by Parks and Wildlife rangers, highlighting the importance of partnerships in adding value to the camping experience and providing opportunities for Aboriginal communities.

## STAYING IN TOUCH

To understand campers’ likes and dislikes and to help guide future planning,

market research is being undertaken to survey campers. Feedback received so far reaffirms that people enjoy the opportunity to get out into the great outdoors to reconnect and spend time with family and friends. A recently completed visitor survey at Cape Range National Park indicated that campers were highly satisfied with the park, the overall camping experience and the quality of camp sites. They also reported that camping provided a range of personal benefits including an ability to appreciate scenic beauty, the natural environment and an ability to access natural experiences. As we continue to deliver high-calibre and innovative camping experiences in natural settings while ensuring the natural values for future generations, would-be-campers can go to [parks.dpaw.wa.gov.au](http://parks.dpaw.wa.gov.au) to plan their next camping trip and look forward to sleeping under the stars and waking to the sounds of nature.



Scan here with your smart phone to watch a short video about the ‘Camping 101’ event at Yanchep National Park.



**Steve Crawford** is Parks and Wildlife’s visitor communications manager. He can be contacted on (08) 9334 0214 or by email ([steve.crawford@dpaw.wa.gov.au](mailto:steve.crawford@dpaw.wa.gov.au)).



# Explore WA with LANDSCOPE

Feature pull-out map

## Department of Parks and Wildlife offices

- Albany (08) 9842 4500
- Broome (08) 9195 5500
- Bunbury (08) 9725 4300
- Busselton (08) 9752 5555
- Collie (08) 9734 1988
- Crawley (08) 9442 0300 (Regional Parks)
- Denham (08) 9948 1208
- Esperance (08) 9083 2100
- Exmouth (08) 9947 8000
- Geraldton (08) 9921 5955
- Jurien Bay (08) 9652 1911
- Kensington (08) 9219 9000 (Head office)
- Kalgoorlie (08) 9080 5555
- Karratha (08) 9182 2000
- Kununurra (08) 9168 4200
- Merredin (08) 9041 2488
- Mundaring (08) 9295 9100
- Narrogin (08) 9881 9200
- Pemberton (08) 9776 1207
- Wanneroo (08) 9405 0700
- Walpole (08) 9840 0400

**WILDCARE helpline** - For sick and injured native wildlife (08) 9474 9055



### North West

- Mirima National Park (Hidden Valley)
- Mitchell River National Park
- Ngamooowalem Conservation Park
- Parry Lagoons Nature Reserve
- Purnululu National Park
- Wolfe Creek Meteorite Crater National Park
- Eighty Mile Beach Marine Park
- Geikie Gorge National Park
- King Leopold Ranges Conservation Park
- Lalang-garram/Camden Sound Marine Park
- Rowley Shoals Marine Park
- Tunnel Creek National Park
- Windjana Gorge National Park
- Dampier Archipelago island reserves
- Karijini National Park
- Millstream Chichester National Park
- Montebello Islands Marine Park
- Murujuja National Park

### Coral Coast

- Cape Range National Park
- Ningaloo Marine Park
- Dirk Hartog Island National Park
- Francois Peron National Park
- Hamelin Pool Marine Nature Reserve

### Experience Perth

- Beeliar Regional Park
- Canning River Regional Park
- Herdman Lake Regional Park
- Jandakot Regional Park
- Marmion Marine Park
- Matilda Bay Reserve
- Rockingham Lakes Regional Park
- Shoalwater Islands Marine Park
- Swan Estuary Marine Park
- Woodman Point Regional Park
- Valgorup National Park
- Yanchep National Park
- Yellagonga Regional Park

### South West

- Penguin Island
- Avon Valley National Park
- Banyowla Regional Park
- Beelu National Park
- Gooseberry Hill National Park
- Greenmount National Park
- Helena National Park
- John Forrest National Park
- Kalamunda National Park
- Korung National Park
- Lane Poole Reserve
- Lesmurdie Falls National Park
- Midgegoroo National Park
- Mundy Regional Park
- Serpentine National Park
- Walyunga National Park
- Wandoo National Park
- Wooroloo Regional Park
- Wungong Regional Park
- Perth Observatory
- Kennedy Range National Park
- Mt Augustus National Park
- Burra Rock Conservation Park
- Cave Hill Conservation Park
- Credo proposed Conservation Park
- Goldfields Woodlands National Park

### Golden Outback

- Kennedy Range National Park
- Mt Augustus National Park
- Burra Rock Conservation Park
- Cave Hill Conservation Park
- Credo proposed Conservation Park
- Goldfields Woodlands National Park
- Goongarrie proposed Conservation Park
- Jaurdi proposed Conservation Park
- Kalgoorlie Arboretum
- Lake Mason proposed Conservation Park
- Lorna Glen (Matuwa) proposed Conservation Park
- Rowles Lagoon Conservation Park
- Victoria Rock Nature Reserve
- Dryandra Woodland
- Barna Mia
- Cape Arid National Park
- Cape Le Grand National Park
- Eucla National Park
- Frank Hann National Park
- Peak Charles National Park
- Stokes National Park
- Woody Island Nature Reserve
- Hoffman Mill Recreation Site
- Leschenault Peninsula Conservation Park
- Wellington National Park
- Wellington Discovery Forest
- Blackwood River National Park
- Bramley National Park
- Leeuwin-Naturaliste National Park
- Ngari Capes Marine Park
- Scott National Park
- St John Brook Conservation Park
- Tuart Forest National Park



Department of Parks and Wildlife



SOUTHERN OCEAN

INDIAN OCEAN





# Dr Denis A Saunders, AM

by Tania Durlik

The endangered Carnaby's cockatoo is lucky to have a friend in Dr Denis Saunders who has spent almost 50 years fighting for its survival. While his efforts to prevent further decline are making a difference, the battle for long-term survival endures.

**D**enis Saunders is a rare sort – almost as rare as the bird species he has devoted nearly half a century trying to save. As a university graduate with a degree in zoology, he never envisaged he would spend the next 47 years investigating ways to help slow the decline of Carnaby's cockatoo (*Calyptorhynchus latirostris*), once thought to be the same as Baudin's cockatoos and previously known as the short-billed white-tailed black cockatoo.

His interest in the species was first ignited in 1968 (the same year he married his university sweetheart) when he joined the wildlife research division of CSIRO to study the ecology of Carnaby's cockatoo, a charismatic bird that also forms life-long bonds with their partners. Little did he know at the time, this work would be vital in his battle to save the species in coming years.

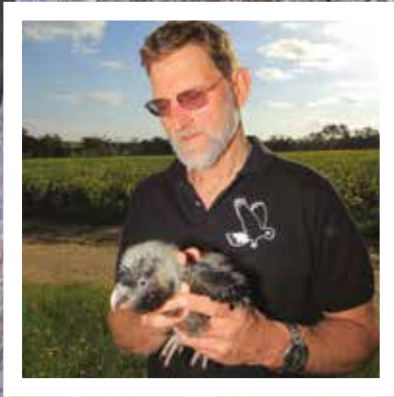
At the time the bird was classified as vermin and had a bounty on its bill due to its fondness for apple and pear seeds and almond crops. It was also a pest in pine plantations, not only because of its

fondness for pine seeds, but because the weight of the birds often caused bent trunks, not suitable for sawn timber.

Early on in his research, Denis unravelled many mysteries surrounding Carnaby's cockatoo and was among the first to explore a significant breeding haven for the species that was quickly recognised as crucial habitat. With these findings came renewed hope.

This was the start of his close association with the wonderful cockatoo, a relationship that his wife describes as his "other marriage". While few men can say they spend the majority of their time with another "bird" and remain married, it's a love affair that continues to grow.

By the late 1980s, the species had disappeared from more than 30 per cent of its breeding range as a result of culling and broadscale clearing of native vegetation for agriculture, and was consequently placed on the State and Federal government endangered species lists. What had started as a fortuitous research opportunity years earlier, rapidly turned into a battle as the species faced extinction.



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**Left** A 30-year-old-female cockatoo first banded by Denis Saunders in 1988.

*Photo – Rick Dawson/Parks and Wildlife*

**Inset** Denis Saunders examines a nestling.

*Photo – Matt Swan/Parks and Wildlife*



Keen to share his knowledge with others to help guide future management of Carnaby's cockatoo, Denis has published 41 papers on the species in peer-reviewed scientific journals and 12 in other publications, including Parks and Wildlife's *Western Wildlife* newsletter.

He still continues to document and publish the results of his research and his work has been recognised on a global scale with countless awards received, including the 1998 International Society for Conservation Biology's Individual in Government Award.

While his dedicated work to help protect crucial Carnaby's cockatoo habitat continues, his concern for their long-term survival endures. He remains hopeful that with strategic planning and increased protection, their distinct and raucous cries will still be heard in our skies centuries from now.

## REALISING A PASSION

The first breakthrough for Denis came when, during his research, he confirmed suggestions documented by Ivan Carnaby in 1948 that there were two species of black cockatoos with white tail-bands in south-western Australia: Baudin's cockatoo responsible for orchard damage and Carnaby's cockatoo responsible for damage to pine trees.

With the taxonomy of Carnaby's cockatoo verified, Denis then shifted his focus to the ecology of the species. As

he set off in search of breeding habitat he met Frank Grigson, a farmer and avid egg collector at Cockleshell Gully, who directed him to Coomaloo Creek, north of Badgingarra. During his first visit to the area Denis immediately realised it was a significant breeding ground. Subsequently, the area became a home away from home for Denis. While conditions were often harsh, flies relentless and the days long, together with his technical officer John Ingram, he soon became acquainted with the birds that were nesting in the small oasis of wandoo trees surrounded by Kwongan and agricultural land.

Since then, Denis has spent thousands of hours at Coomaloo Creek conducting surveys, banding Carnaby's cockatoos, observing their breeding and feeding behaviour, and monitoring their movements throughout the year.

## MOVING FOWARD

Unquestionably, Denis' work at Coomaloo Creek has been pivotal in helping to develop a solid knowledge base to assist with improved management of the species. The breeding population of Carnaby's cockatoo at Coomaloo Creek has been studied in detail since 1969, with at least two site visits made annually in 28 breeding seasons from 1969. After relocating to Canberra in 1997 Denis no longer had the opportunity to monitor the population, but retained his interest in

**Above left** Parks and Wildlife officer Rick Dawson and Denis Saunders inspect a Carnaby's nestling.

**Above** Rick Dawson inspects an artificial hollow installed at Coomaloo Creek.  
*Photos – Matt Swan/Parks and Wildlife*

*Opposite page*  
Five-day-old nestling.  
*Photo – Rick Dawson/Parks and Wildlife*

the subject as an inaugural member of the species' recovery team.

In 2009, Denis resumed his visits to Coomaloo Creek after teaming up with wildlife officer Rick Dawson and zoologist Peter Mawson from the former Department of Environment and Conservation. Both had agreed to assist with Denis' fieldwork and this collaboration has been momentous in sustaining the Carnaby's cockatoo population at Coomaloo Creek.

## CRAFTING NESTING HOLLOWES

In early September 2009, Denis and Rick visited Coomaloo Creek to look for new nesting hollows and banded birds. Their survey work was made considerably easier by the expertise of department staff who used a map of the study area, originally developed by the Australian Survey Office in the 1970s, to produce an updated and detailed map that pinpointed the exact locations of nesting trees.



“... installing artificial hollows in strategic locations is assisting with the species’ recovery. The team has successfully mounted 60 artificial hollows at Coomallo Creek, and during the 2014 breeding season 53 per cent of breeding attempts (eggs laid) were made in artificial hollows.”

The map was then overlaid on satellite imagery enabling Rick and Denis to locate the majority of more than 200 hollow trees used by Carnaby’s cockatoos between 1969 and 1996.

When he first started studying the species, Denis had established that breeding females used the same hollow each year, provided they were successful and the hollow was unoccupied when they returned to breed.

On revisiting the site with Rick and Peter, Denis discovered that many of the hollow trees he had monitored before 1996 no longer existed, or were no longer useable, and many hollows were in need of repair for a variety of reasons including fallen floors and splitting sides.

This inspired a new focus for the team – not only to restore the natural hollows, but also to install artificial ones as part of an experiment to provide greater breeding opportunities for the cockatoos.

To achieve the latter successfully, the structure and dimensions of the artificial hollows needed to be large enough to allow plenty of room for the females to access them, and deep enough to reduce

predation and provide protection from the elements. As the hollows were made from large PVC pipes, they also required a ladder so the birds could climb in and out. Another consideration was the inclusion of a sacrificial wooden post, which the females could chew to add wood chips to the sterilised base on which to lay their eggs.

Artificial hollows for Carnaby’s cockatoos had previously been built and placed in forest and woodland areas since the 1980s. However, there was insufficient information about the use of the hollows to guide the team’s design and placement to maximise the chances of the species using them successfully.

After spending time sourcing the best design, the team set about installing 20 artificial hollows in late September 2011.

More recently the team has refined the design further by creating larger artificial hollows that more closely resemble natural ones, which average one metre deep, have a floor diameter of 40cm and open vertically.

Denis believes that installing artificial hollows in strategic locations is assisting with the species’ recovery. The team has

successfully mounted 60 artificial hollows at Coomallo Creek, and during the 2014 breeding season 53 per cent of breeding attempts (eggs laid) were made in them.

While this in itself is a great feat, Denis is quick to point out that ongoing maintenance is essential to ensure both natural and artificial hollows are repaired as soon as they become derelict. While the artificial hollows have become an important tool in cockatoo conservation Denis says if they are not maintained, they will become unusable.

## STORMY TIMES

The trial of artificial hollows could not have come at a better time. Leading up to the installation of the first of the artificial hollows in 2011, Carnaby’s cockatoos received a major blow with a heatwave in the Great Southern killing at least 208 birds at Hopetoun and Munglinup, and many more may have died but were not recorded. Two months later a hailstorm in Perth killed 57 birds and 24 others were taken into care for rehabilitation.

These events occurred just weeks after a fire at Coomallo Creek, destroyed



16 active nesting hollows and killed three nestlings. The fire also burnt out the southern end of the study area and wiped out part of the breeding habitat.

These were testing times for Denis but the fight to save this highly intelligent and fascinating species never faltered and his research continued.

## BREEDING SUCCESS

As a result of the artificial hollows experiment (which continues today), the number of breeding attempts at

### *The formula*

Denis has developed a formula that enables him to work out the age and health of a Carnaby's cockatoo nestling. The age is calculated using the length of the cockatoo's folded left wing, and the nestling's health is based on the relationship between its age and weight.



Coomallo Creek has risen dramatically over the years, from 41 in 2009 to 101 in 2014. This rapid increase was due to the installation of extra hollows and the repair of derelict ones enabling breeding birds, whose habitat was destroyed in the 2009 fire, to move into the study area. While the statistics are encouraging, the amazing journeys and stories of individual Carnaby's cockatoos are even more uplifting.

Denis recalls that when a female Carnaby's cockatoo with a seven-week-old nestling was killed by a wedge-tailed eagle, her male partner continued to feed the nestling by himself until it fledged. The male was seen a few months later along the Hill River, near Jurien, with both his new partner and his fledgling. The

**Above** The three-year-old banded hen on the left is the youngest-ever confirmed breeding female.

*Photo – Rick Dawson/Parks and Wildlife*

**Above right** A Carnaby's cockatoo nestling inside one of the artificial hollows.

**Left** The age and health of a cockatoo can be measured in the folded wing of the nestling.

*Photos – Matt Swan/Parks and Wildlife*

following year the pair and their newest fledgling were seen together with his fledgling from his previous union, evidence of a resilient family bond.

Another inspirational story close to the heart of both Denis and Rick is that of a female nestling (named 'Cilla' by ABC radio listeners) who was banded in 2010. Her birth and battle to survive was portrayed in the award-winning documentary *On a Wing and a Prayer* and book of the same title. Beating the odds and overcoming many threats, the nestling fledged successfully. She was re-sighted twice in 2014, nesting in a hollow just 600m from where she fledged. Unfortunately, however, like many young and inexperienced birds, she was unsuccessful in her first breeding attempt.

Although many species cast off their offspring as soon as they leave the nest, young Carnaby's cockatoos form very strong parental bonds and stay with their parents until the following breeding season. This provides the parents with an opportunity to show their offspring how food and water are distributed in a very patchy landscape. The bonds between breeding birds are so strong that Denis recalls only ever seeing one case where the partners have separated and bred with other individuals.



“I am absolutely delighted at the iconic status the species has in WA and the individuals of the many groups that are working really hard to save them...”



**Above left** Rick Dawson and Denis Saunders measure a nestling in the field.

*Photo – Matt Swan/Parks and Wildlife*

**Above** The screech of Carnaby's cockatoo is a quintessential Western Australian sound.

**Left** Riley Raffan is the third generation of the Raffan family that have nurtured Carnaby's cockatoos on their property.

*Photos – Rick Dawson/Parks and Wildlife*

that without them and the involvement of future generations he would be fighting a losing battle.

## LIVING WITH HOPE

As an energetic 67-year-old, Denis is showing no signs of slowing down just yet. However, behind his optimism there's a hint of sadness at the reality that if the threats to Carnaby's cockatoo persist, his grandchildren and their grandchildren and beyond may never experience the joy of seeing the majestic beauty of a flock of Carnaby's cockatoos flying across the skies.

Denis sums up his ongoing battle best this way: “I am absolutely delighted at the iconic status the species has in WA and the individuals of the many groups that are working really hard to save them, because effectively under their wings sit a whole swag of other species, and if you get it right for Carnaby's cockatoos you'll get it right for a whole range of other species”.

## SUPPORTING THE CAUSE

The assistance Denis and Rick have received from private landowners and volunteers has been instrumental in the battle to save Carnaby's cockatoos. Much of the study area at Coomallo Creek, where the majority of the artificial hollows have been placed, is on a property owned by the Raffan family who has always been very supportive of the research. They even offered Denis the use of their caravan for accommodation when his study shed collapsed because termites had eaten all the supports.

These days when Denis and Rick visit the area to conduct their annual monitoring in September and November,

they stay in the Raffan's old farmhouse. In return, they share their knowledge with younger family members who have shown a keen interest in the conservation of Carnaby's cockatoo.

In addition to the Raffan family, the Paish and McAlpine families have also supported research on their properties. Volunteers from the Palm Beach Rotary Club and BirdLife Australia have also helped with installing, repairing and checking hollows and nesting sites.

Denis says there have been many other individuals over the years who have dedicated their time and effort to assisting with the research and conservation of these beautiful birds, and Denis admits

**Tania Durlik** is a Parks and Wildlife communications officer. She can be contacted on 9219 9999 or by email ([tania.durlik@dpaw.wa.gov.au](mailto:tania.durlik@dpaw.wa.gov.au)).

Western Australia's mammals:

# ensuring their future



**A comprehensive audit of Australia's mammals has provided a snapshot of their current status, helping the Department of Parks and Wildlife better target management of Western Australia's mammals.**

by Andrew Burbidge,  
John Woinarski and Peter Harrison



Australia has some of the most distinct mammals in the world and 86 per cent of species that live here do not occur anywhere else. Their biology is perfectly adapted to the Australian environment but their fate changed trajectory with the arrival of European settlers. The impacts of factors such as foxes, feral cats and inappropriate fire regimes, as well as land clearing for agriculture and urban development, is well-documented, but until recently we did not

.....  
*Previous page*

**Main** Quokkas occur only in the south-west of WA and numbers are declining.

*Photo – Willi Laufmann/Sallyanne Cousins*

*Photography*

**Inset** Golden-backed tree rat.

*Photo – David Bettini*

**Below** Kantjilpa, also known as pig-footed bandicoots, are one of 20 species of Australian mammals that are extinct, and the cause was probably predation by feral cats.

*Illustration – From The Mammals of Australia by John Gould (1863)*

have a complete and current overview of the status of all Australian mammals.

*The action plan for Australian mammals 2012* is the first review undertaken of all Australian mammals. The audit was carried out in 2012, with the results published in 2014. We evaluated the status of all 315 terrestrial and 58 marine Australian indigenous mammal species and 125 terrestrial and six marine subspecies that were known to have occurred at European settlement. These included 151 terrestrial and 46 marine species, and 40 terrestrial and two marine subspecies that occurred in Western Australia.

## THE REPORT CARD

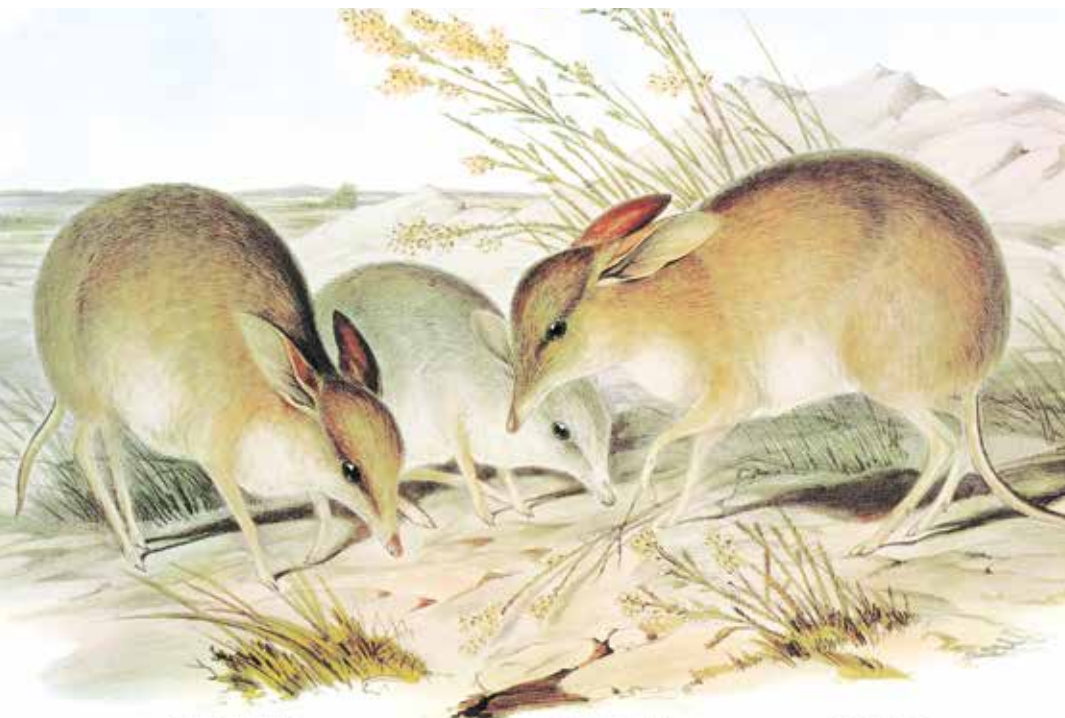
It is fairly well-known that Australia has the worst record for recent mammal extinctions of any country. But the action plan revealed that the number of extinctions is actually about 50 per cent higher than what is listed under the *Environment Protection and Biodiversity Conservation Act 1999*. This number is also far greater than that recorded for any other group of Australian animals. At least 30 species of terrestrial mammals are known to have become extinct since 1788

but this number could rise as research is carried out into subfossils, and species that occurred in Australia at European settlement are still being discovered. In the southern Kimberley, for example, remains of three hitherto unknown extinct species of native rodents were found in caves in 2004, and in Queensland a new species of rabbit-rat (*Conilurus capricornensis*), known only from recent bone deposits, was described in 2010. So, in a little over 200 years, more than 10 per cent of Australia's endemic mammals have been lost.

The action plan also outlines the status, threats, distribution, ecology, past and current conservation efforts and the future actions necessary to conserve all threatened and near-threatened mammal species. It also overviewed the status of each species and subspecies in 1992, 2002 and 2012 (based on 2012 knowledge) so trends could be elucidated and a 'Red List Index' calculated to help guide future management.

The major findings throughout the country are shocking. Post-European settlement extinctions began in Australia around 1860 and have continued at a rate of about one to two extinctions per decade since. Sadly, two mammal species have become extinct in the past decade: the Christmas Island pipistrelle (*Pipistrellus murrayi*) in 2009 and the Bramble Cay melomys (*Melomys rubicola*) sometime in the past few years. The Christmas Island shrew (*Crocidura attenuata*) has not been seen for some decades and has been evaluated as Critically Endangered (Possibly Extinct), so the number of known extinctions may be 33.

Using the IUCN Red List categories and criteria we found that 57 land mammal species (of which 55 are endemic to Australia) are threatened, and a further 52 (42 endemic) are near threatened. At least 12 have populations of fewer than 1500 individuals. Many others have suffered massive declines since European settlement but don't meet the IUCN criteria for listing, which focus on extinction risk, based on geographic range, population size and the recent rate of decline (in 10 years or three generations,



## Changes in status since 1992 to WA mammals

### Improved status

**Chuditch** (*Dasyurus geoffroii*): widespread fox control under *Western Shield*, assisted colonisations

**Quenda** (*Isoodon obesulus fusciventer*): widespread fox control under *Western Shield*

**Koomal** (*Trichosurus vulpecula hypoleucus*): widespread fox control under *Western Shield*

**Boodie** (*Bettongia lesueur*): assisted colonisation to islands and mainland islands

**Mala** (*Lagorchestes hirsutus* (inland)): assisted colonisation to Trimouille Island

**Tammar (western)** (*Macropus eugenii derbianus*): widespread fox control under *Western Shield*, assisted colonisations

**Western brush wallaby** (*Macropus irma*): widespread fox control under *Western Shield*

**Greater stick-nest rat** (*Leporillus conditor*): assisted colonisation to islands and mainland islands

**Southern right whale** (*Eubalaena australis*): recovery since whaling ceased in 1963

**Humpback whale** (*Megaptera novaeangliae*): recovery since whaling ceased in 1963



### Worsened status

**Northern quoll** (*Dasyurus hallucatus*): ingestion of poisonous cane toads

**Butler's dunnart** (*Sminthopsis butleri*): declined in the Northern Territory, not recorded in WA since 1966

**Numbat** (*Myrmecobius fasciatus*): predation by feral cats and foxes

**Western ringtail possum** (*Pseudocheirus occidentalis*): cat and fox predation, urban development and a drying climate

**Northern brushtail possum** (*Trichosurus vulpecula arnhemensis*): predation by feral cats, and past inappropriate fire regimes

**Woylie** (*Bettongia penicillata*): predation by feral cats and foxes, novel disease

**Spectacled hare-wallaby** (*Lagorchestes conspicillatus*): multiple factors including predation and past inappropriate fire regimes

**Nabarlek** (*Petrogale concinna*): information lacking; probably a combination of predation by feral cats and past inappropriate fire regimes

**Black-flanked rock-wallaby** (*Petrogale lateralis lateralis*): multiple factors including residual effects of land clearing and fox and feral cat predation

**Quokka** (*Setonix brachyurus*): fox predation; threatened in the future by climate change

### Ghost bat

(*Macroderma gigas*): habitat loss due to mining, roost site disturbance, collision with barbed wire fences

**Pilbara leaf-nosed bat** (*Rhinonictis aurantia* Pilbara population): habitat loss due to mining

**Brush-tailed rabbit-rat** (*Conilurus penicillata*): predation by feral cats, and past inappropriate fire regimes

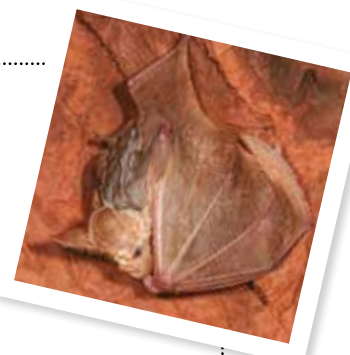
**Black-footed tree-rat** (*Mesembriomys gouldii*): predation by feral cats, and past inappropriate fire regimes

**Plains mouse** (*Pseudomys australis*): predation by feral cats and foxes, habitat degradation due to livestock and feral herbivores, predation by wild dogs

**Heath mouse** (*Pseudomys shorridgei*): residual effects of land clearing, predation by feral cats

**Central rock-rat** (*Zyzomys pedunculatus*): predation by feral cats, and past inappropriate fire regimes

**Pale field-rat (north-western)** (*Rattus tunneyi tunneyi*): inadequate knowledge, probably predation by feral cats, and past inappropriate fire regimes



whichever is longer). Of the threatened species, nine are Critically Endangered, 10 are Endangered and 36 are Vulnerable. The Red List Index shows that mammals have declined at a greater rate than Australian birds (as shown in *The action plan for Australian birds 2010*).

For each threatened species and subspecies we identified the main threats to survival, or, for extinct species, the probable cause of extinction. For extinct terrestrial species, the number one reason was predation by feral cats, which underpins many wildlife recovery programs including *Western Shield* (see 'Hope for WA mammals' on page 46). WA species considered to have become extinct primarily due to cats include

the kantjilpa or pig-footed bandicoot (*Chaeropus ecaudatus*), desert bandicoot (*Perameles eremiana*), central hare-wallaby (*Lagorchestes asomatus*), crescent nailtail wallaby (*Onychogalea lunata*), lesser stick-nest rat (*Leporillus apicalis*) and long-tailed hopping-mouse (*Notomys longicaudata*). Predation by feral cats was also identified as the number one threat to threatened species but predation by red foxes and the effects of inappropriate fire regimes came very close behind. These threats are interrelated and research in northern Australia shows that feral cats hunt much more effectively in recently burned areas than in well-vegetated ones and that very large fires have led to increased cat predation on, and decline of, threatened mammals.

Above left Pale field-rat.

Above Ghost bats are declining in parts of Australia due to habitat loss and collisions with barbed-wire fences.  
Photos – Andrew Burbidge

Below Gilbert's potoroos are recovering due to research and assisted colonisations.  
Photo – Matt Swan/Parks and Wildlife





## Hope for WA mammals

Parks and Wildlife's *Western Shield* program has been operating since 1996. It is the biggest wildlife conservation program ever undertaken in Australia and aims to protect, recover and boost numbers of WA animals. It does this through broadscale baiting programs to reduce European red fox and feral cat density using 1080 poison. This is the manufactured version of a poison that occurs naturally in the native *Gastrolobium* genus of plants, commonly called 'poison peas'. While native animals have evolved with these plants and have a high tolerance to the poison, introduced animals do not.

Parks and Wildlife lays about one million poison baits each year across nearly three million hectares of department-managed land throughout the State from as far north as Karratha, through the forests of the south-west to areas east of Esperance in the south. About 300,000ha of this is baiting undertaken in the rangelands for cat control research.

The second phase of the program is to increase native animal populations through the reintroduction of native animals to baited areas throughout the State where they previously occurred. More than 140 native animal translocations have been undertaken throughout WA since the start of *Western Shield*.

This program is supported by sponsorship from Alcoa, BHP Billiton Worsley Alumina (Worsley) and Tronox.



**Top** A feral cat spotted with a phascogale.  
Photo – Parks and Wildlife

**Above** Southern right whales are recovering since whaling ceased in 1963.  
Photo – Lin Sutherland/OceanwideImages.com

## CAUSE FOR OPTIMISM

It is not all gloom and doom. Positive outcomes have come from the action plan. While 55 species and subspecies throughout Australia have a worsened conservation status since 1992, 19 have an improved status. Others have increased, but did not qualify for an improvement in

their 2012 Red List status. For example, Parks and Wildlife's work with Gilbert's potoroo (*Potorous gilbertii*), via assisted colonisation on Bald Island Nature Reserve and a 'mainland island' (a fenced enclosure to exclude foxes and cats) in Waychinicup National Park had almost reached the numbers necessary for it to be moved from Critically Endangered to Endangered.

It is important that we learn from these success stories and apply the knowledge to other species.

In WA there is a long history of research into, and management of, threatened mammals. So, how are our mammals faring? We found that 18 WA terrestrial species and subspecies had a worsened conservation status since 1992, while 10 had an improved conservation status (see 'Changes in status since 1992 to WA mammals' on page 45). Programs being carried out by Parks and Wildlife, together with a number of private and community organisations and volunteers are making headway, but until these numbers are reduced, there is still work to be done.

## MARINE MAMMALS

The picture for marine mammals is somewhat different. Two species of great whales, the southern right (*Eubalaena australis*) and humpback (*Megaptera*

*novaeangliae*), are recovering after whaling was banned in 1963, but other great whales have yet to respond and have not increased from the remaining very low numbers. Australia's only endemic marine mammal, the Australian sea lion (*Neophoca cinerea*) is Vulnerable, having a small population and a continuing decline due to a variety of threats, including entanglement and drowning in fishing gear. The dugong (*Dugong dugon*) was evaluated as Near Threatened. A major problem in evaluating the status of Australia's marine mammals is lack of information, leading us to assess 46 species and subspecies as 'data deficient'. Much more information on distribution and population numbers and trends is needed before we can say which species are threatened and focus management actions to conserve them.

## WHERE TO FROM HERE?

While there have been some improvements, carrying on with 'business as usual' is likely to result in even more extinctions. Australia has the world's most distinctive mammals, including those from the most ancient lineages. Most have been on this land and in its seas for hundreds of thousands to millions of years. *The action plan for Australian mammals 2012* provides us with the evidence that Australia's loss of mammals is an ongoing problem, not just an unfortunate characteristic of early

pioneering days. Urgent action is required to stop further losses.

For land mammals, the single most beneficial action is broadscale control of feral cats, a task that is becoming feasible after registration of Eradicat, a cat bait developed by Parks and Wildlife. In the interim, the threat can be moderated to some extent by building 'mainland islands', local baiting, assisted colonisation (translocation) of threatened species to cat-and fox-free islands, stronger biosecurity on islands of conservation significance, and more considered management of dingoes (which can suppress cat populations in at least some regions) and fire (which can increase exposure of mammals to predators). Fox control in WA via *Western Shield* has had major benefits for some mammals, but the case of the woylie, which increased in numbers after fox control only to decline again, shows that fox control on its own

### **Protecting the nature of the Kimberley**

The largest conservation project ever undertaken in Western Australia was established in 2011 as part of the State Government's *Kimberley Science and Conservation Strategy* to both understand and maintain the incredible beauty and natural values of the north Kimberley, including its mammal species.

Parks and Wildlife, native title holders and Indigenous ranger groups, government agencies, non-government organisations and pastoralists are working together to protect country and manage threats such as fire, feral animals and weeds.

Better management of fire has halved the area burnt by destructive late dry season fires, improving habitat for threatened wildlife. Cattle numbers have been reduced by up to 44 per cent in key areas, resulting in increased numbers and distribution of threatened mammals.



"Australia has the world's most distinctive mammals, including those from the most ancient lineages. Most have been on this land and in its seas for hundreds of thousands to millions of years."

is insufficient for many species – feral cat control is also necessary and Parks and Wildlife is working on integrated fox and cat baiting. Better fire management, especially in the Kimberley and the arid interior, is also required and has commenced in the Kimberley as part of the State Government's award-winning *Kimberley Science and Conservation Strategy* (see 'Protecting the nature of the Kimberley', *LANDSCOPE*, Summer 2014–15). For marine mammals, more research into populations of the many data deficient species is badly needed.

**Above** The mulgara is one of several Australian mammals with a low public profile. Photo – Babs and Bert Wells/Parks and Wildlife

The low public profile of many Australian mammals contributes to the limited recognition of our loss. Few people know of ningauis, planigales, mulgaras, kowaris, phascogales or dibblers, let alone have seen them. With knowledge, awareness and familiarity, we can encourage greater affinity, care and sense of responsibility

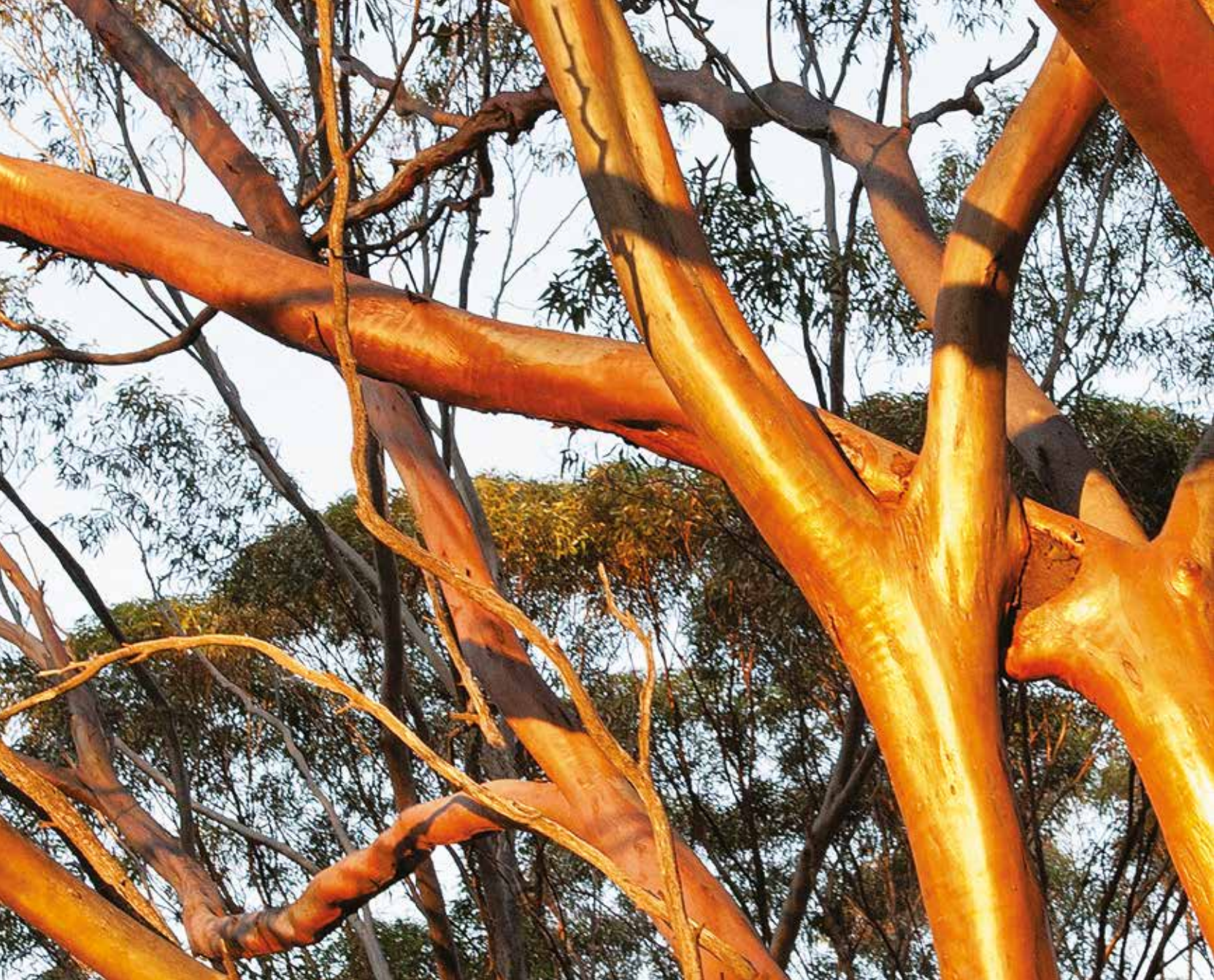
**Dr Andrew Burbidge** is a former Director of Science and threatened species in predecessor departments to Parks and Wildlife and is currently chair of the WA Threatened Species Scientific Committee. He can be contacted by email ([amburbidge@westnet.com.au](mailto:amburbidge@westnet.com.au)).

**Professor John Woinarski** has been involved in research, management and policy relating to Australia's threatened species for more than 30 years. He is employed part-time with the Northern Australian hub of the National Environmental Research Program at the Research Institute for the Environment and Livelihoods of Charles Darwin University.

**Professor Peter Harrison** has worked as a marine ecologist for more than 30 years and is Director of the Marine Ecology Research Centre at Southern Cross University. His diverse research and teaching interests encompass marine mammals to corals, with a focus on linking research findings to improved conservation and management outcomes. He has worked in a wide range of marine environments around the world from the equator to the Antarctic.

The action plan for Australian mammals 2012 *relied on the contributed expertise of more than 200 people, who reviewed draft accounts for individual taxa, provided unpublished data and taxonomic opinion and helped provide assessments of conservation status. Damian Milne collated, analysed and mapped a complex distributional database for terrestrial mammals, and Greg Luker compiled maps for marine mammals. Its publication was supported by funding from the Australian Wildlife Conservancy, the Norman Wettenhall Foundation, the North Australian Hub of the National Environmental Research Program and the Australian Department of the Environment.*

For more information, consult *The action plan for Australian mammals 2012* by J.C.Z Woinarski, A.A. Burbidge and P.L. Harrison (2014) available from [www.publish.csiro.au/pid/7010.htm](http://www.publish.csiro.au/pid/7010.htm).



# WOODLAND

## RECOVERY AFTER FIRE

A collaborative research project has investigated the changes that occur in gimlet woodlands following burning by large, high-intensity bushfires, revealing just how long these ecosystems take to recover. The information is being used to support improved ecological fire management in the Great Western Woodlands.

by Carl Gosper, Suzanne Prober and Colin Yates





The eastern Wheatbelt and Goldfields are renowned for their iconic woodlands – decorated by the various hues of eucalypt trunks which colour the landscape with pink, orange and silver, depending on the species and time of the day. Along with the more well-known salmon gum (*Eucalyptus salmonophloia*), gimlet (*E. salubris*) is a common tree in the woodlands. Its smooth bark ranges in colour from a blazing orange when fresh in autumn (especially when viewed in the dawn or evening sun) through to bronze at other times of year, and the fluted trunk often bulges and twists into a variety of remarkable shapes. While gimlet woodlands in the Wheatbelt have been reduced to isolated remnants, extensive areas remain in the Great Western Woodlands (GWW).

The GWW is an internationally significant area with great biological and cultural richness, arguably comprising the largest and most intact area of temperate woodland remaining on Earth. It extends across approximately 16 million hectares from Southern Cross east to Balladonia, and from Norseman north to Kalgoorlie. It is globally unique among Mediterranean-climate regions in terms of the extent and stature of woodlands occurring at such low mean annual rainfall (200–350mm), with trees regularly exceeding 20m in height and 1m in width (see ‘The Great Western Woodlands,’ *LANDSCOPE*, Summer 2010–11).

Like other Mediterranean-climate regions, and indeed most terrestrial WA ecosystems, the woodlands are subject to recurrent fires which shape the landscape affecting species composition, diversity and structure of vegetation. Fires burn most frequently in the Great Western Woodlands’ diverse shrublands and mallee vegetation, where fuel, made up of leaf litter, twigs, bark and standing vegetation, is most continuous. In contrast, mature eucalypt woodlands are less prone to



Left Morning light illuminates gimlet bark.  
Photo – Sallyanne Cousans

Inset Fire in the gimlet woodlands.  
Photo – Lachie McCaw/Parks and Wildlife





“The oldest stands sampled were thought to be more than 300 years old so it can be concluded that mature gimlet woodlands in the Great Western Woodlands have not experienced bushfire for at least several centuries. By this calculation, gimlet woodlands are thought to be among the least-frequently burnt eucalypt-dominated communities nationally, on par with the tall and wet ash forests of south-eastern Australia.”

burning because of their open tree canopy structure and patchier distribution of shrubs and litter. However, mature woodlands will burn during severe fire weather when conditions are very hot, dry and windy and when flame lengths are longer and can bridge gaps between the patchily distributed fuel. In the past few decades, a number of very large fires (more than 100,000ha) have collectively burnt a substantial proportion of the GWW. These fires have impacted people and their assets, and concerns have been expressed about the impact of the fires on the region’s biodiversity, especially for the iconic woodlands. Previous research in mallee and shrubland vegetation in the region (see ‘To burn or not to burn,’ *LANDSCOPE*, Summer 2010–11) has shown that these ecosystems are resilient to burning by recurrent fires providing they don’t occur more often than every 30 to 40 years. However, much less is known about how long it takes for woodlands to recover following burning by high intensity

fires and how vulnerable recovering woodlands are to burning again before they have matured.

This knowledge is critical for fire planning and management of the GWW. A collaborative partnership between Parks and Wildlife and CSIRO Land and Water Flagship has been investigating these topics to improve the scientific basis of ecological fire management in the area.

### HOW OLD ARE THE TREES?

A crucial first step to understanding the recovery of gimlet woodlands after fire was to develop a method to age gimlet stands, as it was apparent that many woodlands had not burnt in the time covered by records and remotely-sensed Landsat (satellite) imagery. Developing a method to age long-unburnt stands helped answer two important questions. First, the current age-class structure (the proportion of the vegetation in different time-since-fire classes) of gimlet woodlands could be estimated and provide insight into



Top Gimlet woodland near Lake Johnston.  
*Photo – Suzanne Prober/CSIRO*

whether recent extensive bushfires in the woodlands were unprecedented. Second, it enabled the establishment of a chronosequence (sites sampled concurrently but of different times since the last fire) which provided the basis for research into temporal changes and how the woodlands recover over time since fire.



Gimlet has very thin bark and is killed by the intensity of fires typical of bushfires in the woodlands. There is no evidence that mild surface fires in eucalypt woodlands in the GWW have occurred in recent decades, and local Ngadju people report that they did not usually burn woodlands. Therefore, we can conclude that the tree age is unlikely to be greater than the time since the last bushfire.

In gimlet stands burnt in the time covered by the Landsat record (from 1972 to present), growth ring counts were made on trunk sections and compared to the known time since the last fire. This confirmed that growth rings formed annually and could be used to estimate plant age. The tendency for gimlet to develop hollow trunks precluded the use of growth ring counts to estimate the age of trees more than about 100 years old. So the age of older trees was determined from a model estimating growth ring count from tree diameter.

The oldest stands sampled were thought to be more than 300 years old so it can be concluded that mature gimlet woodlands in the GWW have not experienced bushfire for at least several centuries. By this calculation, gimlet woodlands are thought to be among the least-frequently burnt eucalypt-dominated communities nationally, on par with the tall and wet ash forests of south-eastern Australia. This was a remarkable finding given the context of these woodlands, which occur in a relatively flat landscape



**Far left** A view from a rocky outcrop over the extensive woodlands of the GWW.

**Left** *Grevillea acuarria*.

**Above** A trunk section of a sapling gimlet showing the unusual fluted trunk shape and the growth rings used to estimate plant age. Photos – Carl Gosper/Parks and Wildlife

with limited topographic barriers to fire spread, regular occurrence of severe fire weather and being distributed in a mosaic with shrublands and mallee that burn much more frequently.

## POST-FIRE SUCCESSION

To study changes that occur among the plants and animals of gimlet communities after fire, we established a chronosequence along the western edge of the GWW, sampling sites ranging in time since fire from two to more than 300 years. In the hundreds of years after a fire, gimlet communities pass through an ordered vegetation succession before they return to the iconic open woodlands characterised by large, widely spaced trees.

In the years immediately following fire, dense regeneration of gimlet and other obligate seeding plants becomes established, taking advantage of lower levels of competition in the absence of mature trees. A range of post-fire ephemerals also feature in the above-ground vegetation. Several decades later the dense gimlet regeneration grows to a size in which competition for light and water between individuals becomes intense. Diversity in lower vegetation layers declines, presumably suppressed by competition from the dominant canopy trees. Peak canopy and litter cover is reached, which suggests that regenerating woodlands may burn under milder weather conditions than mature woodlands, although this is yet

to be tested experimentally. After a protracted period of intense competition occurring over more than 100 years, gradual thinning of sapling gimlets enables surviving individuals to increase in size while ground-layer plants can exploit increasing availability of light and water such that mature woodlands have unique composition and maximum plant richness and evenness. This pattern of change in diversity with time since fire, being high in recently burnt and long-unburnt woodlands but lower over the intervening period, is rare throughout the world.

Similarly, animals exhibit predictable post-fire changes, albeit largely in response to the changes in vegetation composition and structure rather than due to the passage of time since fire itself. Ant species that thrive in hot conditions favour the more open habitats of recently burnt and long-unburnt woodlands, where canopy and litter cover is lower and exposure to the sun at the ground surface is greater. In contrast, groups of ants that favour less-exposed habitats are more prominent at intermediate times since fire, mirroring the non-linear post-fire changes in canopy and litter cover.

It would have been impossible to document these multi-century changes in plant and animal communities based solely on the remote sensing record, demonstrating the importance of developing alternative methods for describing the fire history and guiding landscape fire management in infrequently burnt communities like gimlet woodlands.



## Experiencing the beauty of gimlet woodlands...


There are many opportunities for people to get out and explore the Great Western Woodlands. Walks and drives through magnificent stands of gimlet or other eucalypt woodland communities lead visitors on a journey to discover the area's Aboriginal and colonial history, geology as well as its many fascinating and spectacular landscapes. If you're lucky, you might come across some curious native animals along the way. Camping spots include the proposed Credo and Jaurdi conservation reserves and Peak Charles National Park (all managed by Parks and Wildlife), and touring routes include the Granite and Woodlands Discovery Trail, Golden Quest Discovery Trail, Green Trail and the Golden Pipeline Heritage Trail. See [www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-western-woodlands](http://www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-western-woodlands) for more information and tips for safe travel or grab a copy of *Guide to the Great Western Woodlands* from [shop.dpaw.wa.gov.au](http://shop.dpaw.wa.gov.au), from Parks and Wildlife offices and good bookshops for \$29.95.

## WHAT DOES THE FUTURE HOLD?

Gimlet woodlands are resilient to very occasional bushfires. However, increases in the frequency of bushfires or in their extent across the landscape are likely to have substantial adverse implications for the conservation values of gimlet woodlands, due to the very long period over which post-fire recovery occurs. Climate changes are predicted to increase the incidence of weather conditions conducive to bushfires, which may lead to greater frequency and extent of bushfire, although how changes in weather interact with changes in the rates of fuel accumulation makes predicting future fire regimes uncertain. If an area of woodland of an intermediate length of time since fire is indeed more flammable as the changes in canopy and litter cover indicate, replacement of mature woodlands with intermediate time-since-fire woodlands may instigate a self-reinforcing fire regime shift favouring larger and more uniform fires. This would be detrimental for mature woodlands, which have important conservation and cultural values.

Fire management by Parks and Wildlife in the GWW aims to maintain long-unburnt woodlands. To this end, a number of fire management initiatives have been recently implemented or are planned. Fire management infrastructure has been upgraded to enable more rapid and safer access to prescribed and unplanned fires. Landscape fire management trials and research are ongoing to operationally test the feasibility of lowering fuel loads in surrounding shrublands to reduce the occurrence and intensity of shrubland fires under the severe weather conditions when such fires can spread into woodlands. Opportunities to increase the involvement of traditional owners in fire management are also being

explored. This aims to instil a degree of ownership in fire management on country and enhance local capacity to respond quickly to unplanned fires, potentially containing them before the occurrence of more severe fire weather initiates more rapid and less containable fire spread.



**Carl Gosper** is a research scientist investigating the role of fire in plant conservation jointly supported by Parks and Wildlife's Science and Conservation Division and the CSIRO Land and Water Flagship. He can be contacted by email ([carl.gosper@dpaw.wa.gov.au](mailto:carl.gosper@dpaw.wa.gov.au)).

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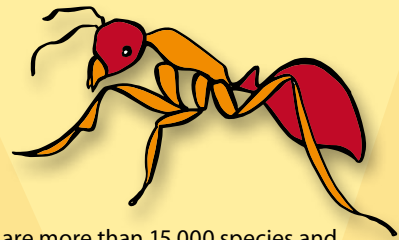
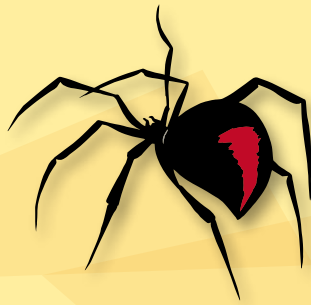
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The authors would like to acknowledge Glen Daniel from Parks and Wildlife's Regional and Fire Management Services Division for the provision of remote sensing data and Georg Wiehl (CSIRO Land and Water Flagship) for field assistance. This research was funded through the Great Western Woodlands Biodiversity and Cultural Conservation Strategy and the Great Western Woodlands Supersite, part of Australia's Terrestrial Ecosystem Research Network.

Above Banks Rock, GWW.  
Photo – Marie Lochman

by Lauren Emmerson

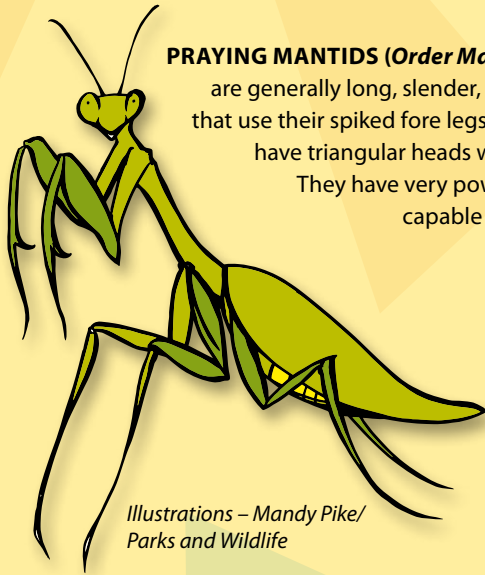
## Focus on... Bugs in the backyard



There are lots of bugs in your backyard! You can see them flying, crawling and slithering if you look hard enough. Here are some bugs you might find in your garden.

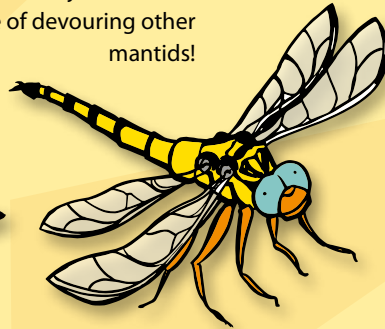
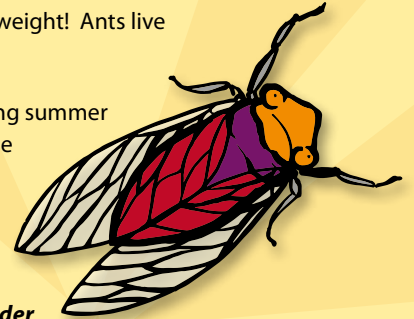
**REDBACK SPIDERS (*Latrodectus hasselti*)** – these dangerous black spiders have a body the size of a pea and a red stripe on their back. Their venom is extremely deadly so watch out!

**ANTS (Order Hymenoptera)** – there are more than 15,000 species and subspecies of ants most of them black, brown or rust coloured. These tiny little bugs can lift objects 50 times their own weight! Ants live underground in a maze of tunnels and rooms.



**PRAYING MANTIDS (Order Mantodea)** – mantids are generally long, slender, stilt-legged insects that use their spiked fore legs to seize prey. They have triangular heads with two large eyes. They have very powerful jaws that are capable of devouring other mantids!

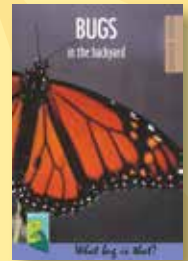
**CICADAS (Family Cicadidae)** – during summer and spring you can hear cicadas in the backyard – they make a drumming, buzzing-like sound using air sacs on the underside of their abdomen.



**DRAGONFLIES (Order Odonata)** – dragonflies are large bugs with long bodies and big wings, that can fly forwards, backwards and vertically. Dragonflies eat other small insects and mate while they are in flight.

Illustrations – Mandy Pike/  
Parks and Wildlife

Grab a copy of the *Bugs in the backyard* Bush Book at [shop.dpaw.wa.gov.au](http://shop.dpaw.wa.gov.au).



## Kids... in the field



**Left** These kids are making their way through the forest BLINDFOLDED! They're taking part in the Sense-ational Scavenger Hunt run by *Nearer to Nature* and using GPS navigation to touch, feel, and smell the environment, then taking a blindfold walk along the rope trail to get a sense-ational insight into the forest.

[www.dpaw.wa.gov.au/get-involved/schools-programs](http://www.dpaw.wa.gov.au/get-involved/schools-programs)

**Right** Take a bunch of kids out into Yanchep National Park, tell them to build a shelter with whatever they can find, and this is what you get! These guys are participating in the Great Aussie Camp Out and made this awesome cubby house out of sticks they found in the bush.

Photos – Parks and Wildlife



LANDSCOPE'S KALEIDOSCOPE kids exploring nature page is an exciting regular feature for kids. Find out about our national and marine parks and reserves, and what kids are exploring out in nature.



## Black-flanked rock-wallaby (*Petrogale lateralis*)

The shy black-flanked rock-wallaby lives on granite outcrops where it shelters in caves and crevices. Black-flanked rock-wallabies are classed as Vulnerable and suffer from predation by feral cats and foxes and the effects of habitat loss due to land clearing. They live on a diet of annual or perennial grasses, and succulents, herbs, leaves and fruit. They have a thick, woolly coat and a slight brush on the end of their tail.

Illustration by Gooitzen van der Meer

Reference photo by Jiri Lochman



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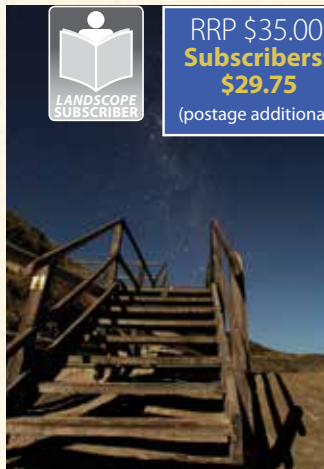
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