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Find all this issue's related content at:
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DONATE: Save the earless dragon (p31).

VIDEO: Watch the film of the stunning Mitta Mitta River flowing from Victoria's High Country to below Lake Hume (p79).

WIN: A copy of the landmark ocean documentary *Blue* (p29).

Members of Indigenous communities are warned that this edition of Australian Geographic may contain images and names of deceased individuals.

Geobuzz & regulars

12 Your Say
Mailbag and reader photos

14 Big Picture
Unforgettable images

16 Nature's big battle

19 Canopy curiosity

20 Dr Karl Kruszelnicki
Is this Insectageddon?

21 Greener cleaning

22 Defining moments in Australian history

23 National Treasure

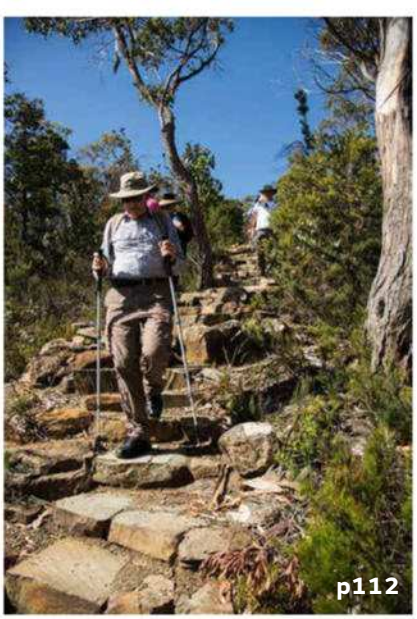
24 Our history
The Greek milk bars that sold American dreams to Australia

26 Space
Detecting the first stars that existed after the Big Bang

28 The List
Visit, download, read and more

32 Wild Australia
Essential highlights

Canopy curiosity p19



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On the cover

Rainbow lorikeets (*Trichoglossus haematodus*) are a common sight in our gardens, partly because they love the nectar-bearing native species we often plant. Feeding backyard birds, however, is a controversial topic that our expert writer explores on page 36. These lorikeets, native to the northern and eastern coasts, also brighten our rainforests and woodlands.

PHOTO CREDITS, OPPOSITE PAGE: RALPH ALPHONSO; THIS PAGE, CLOCKWISE FROM TOP: ELLEN HUSAIN; KAREN GRAHAM; CHRISSIE GOLDRICK/AUSTRALIAN GEOGRAPHIC; BILL HATCHER/AUSTRALIAN GEOGRAPHIC
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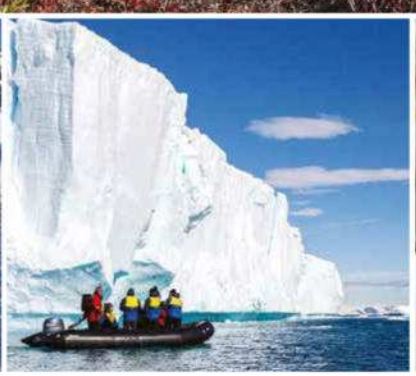

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Food matters

I CONFESS TO being a backyard bird-feeder – and I feel rather guilt-ridden about it. I know a pair of kookaburras and a magpie family who know exactly where to come for guaranteed tidbits. Their arrival is always timed perfectly to coincide with our family meal times out on the deck in the warmer months when there are always plenty of tasty morsels going spare. I love the intimacy of such encounters with these wild creatures and the chance to see them at close range. It's an even bigger thrill to see the reaction of overseas guests when seemingly tame birds arrive for a feed.

But I've often felt confused by conflicting advice on this common practice. Am I somehow encouraging dependency and perhaps even doing harm? By using the latest scientific research, Professor Darryl Jones from Griffith University digs deep into our bird-feeding compulsions and is able to answer those questions. In *Seeds of doubt* (page 36), Darryl provides assurances that we're unlikely to inflict lasting damage on our feathered friends if we choose to feed them and he offers practical advice on how to feed birds sensibly and safely using the most suitable food. What a relief for all us furtive feeders out there!

Just as it is for birds, the source and quality of the food we humans eat is important. This is becoming an increasing priority for many, driven by the fitness and wellness movement, farm animal welfare concerns and sustainability issues. We meet a host of passionate farmers and their customers who are disrupting the contemporary food supply chain in ways that are both innovative and traditional, with the added bonus of building stronger and healthier local communities. It's a passion shared by the powerhouse families and individuals behind our booming wine industry, which is experiencing unprecedented growth, particularly in Asian export markets, and enhances our reputation for quality and excellence all over the world (see *The fruit of the land*, page 62).

Aussies striving for excellence is something we are dedicated to supporting here at AUSTRALIAN GEOGRAPHIC and it's that time of year when we are calling for nominations for our annual awards for adventure and conservation. We're keen to uncover unsung heroes of wildlife conservation and environmental warriors perhaps we haven't yet met through the pages of the magazine or the Society. If you would like to nominate someone for a 2018 award, please visit page 30 for the list of categories and how to do so.

Chrissie Goldrick

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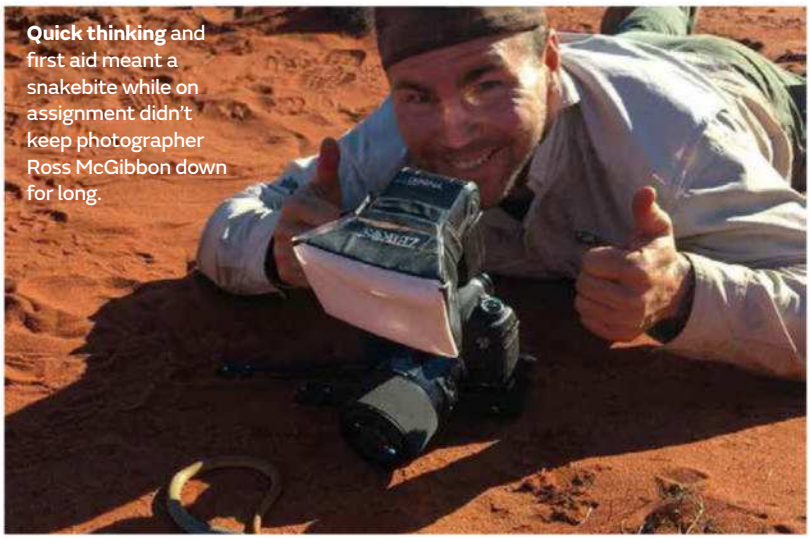
Notes from the field

YOU COULD SAY snakes are an occupational hazard for our correspondents when they head into the field for stories. Australia, after all, has many of the world's deadliest species of these reptiles and our writers and photographers often work where snakes are found. Certainly we see a lot of them, but thankfully it's rarely been necessary to deal with a bite.

So it was unusual that snakebite was a concern during two assignments for stories in this issue. The most serious episode involved writer and photographer Ross McGibbon, who, while working on *Taipan territory* (see page 44), was bitten by one of the world's most **venomous snakes** – a mulga snake, also known as a king brown.

It happened early one evening, about 1000km east of Perth, when Ross was trying to move the snake off the road "so it didn't get flattened by a road train". Because no nearby town had the appropriate antivenom, Ross was flown to Perth by the Royal Flying Doctor Service. "But I was lucky to only get a very small dose of venom," he says. "I was bitten by a juvenile about 30cm long and it only got one fang in." Ross didn't end up needing antivenom, was discharged from hospital the next morning and went on to complete the rest of the assignment. He did, however, end up with localised pain and swelling in his hand and arm, although the pressure bandage he quickly applied after the bite prevented the venom spreading further.

When writer and photographer Karen Graham rode across a →



Quick thinking and first aid meant a snakebite while on assignment didn't keep photographer Ross McGibbon down for long.

brown snake – literally – and came off her bike while cycling Victoria's **East Gippsland Rail Trail** (see page 104), she wasn't sure she'd been bitten, but, understanding how critical quick and efficient first aid is with snakebite, didn't take any chances. Once she knew where the snake was and that it was no longer a threat, Karen lay still while her companions checked her for signs of a bite and until paramedics arrived to take her to hospital, where she got the all clear.

AG staff and contributors take the risk of snakebite very seriously when in the field, always carry a first aid kit equipped with a pressure bandage and know how to use it. For information on what to do in case of a snakebite, including how to apply a pressure bandage, see Australian Geographic's recently updated book *Australia's Most Dangerous.*

Photographer Don Fuchs and writer Jeremy Bourke knew snakes weren't going to be a problem for them in Victoria's High Country as they set out to follow the **Mitta Mitta River** (see page 72). It was too cold for snakes! "We started from Mt Loch car park near the Mt Hotham ski village and the air temperature was –2˚C without the chill factor," Don recalls. "The ground was frozen, covered in ice and freshly fallen snow – the result of a rather late and unexpected resurgence of winter."

"To make sure we captured the Mitta Mitta in its wildest state, we knew we had to pick our moment," Jeremy says. "And we reckoned that by the last week of October, the snowmelt meant the river would be running wild. But we didn't expect it to be still snowing at Mt Hotham."

They started out for the Mitta Mitta's main tributary, the Cobungra, in thermals and Gore-Tex. But, fortunately, by the time they returned to the village it was sunny, the snow was gone and Don and Jeremy managed to successfully trace the Mitta Mitta from its source to where it empties into Lake Hume.

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PHOTO CREDIT: TIM SQUIRES

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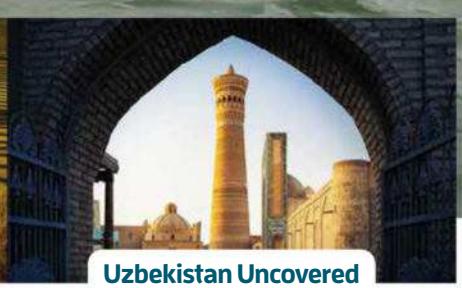

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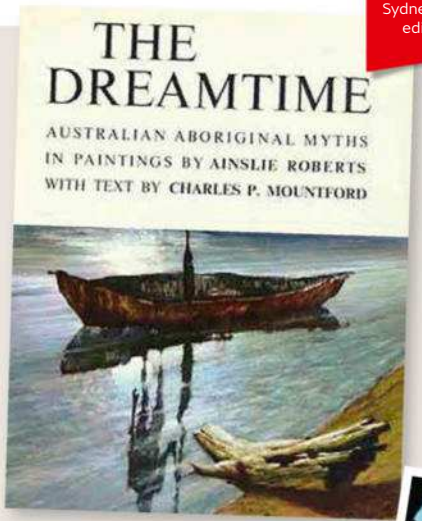
Featured Letter

DREAMTIME ART

I read with enthusiasm your article *The last great expedition* (AG 142) about Arnhem Land, because I have a book series known as *The Dreamtime Books* with words by Charles 'Monty' Mountford (featured in your article) and pictures by Ainslie Roberts. Roberts ran a successful Adelaide advertising agency, but gave it up due to ill health and overwork. As part of his recovery he went to Alice Springs, where he met up with Monty and collaborated on some of the books in the series. Roberts painted scenes in vivid colours from the Dreamtime stories Monty told him. The full story of the Roberts–Mountford collaboration can be found in *Ainslie Roberts and the Dreamtime*, by Charles E. Hulley. I think all of these books are out of print but I have salvaged them from pre-loved book sales. Monty was a man well ahead of his time, as later finds have verified, and these books, together with this article, help reinforce his reputation. I loved the article.

IAN JOHNSON, MORAYFIELDS, QLD



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Send us a great letter about AG or a relevant topic for the chance to be our featured letter and win an AG T-shirt.

TRAINED EYE

I love your magazine, especially the recent edition that includes great Australian train journeys (AG 143). I'd like, however, to draw your attention to a typo: the distance between Townsville and Mount Isa should read 977km, not 97km. Thanks for this informative article. I am doing the Indian Pacific trip this year and can't wait to go!

PETER ANDJELKOVIC, ADELAIDE, SA

FALLING FOR RATS

Your feature *Our remarkable rodents* (AG 143) brought back a fond memory. After seeing the1970s TV series *In the Wild with Harry Butler*, where Harry tried and failed to find a water-rat at Lawn Hill, I made one of many visits to Boodjamulla National Park. Accompanied by my friends Dr Mark and Cherie Weller of Mount Isa and others, we camped beside a river. The others retired to their tents while I was to sleep in the open. Within minutes I heard rustling and shone my torch on a beautiful water-rat. Next morning I told the others, and that night we were determined to get photographic proof. We arranged our chairs near the waterline with cameras and torches at the ready. Soon after lights out the rustling began. The signal for action was to be the count of three. But before we got to three, one of us toppled backwards into the water with a yell as the legs of a chair gave way and we missed the rat.

JOHN (JACK) HICKEY, COOLANGATTA, QLD

NATURE LOVERS UNITE

In this digital world it was good to read that "we are a nation of nature lovers" (Wild Australia, AG 142), because I sometimes despair that the world of nature, of which we are an integral part, is being ignored. A recent example was when I was on the highest deck of a ferry crossing Melbourne's Port Phillip Bay, enjoying a brisk breeze and an enticing view. One couple joined me – apparently because mobile reception was not good in the warm cabins below. Tumbling into view came some lively seals, frolicking through the waves with a captive piece of seaweed. It was such a joy to watch that I cried out to the strangers by my side, "Oh, look at the playing seals!" The young man looked up and nodded, before immediately resuming his task, his partner kept texting and the joy of nature only affected me. So, I was relieved to read of research that strengthens our knowledge of the value of the relationship of humans to the natural world. Thank you.

CAROLE O'NEILL, ST LEONARDS, VIC

WOLVES IN PERSPECTIVE

Killer animals in perspective was a good article (AG 143). However, wolves as killers get a bad rap. I do not believe there has ever been a substantiated death of a human by a wolf in Canada's wilds. Images of wolves chasing a Russian troika (a horse and sleigh combination) caused fears in Europe, when the wolves were really after the horses. Coming back to Canada though, most deaths attributed to wolves turn out to be wild dog attacks. Perhaps the infographic should read Dog 10, not Wolf 10.

RONALD FRITH, OTTAWA, CANADA

DEADLY CARRIERS

Killer animals in perspective (AG 143) claims the mosquito is the "biggest killer" of humans. I disagree. The mosquito kills no-one; it is merely a vector, carrying the malaria parasite plasmodium, which does the killing. Likewise, the freshwater snail carries the schistosomiasis parasite that does

the killing. I may be pedantic, but using your line of reasoning, I could claim that the horse has killed millions of people over centuries. But it is not horses but soldiers on their backs that did the killing. Nevertheless, the article is correct in identifying that the smallest animals are the biggest killers of humans. But these are even smaller than those claimed – microscopic parasites, not their vectors.

ALAN MOSKWA, MAGILL, SA

SHARK MATTERS

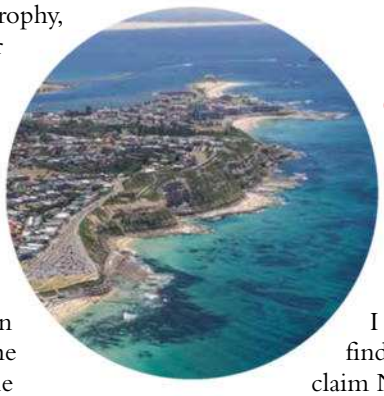
The photo of the thresher shark caught in a shark net in *Putting shark attacks in perspective* (AG 143) gives an unbalanced view. That shark had a greater chance of being caught by a trophy, sport or spear fisher than being trapped in a beach net. Gold Coast television features, as part of a news segment, trophy catches of magnificent but harmless fish. I often shake my head at the waste of some of the marine life shown in these clips. The small length of beach protected by nets on the Gold Coast hardly bears a mention in the scheme of things. If a bather was attacked by a shark on a Gold Coast beach it would be headline news and could bring the tourist industry to its knees. Unless something else proven to be better can be adopted, may the Gold Coast Council never reconsider its current beach net protective measures for bathers.

NEVILLE PARKER, PARADISE WATERS, QLD

MAGPIE MAGIC

A few years ago I heard a juvenile magpie call in the tree outside my window. Nearby, an adult bird had one foot on a branch and the other holding a grasshopper wedged into where a twig joined the branch. I watched amazed as it used this junction for traction to peel off the grasshopper's tough exoskeleton, freeing the soft centre to feed to the young bird. I have many magpies around my house and street and if I see one I always say, "Hello, Maggie," as I pass. We found that if you talk to them or feed them [see *Seeds of doubt*, page 36], they don't see you as a threat but as a friend…and you don't get swooped! I wonder if feeding them would stop them from diving on the poor posties and schoolchildren who get bombarded by them every year. Of course, if people throw things at them, or chase them, they have long memories and will swoop at anything similar thereafter.

JENNIFER HELYAR, BRISBANE, QLD



OLDEST CITY

What a fantastic issue AG 143 is, filled with stories that seem particular to my interests. However, I was surprised to find an error in the claim Newcastle (left) is Australia's second-oldest city. If you class settlements such as Parramatta and Liverpool as being part of the city of Sydney, Hobart is the second-oldest city. Even Tassie's George Town predates Newcastle, although settled in the same year.

LYNDELL GEEVES, LAUNCESTON, TAS

Ed: *Both Newcastle and Hobart were founded in 1804, but there are records from 1801 of a coalmining settlement on the Newcastle headland.*

POSTSCRIPT

On page 69 of AG 143 text relating to an acoustic shark repellent advised that it was "only effective in water cooler than 21°C". It should have said "potentially only effective in water warmer than 21°C".

PHOTO CREDITS, FROM LEFT: BEAU PILGRIM/AUSTRALIAN GEOGRAPHIC; STEPHEN ZOYAYA
SCIENTIFIC NAME: *Hemidactylus frenatus*

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Talkb@ck

In April, Australian Geographic contributor Elizabeth Arrigo asked whether we should love or hate the Asian house gecko. Here's what you had to say:

AMANDA LEE ROBERTSON
We used to have a redback spider plague every summer, until the Asian geckos moved in. No problem since.

PAUL MCKIVER
Bag them, freeze them, bin them, feed them to magpies and kookas. Give no pity, same as for any other introduced animal.

SUZETTE EDGE
Our hardwired smoke alarm went off recently at 2am and we couldn't work out why. We broke it open to find an Asian house gecko curled up inside.

RACH LOOSEMORE
They're awesome at keeping pests down and so well established in Australia now that it's pointless to try eradicating them.

BRETT KAKOSCHKE
Better than insecticide in a can! Eats all pesky insects for free. One or more in every room is the norm living in the tropics.

Geobuzz

May · June 2018

PHOTO CREDIT: CHARLES DAVIS

Big picture

Spine chilling

The echidna (*Tachyglossus aculeatus*) is a monotreme, an egg-laying mammal that feeds its young on milk. Echidnas are adaptable creatures that can thrive anywhere from arid deserts in the Northern Territory to cold alpine regions (as evidenced by this inhabitant of the Snowy Mountains in New South Wales). In cooler, more southerly climates, the echidna grows thicker, longer fur in between its defensive spines to keep it warm. Even in the snow, its powerful paws can dig out enough of its diet of ants, termites, worms, spiders and beetles to survive. Usually solitary animals, at mating time up to 10 male echidnas follow a female in a 'train' for weeks until one male wins out. See page 23 for how you can help track echidna populations with the Echidna CSI app.

Nature's big battle

Orca attacks on humpback whales are distressing to witness, but could be a good sign for our oceans.

STORY AND PHOTOGRAPHY BY ELLEN HUSAIN

IT'S THE PLANET'S biggest hunt – a pod of orcas (killer whales) with a combined weight of 30 tonnes taking on 100-plus tonnes of riled-up adult humpbacks. Filming such an epic event under water and from the air in the crystalline waters of Ningaloo Marine Park off Western Australia, it was incredible to think no-one had witnessed it in this way before.

Two big revelations came from filming the hunt for the first time for a BBC documentary. First, it was proof that such events actually happen. Second, it was the discovery that far from being passive, slow-cruising leviathans, humpbacks will band together and fight hard. Scientists have long suspected that orcas hunt humpbacks; documenting the behaviour was a first. "Although killer whales had previously been recorded harassing humpback whales in various places around the world, there had never been a kill documented," says orca scientist Bob Pitman, a US National Oceanic and Atmospheric Administration marine ecologist and a collaborator on the project. "People thought that all large whales, including humpbacks, were 'too big to fail'."

During the past decade, researchers have found that orcas are fussy eaters, and what had previously been considered a single global species is increasingly being seen as non-interbreeding 'ecotypes' with different diets. Some, such as those in Norway's fjords, live on fish. Others are specialist mammal eaters, although the extent to which orcas hunt 'great whales' is unclear. Well-known attacks on gray whales off the US West Coast are an exception. One was famously filmed for the BBC's *Blue Planet* in 2001. Evidence for predation on other great whales is suggested by 'rake marks' – scars caused apparently by orca teeth. In some areas up to 40 per cent of humpbacks bear such scars.

Filming the orca attacks took much detective work. The Ningaloo part of the story began in 2011, when a whale shark spotter plane pilot saw an orca-humpback altercation. It was hot news, but local boat operators and pilots were unable to provide much more information. I could uncover only five anecdotal tales of hunts, stretching back more than seven years – a small number on which to mount an expensive film shoot. Even worse, orcas were so infrequently sighted around Ningaloo they weren't even listed as being present in the marine park. No-one knew where they came from, how long they stayed or where they went to, but the consensus among those who'd seen them was that they passed through for about two weeks in July.

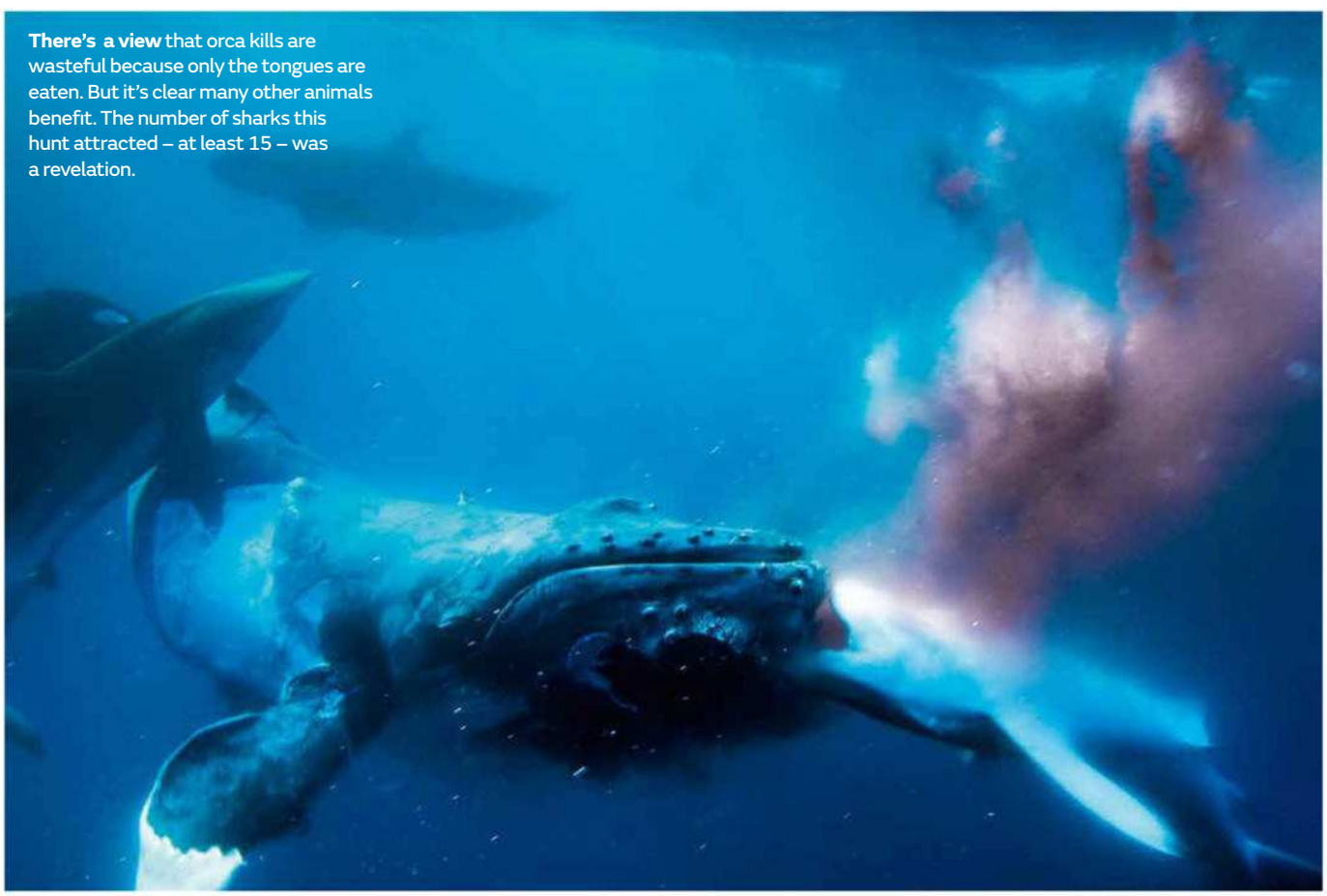
▲ **The aerial filming** team with the gyrostabilised 6k filming system used to capture footage of orcas hunting humpbacks in WA's Ningaloo Marine Park: (L–R) helicopter pilot Dale Web, aerial cameraman Blair Monk and producer/director Ellen Husain.

WITH LITTLE TO GO on and much to learn, collaboration made sense. We approached John Totterdell of the Marine Information and Research Group Australia who, along with Bob Pitman, mounted the first formal scientific study of Ningaloo's orcas, using satellite tracking tags, while my crew and I attempted to film their behaviour.

Finding the orcas was challenging. A few days into the shoot, they proved their transient mobile predator prowess – they can travel 100km a day – and headed south and out of our filming range. For nine excruciating days we wondered if their two-week visit to Ningaloo was over. "They could go all the way to Antarctica if they wanted," Bob said, offering little consolation. Then the satellite-tag pings signalled they had turned around and were heading our way. Eventually, over more than five weeks we witnessed several attacks, from which we collected underwater, boat-level and aerial footage that comprehensively documented the hunts from every available angle.

So why has this behaviour been witnessed so rarely? One theory suggests orcas just don't do it that often. "There has been a lot of debate about how much of an impact orca predation has on large whales," Bob says. "The people who think it's ▶

Filming the hunt from the boat, the crew was able to keep up with the chase for an unparalleled view of the orca pod in action – right on a humpback's tail.



There's a view that orca kills are wasteful because only the tongues are eaten. But it's clear many other animals benefit. The number of sharks this hunt attracted – at least 15 – was a revelation.

These two humpbacks journeying north side by side, along the coast of WA, were spotted while filming.

The crew worked with a gyrostabilised camera mounted on a crane at sea. *The Hunt* is available from DVD retailers and on Netflix.

minimal always point out that if orca predation on large whales was significant, then why do whale researchers only rarely witness these events?" After all, humpbacks are the best studied of all the whales so if this behaviour was common you'd expect it to be well documented.

BUT THERE'S A TWIST in the tale: whaling. When factory ships were introduced in the early 1900s, whale populations worldwide declined steeply, and three decades later 80 per cent of great whale species – a group of 13 that includes humpbacks along with bowhead, right, gray, blue and fin whales – were thought to be facing extinction. Although orcas were never targeted, the great whales were squarely in harpooners' sights.

Scientific study of orcas only really began in the 1970s, by which time great whale populations were catastrophically depleted. "Before we started seriously studying whales, we had nearly killed them all off," Bob explains. "It's hard to know what whales were doing before we slaughtered almost all of them." If, before the whaling era, orcas had been hunting great whales, they would have been impacted by the global decline of their prey. Given the scale of whaling across the world's oceans, it's clear the picture we've had until recently has been skewed by severe declines in many whale populations.

What's happening in Ningaloo supports this. During the whaling era, WA's humpback population was heavily targeted, in both Antarctic and Australian waters. It's estimated that by 1963, when whaling of WA's humpbacks ended, the population was at 2.7 per cent of its pre-whaling level: from about 22,000 to just 500–600 whales. "If there were orcas that preyed on this population historically, they probably would have either died out or moved away," Bob says.

Since whaling was banned, WA's humpbacks have made a significant recovery and now form the world's largest breeding population. Each year, an estimated 20,000–30,000 undertake the 7000km journey up Australia's west coast, from summer feeding grounds in Antarctica to breeding grounds in the Kimberley's sheltered tropical bays.

Some give birth during the journey and these calves are vulnerable to attack. It seems there are now enough calves being born each year to support a pod of orcas, at least during the migration season. "The killer whales may now be rediscovering this population," Bob says. "Only time will tell how big the killer whale population will grow and how much of an impact they will have on these recovering humpbacks."

Ningaloo's orcas may have needed to bounce back from an extremely low starting point, and with a population growth rate about a third that of humpbacks – plus the fact that predator numbers tend to lag behind prey numbers as they catch up with new availability of food – it's understandable attacks have only been seen fairly recently. In fact, it's possible that the situation with WA's humpbacks is mirroring that of California's gray whales, which have also recovered from whaling-era lows. While orca predation on gray whales was barely recorded in the past, it's now thought that, in some years, up to half of gray whale calves are taken by orcas. As Bob says: "Now that large whales and their killer whale predators are starting to recover from near extinction, we may finally start to see how they interact with each other."

The attacks themselves weren't the only revelations we filmed on Ningaloo. The behaviour of 'escort' whales coming to the aid of mothers and calves was also new. The role of escorts – typically males that tag along with pregnant and nursing females – has also been the subject of debate. At Ningaloo, aerial filming gave us an unparalleled view. During one attack, three adult humpbacks combined to defend a single calf – two escort whales flanking the mother on either side, fending off the orcas with their flippers, charging and swiping them with their immense tails. Simultaneously, the mother lifted her baby high on her back and out of the water, her 5m pectoral fins extended either side, holding off would-be attackers.

It may seem counterintuitive, but escorts are believed to be suitors waiting for opportunities to mate, rather than the calves' fathers. This has never been confirmed, but the fact that we filmed two escorts defending a mother and calf makes it clear that at least one of them wasn't the father. To Bob, this raises the possibility of altruism among humpbacks – a matter for future research.

Although the attacks can be distressing to watch, they're also an inspiring sign of Ningaloo's improving health and of the restoration of the natural order in at least one part of our oceans. AG

Canopy curiosity

Rare Bennett's tree kangaroos have become used to people at Cape Tribulation, so it's easy to spot and photograph them.

DESPITE BEING Australia's largest climbing animal, Bennett's tree kangaroos have been almost impossible to see in the wild. So we were excited to capture some of the best-ever photos of the species for a 2013 feature (AG 113).

That story made Daintree local Sheena Walshaw realise how unusual it was to have tree kangaroos living near the Jungle Surfing zipline attraction she manages at Cape Tribulation, in far north Queensland. She contacted world expert Dr Roger Martin, who featured in our story, and he's since visited several times to see them. That these marsupials are accustomed to people moving in the canopy around them is unprecedented, says Roger, a James Cook University research fellow. Animals used to people are more likely to show normal behaviours, he explains: "Observing habituated animals is valuable in detecting rarer interactions – such as those between mothers and young, or mating."

Roger has previously used a thermal imaging camera to find the roos and Sheena has now installed camera traps to capture their daily comings and goings. Radio collars may be used to track them in the future.

"It was the AG feature that originally alerted us to the unique position we were in, spotting so many Bennett's tree kangaroos, and we've been doing our best to find out as much as we can about them since," Sheena says. "They are incredibly cryptic and often the only clue is the tail hanging down, 20m above us, or sometimes just falling leaves if they're having a good old chomp up in the canopy. We started to see them fairly regularly, maybe once a fortnight."

JOHN PICKRELL

NEED TO KNOW

with Dr Karl Kruszelnicki

Is this Insectageddon?

INSECTS MIGHT BE the most successful critters to inhabit the Earth. So why did a recent *PLOS One* paper claim that, during the past 27 years, 75 per cent of the flying insect biomass has vanished?

There are thought to be 10 million species of insect, with 1 million described by science. Insects are essential to ecosystems. They pollinate 80 per cent of wild plants and form 60 per cent of what birds eat. Amphibians and mammals eat them, too. Insects recycle nutrients through food chains by eating plants and debris, control pests and provide useful substances for us.

The study that was the subject of the *PLOS One* article took place in Germany – in nature protection areas, where human interactions are minimised. However, nature protection areas are surrounded by agricultural landscapes. The scientists monitored the biomass of flying insects at 63 sites in these areas from 1989 to 2016, and found it dropped by 75 per cent.

The study was done in Germany only, so we don't have data for any other continents. And the authors could not find any definite causes for this drop, although they know it wasn't changes in the weather or climate, changes in land use or changes in local habitats.

They suggested it might be related to agricultural intensification. Perhaps the land around the protection areas was now 'hostile' to insects, because of increasing use of fertilisers and insecticides. Or was year-round tillage of the soil the cause? We simply don't know.

Given we spend big bucks killing bugs, it's not surprising their numbers are dropping. And it's always the way: you don't know what you need till it's gone.

If we want bug numbers to take flight again, perhaps their PR image needs a bigger buzz. Or perhaps a SWAT team of scientists can save these critters from Insectageddon.

DR KARL is a prolific broadcaster, author and Julius Sumner Miller fellow in the School of Physics at the University of Sydney. His latest book, *Karl, the Universe and Everything*, is published by Pan Macmillan. Follow him on Twitter: @DoctorKarl

Mermaid tales

VALERIE TAYLOR is well known for the groundbreaking shark stories, photos and films that she and late husband Ron created from the 1960s onwards, but perhaps less recognised are her artistic skills. Inspired by the underwater realm, Valerie has been creating exquisite watercolour depictions of creatures and scenes all her life. Her charming story of Melody the mermaid has now been published as a beautiful children's book. Proceeds from the book will support marine education and conservation organisations including the Women Divers Hall of Fame, of which Valerie herself is the inaugural inductee.

Available from *amazon.com.au*

▲ **Valerie Taylor**, aka the shark lady, practises her watercolour art at home in Sydney.

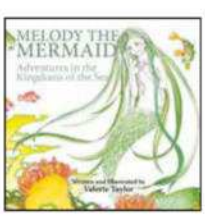


PHOTO CREDITS, FROM TOP: JOHAN LARSON/SHUTTERSTOCK; COURTESY VALERIE TAYLOR
SCIENTIFIC NAME, TOP: *Ornithoptera euphorion*
ILLUSTRATIONS: VALERIE TAYLOR

Greener cleaning

TRY THESE alternatives to harsh and expensive chemical products around your home.

Natural cleaning or 'green cleaning' is a way to clean your home using fewer cleaning products and safer alternatives. This produces less waste and reduces the need for artificial chemicals that can be harmful to your family and the environment.

To clean well, cheaply and safely throughout your home, try these basic ingredients.

You can buy these inexpensive items from your local supermarket.

Bicarbonate of soda (baking soda or sodium bicarbonate) cleans, deodorises, softens water and scours. Store in a flour shaker to keep it dry.

Borax is a natural mineral salt. It cleans, deodorises, bleaches and disinfects. Borax also controls ants and cockroaches. (It's toxic, so keep it away from children and pets.)

Lemon juice is a mild bleach, a deodorant and a cleaning agent.

Washing soda cuts through grease and removes stains.

White vinegar also cuts through grease and acts as a deodoriser and mild disinfectant. Mix half and half white vinegar with water and store in a labelled spray bottle.

Pure soap is a general-purpose cleaner that biodegrades completely.

Eucalyptus oil can be used to remove stains, and as a disinfectant and deodoriser. It cuts through grease and grime and leaves laundry smelling fresh.

Microfibre cloths clean surfaces effectively with just water.

Green cleaning recipes

They're safe, smell good and really work.

All-purpose cleaner
Warm water mixed with pure soap or white vinegar is a cheap and easy general cleaner you can use throughout the home.

IN THE BATHROOM

Toilet cleaner Make a paste from borax and lemon juice for cleaning non-septic toilet bowls.
Ceramic cleaner Clean tiles, sinks, toilets and baths with bicarbonate of soda using a damp cloth.
Mirror cleaner Apply eucalyptus oil with a wad of newspaper to prevent mirrors fogging.

IN THE KITCHEN

Surface cleaner
Use bicarbonate of soda on a damp cloth to clean benchtops, sinks, windows and all the surfaces of your refrigerator.
Dishwashing detergent
Use pure soap and add white vinegar to the rinse water to give glasses an extra shine.
Oven cleaner
Wipe the oven down with a soapy cloth while it's still warm from use.

IN THE LAUNDRY

Bleach
Use 1 cup of lemon juice in half a bucket of water. Soak overnight. Or add half a cup of borax per wash to whiten whites and brighten colours.
Stain remover
Use eucalyptus oil to remove stains before washing. Apply a few drops and let it evaporate.
Laundry detergent
Mix one-third of a cake of pure soap (grated) with one-third of a cup of washing soda. Dissolve in hot water and top up with water. The mixture will set to a soft gel. Use 2–3 cups per wash.

IN THE LIVING ROOM

Carpet cleaner
Sprinkle bicarbonate of soda on the carpet before vacuuming to deodorise.
Window cleaner
Wash windows with warm soapy water if they're really dirty. Add half a cup of vinegar to a litre of warm water. Use crumpled newspaper moistened with vinegar to get a beautiful sheen.

TIPS

Reduce your use of household cleaners by buying less, using less and looking for natural, safer alternatives.

Be smart when you shop. Read the label, avoid buying the more toxic products and buy only what you need.

Think safe when handling and storing cleaners and dispose of them legally.

PHOTO CREDITS: SHUTTERSTOCK. SOURCE: NSW OFFICE OF ENVIRONMENT AND HERITAGE

DEFINING MOMENTS IN AUSTRALIAN HISTORY

1956: Television introduced in time for Australia's first Olympic Games in Melbourne

"GOOD EVENING and welcome to television." These, the first words on Australian television, were uttered by Bruce Gyngell on 16 September 1956. Since then, TV has become the nation's most influential news and entertainment medium. In 1956 there were fewer than 100,000 televisions. Today Australia has more than 18 million sets.

Experimentation with and discussion about TV began in Australia in the 1930s but World War II halted its development. National debate restarted in 1949 when prime minister Ben Chifley announced the implementation of a national television service. But his Labor government was ousted and the Liberal-Country Party coalition came to power under Robert Menzies, who said in 1952 to a visiting BBC representative: "I hope this thing will not come to Australia in my term of office."

Australians were, however, clamouring for the new technology, and in 1953 Menzies set up a royal commission. It recommended that the law allow for a system of both national and commercial stations similar to that developed for radio since the ABC's 1932 creation.

The government wanted the network to be ready for the 1956 Melbourne Olympics and that year, on 16 September, TCN9 Sydney produced the first official broadcast. Audiences heard station announcer John Godson declare that the station was on-air at 7pm before throwing to Bruce Gyngell who, dressed in a dinner suit, appeared on black-and-white screens across Sydney and delivered that famous line.

Crowds of Sydneysiders watched shop window displays and parties were hosted by TV retailers and people who'd bought sets ahead of the transmission.

This Morris Model FE Pye outside broadcast van was used by the ABC's ABN2 during the 1956 Melbourne Olympics.

HSV7 Melbourne began transmission on 4 November and the ABC followed suit from Sydney the next day, two weeks ahead of the Olympic opening ceremony. In 1959 television was introduced to Queensland, South Australia and Western Australia; Tasmania followed in 1960 and the Australian Capital Territory in 1962.

Sales of TV sets boomed. The *Women's Weekly* offered advice on how to rearrange living rooms for the new addition. And some inner-city cinemas and theatres closed down due to competition for their audience.

TCN9, HSV7 and ABN2 televised the Olympics, although arrangements for rights to particular events were not confirmed until three days beforehand. Organisers insisted they should be paid for rights while film companies and television stations lobbied for the Olympics to be classified as news, which didn't require paid rights. Eventually it was agreed that rights would be paid for, setting a precedent for future Games.

The Melbourne Olympics were touted as the Friendly Games but took place against a backdrop of heightened global tensions, with news dominated by the Cold War, Suez Crisis and Hungarian Uprising. These hostilities spilt into the Games when Hungary and the Soviet Union contested a particularly tense water polo match.

As a result, the organising committee's chair Kent Hughes took seriously the suggestion of Chinese-Australian boy John Ian Wing, aged 17, to change the closing ceremony's format. He suggested athletes march as individuals, not as teams representing nations, and mingle in the spirit of the Friendly Games. "During the march there will be only one Nation," Wing suggested. "War, politics and nationality will be forgotten. What more could anyone want, if the whole world could be made as one Nation?"

We saw it all unfold on TV and the tradition has since been followed at every Olympics.

Part of the Defining Moments in Australian History project.
To find out more: ***nma.gov.au/definingmoments***

national museum australia

PHOTO CREDIT: GEORGE SERRAS/NATIONAL MUSEUM OF AUSTRALIA

Download

Echidna CSI

Although echidnas are among our most widely recognised animals, we know little about them. They are notoriously shy and difficult to see in the wild, making populations hard to study. But now you can help! Become a citizen scientist and help CSIRO track echidna populations and report any sightings through the Echidna CSI app. It even explains how you can mail echidna scat (droppings) samples to the research team.

Listen

Off Track

Hosted by ABC's Ann Jones, this radio show and podcast is recorded in Australia's great outdoors. Complete with sounds of our natural habitats, it features wildlife and environmental science stories. Recent topics have ranged from carnivorous plants to the battle to save Australia's largest tract of temperate rainforest in the Tarkine, north-west Tasmania.

National Treasure

Maitland Bar Nugget

On display at the Australian Museum, Sydney

About the size of a loaf of bread and with a total weight of 10.7kg (with a gold component of 9kg), the Maitland Bar Nugget is one of the purest gold nuggets ever unearthed. It was found in 1887 by miners Jonathan Thorpe, Isaac Holmes and Frederick Leader, at Maitland Bar, near Mudgee, New South Wales. The nugget was discovered 3.4m down in a mine shaft beside Meroo Creek, and at first was thought to be nothing special. One of the miners, possibly Thorpe, reportedly said, in a clear understatement, as he passed it up to a mate, "Here's a big stone for you."

The discovery, however, caused a stir in the local community and it was suggested the NSW government buy the nugget and display it at the Adelaide Jubilee International Exhibition that year. The government agreed to pay the value of the contained gold, then slightly more than £1200. The nugget was displayed at exhibitions and fairs around the world, to show off the wealth of the nation, right up until the 1930s.

It was forgotten for two decades until 25 April 1956, when an audit at the then Department of Mines showed that a "famous gold nugget" had gone to Treasury for safekeeping. There, the box containing it had unwittingly become the stumps for impromptu hallway cricket games. The nugget's current value is estimated to be about $3.7million.

Oz words

By Kel Richards

Neenish tart

A neenish tart is a mock cream-filled pastry iced in white and brown or pink and brown. Is it Australian? If so, where does the name come from? One well-known story from the *Sydney Morning Herald* in 1988 goes that a Mrs Evans claimed the tarts were first made in her NSW home town of Grong Grong: the originator was her mother's friend Mrs Ruby Neenish, who in 1913, running out of cocoa, used half-chocolate and half-white icing to create the first neenish tarts. However, a 2016 article in the same newspaper claimed the story began as a joke. The earliest reference to neenish is for 'neenish cakes' and appears in a 1929 cookbook published at Glenferrie, Victoria. But the citizens of Orange, in NSW, claim the first true neenish tart recipe was in the *Orange Recipe Gift Book* – from where it was reproduced in many other cookbooks (especially by the Country Women's Association). Those who think the alternative spelling of 'nienish' or 'nienich' was the original spelling claim this sweet treat was originally of Austrian or German origin. But I'll stick with Mrs Ruby Neenish.

PHOTO CREDITS, CLOCKWISE FROM TOP LEFT: COURTESY APPLE APP STORE; AUSTRALIAN MUSEUM
BIRD ILLUSTRATION: MICHAEL STREICH

PHOTO CREDIT: © IN THEIR OWN IMAGE: GREEK-AUSTRALIANS NATIONAL PROJECT ARCHIVES (PHOTO COURTESY X. STATHIS). FOR MORE INFORMATION, SEE THE BOOK *GREEK CAFES & MILK BARS OF AUSTRALIA*, AVAILABLE FROM *CAFESANDMILKBARS.COM.AU*

The Capitol Theatre in Wagga Wagga, NSW, had a thriving milk bar in the 1920s and 1930s run by Sam Nomarhis (above, second from left). Milk bars sold tempting treats and a splash of American glamour, but other than milkshakes and sodas, food remained Anglo.

OUR HISTORY

Milkshake, rattle and roll

Greek cafes sold American dreams – and gave their owners a foothold in Australia.

OUR CULTURE owes a great deal to the Greek milk bars and cafes that opened for business in just about every Australian town and city throughout the 1930s. Modelled on the American drugstore soda bars, they fed a growing hunger for Hollywood glamour, flavoured milkshakes, ice cream and handsomely wrapped chocolates, and rapidly transformed our food culture.

The Black and White Milk Bar that Mick Adams (Joachim Tavlarides) opened in Martin Place, Sydney, in 1932 is thought to have been Australia's first, sporting a sleek bar topped with soda fountain pumps and gleaming milkshake makers. Trade was brisk on its first day, with 5000 customers breasting the bar, and soon weekly patronage had grown to 27,000.

Other Greek entrepreneurs with little English but lots of energy were quick to follow suit – like Sam Nomarhis (left, second from left), who was operating the cafe in the Capitol Theatre in Wagga Wagga in the mid-1930s. It stocked a tempting array of handmade lollies and chocolates every bit as exotic as the imported films the theatre screened.

The cafes and milk bars borrowed heavily from American traditions – not just the menus, but also the architecture, decor and stylish uniforms. Names like the Astoria, Paragon, Niagara, Golden Gate and Monterey recalled the experiences of many Greek migrants who'd chanced their luck on the Californian goldfields en route to Australia.

By 1937 there were reportedly 4000 milk bars across the country run by Greek families. The businesses gave them an economic and social foothold in their new homeland, and the ability to maintain family culture and catering traditions within a shared workplace.

But while the cafes and milk bars helped to sow the seeds of modern-day multiculturalism, true social acceptance in many conservative communities was hard-won. Many Greek proprietors Anglicised their names, appointed Australian staff and reserved the Greek dishes for private family gatherings.

"They sold aspects of the American dream; it was like stepping into another world," says Macquarie University historian Leonard Janiszewski, who with photographer Effy Alexakis has spent more than 25 years researching and documenting their history. "It was a fantasy package and these cafes and milk bars soon became the social centres of town, where you could pick up gossip or your mail, have meetings or even wedding receptions. It was all-come-all-serve."

However, even the addition of British and Australian meals and jukeboxes thrumming with American rock'n'roll was not enough to extend the golden age of the Greek cafes.

"By the 1970s many were closing," Leonard says. "But whenever you drink a Coke or have a sweet chocolate treat; whenever you go to the cinema, or enjoy an ice cream, you can thank these Greek settlers. They were seminal in the development of Australia's public eating culture."

AMANDA BURDON

This artist's impression is of the very distant young galaxy A2744_YD4 when the Universe was just 4 per cent of its current age. It's rich in dust produced by the generation of very early stars.

SPACE

Detecting the first stars

New observations show that the first stars switched on surprisingly soon after the Big Bang.

WHAT DO YOU THINK are the Holy Grails sought by today's astronomers and space scientists? Evidence of life beyond Earth is one, of course. Another is identifying the two mysterious entities that hold galaxies together and accelerate the expansion of the Universe – dark matter and dark energy. Also among the big ones is detecting the first stars to shine in the Universe. When was the mass switch-on that signified the end of the 'dark ages', when no stars existed?

Remarkably, that can now be ticked off, thanks to observations made not with a gigantic optical dish somewhere in Chile, but with a modest radio telescope in Western Australia. The secret to observing the first stars is the ability to look back in time as you look further out in space. That is a trick all astronomers have at their disposal, thanks to the finite speed of light.

So far so good, but doesn't that mean you'd have to look back by almost the whole age of the Universe – some 13.8 billion years – to find the very first stars? And, at that distance, wouldn't they be incredibly faint? Both answers are yes, but astronomers have another trick up their sleeves. The first stars didn't just shine with visible light. They also emitted copious amounts of ultraviolet radiation, which modified the hydrogen gas in which they were embedded. That gas emits its own radio signal, and the change caused by the first stars imprints a time-stamp on it that is detectable today.

What the new observations reveal is that the first stars switched on as soon as about 180 million years after the Big Bang. This is surprisingly early, but ties in with other measurements of youthful galaxies in the infant Universe. An even more surprising discovery is that the background gas is much colder than expected. One explanation for this could be that it is interacting with the mysterious dark matter, which we know doesn't happen in today's Universe. Is this a clue to another Holy Grail, then?

Watch this space…

FRED WATSON
is an astronomer at the Australian Astronomical Observatory.

FRED ANSWERS YOUR QUESTIONS

The Universe is about 13.8 billion years old but time varies depending on the speed one is going relative to other objects. So, when there was no matter and the Universe was expanding faster than the speed of light, how was time measured to give us the 13.8 billion figure?
D. M. Piers, Sydney, NSW

Our estimate of the Universe's age is based on look-back time to the Big Bang, when all of space was concentrated to one point. It comes partly from observations of distant galaxies and the flash of the Big Bang. Yes, time varies between observers moving at different speeds through space, but the expansion of space doesn't affect it. The time the Universe was expanding faster than the speed of light, after the Big Bang, was very brief. Uncertainties in our estimates of its duration don't impact the age.

If you have a space question for Fred, email it to editorial@ausgeo.com.au

PHOTO CREDIT: ESO/M. KORNMESSER

100 million-year-old opalised tooth.
Collection of the Australian Opal Centre.
Donated by J. Fahey through the Australian Government's Cultural Gifts Program.

Join us and protect priceless Australian national treasures

Do you want to be part of Australia's most exciting community-based initiative to protect and preserve rare natural and cultural treasures?

The Australian Opal Centre is the world's leading not-for-profit facility for opal-related research, education and training, and a vital centre for creativity, culture and regional economic development.

Custodian of the world's finest public collection of rare opalised fossils, opal-related cultural heritage and breathtaking opal gemstones, the Australian Opal Centre is building a new home for these national treasures, at the legendary outback opal mining town of Lightning Ridge in NSW.

Designed by revered architects Glenn Murcutt and Wendy Lewin, the new Australian Opal Centre will be an icon of sustainable architecture in semi-arid Australia, insulated by the earth, solar powered and water conserving.

The Australian Opal Centre is inviting Australian Geographic supporters to help save priceless national treasures by becoming patrons of the new Murcutt + Lewin building.

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The List

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Visit Berry Celtic Festival

26 May, Berry, NSW

Celebrate all things Scottish with this year's Berry Celtic Festival. Kicking off with a grand street parade through the picturesque town of Berry, complete with pipe bands marching in their distinctive tartan kilts, Scottish terriers, motorcycles and vintage cars. A full day of entertainment follows, with Scottish clan stalls, authentic Middle Ages food, Celtic fiddlers, Highland dancing and a battle between medieval knights. For more information, visit: *berryrotary.org.au/celtic-festival*

Visit Coober Pedy Opal Festival

22–23 June, Coober Pedy, SA

COOBER PEDY, as colourful as the opals mined there, showcases its heritage with this weekend of entertainment. It begins on Friday night with the Opal Festival Ball, featuring live music and fireworks. Try your luck specking for opal or take in the many novelty events such as the Opal King and Queen Ironman/Woman competition and street pageant. For more information, visit: *opalfestival.com.au*

Visit Magnificent Makers

Until 3 June, State Library of Queensland, QLD

DISCOVER THE lives and works of remarkable Queenslanders who crafted pioneering creations. *Magnificent Makers* is an exhibition about creators and inventors from the late 19th century onwards, such as the 'fairy godfather of blind children', Richard Frank Tunley, and Carbon Creative's Wayne Denning. Visit: *makers.slq.qld.gov.au*

looking up

with Glenn Dawes

Glenn Dawes is a co-author of the yearbook *Astronomy 2018 Australia* (Quasar Publishing).

x1 **Naked eye**
The Southern Cross (Crux) is a great marker to a magnificent region of the Milky Way. It is also the most southerly extent of our galaxy. Many stargazers are envious of Australia's view of the Milky Way, because it's out of sight from much of the Northern Hemisphere.

x10 **Binoculars**
High in the eastern evening sky is Scorpius (the scorpion). At its heart is the brilliant red star Antares, whose vivid colour is clearly visible through binoculars. In the same field lies the multicoloured triple star Rho Ophiuchi, which forms an isosceles triangle.

x100 **Small telescope**
It's an excellent time to observe the outer Solar System's showpieces, with Jupiter and Saturn at their brightest and closest in May and June, respectively. Any small telescope will show the Jovian cloud bands and magnificent Saturnian rings.

PHOTO CREDITS: COURTESY ROTARY CLUB OF BERRY

Read

Aesop's Outback Fables

Ray Ching, Artis Gallery, NZ$78

FOLLOWING ON from the success of his *Aesop's Kiwi Fables*, published in 2012, world-renowned artist Ray Ching brings his retellings of Aesop's fables to life once more – this time with beautifully illustrated Australian animals. In *Aesop's Outback Fables*, kiwi are replaced by koalas, pukeko by possums, and weka by wombats, all rendered in Ray Ching's wonderfully exquisite detail, supported by his hand-written interpretations of the cautionary tales of Aesop and others. Restricted to 460 individually numbered copies, this limited edition book will appeal to devotees of the work of Ray Ching as well as lovers of Australia's unique wildlife.

The Best Australian Science Writing 2017

Edited by Michael Slezak, NewSouth Books, $29.99

THIS ANNUAL CELEBRATION of some of the finest voices in Australian science writing is now in its seventh year. The beautifully written essays in this issue – some of which have been contributed by Australian Geographic journalists, including former editor John Pickrell – take us on fascinating and accessible journeys into the furthest reaches of scientific exploration.

Join

Rainforest Rescue Community Tree Planting

5 May, Wonga, QLD

Help Rainforest Rescue plant over 2000 rainforest seedlings at Nightwings Rainforest Centre. The holes have been dug in advance and the site prepared. All they need are volunteers willing to get their hands dirty to help plant the seedlings, restoring rainforest habitat. All the young trees have been propagated from seed collected across their Daintree Nature Refuges and grown at their Daintree Native Nursery.

Register online to book your free place by 4 May: *rainforestrescue.org.au/events/10/2018 community-tree-planting-day*

Visit

WA wildflower season start

1 June, WA

WORLD-FAMOUS FOR its dazzling wildflowers, Western Australia is home to the largest array of native blooms on Earth. During the wildflower season the state is carpeted in the colourful blooms of more than 12,000 different species, 60 per cent of which are found nowhere else on the planet. The season officially begins in the north of the state in early June, before sweeping south and finishing on the south coast in November. For more information, visit: *westernaustralia.com/en/things_to_do/forest_and_flowers/pages/wawildflowers.aspx*

Visit

Barunga Festival

8–10 June, Barunga, NT

THE BARUNGA FESTIVAL celebrates the rich cultural history of the town of Katherine and its surrounding remote Aboriginal communities. Celebrating 30 years in 2018, the festival showcases the best of remote Indigenous Australia through a jam-packed program of music, sport, traditional arts and cultural activities. Located 70km south-east of Katherine on Central Arnhem Road, the event is held during the June long weekend. For more information, visit: *barungafestival.com.au*

Enter

Competition

WE'RE GIVING AWAY 10 copies of the landmark documentary *Blue*. Tackling themes of habitat destruction and degradation and species loss, *Blue* takes us into the marine realm to show us how the ocean and the creatures that depend on it are being affected by human activity. Featuring stunning original footage and ocean advocates such as Val Taylor, it will shock, move and inspire you.

Enter at: *australiangeographic.com.au/issue144*

PHOTO CREDITS, FROM TOP RIGHT: DON FUCHS; DUANE PRESTON; WIKI COMMONS
SCIENTIFIC NAME: *Verticordia grandis*

Your Society

Australian Geographic Society news and events

Lisa Blair
Spirit of Adventure 2017

Visit

australiangeographic.com.au/society
to download the nomination form

Lifetime of Adventure
Adventurer of the Year
Young Adventurer of the Year
Spirit of Adventure
Lifetime of Conservation
Conservationist of the Year
Young Conservationist of the Year

Sam Mitchell
Young Adventurer of the Year 2017

Australian Geographic Society Awards 2018

Open for nominations

IT'S THAT TIME of year when we start preparations for the Australian Geographic Society Gala Awards, which will be held later this year in Sydney. We welcome nominations from our readers for each of the categories listed above.

In the past year or so we have witnessed amazing achievements in adventure such as Jade Hameister's completion of the polar hat-trick and Justin and Lauren Jones's 1800km desert walk with their baby daughter, Morgan. Both Jade's and the Joneses' achievements demonstrate that you're never too young to start your adventurous life. There's also Matty Hunter's paddle down the Murray and Terra Lalirra Roam's epic walk (right). Perhaps you know of a wildlife or environmental warrior who deserves an accolade, too. This is the opportunity to shine a light on ordinary Australians doing extraordinary things and helping to make Australia a better place.

Nomination forms for all the categories mentioned above are available to download now from our website. Entries close on 30 June 2018, so don't delay.

Adventure

Grand Murray River paddle completed

Matty Hunter

PADDLING INTO GOOLWA, South Australia, bang on schedule on 3 March 2018, Matty Hunter succeeded in his goal of hiking, rafting and canoeing the entire length of the Murray River. Averaging 35km per day for three months, Matty observed the many changes now affecting this major ecosystem. Back on dry land, he's now hard at work on his larger goal – building an interactive information centre at Secret Creek Sanctuary near Lithgow, NSW. The centre will focus on educating visitors about how we can better care for Australia's unique wildlife. Plans also include the rejuvenation of the once-mined Secret Creek as a platypus sanctuary.

PHOTO CREDITS: THIS PAGE: COURTESY LISA BLAIR; CHARLES BARROW; COURTESY MATTY HUNTER

An architect's rendering of the proposed new Australian Opal Centre.

Community

An extraordinary new home for uniquely Australian treasures

A VISIONARY PROJECT is underway in Australia's outback: to build the world's leading facility for the preservation, exhibition and study of Australian gemstones and opalised fossils from the age of dinosaurs.

An off-grid, state-of-the-art, largely underground building has been designed for the new Australian Opal Centre (AOC) by world-renowned Australian architects Glenn Murcutt AO and Wendy Lewin. It will be a 21st-century icon of Australian sustainable architecture, an international tourist destination, a learning centre and a showcase for a collection of uniquely Australian treasures.

Dr Elizabeth Smith, a palaeontologist at the centre, said it would advance fossil- and opal-related scientific endeavour in Australia and internationally, and would be the world's leading facility for opal-related research, education, training and certification.

"The AOC's collection is the finest of its kind in the world, thanks to opal miners, other donors and the new discoveries made during the fossil digs run with the AG Society each August," Elizabeth says.

The AOC is offering AG readers the chance to become patrons of the new Murcutt-Lewin building, which is scheduled for construction in 2019–20. Only 148 AOC Founder opportunities are available. For more, visit: *australianopalcentre.com* or call 02 6829 1667.

ADVENTURE

Done roaming

TERRA LALIRRA ROAM is set to become the first woman to walk more than 16,000km around Australia, solo and with no support vehicles. For more than four years, Terra has pushed a custom-designed barrow carrying all her water, food and camping equipment and has endured cyclones, fires, floods, an earthquake and a dislocated ankle. She'll complete the final, off-road backpacking leg down the east coast to Newcastle in NSW in May 2018. Follow Terra's progress through the Terra Roams Instagram and Facebook pages and her website *terraroams.earth*

ADVENTURE

Nancy-Bird Walton Sponsorship 2018

FROM AN IMPRESSIVE pool of women adventurers, the 2018 Nancy-Bird Walton Sponsorship has been awarded to Clemmie Wotherspoon. Inspired by Robyn Davidson's 1980 journey across the outback with camels, Clemmie is undertaking a solo, unsupported horseback trek across Australia. Clemmie has worked with horses for four years in preparation for the expedition and hopes to shine a light on mental-health issues and the efficacy of equine therapy in treating mental illness. Beginning in February this year, less than two weeks into her adventure, Clemmie had already faced bushfires, near-anaphylactic shock in a horse, midnight visitors to her camp and challenging treks lasting late into the evening.

Clemmie Wotherspoon

Follow Clemmie at: *facebook.com/wildtracksaustralia*, Instagram @wildtracksaustralia, and *wildtracksaustralia.com*

PHOTO CREDITS, CLOCKWISE FROM TOP: CANDALEPAS ASSOCIATES; COURTESY DAVID HASLINGDEN; COURTESY WILD TRACKS; COURTESY TERRA ROAM

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To subscribe, call 1300 555 176

Who are the Australian Geographic Society?

Patron: Dick Smith AC
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Directors: Kerry Morrow, Jo Runciman
Advisory Council: Chrissie Goldrick, John Leece AM, Tim Jarvis AM, Anna Rose, Todd Tai, Tim Flannery
Society administrator: Rebecca Cotton

THE SOCIETY runs sponsorship rounds in April and November – during which it considers applications and disperses grants that are funded by the Australian Geographic business. It also awards the Nancy-Bird Walton sponsorship for female adventurers and hosts annual awards for conservation and adventure. It runs fundraisers through AG retail stores. Each year it gives in excess of $100,000 to worthy projects.

Welcome

DAVID HASLINGDEN

We're thrilled to announce a new chair for the AG Society, David Haslingden. David brings a wealth of experience in business and natural history filmmaking and is a passionate advocate for the natural environment.

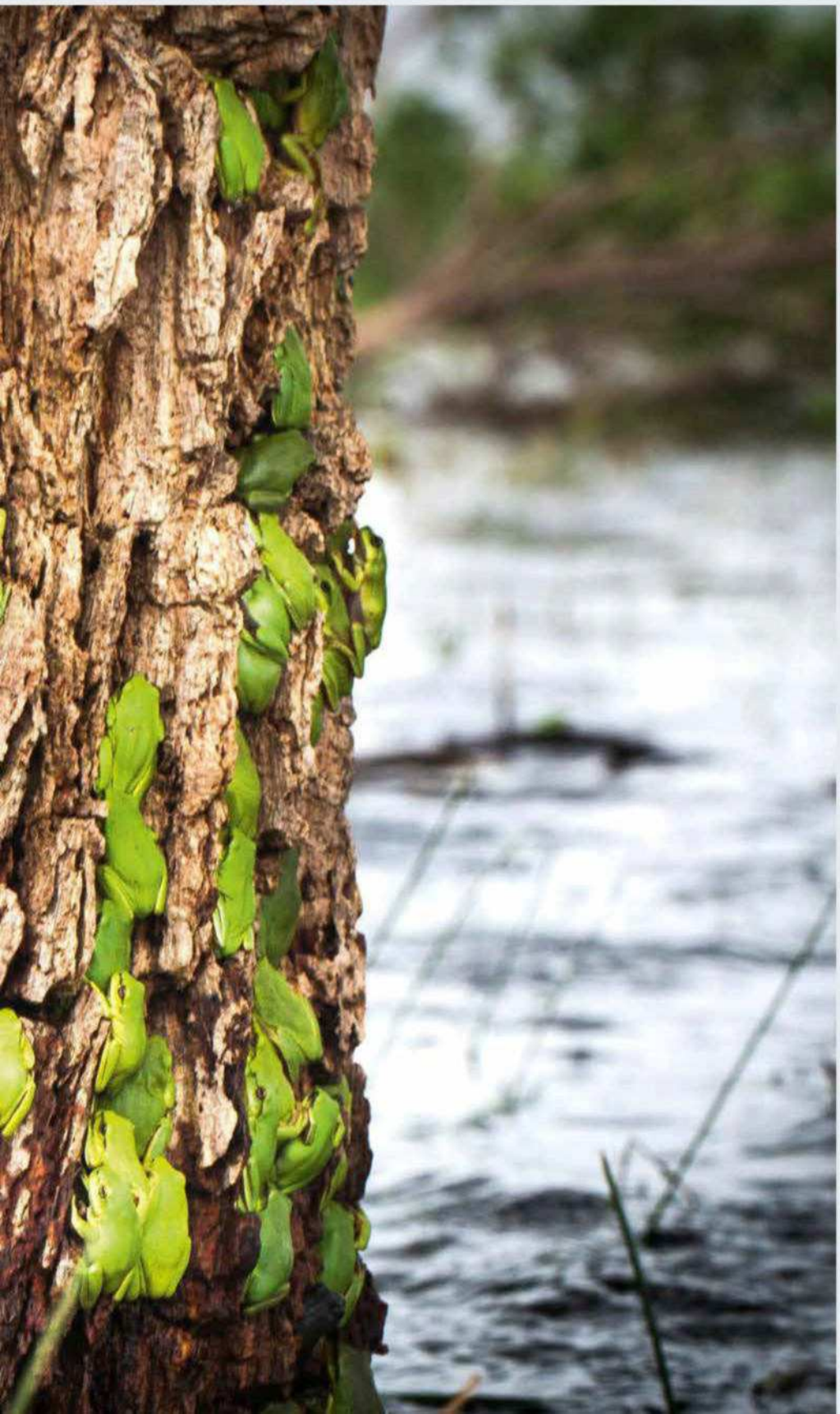
Wild Australia

MAY · JUNE 2018

Essential wildlife highlights that can't be missed

NSW NEW HOLLAND HONEYEATERS, ROYAL NATIONAL PARK

Just south of Sydney's CBD, Royal NP is great for bushwalking in the cooler months, with some of the 300 bird species recorded here being very active in winter. Look for the yellow patches of New Holland honeyeaters as they forage around coastal scrub.
More info: Call 02 9542 0648 or visit *nationalparks.nsw.gov.au/visit-a-park/parks/royal-national-park*



Big picture

Vertical life raft

By Damian Kelly

After record-breaking rainfall in the northern WA town of Broome in January and February this year, a large number of reptiles and amphibians, including these tree frogs, were seen huddling together wherever and with whomever they could, taking refuge and waiting for floodwaters to fall. On the large and usually walkable Buckleys Plain, Environs Kimberley ecologist Dr Malcolm Lindsay says he found that "one small paperbark shrub alone had more than 500 frogs, 10 skinks, four blue-tongues, two snakes and three goannas!"

WA DINOSAUR FOOTPRINTS, DAMPIER PENINSULA

Gantheaume Point, near Broome, is famous for dinosaur tracks and in the past six years, thousands of 130-million-year-old dinosaur prints and trackways have been documented here and along 80km of the Dampier Peninsula, from Roebuck Bay to Cape Leveque. Other places to find them around Broome include Yinara (Reddell Beach south) and Entrance Point. A hovercraft tour (*broomehovercraft.com.au*) is an unusual way to reach some prints. **More info:** Call the Dinosaur Coast Management Group on 0400 769019 or visit *dinosaurcoast.org.au*.

PHOTO CREDITS, CLOCKWISE FROM TOP: MINDEN PICTURES/ALAMY STOCK PHOTO; JOHN CRUX PHOTOGRAPHY/GETTY; DAMIAN KELLY
SCIENTIFIC NAME: *Phyllodonyris novaehollandiae*

VIC

WINTER-FLOWERING GUMS, CENTRAL VICTORIA

Many of Australia's eucalypt species flower in spring and summer, relying on abundant insects for pollination. But a whole bunch burst into brilliant colour in winter and rely instead on nectar-feeding possums, parrots and bats. From late autumn into winter, species like the mugga, or red ironbark (*Eucalyptus sideroxylon*) provide sustenance to birds such as swift parrots, which fly across Bass Strait for them. Spot them in Kara Kara NP, which is about 120km drive from both Bendigo and Ballarat and has one of the largest intact areas of box-ironbark forest. **More info:** Call Parks Victoria on 13 1963 or visit *parkweb.vic.gov.au/explore/parks/kara-kara-national-park*

TAS

CAPE BARREN GEESE, CAPE PORTLAND

Cape Portland, in north-east Tasmania, supports a population of beautiful Cape Barren geese, which, along with hooded plovers and chestnut teals, are protected in a 6700ha Important Bird Area. In autumn the geese establish territories that they fiercely guard and where their eggs are laid in nests amid tussocks in open grassland. Also worth a visit are Musselroe Bay's white beaches, on Cape Portland's east, within Mt William NP. **More info:** Call 03 6387 5510 or visit *parks.tas.gov.au*

WA

NORTHERN QUOLLS, ARTESIAN RANGE

The Kimberley's Artesian Range, 300km from Derby, is an endangered northern quoll stronghold and great to visit in the Dry. Camp at the Australian Wildlife Conservancy's Charnley River-Artesian Range reserve, two hours drive north of the Gibb River Rd, which has populations of other rare mammals including scaly-tailed possums and monjon rock-wallabies. **More info:** Call 08 9191 4646 or visit *australianwildlife.org/sanctuaries/artesian-range-sanctuary*

GOING WILD

Check out our regular section that helps connect you with nature through a truly wild experience. In this issue, Going Wild takes you on a scenic cycle suitable for the whole family as we join the annual Great East Rail Trail Ride (see page 104). So come with us far from the pace of modern life along an abandoned railway corridor through picturesque eastern Victoria.

PHOTO CREDITS, CLOCKWISE FROM TOP LEFT: REDA & CO SRL/ALAMY STOCK PHOTO; CHRISSIE GOLDRICK/AUSTRALIAN GEOGRAPHIC; DAVID HUNTER
SCIENTIFIC NAMES, CLOCKWISE FROM TOP LEFT: *Eucalyptus sideroxylon; Cereopsis novaehollandiae; Tympanocryptis pinguicolla*

AG Society fundraiser

SHOUT-OUT FOR A DRAGON

The grassland earless dragon – one of Australia's most stunning lizards – was once widespread in south-eastern Australia. Now just 1 per cent of its original population survives. Some occur in the ACT, and individuals have been found at locations near Cooma, NSW. But it hasn't been seen in Victoria since 1969.

Vast areas have been cleared of the lizards' native grassland habitat, where it uses spider and insect holes to hide from temperature extremes. Donate now to help save this exquisite reptile. As part of a conservation program partnership with the NSW Saving our Species program and similar work in the ACT, your funds will be used to provide artificial spider tubes, which will help rebuild the dragon's wild population.

TO DONATE: Visit *australiangeographic.com.au/society* or post a cheque to: AGS Administrator, Level 9, 54 Park St, Sydney NSW 2000.

NATURE

The secret history of raptors

That falcons are more closely related to parrots than other birds of prey is one of the surprising finds by recent genetic studies of birds.

BIRDS OF PREY, or raptors, are highly skilled predators with keen vision, sharp talons, powerful hooked beaks, exquisite flight capabilities and solitary habits. They're found worldwide, often have feathers in muted greys and browns and include eagles, hawks, ospreys, owls, kites, buzzards, vultures, falcons and kestrels.

It makes sense these animals would be close evolutionary relatives. But recent detailed analyses of bird DNA has thrown up some huge surprises. Perhaps most unexpected is that, despite physical and behavioural similarities, falcons and kestrels (family Falconidae) are more closely related to parrots than to hawks and eagles (family Accipitridae). These results were first suggested in a major genetic study of the bird family tree in 2008 and confirmed by another extensive analysis in 2014.

Falcons do have a few differences from other raptors. Accipitrids glide on thermals to scope out prey and kill with their talons, while falconids are high-speed pursuit predators that kill with their hooked beaks.

But apart from the beaks falcons share with parrots, there seem to be few other similarities. Parrots are gregarious, often brightly decorated and typically eat fruit, nectar and seeds – although recent evidence indicates many eat meat when they need protein (see page 36).

When it comes to birds, looks can be very deceiving. Part of the reason it's been hard to understand avian evolutionary relationships is that, after the non-bird dinosaurs disappeared 66 million years ago, there was an explosion of evolution in birds as they rapidly diversified into most of the modern groups we know today. Fossil evidence has been scant, while constraints placed on evolution by flight – such as the need for wings, feathers and light bones – means birds' bodies have remained similar, confounding morphological studies of relatedness.

An interesting result of the findings that connect parrots and birds of prey is that falcons and eagles must have developed similar appearances and behaviours through 'convergent evolution'. For a carnivorous bird that flies on the hunt for prey, certain characteristics – such as well-camouflaged plumage, excellent flight, great vision and powerful hooked beaks – are very useful, and evolution has led to their acquisition more than once during the history of life on Earth.

DNA analyses have revealed other surprises about birds, including that the evolution of most species can be traced back to Australia. The closest relatives of parrots, it turns out, are the passerines, or songbirds. This group comprises half of all living birds – about 5000 species, including the Northern Hemisphere's robins, mockingbirds, jays and thrushes and the magpies, bowerbirds and lyrebirds of Australia.

During much of the past century ornithologists were convinced songbirds evolved in the north and later spread to Australia. But fossils from Down Under of early songbirds that are up to 54 million years old began to raise doubts about that view.

Then genetic evidence trickled in, further challenging the accepted dogma. The idea songbirds came from Australia took time to be accepted, but a study of the DNA of 100 songbirds from 25 countries left little doubt when it was published in *Nature Communications* in 2016, showing that the greatest genetic diversity of the group is found here.

As biologist, author and AG contributor Tim Low notes in his book *Where Song Began*, which was first published in 2014, we now know parrots, songbirds and pigeons/doves are all groups that originated in Australia. Songbirds perhaps began to diversify here 33 million years ago, before spreading to the world.

Few people realise how pivotal Australia has been in bird evolution or that it's home today to about 830 species, nearly 10 per cent of the world's entire avian diversity.

So, next time you look up at the trees and sky, have a think about the wonderful variety of birds around you and how evolution has acted in somewhat surprising ways to generate the delightful diversity of avian life.

A symbol of speed and power, the peregrine falcon is the world's fastest bird in the air.

PHOTO CREDIT: SIMON CARTER/AUSTRALIAN GEOGRAPHIC
SCIENTIFIC NAME: *Falco peregrinus*

JOHN PICKRELL
is a former AUSTRALIAN GEOGRAPHIC editor. Follow him on Twitter: @john_pickrell

Seeds of doubt

Should we feed our native birds? The answer is not so simple.

STORY BY DARRYL JONES

Handfeeding is one of the most intimate ways people can interact with nature. A truly wild animal trusting enough to ignore its natural fears: it's hardly surprising this is widely regarded as a special experience.

CONSIDER THESE TWO typical Australian garden scenes. In one, a boisterous rainbow lorikeet flock squabbles and squawks over a mass of brilliant crimson bottlebrush blossoms. In the second, a pair of lorikeets nibbles delicately at a pile of minced meat placed on a bird table for magpies, which are looking on warily from a nearby fence.

Before categorising these scenes as either natural versus unnatural or even good versus bad, consider some additional information. That bottlebrush is one of the visually spectacular *Callistemon* cultivars developed from plants native to Western Australia's arid interior but manipulated to flower year-round, with blooms twice the normal size and producing much more nectar than usual. It's heaven for any bird with a 'sweet tooth' and lorikeets – as well as miners, wattlebirds and friarbirds – love them. These avian nectar-lovers have rushed en masse into suburbs across the country now festooned with seemingly 'bird-friendly' native plants. And they've done it to such an extent that rainbow lorikeets have become one of the most abundant bird species in every large city in the country. The notorious noisy miner is another native that's prospered, to the detriment of countless smaller species. For many of us, planting all those callistemons, grevilleas and banksias supporting this urban avian life was an attempt to provide native bird habitat. In the end, however, we've often ended up with plenty of birds but not so much species diversity.

It may not seem like it, but growing these plants is a form of bird-feeding. And it's promoted and supported by all the relevant bird, conservation, environmental and government agencies, even if they vigorously oppose regular bird-feeding.

To discover that a nectar-and-pollen specialist such as the rainbow lorikeet is now consuming meat seems like another – particularly grotesque – reason not to feed birds. Yet it's recently been discovered that lorikeets and other parrot-like birds naturally consume meat when they apparently need protein.

I have photos of lorikeets red with the gore of a dead kangaroo, galahs hanging from a butchered beef carcass and videos of pet cockatiels stealing chicken from the family dining table. We have also long known that despite their remarkable brush-tongues, all lorikeets eat a wide variety of seeds, grains, fruits and flowers. They do not lose their brushes by eating seed supplied in bird-feeders.

So, that seemingly straightforward division between natural and unnatural, good and bad now seems a little more complex.

Fruit can be a great way to attract different species, including beauties such as this zebra finch. We now know birds visiting feeders get most of their food from natural sources, so adding variety can be safe and fun.

IT WON'T SURPRISE most readers that the topic of bird-feeding is enormously controversial in this country. What is perhaps less well known is that the widespread and sustained opposition to bird-feeding in Australia is unique. Certainly there is no concern in any other country where feeding is practised, and the most respected and prominent conservation and bird organisations elsewhere actively promote bird-feeding, typically as a form of conservation. Leading groups such as the Royal Society for the Protection of Birds in the UK and the US-based Cornell Laboratory of Ornithology are united in support for this activity. So why is the attitude so different in Australia?

One reason may relate to the origins of this practice in the Northern Hemisphere. The primary influences, in Britain at least, seem associated with Victorian-era charitable social attitudes, combined with exceptionally harsh winters. Ordinary people everywhere in Britain have always responded to the plight of birds suffering during winter: picture the proverbial crumbs on snow-covered windowsills for starving robins, or the *Mary Poppins* song 'Feed the Birds (Tuppence a Bag)'. This nature-loving attitude seems all the more remarkable because it stems from a time of stringent frugality, when nothing whatsoever was wasted. Any leftovers from family meals would be used: dry bread

Continued page 43

Darryl Jones

Professor Darryl Jones is Deputy Director of the Environmental Futures Research Institute at Griffith University in Queensland. For more information, see his book *The Birds at My Table*, published in 2018 by NewSouth Publishing.

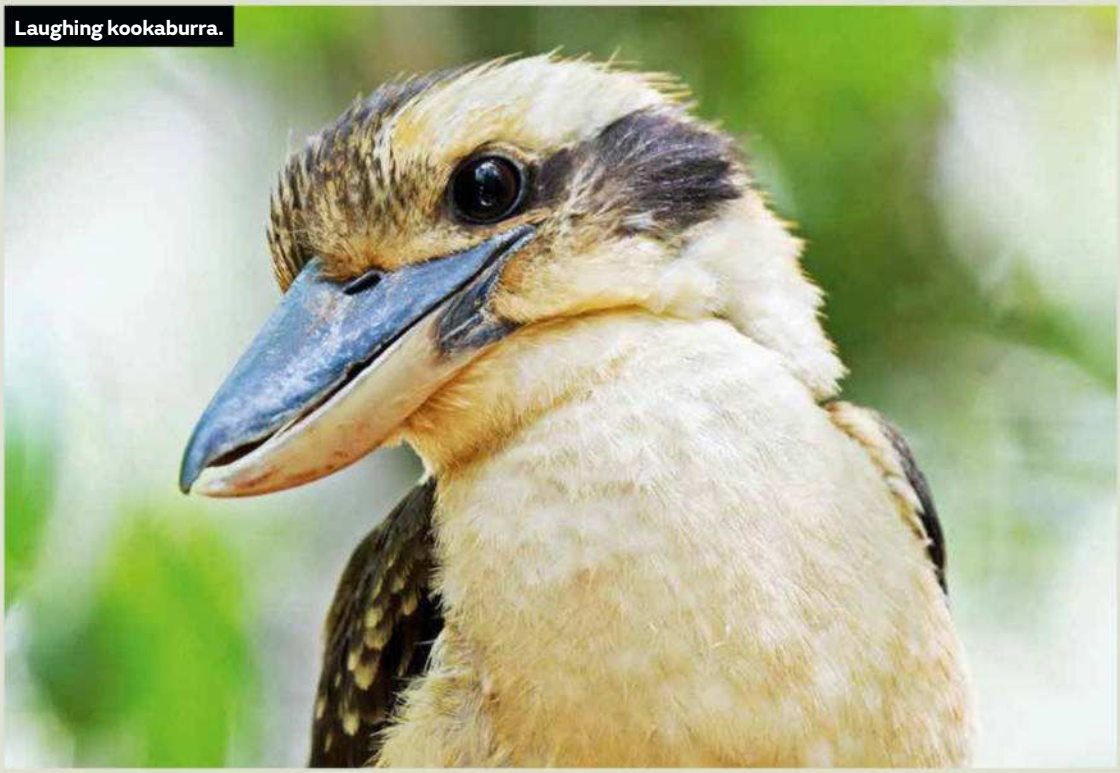
PHOTO CREDITS, PREVIOUS PAGE: SHUTTERSTOCK; THIS PAGE: ARTERRA PICTURE LIBRARY/ALAMY STOCK PHOTO
SCIENTIFIC NAMES, PREVIOUS PAGE: *Alisterus scapularis*; THIS PAGE: *Taeniopygia guttata*

▲ **Big, beautiful** and sometimes bossy, the sulphur-crested cockatoo is among the largest birds visiting Aussie feeders. They have been known to damage nearby structures... so, be warned.

▼ **Bird food** is not only seed. If you want to attract native species to your place, always start with native plants. As well as providing something natural to snack on, they provide habitat, shelter and even nesting sites.

PHOTO CREDITS, FROM TOP: ROBERT WYATT/ALAMY STOCK PHOTO; GENEVIEVE VALLEE/ALAMY STOCK PHOTO
SCIENTIFIC NAMES, FROM TOP: *Cacatua galerita*; *Manorina melanophrys*

Backyard feeding has helped make rainbow lorikeets so common in suburban Australia that we often take their exquisitely beautiful plumage for granted.



Laughing kookaburra.

Sensible bird-feeding

Having wild creatures visit our homes is a privilege. We feed them for our own sake, not for theirs. To attract birds and other wild creatures to your garden, plant vegetation native to your area, and, if you want to offer birds additional food, here are some practical guidelines you should follow.

1. **Ensure feeding stations are placed out of reach of cats and other predators.**

2. Clean stations daily and remove food after an hour. Vary the time of day in which you provide the food.

3. **Use good-quality food such as commercial nectar mixes or seed mixes. Cheaper supermarket seed does not contain sufficient nutrition for birds. Never provide junk food.**

4. If feeding meat-eating birds, such as kookaburras, use sliced meats rather than minced or processed meats. It's even better if it can be supplemented with an insectivore mix, such as Wombaroo.

5. **Cease feeding if large flocks (of 20-plus birds) begin feeding at the same time.**

6. Feed your pets indoors or remove their leftover food. Common mynas and other birds regularly eat pet food so limit their access to it.

7. **Create habitat for birds by growing local native plant species that will provide natural food sources and potential nesting sites.**

8. Never feed birds in natural areas or parks.

9. **Make feeding an occasional treat (for you and the birds), not a daily event. Think of it as a Tim Tam and a cup of tea...**

Information courtesy of BirdLife Australia and its Birds in Backyards project.

PHOTO CREDITS, PREVIOUS PAGE: MICHELE AND TOM GRIMM/ALAMY STOCK PHOTO; THIS PAGE: SHUTTERSTOCK
SCIENTIFIC NAMES, PREVIOUS PAGE: *Trichoglossus moluccanus*; THIS PAGE: *Dacelo novaeguineae*

Crimson rosellas are favourites at feeders. Because they eat a wide variety of seeds in the wild, they can be attracted with a good seed mix. But be sure this is high quality and that the feeder is always very clean.

PHOTO CREDIT: LAURIE STRACHAN/ALAMY STOCK PHOTO
SCIENTIFIC NAME: *Platycercus elegans*

There is little evidence of birds becoming dependent on human-provided food.

for stuffing, fat for puddings and pastries. Offering such items to birds that didn't need it would have been unacceptably wasteful.

Yet, it seems, the prolonged blizzards of the 1890s swayed even severe Victorian reserve. Newspapers of the day were full of heartfelt pleas for people to help distressed birds and included recipes for homemade concoctions that could be offered. People responded en masse. Suet balls and grain intended for horses were placed out in public parks. Pupils set up feeding tables in schoolyards. Factory workers took up collections of lunch scraps and placed these out beside the frozen River Thames. Organised and intentional bird-feeding became much more accepted and widely practised, although still only in winter.

Of course, feeding birds can't all be about human benevolence to feathered creatures suffering in the cold. In Australia, few places experience relatively severe winters. But we do have other environmental and climatic extremes, with prolonged droughts, widespread bushfires and devastating cyclones being irregular but familiar features. All of these exert a major influence on the natural food resources available for wildlife. People have always responded to the plight of birds affected by these events, setting up birdbaths and leaving out things they might be able to eat. This assistance, was always temporary, though, because of a long-held attitude that wild birds 'have to be able to look after themselves'.

THE CONCERN THAT birds may become reliant on artificial sources of food is the most prominent issue for both proponents and opponents of bird-feeding throughout the world. It's been used to argue against feeding, with the idea that birds will forget how to forage naturally. And it's been used to caution those already feeding not to stop – the feeder's so-called Golden Rule. This has resulted in untold levels of worry and guilt but has also been a key influence on the extraordinary growth of what is now a gigantic global bird-food industry.

But there is little evidence of birds becoming dependent on human-provided food. In fact, studies from around the world show that only a tiny fraction of visiting birds' daily diet comes from feeders. Even when birds have access to lots of feeders, they still prefer to gather most of their food from natural sources. When these are in abundance, they often don't bother with feeders at all.

This is welcome news. It means they aren't reliant on food we provide and we can stop worrying about the Golden Rule. Birds don't need us at all! It may be tough to accept, but our feeders are more for us than them. Their visitors don't come out of necessity, but that's okay. It means we can enjoy them even more. AG

Taipan territory

An encounter with one of the world's most venomous snakes in an Australian desert: what more could a reptile enthusiast want?

STORY AND PHOTOGRAPHY BY **ROSS McGIBBON**

The western desert taipan has less potent venom than the inland taipan, but it can still kill. When approached, it shows curiosity rather than hostility, raising its head to look rather than fleeing or adopting a strike pose.

A mulga snake rears like a cobra to look intimidating, a defensive behaviour that may save its life one day. This snake is found across the continent and has the widest distribution of any Australian snake species.

IMAGINE THAT YOU'RE A passionate surfer. You talk about surfing to anyone who'll listen; read every surfing book and magazine you can find; spend all your spare time travelling in search of the best waves.

Now, translate that enthusiasm into finding and photographing reptiles in the wild and you'll begin to understand the passion that I have for these animals. It's this enthusiasm that led fellow wildlife photographer Tim Squires and me on an expedition into the remote Great Victoria Desert, about 1500km inland from Perth, where we hoped to find and photograph the western desert taipan (*Oxyuranus temporalis*).

Most Australians would have heard of taipans because these reptiles are among the world's most infamous snakes and Australia is home to all three known species. These are the notorious coastal taipan, which is also found in southern New Guinea; the inland taipan, sometimes known popularly as the fierce snake and believed to have the most toxic venom of any land snake; and the recently described western desert taipan.

They are all formidable snake species, possessing large fangs, extremely potent venom and an agility that demands the utmost respect from even the most experienced of snake handlers. Returning to the surfing analogy, photographing taipans is like big-wave riding – succeed, and you won't remember a happier moment; get it wrong and it may cost you your life.

Tim knows about this better than most. It's almost a year since our last taipan expedition, during which he nearly died after being bitten by an inland taipan. It's an ordeal neither of us is eager to repeat.

But where there's risk, there's reward, and, for me, there's no greater reward than seeing these wild places and animals with my own eyes.

Sitting at the top of my list is the western desert taipan, a reptile first described by scientists as recently as 2007. Fewer than 20 encounters with this reptile have been recorded, although the Pila Nguru – the Spinifex People – would surely have come across this snake regularly during the 15,000 or more years that they have lived in the Great Victoria Desert.

Excitement levels are high as Tim and I hit the road. Almost four hours into the drive, we encounter the trip's first reptile: a western blue-tongue lizard crossing the road ahead of us. We escort it from the road and watch it scurry off into the undergrowth.

As the bitumen gives way to dirt east of Kalgoorlie, Tim shouts, "Stop! Snake!" I see it too and bring the vehicle to an abrupt halt. Sadly, our excitement quickly turns to disappointment as we realise that the snake is roadkill.

As the colour drains from the sky, we take a moment to enjoy some dinner and discuss which nocturnal species we hope to encounter after dark. The desert death adder is the number one attraction in this area, but I fear the temperature is dropping too quickly to support much reptile activity.

My prediction proves correct; by 11pm a few geckos are all we have to show for our efforts.

SCIENTIFIC NAME, PREVIOUS PAGE AND OPPOSITE PAGE: *Oxyuranus temporalis*; THIS PAGE: *Pseudechis australis*

As if aware of its venomous potential, a western desert taipan is not a snake that shies away from any encounter. It will, however, slip away quietly, preferring to avoid a confrontation.

Not afraid to put himself in harm's way for a good photo, Tim photographs a yellow-faced whip snake that's not considered dangerous but can deliver an extremely painful bite.

NEXT MORNING WE wake with the birds and face almost 1000km of driving. The small outback town of Laverton is our last stop for fuel, supplies and phone reception. Tim quickly calls home to explain we'll be out of contact for up to a week. I feel for Tim's partner, who'll no doubt be nervously awaiting a phone call, hoping it will be Tim's voice on the other end this time, not hospital staff.

To my surprise, the dirt road into the desert is well maintained, allowing us to travel at a good speed. Soon we have to brake for our first snake. This time it's a mulga snake sitting on the shoulder of the road with its head in a bush, very much alive. Grabbing our cameras, we approach the snake, which has only just noticed us. It rears up and advances towards us, neck flattened like a cobra's – defensive posturing that comes in handy when deterring predators. We rattle off a flurry of photos before the snake grows tired of us and retreats.

By nightfall, we're only halfway to our campsite and need to get a move on if we're to get any sleep before tomorrow's early wake-up. However, we can't resist stopping for two more mulga snakes and numerous geckos. By 1am we're in taipan country and we wearily make camp in a small clearing before retiring to our swags.

On any other day I'd be cursing my alarm, but when it goes off at 4.30am I spring excitedly from my swag. Half an hour later, we're cruising around in the four-wheel-drive searching for taipans – a game of luck that requires us to be in exactly the right place at the right time to see one crossing, or basking on, the track.

After almost three hours of fruitless searching, we grab a quick break, but 10 minutes later we're on the road again. After another 15 minutes, I spot a long, dark snake slowly slithering across the track. There's no mistaking its identity and I leap from the passenger side before Tim can stop the vehicle. He isn't far behind and, with cameras poised, we approach the 1.8m taipan. It raises its head out of curiosity, but to my amazement, it doesn't alter its speed or direction.

The taipan approaches to within a metre, raises its head and opens its mouth.

I snap the snake in the middle of the track and we slowly creep closer until we're within 2m of it. Still the taipan keeps its composure and we take more photos as it cruises through the spinifex. At one point, I position myself directly in the snake's path. The taipan approaches to within a metre, raises its head and opens its mouth, exposing just enough of its fangs to let me know what's in store if I don't let it pass – and providing me with one of my favourite shots of the trip.

By mid-morning we've completed our mission. We can't stop grinning. We're now among the fortunate few to have observed and documented one of Australia's least-known snakes. And thanks to 'our' taipan's calm disposition, we've had the sort of interaction of which a wildlife photographer can only dream.

To see more pictures from this intrepid desert shoot, go to: *australiangeographic.com.au/issue144*

SCIENTIFIC NAME: *Demansia psammophis*

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Leanne Nicolle, an intern at the SAGE community garden in Moruya, NSW, harvests rhubarb to be sold at the weekly farmers' market.

STORY BY **AMANDA BURDON**

In Season

Australia's farmers are delivering food in new and old ways.

Stuart Whitelaw

is excited that potatoes are back on the menu. Not just any potatoes, but creamy early Sebago spuds grown at Deua Farm, on the fertile river flats just 5km upstream of his home near Moruya, on the NSW South Coast.

He's fresh from the town's Tuesday farmers' market, having filled his basket with potatoes, fennel, beetroot, cauliflower, broccoli, blueberries, stout bread, and full-cream Jersey milk and cheeses – all grown and made by people he knows, no further than 20km away.

"The joy of our market is that it has brought us back into the rhythm of the growing cycle, eating whatever is in season," says Stuart, a retired architect, artist and keen home gardener, who helped establish the market. "You can buy just about everything you need – seafood, meat, dairy and vegetables – and it's true local food. I know exactly where it came from and the values of the people who produced it."

Vegetable production – mostly corn, tomatoes, beans and potatoes – was a mainstay of the Eurobodalla Shire economy throughout the 1950s and '60s. But mechanisation and larger-scale agricultural production put paid to most of the small market gardens that quilted the coastal strip. It became nearly impossible for residents to buy anything grown locally.

Then, in 2009, came not-for-profit community organisation SAGE (Sustainable Agriculture and Gardening Eurobodalla) with a bold plan: to inspire home gardeners to get their hands dirty and grow a commercial food supply.

"We wanted to become much more self-sufficient locally and to recapture and share the knowledge and expertise of the old farmers before it was lost," Stuart says. "But any food system is about a lot more than food. It's also about growing the community."

SAGE started by establishing a community garden on Moruya's outskirts and offering education and workshops to empower locals to garden and cook. It appointed an intern to tend the garden and established a Seed Savers group to preserve heirloom varieties adapted to the regional climate. Very soon, small-scale food enterprises began to flourish and, in 2013, the farmers' market germinated in this rich soil.

It's been a boon to the community. The market turns over an estimated $1.7 million a year and injects a further $1.4 million into the regional economy. "When people are eating well, it leads to a healthy community," Stuart says. "We have proven the viability of small-scale farmers living off 1ha, but we've also provided an important means of social connectivity. Our market is the reason why people now move here."

▲ **Farmers' markets**, such as this one at Moruya, are bringing together people to make conscious food choices and reward local growers for their efforts.

▲ **Stuart Whitelaw** (top) helps drive the local food production revival in Moruya, where the farmers' market and community garden gather support.

Local food. Slow food. Fair food. Across Australia, a quiet revolution is underway. New and not-so-new farming methods are satisfying a growing hunger for food produced in environmentally sustainable, ethical and socially responsible ways. From pastured eggs to organic fruit and vegetables and carbon-neutral meat, a small but passionate crop of farmers is delivering food they say is kinder to the Earth and animals. Concentrated in densely populated regions within reach of major cities, they are slowly starting to carve out profitable niche markets and inject vitality into regional communities, determined to put the culture back into agriculture.

"The public is clamouring for our food; they want to know their farmers and where and how their food is produced," says Victorian pig farmer Tammi Jonas, president of the Australian Food Sovereignty Alliance, which advocates for ethical and sustainable farming practices. "A growing number of Australians are also devoting their lives to growing sustainable produce. They want to contribute to a better future for everyone, and this will continue to grow as we see more public health issues and ecological destruction."

Sarah Hyland from the Australian Institute of Food Science and Technology highlights the bigger geopolitical, economic, ▸

PHOTO CREDITS, PREVIOUS PAGE, THIS PAGE AND OPPOSITE: JUSTIN GILLIGAN

Newly plucked radishes from the SAGE community garden in Moruya, NSW, are typical of the low-food-mileage, ethical produce finding favour.

Litters of piglets like this one roam together freely on the Jonai family farm in VIC, which prides itself on humane animal husbandry practices.

▼ **Laura Riccardi** and Jakub Kotulek pack boxes of fruit and vegetables for customers of Food Connect, the collective distribution hub based in Salisbury, QLD.

▲ **Food Connect** collective CEO Rob Pekin believes the cost of fair food should be independent of market forces, and reflect the true ecological price of year-round production.

environmental and social forces at work. "Throughout the world we are seeing a change in the social values around food," she says. "After 9/11 and the GFC, especially, people became frightened and retreated to more retrospective thinking. Concerns about food safety and security mean we want more transparency and we're questioning whether conventional farming is sustainable."

A 2015 Rural Industries Research and Development Corporation report predicts that by 2050 wealthier and better informed consumers will expect food to be nothing less than healthy, nutritious, clean, green and ethically produced. It foreshadows technology giving shoppers a greater ability to "selectively access, share and validate information about products", enabling Australian rural industries to "increase market share by communicating the provenance, ethics, environmental performance and healthiness of their crop and livestock products".

That's already happening, to some extent, courtesy of farmers' markets and direct distribution systems – such as food hubs, convergences, Community Supported Agriculture (CSA) enterprises, farmers' cooperatives and collectives – that have sprouted around the country.

Jane Adams, Australian Farmers' Markets Association national spokesperson, says at least 180 farmers' markets now operate in Australia and, although it's difficult to estimate national annual turnover, takings for April 2016 from just 56 markets exceeded $70 million. "Farmers' markets not only showcase regional produce; they help develop a regional identity and are a powerful platform for community engagement," Jane says. "They provide enormous economic and social stimulus to their communities, and are wonderful business incubators. The cost of participation is very low and it's a very supportive environment for producers starting out and trying to build a brand. They've helped create agricultural diversity and have saved many family farms."

At farmers' markets, shoppers are discussing provenance and food miles, climatic changes and artisanal products that preserve age-old techniques. Some consumers have become so inspired they invest more deeply in food security and integrity, by subscribing to CSA enterprises and directly sharing in the risks and rewards of farming. Opportunities are also opening up for collaboration across supply chains, with the development of on-farm and regional processing, and food hubs to aggregate sales.

"It's best-practice agriculture and should be the way it's done everywhere."

A pioneer of collective distribution is Food Connect, a social enterprise that began in Brisbane and recently expanded into Sydney, Melbourne and Adelaide. It pays ecological farmers about four times what they could earn from supermarkets and distributes their produce in boxes through a 'City Cousins' network. Founder Robert Pekin, a dairy farmer who was forced off his farm in the late 1990s, says the massive power of Australia's supermarket duopoly and their 'down, down' pricing philosophy has made it difficult for smaller farmers to compete.

"But, increasingly, [farmers] are being encouraged to be better than organic and much more holistic in their practices, to connect with each other, their customers and their community," Robert says. "Our system has built solidarity, given them ways to share, and given them hope."

AT 82 YEARS of age, Bob Davie can hardly be described as a 'new breed' of farmer. But the vast experience and knowledge this Phillip Island producer has amassed during more than 65 years raising cattle has led to some of the most progressive practices you can get. "We have always enjoyed a challenge and have tried to lead by example," Bob says. "Fifty years ago we built one of the first herringbone dairies in Victoria and we've always tried to do everything as best we can for the environment. It's best-practice agriculture and should be the way it's done everywhere."

PHOTO CREDITS, PREVIOUS PAGE: RALPH ALPHONSO; THIS PAGE: RUSSELL SHAKESPEARE

▼**Just outside** Daylesford, VIC, Tammi Jonas works in her farm's meatworks, which was financed by crowdfunding and supplies pork to members of a Community Supported Agriculture enterprise.

▲ **One of Bob Davie's** prized bulls moves in for a gentle pat at the carbon-neutral Bimbadeen, where Bob's Gippsland Natural Beef is raised according to stringent environmental standards.

In 2001 Bob and his wife, Anne, joined the producer-owned cooperative Gippsland Natural Beef to sell grass-fed meat direct to butchers, restaurants, homes and workplaces. All 35 Gippsland Natural suppliers abide by the environmental management system ISO14001 and sell their meat under the Enviromeat brand. The system monitors impacts of their farming (including animal welfare, pasture management and water use), and the standards that must be met for Meat Standards Australia grading.

Bob and Anne have taken things even further. Their farm Bimbadeen was declared carbon neutral in July 2014 and the couple now hopes to make history by becoming the first farmers in Australia to derive an income from carbon sequestration. They have begun negotiations for trading on the voluntary scheme (offsetting greenhouse gas emissions of Melbourne clients of Gippsland Natural) and are almost ready to begin exporting their carbon-neutral product. "Bimbadeen has proven the carbon sequestration methods, increasing total organic carbon (TOC) from 160 to 220 tonnes in a trial paddock, and sound management has improved the TOC levels in other paddocks across our property," Bob says. "Farmers have the ability to dramatically increase soil carbon in Gippsland; it's sitting under the ground like a bank, earning interest as it builds. Australian farmers have an opportunity to be on the front foot to mitigate the impacts of climate change and these actions will be viewed positively by consumers, particularly younger generations. It's a win for producers and the environment."

As well as organic and biodynamic certification, some of our most progressive food producers are moving to peer-review testing of their environmental performance or banding together for third-party accreditation. Outside Warwick, in Queensland, grass-fed beef producers Helen and Ian Lewis have been conducting their own biological monitoring for the past five years at Picots Farm and are now looking to formalise that process.

Internationally certified Holistic Management educator Helen says using holistic-planned grazing (where animals are moved around to regenerate pastures) has boosted carbon levels to 4 per cent – a great base for food production and increasing plant diversity. She believes the take-up of such landscape stewardship is growing in livestock production. "It's slowly becoming mainstream, as many people are starting to adopt a version of planned grazing, and our national grazing bodies are starting to see how important it is for maintaining groundcover," she says. Farmers adopting more regenerative practices are motivated by improving the land, as well as food quality and provenance for customers. "People want to be proud of what they produce and many farmers want to know their customers," Helen says. "People who can verify they are producing naturally invite people to visit their farm. It's an open gate.

"You feel good that you are producing food, the healthiest food you can."

"For us, holistic management is a decision-making process that ensures social, financial and environmental outcomes. You feel good that you are producing food, the healthiest food you can. Our techniques address the root causes of environmental damage and that represents a massive saving for us in inputs. It also means we can forward plan and have cash flow. It allows producers, people and businesses to be green but in the black."

When it comes to food miles, Melshell Oysters is hard to beat. "It's about 100m," Cassie Melrose says. "You can't get fresher." It was a gamble, two years ago, when Cassie and her husband, Ian, an oyster farmer of 35 years, spruced up a vintage caravan for selling their family's oysters direct to the public from their Dolphin Sands lease, 15km from Swansea, Tasmania. They had successful wholesale markets in Melbourne, Sydney, and as far north as Cairns, but their growing family needed a different business model. ▶

PHOTO CREDITS: THIS PAGE: RALPH ALPHONSO; OPPOSITE: MATTHEW NEWTON

Plump Melshell oysters are plucked straight from the nearby Swan River for people who stop to buy them at the Melrose family's quirky retail outlet in TAS.

▼ **Relishing contact** with their customers, the friendly faces of Cassie and Ian Melrose, of Melshell Oysters, are regularly seen at the farm gate shop where they sell directly to the public just metres from their lease.

"It's about providing people with a memory, and we want the experience to sparkle for them."

"I thought we would be lucky to get five customers a day, and it was slow going at first, but it's just got bigger and bigger," Cassie says. Now they daily get 30 cars and sell 40 dozen oysters. To shuck and slurp down fresh oysters metres from where they were grown, in the Swan River, is part of the appeal, but something more keeps customers returning. "It's easy to sell a good product, but people really seem to enjoy the interaction with us," Cassie says. "It's very intimate and they want to hear the story of how the oysters are grown and see where they are produced."

The Melroses are thrilled to be keeping some Tassie produce on the island for visitors to enjoy. "When we were selling into the wholesale market, our oysters were a commodity," Cassie says. "We had no connection with the people who ate them. Now, Melshell Oysters are a brand and have a reputation, to the point where we have to limit the number of restaurants we supply, to guarantee enough for the van. It's about providing people with a memory, and we want the experience to sparkle for them. It's a lot of fun meeting people and the feedback has been amazing: it makes you stand a little taller."

To reduce food miles and guarantee ethical production, some Australian farmers are now doing their own on-site processing. To finance their Victorian farm butcher shop, the Jonas family, who butcher, cook and cure pork and beef grown on their Jonai Farms pastures outside Daylesford, turned to crowdfunding. In 2013, 166 people pledged almost $30,000 for 'ethical pork rewards' and became their first CSA members. A second crowdfunding appeal, to add a commercial curing room for making charcuterie, was equally successful. "Other producers are now using crowdfunding to finance major infrastructure and it makes perfect sense," Tammi says. "When we're not using our boning room, our neighbouring duck producers use it. We're seeing more livestock farmers sharing resources, storage and distribution outlets in this way, like we've seen in market gardening." Under the CSA model, people buy shares in a farm's projected harvest in advance and receive regular deliveries during the season. It gives the farmer economic security, guaranteed sales and cost savings. The consumer enjoys access to seasonal food aligned with their personal values – the Jonases, for example, allow their pigs to free-range in family groups and slaughter them humanely. It has proven so successful that the family has closed membership at 80 and has a 20-year waiting list.

"A CSA takes traceability to a new level,' Tammi says. "When people joined our CSA we became their farmers and the farm became their farm, and they use that language. We have a CSA open day coming up, where we will get together, do some cooking and share our profit-loss statements. It's not achievable everywhere, but it's the absolute epitome of fair food – a solidarity economy with no middle people, characterised by incredible transparency, communication and trust. And you're not seeking to grow beyond the land's capacity, just enough to supply your members."

But the economic viability of small-scale production remains a challenge for many. Fraser Bayley, who with his partner, Kirsti Wilkinson, grows vegetables on 2.5ha at their Old Mill Road BioFarm in Moruya, says margins are tight. Sharing resources and marketing helps. They collaborate with other producers to deliver boxed vegetables to residential customers and direct to restaurants and cafes, and are working to establish a food hub for the Canberra region. "As volume increases, we may have to look at a cooperative structure," Fraser says. "But you will only enjoy this lifestyle if it pays the bills. You need to be of sufficient scale but not too big; it's a question of finding the sweet spot."

For Katie and Hugh Finlay, of Mt Alexander Fruit Gardens in Harcourt, Victoria, that quest has seen them form an alliance of certified organic producers. In an Australian first, they are about to lease their orchard to a young farmer, whom they will mentor, and open up the rest of their 25ha property for the establishment of a micro-dairy, market garden and heritage fruit-tree nursery. "It is both a growth plan and a succession plan for our farm," says Katie of the alliance, which will give the couple more time to devote to their online education and training business. "If we can get the model to work, we think it will help to connect landless farmers with retiring farmers without a succession plan."

PRODUCTION OF Oak and Swan Sourdough in South Gippsland, Victoria, is a virtuous loop. Betsy and Greg Evans source wheat, spelt and rye from organic and biodynamic growers. Greg mills the flour and Betsy makes the loaves (all organic) by hand and bakes them in their wood-fired bakery. Their energy costs are low – wood fuel is collected on the property and some remaining power needs are met by solar.

"Eventually we would like to get off the grid," says Betsy, who learnt baking from her mother and grandmother. "Bread never used to take that much energy to produce; it was a communal thing and we don't want those traditional skills to be lost. We support the growers who take the extra time and care

PHOTO CREDIT: MATTHEW NEWTON

At Oak and Swan Sourdough, in South Gippsland, Betsy Evans feeds her wood-fired oven with loaves made according to time-honoured traditions.

PHOTO CREDIT: RALPH ALPHONSO

to avoid the use of chemicals, and we favour the heritage grains, which have more flavour and are more nutritious. People often say to me that our bread reminds them of bread they used to get in Europe 30 years ago."

The Evanses would one day like to grow grain themselves, but for now are busy enough baking 300 loaves a week for sale through farmers' markets, a food hub and health food shops. They might consider community shared baking, where customers order and pay for loaves in advance. "I can also see us opening to the public one or two days a week, for workshops and so people can buy bread fresh from the oven," Betsy says. "There is much more awareness around eating today and meeting those who eat our bread is very rewarding. You feel like you have another family out there and get to know them and their kids, who are learning that bread isn't all square and white."

FRASER BAYLEY WAS new to farming a decade ago and has seen a profound change in attitudes to it in that time. "People are now wanting to farm and proving they can do it differently and create a demand for a different kind of product," he says. "The cost of land and the investment required to become a mid-size farmer is beyond most people these days. But smaller, local production is a way it can be done – on a scale that allows stewardship of the land and access to good-quality food."

In 2013 the United Nations Conference on Trade and Development advocated a shift towards "mosaics of sustainable, regenerative production systems that also considerably improve the productivity of small-scale farmers". In reporting on food security in a changing climate, it recommended we see farmers not only as producers of agricultural goods, but as managers of agro-ecological systems that provide public goods and services, such as water, soil, energy and biodiversity.

While he continues to support the large-scale food revolution, Fraser believes action can be most effective at the local or regional level. "There's a view that 'peasant farming' won't feed the world, but I think in time we will be able to," he says. "In the meantime, we can feed our communities. To see people turning farms around and making them profitable, and the environment being repaired while they are making a living, is a wonderful legacy."

While Katie Finlay concedes that the percentage of food sold through farmers' markets and even food hubs such as Food Connect is still a drop in the ocean, she says that means there is plenty of room for growth. "The consumption of organic food is growing at about 7 per cent per annum globally," she says. "The tide hasn't turned yet, but consumers are becoming aware of the true cost of food production – financially and environmentally. Organic food isn't more expensive because it's trendy. It's more expensive because that's how much it costs to produce it, and organic farmers still mostly bear that cost themselves."

In an age when we are more technologically connected yet more socially disconnected than ever before, the sustainable farming movement is uniting people over the dinner table. "People are craving connection and simplicity, and we are starting to eat more thoughtfully," says Stuart Whitelaw, who sees SAGE establishing a demonstration agricultural or research college for sustainable food production. "The more you learn, the more you seek out different sorts of foods, and eventually, hopefully, you will find your way to a farmer." AG

The fruit of the land

With roots that stretch deep into the earth – and into our cultural history – the vines our winemakers grow are as important as family, community and tradition to Australia's wildly successful wine industry.

STORY BY **HANNAH JAMES**
PHOTOGRAPHY BY **RANDY LARCOMBE**

THE MIGHTY AUSTRALIAN wine industry began at a set of traffic lights. "In 1788 the first vines were planted somewhere near the old Government House, what's now the Museum of Sydney," says Dale Dixon, curator manager of the Royal Botanic Garden Sydney. It's impossible to pinpoint, but the spot can't have been far from this busy intersection choked with buses, tourists and suit-clad workers.

This urban setting seems an unlikely birthplace for what has become a world-conquering viticultural behemoth. The Australian wine industry now contributes more than $40 billion annually to the economy. But it started humbly, with a few vines brought from Brazil and the Cape of Good Hope, in South Africa, by governor Arthur Phillip and optimistically planted in Sydney Cove's sandy soil.

Phillip was the first champion of Australia's wine industry. When he planted those vines at Sydney Cove, he hoped Australian viticulture would become a thriving export industry, and that locally produced wines would "become an indispensable part of the luxury of European tables". According to Nicholas Faith, author of *Australia's Liquid Gold* (2002), Phillip predicted that "in a climate so favourable the cultivation of the vines may doubtless be carried to any degree of perfection".

Bubbles of carbon dioxide, released during the fermentation process, rise up as David Lehmann, of David Franz winery in the Barossa Valley, SA, runs his hands through a bin of shiraz grapes.

PERFECTION IS A LOFTY goal. One place where winegrowers come close to achieving it is South Australia, where the roots of our wine industry literally lie. "Wine is all about geography…about climate and soil," says Jonathan Bitter of Langmeil winery, in the Barossa Valley. In the Barossa, about 60km north-east of Adelaide, that alchemical combination of earth and weather produces extraordinary results.

During the 19th century, SA – Australia's biggest wine-producing state – welcomed exiles from Silesia, part of eastern Europe that is now located mostly in Poland but was then part of Prussia. Many of these migrants re-created what they'd left behind: mixed-use farms with crops, cattle, dairy, fruit and vines. The vines flourished and winemaking soon became a commercial enterprise.

Langmeil is one such winery. It dates back to 1842, when Christian Auricht, a Silesian blacksmith, bought the land for his family. In 1843 he planted shiraz vines, and astonishingly 1.4ha of them still survive. The vines are gnarled and twisted, with roots that reach deep into the earth. "Anyone who's keeping old vines is keeping them because of their quality," says Jonathan. "They're resilient after 175 years of dealing with everything Mother Nature can throw at them. They've got deep tap roots searching for water, so they're drawing on a different soil profile from younger vines." Despite their longevity, old vines are fragile, needing to be worked by hand. "A machine harvester or pruner would smash them to pieces," Jonathan says, explaining it's a time-consuming labour of love. "But nothing of value comes easily."

ALTHOUGH EUROPE is home to centuries-old winemaking traditions, these venerable, valuable vines in the Barossa are some of the oldest, not only in Australia, but in the world. During the 19th and 20th centuries, European vineyards were devastated by grape phylloxera, a tiny insect that destroys grapevines and for which the only cure is to pull up affected vines and replant with new vines, grafting the desired varietal onto immune rootstock. Phylloxera soon made its way to Australia, but the Barossa – unlike the similarly historic Yarra Valley wine region in Victoria – was spared its depredations due to its hotter climate and sandier soil, as well as strict quarantine regulations.

Jonathan Bitter conducts a tasting in Langmeil's Freedom Cellar, once the cobbler's shop when Langmeil village was home to 12 Silesian migrant families in the 19th century.

"The absence of phylloxera means…we have more 100-plus-year-old vines in the Barossa than anywhere else in the world," Jonathan says. "It's a time capsule."

When those vines were planted, Barossa life was very different from today. With Adelaide three days away by horse, Jonathan says, "If you wanted something, you made it, grew it or learnt to live without." That mindset survives: self-sufficiency mixed with neighbourliness means growers and winemakers band together to celebrate the good times and survive the bad. "We've been doing this for 175 years. The styles of wine may have changed, but the community is the same," Jonathan says.

Community is what another of Australia's oldest wineries, 1851-founded Seppeltsfield, was built on. "Its original concept was a working village," says Chad Elson, whose family history at Seppeltsfield stretches back generations. (His unfortunate great-great-grandfather died after an accident while delivering grapes to the winery.) "It always had a community focus." The village feel is still evident today. Leatherworkers, knife-makers, ceramicists and artists occupy the old stables, and three leather-aproned coopers handcraft port and whisky barrels.

Such threads of family and community course through the veins of another Barossa winemaker, David Lehmann, who owns the David Franz winery and whose father was renowned wine producer Peter Lehmann. As a winemaker/manager at Saltram, another long-standing Barossa estate, Peter refused

PHOTO CREDIT: COURTESY LANGMEIL WINERY

A history of wine

Hard at work in the barrel shed, Adam 'Nuggy' McLean, a cellar hand at Langmeil, checks wine levels.

"I let the circle of life do its thing," David Lehmann says as he inspects his almost-ripe cabernet grapes. "You've got to respect nature."

In 2000 when Marco Cirillo took over his father's winery in the Barossa, "People said I was mad for making my soft, savoury, Old World grenache," he says. "But I've got that southern Italian stubbornness. And now everyone is coming this way."

He works by hand 5500 grenache vines planted in 1848, thought to be the world's oldest continually producing grenache vines.

during the 1978 grape glut to comply with his bosses' instructions to renege on agreements to buy grapes from growers. He bought the grapes himself, cementing not only his relationships with growers, but also his nascent business – and his legend.

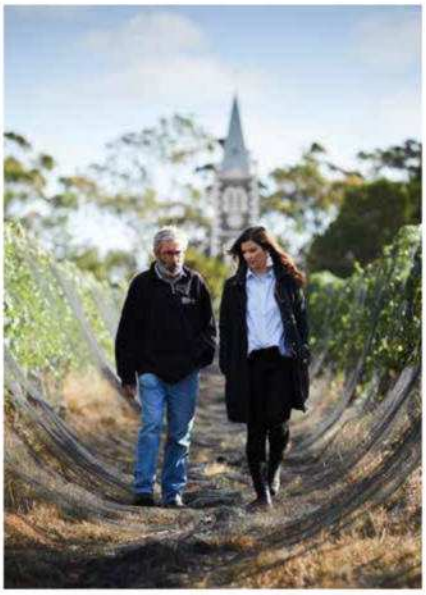
David's winemaking passion is clear as he pours me taste after taste. "This 2015 semillon is made from 135-year-old vines. It's soft, honeyed. Now try the 2017…taste the lemon cordial? It's sharper, a bit acidic – after another year in the bottle it'll be more generous," he says. "If you cut me, I'll bleed semillon."

Soon his mother, Margaret Lehmann, drops by and sweeps me off to sit at her huge kitchen table where I sip chilled riesling, eat homemade cheese biscuits and soak up her decades of wine knowhow. Her house, stocked with mementoes and bookshelves, tells of a life – and a mind – well furnished with experience and knowledge. Her decades in the wine industry allow her to take a long view, as she provides me with a concise history.

"Settlers weren't granted land here, so they had to work for it and they expected it to be productive from the outset," she says. "Immigrants to the Barossa were shrewd and hardworking peasants who became entrepreneurs. They grew what would feed their families. And they could sell wine – at first to Britain, which preferred fortified wine, so that's what they grew. Then there were the waves of post-war migration, which brought a marvellous cultural infusion and a new approach."

One family of such immigrants was that of Marco Cirillo, whose parents both came from Calabria, in southern Italy, but met and married in Adelaide. He has the down-to-earth attitude Margaret Lehmann praises. "We're farmers who make wine. It's not rocket science," he says. "If I don't get it right in the vineyard, I can't get it right in the winery."

His family, like the Silesian immigrants, have always made their own wines. His parents bought the land that makes Cirillo Estate Wines in the late '60s, Marco says. "We knew there were old vines here, but we didn't know how old." He knows now: since taking over from his father in 2000, he works by hand 5500 grenache vines planted in 1848, thought to be the world's oldest continually producing grenache vines. "A lot of old vines were pulled up during the vine pull because they don't produce as much fruit as new vines and they're hard to work with," Marco says. "But old vines aren't good because they're old, they're old because they're good." It all began with family, and Marco hopes it will continue that way: "Hopefully, one of my daughters or nieces or nephews will take it over. We've built this for life, and for the next generation."



With Gnadenberg church rising behind them, Stephen Henschke and his daughter Justine walk in the Hill of Grace vineyard, where some vines date back to 1860.

THAT PASSING-DOWN through generations is exactly what's happened at Henschke. "We grew up working vintages – working on the cellar door, bottling, picking grapes," says Justine Henschke, a sixth-generation member of her winemaking family. Like the Aurichts and the Lehmanns, the Henschkes were Silesian exiles. They arrived in Adelaide in 1841 and soon made their way to the Barossa. "They were the perfect people to populate this area," Justine says. "They were practical German peasants."

During my visit, workers are pressing pinot gris grapes from the Adelaide Hills, before soon moving on to their Eden Valley whites, then reds. "All the grapes we use are processed here," Justine says. "We have absolute control over everything, [from] grape-growing to bottling and sales." That close eye for detail

1838 VIC: The Ryrie brothers planted Victoria's first vineyard at Yering Station, Yarra Valley

1844 SA: Dr Christopher Rawson Penfold bought Magill Estate and planted grenache

1873 Australian wines won 12 medals at the Vienna Exhibition

1877 VIC: Phylloxera arrived, damaging vineyards for a century

1925 Imperial Preference introduced, boosting Empire countries' exports to the UK

While the Henschkes have a practical focus on the future, their past is ever-present.

▲ **Winemaker Sandra de Pury** and her father, Guill, who restarted the family winery at Yeringberg, VIC, stand inside the old winery, which was built in 1865 and is packed with relics of past vintages.

pays off. "It's our 150th anniversary this year – our first commercial vintage was in 1868."

Justine's father, Stephen, took over winemaking from his father in 1979, and her mother, Prue, is a viticulturalist who focuses on sustainability and biodynamic principles. "She wants to tread as lightly on the land as possible," Justine explains. While the Henschkes have a practical focus on the future, their past is ever-present. The stone cottage Justine's parents live in was built in the 1860s by those original Henschke immigrants, whose son Julius, a sculptor and stonemason, carved practice inscriptions that can still be seen on a wall by the holding cellar.

Justine shows me a little room that's now used for tastings. "It used to be a milk cellar," she says. "Dad remembers churning milk into butter here." The oldest vines endure, too. In 1860 a pretty little Lutheran church called Gnadenberg was built on what's now the Henschke estate and in the same year the first vines were planted on the now-famous Hill of Grace vineyard nearby. Justine's grandfather Cyril made the first Hill of Grace shiraz in 1958 and immediately, Justine says, "It stormed the wine-show circuit and put Henschke on the map."

The 158-year-old vines are still going strong. And so are the Henschkes, the family's roots reaching as deep as the vines in the rich Barossa soil. "The business is ingrained in us," Justine says of herself and her two brothers, Andreas and Johann. "We take the long view across the generations – what our forebears planned, we carry out."

THE SAME CAN be said of Sandra de Pury, the winemaker at Yeringberg, her family's winery in the Yarra Valley, Victoria. Sandra's father, Guill, tells me how his grandfather Baron Guillaume de Pury bought land here in 1863. The winery at Yeringberg was built between 1865 and 1885, and Guill shows me around the wooden building, in whose beams you can see the cuts of the broadaxe. It has museum pieces in every corner, from a bench of coopers' tools to a tall black buggy in which his grandmother would make the four-hour drive to Melbourne. "They'd change horses in Ringwood," he says.

Up a wooden ladder, on a catwalk in the rafters, lies an extraordinary steam railway. It once carted the grapes from the top tank down to the fermenters and is complete with points and a wooden truck. On the wall a record is still chalked of the March 1900 vintage. Just 21 years after that vintage, though, the steam engines shuddered to a stop and the coopers laid down their tools. The Yarra wine industry had plunged into a downturn, due to changing public tastes and then the Great Depression. For a full half-century, the dust grew thick in the winery until Guill, who hadn't even been born when his father stopped making wine, took things into his own hands.

"In 1969 there were five or six of us who thought it might be interesting to restart the Yarra Valley wine industry," he says with a twinkle. Already farming sheep and cattle on the 500ha property, he planted vines and began making wine again, in what he calls "an overgrown historical hobby". It was a hobby that soon resulted in medals. When his children, winemaker Sandra and her viticulturalist brother David, started working there, Yeringberg became a commercial proposition. It's still tiny, however, producing just 20,000 bottles a year in a hands-on, low-tech fashion I get to experience. With Sandra's friends and neighbours, I sort grapes still cool and dewy from the vineyard as they're sent trundling down a short conveyor belt to the crusher.

PHOTO CREDIT: COURTESY SANDRA DE PURY

The Hill of Grace vines, the jewels in Henschke's crown, are so ancient and delicate they must be worked by hand to produce their precious wine.

The fact we're labouring in the cellar where Sandra's family first started winemaking 155 years ago causes a frisson. "It's there – the magic," Sandra confirms. "The stone this cellar is built from was quarried here – the same stone that makes up the earth the vines grow in." Everything is rooted right here – the grapes, the building materials, the family – and that sense of belonging that brought Sandra and her family back home from her globetrotting chef's career has only grown stronger. "We're just custodians here for the next generation," she says.

THE PERFECTION governor Phillip sought, like all good things, takes time. Before Australian wine achieved its current global pre-eminence, it had to rise above phylloxera, the changing tastes of domestic and export markets and periodic gluts that prompted the government to pay growers to pull up vines as recently as the 1980s. Tastes still change, gluts occasionally still occur, and phylloxera continues to loom.

"No-one's ever stopped it. I'm just assuming we'll get it," Sandra says. But she's not nursing ancient vines like some Barossa vineyards, so the prospect, although difficult, isn't disastrous. She's planning a new vineyard of immune rootstock, as insurance if the old ones get phylloxera.

But the wine industry is facing a new problem. The meticulous records all winemakers keep already display the effects of climate change. Every winemaker I spoke to for this story is actively making changes to future-proof their business against hotter, drier summers and more unpredictable weather.

"Climate change is happening," says Langmeil's Jonathan Bitter. "Everything's happening earlier in vintages. There's a six-week difference in harvest times." It's not only evident in harvest times, but also in the varietals that flourish now, he adds. "Eden Valley has always been known for its whites [which grow better in cooler climates], but now red is in the ascendant." That's borne out by the data: Wine Australia recorded a 15 per cent rise in red-wine production and a 5 per cent decline in white-wine production from 2016 to 2017.

"Our climate is changing," Marco Cirillo agrees. Fortunately, he already grows heat-loving Mediterranean varieties. "My grenache and mataro will fight on."

DESPITE THE CHALLENGES, the future is looking bright. In the Barossa, David Lehmann bubbles with enthusiasm both for his own wines, and for the future of the industry: "I have new ideas every vintage, playing with how we work the fruit, how to evolve texture, retain the aromatics," he says.

For David, the future is in young people. "Younger drinkers are keen to explore wine – it's partly the internet, they've got

Phylloxera has attacked these vines, yellowing their leaves. The insects eat the roots and leaves of the vines, infecting them with a poison that eventually kills them. The only response is to destroy the vines.

exposure to stuff they otherwise wouldn't know about. Plus wines are so accessible now," he says. "There's never been a better time to be a winemaker and try whatever you want. Dad passed down to me the idea of making what you love – then if it doesn't sell, you can enjoy it yourself!"

His mother, Margaret, agrees: "It's a great time. I see the rise of the smaller makers, and the cafe and bar and restaurant culture and their emphasis on interesting wine lists. The economic engine for regions is very likely to be food and wine these days."

Marco Cirillo says he has three reasons to be optimistic. "Those foodie TV shows make people think about food and wine pairing," he says. "People travel, too, then they come home and want to drink what they had overseas. Finally, immigration has changed Australia as well – that foodie culture wasn't there even 15 years ago. The Italian food I got laughed at for taking to school, now people want to eat it. All that means the wine industry's in a great place."

He's right: Australian wine contributes more every year to our national economy. And it's a uniquely local product that's hard to uproot or replicate.

"The importance of wine is its connection to nature," says Jonathan Bitter of Langmeil. "We take a crop that's in abundance and preserve it for future consumption. We're taking the season and characteristics of a time and a place, and capturing them in a bottle. In the depths of winter, that bottle of wine is the ghost of summers past."

I taste those summers in Seppeltsfield's Centennial Cellar. Every February, a 100-year-old tawny port is released from this unique cellar that has a barrel dating from every year since Benno Seppelt first conceived the notion in 1878.

The 1918 Para Tawny flows like nectar over my tongue, intensely rich and complex and heavy with history. In my tasting glass is the legacy of a visionary winemaker who knew it can take a century – or more – to achieve perfection.

I silently raise that glass to Arthur Phillip, to Benno Seppelt, to all the winemakers past, present and future who create liquid gold from nothing more than soil, weather and the passage of time. AG

12 months in Australia's export market

Here's how our wine exports grew (and grew) from 2016 to 2017

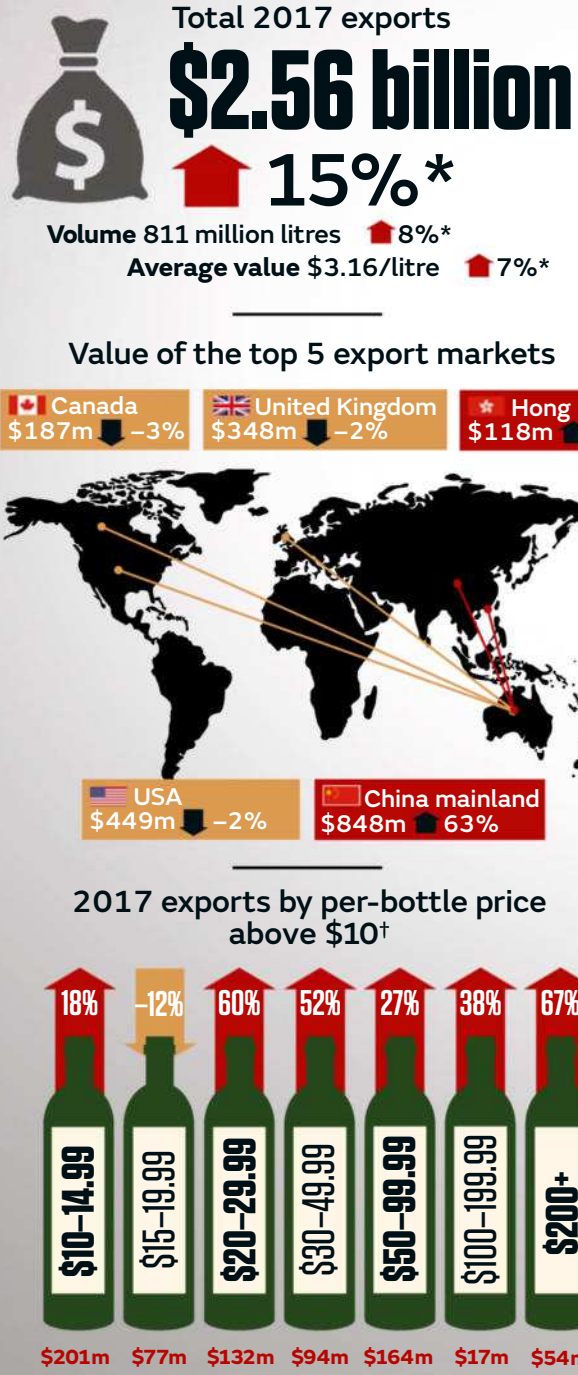


PHOTO CREDITS, CLOCKWISE FROM TOP LEFT: FEDERICO ROSTAGNO/SHUTTERSTOCK; SHUTTERSTOCK; TETIANA YURCHENKO/SHUTTERSTOCK. INFOGRAPHIC SOURCE: WINE AUSTRALIA. *ON PREVIOUS YEAR. †PER-BOTTLE PRICE IS FREE-ON-BOARD VALUE (VALUE AT THE POINT WHERE GOODS ARE PLACED ON BOARD THE INTERNATIONAL CARRIER)

Australia's 64 wine regions

Australia's total vineyard area is about **1350** ha, with **100** grape varieties planted

Western Australia

1 Swan District
2 Perth Hills
3 Peel
4 Geographe
5 Margaret River
6 Blackwood Valley
7 Pemberton
8 Manjimup
9 Great Southern

South Australia

10 Southern Flinders Ranges
11 Clare Valley
12 Adelaide Plains
13 Barossa Valley
14 Eden Valley
15 Riverland
16 Adelaide Hills
17 McLaren Vale
18 Kangaroo Island
19 Southern Fleurieu
20 Currency Creek
21 Langhorne Creek
22 Mount Benson
23 Robe
24 Padthaway
25 Wrattonbully
26 Coonawarra
27 Mount Gambier

Victoria

28 Henty
29 Grampians
30 Pyrenees
31 Bendigo
32 Heathcote
33 Macedon Ranges
34 Sunbury
35 Geelong
36 Mornington Peninsula
37 Yarra Valley
38 Upper Goulburn
39 Strathbogie Ranges
40 Goulburn Valley
41 Glenrowan
42 King Valley
43 Alpine Valleys
44 Beechworth
45 Rutherglen
46 Swan Hill
47 Murray-Darling

New South Wales

48 Perricoota
49 Riverina
50 Gundagai
51 Tumbarumba
52 Canberra District
53 Shoalhaven Coast
54 Southern Highlands
55 Hilltops
56 Cowra
57 Orange
58 Mudgee
59 Hunter
60 Hastings River
61 New England

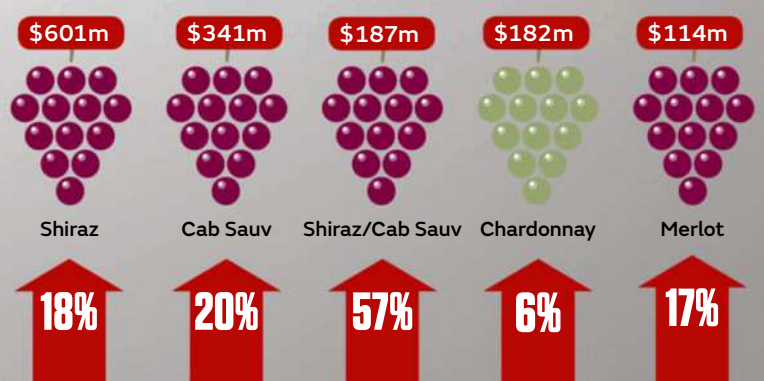
Queensland

62 Granite Belt
63 South Burnett

Tasmania

64 Tasmania

Top 5 exported varieties by label claim



Follow the flow

Loved by anglers and whitewater rafters, the Mitta Mitta River wends from its headwaters in Victoria's High Country down to join the Murray River through magnificent native forest and a lush farming valley.

STORY BY **JEREMY BOURKE** PHOTOGRAPHY BY **DON FUCHS**

Even at its source in the Cobungra Gap, below Mt Hotham, VIC, the Mitta Mitta's main tributary, the Cobungra River, is already a major force.

Snow, which here surrounds Derrick Hut near Mt Hotham, is much of the Mitta Mitta's 'raw material'. Last year it fell right up to the end of spring.

THE RANGE THAT holds Victoria's highest mountains has been described as a giant sponge. Forming the southern end of the Australian Alps, it absorbs the area's high rain and snowfall and releases it slowly through countless pores to form the soaks, streams, creeks and ultimately the rivers that feed into the catchment of the continent's largest river system, the Murray-Darling Basin.

It's late October, -2°C, overnight snow has carpeted the range and the morning sun is high as we stand in the lee of Mt Hotham. Below are the elusive headwaters of the tributaries of the Mitta Mitta, itself one of the great tributaries of the mighty Murray River. Protected as a 'heritage river' in its upper reaches, the Mitta Mitta is a major player in the ecology, history and economy of this high corner of Victoria.

Along its 204km course, it slices through terrain so rugged there's only trace evidence of human habitation – either past or present – associated with the river until it emerges into a picturesque farming valley. Modern engineering has tamed this wild force of nature into a significant provider of water for the Murray-Darling Basin, which serves more than 16 per cent of Australia's population.

The Mitta Mitta's importance is hard to appreciate, at first, when you're on wooded slopes remote from any permanent settlement other than the ski village above. Photographer Don Fuchs and I are seeking the start of the Mitta Mitta's most significant tributary, the Cobungra River. Our route lies along the Australian Alps Walking Track, but the weather forces us to rely on orange snow pole markers for guidance.

As we descend, the ground becomes sludgy, then pools appear from which a stream trickles. This, we reason, must be the beginning of Swindlers Creek, one of dozens of little watercourses that feed the Cobungra.

We finally enter the treeline and just before the shelter known as Derrick Hut pass through a copse of snow gums believed to be up to 400 years old. This eventually gives way to wattle, its yellow blooms acknowledging the spring, and we descend into Cobungra Gap to just below the Cobungra River's official starting point. Its roaring flow can be heard well up the hill.

▶ **Looking down into** the Cobungra River's valley, the scars of a bushfire in February 2013 are still starkly evident.

▼ **The alpine marsh-marigold** is a tiny perennial that usually flowers only at the edge of receding snowdrifts.

SCIENTIFIC NAME: *Caltha introloba*

Rivers of gold

We could have chosen any of the Mitta Mitta's feeder sites to begin this river's story, but Hotham incorporates the human element. Local historian and archaeologist Andrew Swift attributes this area's development to rivers of gold, not water.

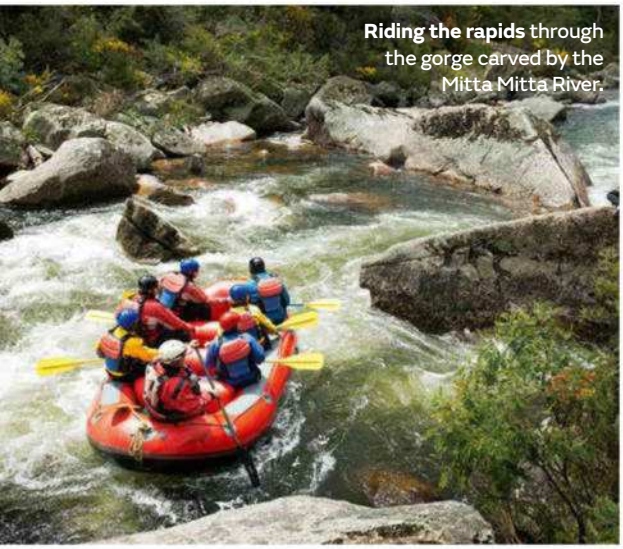
"Its geology is basically sedimentary rocks overlaid with basalt, and gold deposits from ancient river streams eroded into it [the Cobungra] over time," he says.

Andrew has extensively researched the area's diggings, particularly at Brandy Creek, found via a track off Continued page 81

▲ **The Mitta Mitta**, according to some experts, becomes its own river near Anglers Rest, where the Bundara, Big and Cobungra rivers merge.

◀ **Located near** Anglers Rest, the historic Blue Duck Inn, which incorporates a former butcher shop built in 1900, is a traditional country pub used by trout fishers, skiers, bushwalkers and kayakers.

Mitta Mitta FACTS & FIGURES



Riding the rapids through the gorge carved by the Mitta Mitta River.

River length: **204km**

Starting point: Anglers Rest (confluence of Big and Cobungra rivers)

Mouth: Murray River at Lake Hume

Catchment area: **0.9 per cent** of the Murray-Darling Basin

Contribution to basin water: 10 per cent of Murray inflow

Annual stream flow: **900GL** (into Dartmouth Dam)

Major tributaries: Big, Bundara and Cobungra rivers, Snowy, Little Snowy and Livingstone creeks

Major communities: Dartmouth, Eskdale, Mitta Mitta

Major water storage: Dartmouth (3856GL). It has the highest dam wall (180m) in Australia. It has the capacity to hold up to 40 per cent of the water for the Murray River system.

Key water users: Urban water supply, stock and domestic, irrigation

SOURCE: NORTH EAST CATCHMENT MANAGEMENT AUTHORITY

Mitta Mitta's water source

Alluvial aquifers, especially in its lower reaches and on the floodplain, supply the Mitta Mitta. Most upland streams receive flow from fractured rock aquifers. From this high alpine environment, the Mitta Mitta descends into wet eucalyptus forest before opening out into pasture once it passes through the gorge.

Mitta Mitta's geology

The tributary mountain streams flow from a tableland that was uplifted by numerous geological events. At one time it was considerably higher but it has been lowered by erosion, sometimes by glacial action.

About 70 per cent of the area is slates and schists, derived from the massive sediment accumulation in the Palaeozoic basin. The remaining 30 per cent of the now exposed area of Palaeozoic rock is granite.

There are scattered cappings of grey basalt, residuals of great lava flows some 340 million years ago.

Where to stay

On the tributary rivers' upper reaches, there are facilities year-round at Dinner Plain (*visitdinnerplain.com*) and Mt Hotham (*mthotham.com.au*) and, outside of winter, the Blue Duck Inn at Anglers Rest (*blueduckinn.com.au*). On the Mitta Mitta's lower reaches, try Mitta Mitta (*mitta.com.au*) or Dartmouth (*dartmouthmotorinn.com.au*).

Go to *victoriashighcountry.com.au* for more visitor information. Contact *raftingaustralia.com* to experience the river through the gorge.

More information

North East Catchment Management Authority: *necma.vic.gov.au*
Murray-Darling Basin Authority: *mdba.gov.au*
Parks Victoria: *parkweb.vic.gov.au*

CARTOGRAPHY ROGER SMITH

▲ **Writer Jeremy Bourke** returns to Mt Hotham after hiking to the Cobungra River source near Dibbins Hut.

◀ **As it approaches** Lake Hume, the lower Mitta Mitta winds through a green valley awash with billabongs.

< Murray River
New South Wales
Victoria
bury
Murray River
Lake Hume
C547
B400
B400
B400
C543
Floodplains
C537
C531
Approximate scale
0
5
10
15 km
N
TO WATCH Don Fuchs' video of the stunning MItta Mitta River as it flows from Victoria's High Country to below Lake Hume, go to: australiangeographic.com.au/issue144
NSW
VICTORIA
enlarged
< Mitta Mitta River
Eskdale
Little Snowy Ck >
Dartmouth
Dartmouth Dam
Mitta Mitta
Lake Banimboola
< Snowy Ck
Lake Dartmouth
C531
C543
B500
OMEO HWY
C531
Big River >
Falls Creek
Mitta Mitta River >
Mitta Mitta valley
Cobungra Gap
Mt Hotham
Bundara River >
Mitta Mitta gorge
GREAT ALPINE RD
B500
Cobungra River >
Dinner Plain
Anglers Rest
Start of Mitta Mitta River
C543
Livingstone Ck >
C545
Omeo

▲ **As the Mitta Mitta** flows south, it incorporates a series of rapids with such evocative names as Graveyard, Dislocation, and Bump and Grind. It's a whitewater rafter's paradise.

▶ **On the Cobungra** River below Victoria Falls, remnants of a hydro station used to power the Cassilis Gold Mine 100 years ago are testament to the resource behind the area's development.

▲ **Whitewater rafting** guide Linton Smith says the Mitta Mitta is "pristine wilderness" of the kind that many of his clients are surprised to find in VIC.

Debris on the bank at least 5m above the current water level shows how high this wild river can run.

▲ **Construction of** Dartmouth Dam in the 1970s tamed the Mitta Mitta, and the reservoir can now store up to 40 per cent of the water for the Murray River system.

the road between Mt Hotham and the village of Dinner Plain. It traverses the course of a 12km water race from the head of Swindlers Creek, which fed the hydraulic sluicing machinery used to dislodge the alluvial gold. The flow-on effect of being able to harness this river's power, he says, led to the opening of the Great Alpine Road, which in turn opened up this high country to recreational visitors.

The Great Alpine Road shadows the Cobungra for about 35km, and provides only a few access points to the river. One is a deep descent below Victoria Falls to the site of an abandoned power station. This attempt to harness the river's power to run the Cassilis Gold Mine lasted just nine years until the mine closed in 1916. Debris on the bank at least 5m above the current water level shows how high this wild river can run.

From here the Cobungra turns north, well away from the Great Alpine Road, and can't be sighted again until it meets the Big River, near Anglers Rest. This confluence of two significant streams – the Cobungra from the west and the Big from the north, abetted by the arrival of the Bundara River a few kilometres upstream – is regarded by the Murray-Darling Basin Authority as the starting point of the Mitta Mitta, because this is the place where the river flow turns around and heads towards the Murray.

Remote and magical

Linton Smith, who's been paddling here for 40 years and runs whitewater excursions through the gorge carved by the Mitta Mitta, describes the river as "wicked".

"When I first paddled this, I spent five years looking at rapids before I actually took a look at the scenery, which is stunning," he says. "It's incredible that pristine wilderness is smack in the middle of Victoria. People don't perceive wilderness as being Victorian at all, and they get here and think they're in New Zealand or Tasmania. That's the experience the river has."

The Mitta Mitta, Linton says, must be respected.

"With a lot of snow in the catchment and a lot of warm rain, it all comes down at once, and that's when the river is at its most dangerous and you don't want to be out there. All the rapids link together.

"We've run it in moderate flood conditions. This section [the gorge] usually takes 4–5 hours to paddle, and [that day] it took us 47 minutes from start to finish."

This side of Dartmouth Dam, the Mitta Mitta is so remote it hosts no town or even a village. Anglers Rest, a few kilometres up the Cobungra, is the only populated community in the vicinity. And the only thing there is the Blue Duck Inn, with a fame that easily outweighs its size. "Everyone knows about the Blue Duck Inn," says Michael Mullins, who with partner Lana Anthony has owned the 90-year-old hotel since 2009. "We get people from overseas ring up. There's a lot of camping in the area." The area is also a beacon for trout fishers, canoeists and motorcyclists.

For trout (the most popular river fish for anglers in Victoria), Michael's favourite spot is in front of his hotel. "I think the Cobungra is fished the least," he says. "Blackberries make it pretty inaccessible in a lot of areas." The narrow flat across the river from the inn had significance long before its present-day use as a camping ground. It's one of several sites along the Mitta Mitta and its tributaries identified as stopping places for the major Aboriginal group from this area, the Ya-itma-thang, who believed the river was a source of a special force. According to anthropologist Aldo Massola in his book *Journey to Aboriginal Victoria* (published in 1969), the Ya-itma-thang would collect quartz crystals known as gibba from the water. These possessed magic powers and, invisibly projected by the 'medicine man', would kill an enemy.

After the gorge, the Mitta Mitta escapes the mountains, flowing into a valley described in 1835 by early pastoralist George Mackillop as "60,000 acres of as fine land as I have seen in the Colonies". By early 1836 cattle had been brought to the area, and today the Mitta Mitta valley has some of the finest beef and dairy pasture in the state.

There are no communities of any note serving these industries until the Mitta Mitta passes through Lake Dartmouth. The largest is Eskdale, 50km from where the river meets Lake Hume, but it's preceded by Mitta Mitta, a respite for those who have completed the countless tight bends on the Omeo Highway from Anglers Rest.

Dammed if you do

Before Eskdale is Dartmouth, a place that didn't exist until John Scales' grandfather was obliged to hive off 130ha of the family property Banimboola in 1971 as the site for a town to house workers on the Dartmouth Dam project.

"We weren't really keen on losing [that land] because it was all river frontage country and the best of what Banimboola had to offer," says John, a fifth-generation farmer here.

The accursed English willow at Mitta Mitta township: planted for its beauty and ability to hold together a riverbank, it now causes major erosion problems.

"The whole regime of the river has turned upside down since Dartmouth Dam was built," he says. "You now get your high flows in the summer because it's irrigation flow, and for a large amount of the time the Mitta runs at thousands of megalitres [a day] – that's the equivalent of 4000 Olympic-sized swimming pools of water.

"Then in the winter, when the big flows are coming in, they're storing water so you only get a 200ML flow [80 Olympic-sized swimming pools]." And that, John adds, is not the river's finest hour, despite his assertion that the dam has been good for the valley overall. "I've seen the Mitta go from a vibrant, strong, dependable, really exciting river that would run up to 50,000ML at times, to now become just a drain. At a 200ML riparian flow, the river this side of Mitta Mitta [township] is a bit of an embarrassment."

But, at the other end of the scale, overflows have been spectacular. "Every time it's flowed over it's boosted the economy of Dartmouth no end," John recalls. "It's happened on about five occasions. The last time, in November of '96, 23,500ML came over the spillway. There were unprecedented rains, warm rain on snow from the alpine country and the dam was rising a metre a day.

"It was the most magnificent sight you'd see anywhere in Australia. There was a line of cars from Albury to Dartmouth that you couldn't break into."

> "I've seen the Mitta go from a vibrant, strong, dependable, really exciting river...to now become just a drain."

Managing the Mitta

The beauty is without question – the floodplain dotted with billabongs and the course of the river marked by a proliferation of English willow. Yet the willow is a scourge. It was introduced in the 1800s, for aesthetic reasons and because its extensive root mass would help hold the riverbank together. But long term it has proved disastrous, and now the North East Catchment Management Authority (NECMA) is trying to eradicate willow at key points on the river.

We catch up with a NECMA team at the caravan park at Mitta Mitta township, where the river is joined by its last significant tributary, Snowy Creek. This confluence is another significant Ya-itma-thang campsite.

"[The willow] has created this legacy of encroachment into the streams, collapsing and turning into mid-stream islands that create erosion issues," says Mick Broughton, project officer for NECMA's Channel Capacity Program. "As their root system

The final channel of the Mitta Mitta before it joins the Murray near Albury is now below Lake Hume. The river has flowed 204km to get here from its source streams in VIC's High Country.

develops, they shallow out the bed of the stream, so what would be once classed as a mild flood and stay within the channel is breaking out. It impacts landholders and public infrastructure.

"The program is about ensuring capacity of the river so that flows released from Dartmouth get to Lake Hume in the same quantity and aren't impacted by narrowing of the channel or any excessive water off-takes."

Another impact is leaf drop in autumn/winter. "The willow dumps everything in one hit, and as that leaf litter breaks down it takes the oxygen away from the water," Mick says. "That unbalances the macro-invertebrate ecosystem…and that impacts on it being a good source for fish and platypus. They move away from those really heavily infested areas." Once the willow has been removed from key sites, the next step is to maintain the integrity of the river through fencing and revegetation.

NECMA is also in the last year of a three-year program to improve the fish habitat on the lower Mitta Mitta after a 2015 census showed it to be severely depleted, the result of the irregular flow regime from the dam. Placing timber logs in the river at more than 20 sites has aimed to maximise survival rates and provide spawning opportunities for native species, particularly Murray cod. A March 2017 audit showed trout, redfin and freshwater crayfish were also there. "At this moment, I can't give solid data on what or why," Mick Broughton says, "but it certainly shows that 'if you build it, they will come'."

This progress has come none too soon. A Sustainable Rivers Audit released by the basin authority in 2012 reported the Mitta Mitta ecosystem was in poor health. The fish community received the lowest score of all the basin's audited valleys: most expected native species were absent and alien species dominated, particularly the brown trout, which is found all along the river from Cobungra to Lake Hume.

The audit had better news, however, for the macroinvertebrate community, showing high diversity particularly in the upland zone, and with most fauna found in the upper reaches. Riverine vegetation was in moderate condition overall, rating from extremely poor in the slopes zone to good in the upland and montane zones. The Mitta Mitta system's hydrology was also rated as good, although there were significant changes in flow seasonality.

This macro view, however, is not the concern of the willow team at the caravan park using chainsaws and a bulldozer, although one worker, Shannon Hanley, agrees he probably has a job for life. He asks about our interest in the Mitta Mitta, and I say it's part of a series on wild rivers around Australia.

He smiles. "You couldn't have chosen a better river." AG

AUSTRALIAN GEOGRAPHIC thanks Tourism Victoria, Tourism North East and staff from North East Catchment Management Authority for their assistance.

Shifting boundaries

The disastrous consequences of foxes, cane toads and other overseas animals settling in Australia are well known. But there can be problems too when our native species move beyond their natural home ranges.

STORY BY **TIM LOW**

Sugar gliders look cute, but motion-triggered cameras monitoring bird nests at night have outed them as predators of rare bird species, especially in TAS, where they were introduced in the 19th century.

Tim Low is the author of *The New Nature* (Penguin, 2017), which discusses species' changing ranges.

FROM: normal range from the Whitsunday Islands, QLD, south to VIC and TAS

TO: WA, where it now occurs in two populations, in the Swan River estuary and Cockburn Sound

Imagine 6.3 billion snails releasing 23 tonnes of faeces a day. That's the situation today in the Swan River in Perth, where mud snails now reign supreme.

Their numbers have exploded since they were first detected there in 1954 and, in the river's lower reaches, they now crowd the bed in densities of up to 400 per square metre. This species is native but its natural range lies more than 3000km away in eastern Australia.

Seagrass beds in the Swan are now under siege thanks to the snail's success. Before it arrived, the river had few hard surfaces on which small seaweeds could grow. Now, seagrass is being uprooted by snails and smothered by seaweed that dislodges from snail shells at the rate of 433 million fragments a day. Snail faeces are thought to be aggravating the problem by fertilising the seaweed.

We often hear of harmful animals from overseas – foxes, cats, toads and the like – but problems also ensue when our own native species spread from one region to another. In two centuries, hundreds of species in Australia have moved in every possible direction, amounting to a major reshuffling of the ecological pack. Anything and everything is involved, including spiders, cicadas, earthworms, marsupials, fish, birds, frogs and even diseases, although only some are regarded with concern.

Species are often moved unintentionally. Mud snails are thought to have travelled on live oysters taken from eastern Australia to Perth and stored in the Swan before use. Northern Queensland frogs regularly travel south inside bunches of bananas; spiders relocate in building supplies; lizards move with firewood; and outback seeds reach the coast aboard cattle trains. The Victorian Frog Group estimates that more than 6000 'banana frogs' reach Victoria each year, although the only lasting outcome observed so far is a colony of dwarf tree frogs that has taken up residence in a flooded quarry near Melbourne.

Other animals have extended their ranges by themselves because changes to the landscapes have suited them. Waterbirds arrive wherever dams go in, bats find abandoned mines and orchard swallowtail butterflies locate citrus trees planted around outback homesteads. Many of the birds found in our capital cities weren't anywhere near them in the past. Writing of the crested pigeon in 1865, naturalist John Gould regretted that "being exclusively an inhabitant of the plains of the interior, it can never become an object of general observation". Today, crested pigeons strut about in Hyde Park in Sydney, where lawns with trees stand in for outback woodlands. Galahs, little corellas and red-rumped parrots have moved with them. Because of its dams, Perth now has a range of birds from the other side of Australia, including spoonbills, moorhens, darters and great crested grebes.

Some animals have been moved deliberately. Kookaburras were taken long ago to Tasmania and Perth, well beyond their natural range, for the purpose of killing snakes. Platypuses were introduced to Flinders Chase National Park on Kangaroo Island

PHOTO CREDITS, PREVIOUS PAGE: ANYKA/ALAMY STOCK PHOTO; THIS PAGE: SCOTT GIBBONS/GETTY
SCIENTIFIC NAMES, PREVIOUS PAGE: *Petaurus breviceps*; THIS PAGE: *Batillaria australis*

Dams built on farms have helped the yellow-billed spoonbill colonise south-western Australia.

CRESTED PIGEON

Ocyphaps lophotes

FROM: arid and semi-arid inland Australia; originally only vagrants recorded close to the coast

TO: coastal cities, first Adelaide, but with Brisbane and Perth quickly following; now also common in Sydney, Canberra and Melbourne and elsewhere in mainland Australia

PHOTO CREDITS, FROM TOP: MICHAEL WILLIS/ALAMY STOCK PHOTO; ANDREW WALMSLEY/ALAMY STOCK PHOTO
SCIENTIFIC NAMES, FROM TOP: *Platalea flavipes*; *Ocyphaps lophotes*

in the 1920s following concern the mammal was declining on the mainland. Brush turkeys too were introduced to the island.

Vast numbers of plants have escaped from cultivation after being grown somewhere new. When I waded into the Swan to see the mud snails I passed feral swamp she-oaks from eastern Australia. Among other easterners growing wild around Perth are tree ferns, tea-trees, eucalypts, kurrajongs and acacias, including Australia's floral emblem, the golden wattle.

Fish stocking has given many rivers new fish – the upper Barron River in Queensland has 12 extra species. Crayfish were put into rivers for future meals, or stocked in farm dams that overflow in floods, sending them into streams.

NO-ONE KEEPS a database of all this movement and serious sleuthing is needed to get to the bottom of some changes. Redback spiders live in sheds and under outdoor furniture but seldom in forests. Spider authority Robert Raven has wondered why this species went undiscovered until 1870, by which time 200 other Australian spiders had been named. Redbacks were hardly mentioned by early travellers and naturalists, and rarely feature in Aboriginal legends and languages.

Back in 1988 I wrote in this magazine (AG 10) of Robert's suspicion that redbacks had been ▸

Redback spiders are now found in built-up areas Australia-wide. But it's believed their natural range was originally in the region from Adelaide to Perth.

The rainbow lorikeets around Perth, descended from cage birds that won their freedom, have been declared a state pest.

introduced to Australia from abroad. A mention was later found in an 1850 book of black-and-red spiders around Adelaide, and the thinking today is that redbacks are native to the country's south-western third, and were introduced eastwards.

Flying-fox movements also warrant careful interpretation. When University of Oxford scientist Francis Ratcliffe came to study flying foxes in the 1920s, he documented a situation that defies belief today. Grey-headed flying foxes were sometimes wandering down to Victoria during the warmer months but in winter there were no bat camps south of the Mary River in southern Queensland.

That situation prevailed until 1928, when a winter camp formed in northern New South Wales at Nambucca Heads. Today, there are permanent grey-headed flying fox camps right down to Melbourne and in Adelaide, where they first arrived in 2010.

Their presence in these cities is made possible by planted vegetation that provides them with year-round food, especially fruit trees and winter-flowering gums. The slower to spread black flying fox has progressed south from Rockhampton in central Queensland to Sydney. In our suburbs, flying foxes can appear to be thriving, but national counts show numbers well below those in Ratcliffe's day, when a 'large' camp had more than 50,000 bats. In a national survey in late 2016, no camp of 'greys' reached that size. Trees in cities can't make up for the vast tracts of rainforest, eucalypt forest and paperbark swamp cleared since 1788.

Species on the move challenge us. We think of lyrebirds as native to Australia, but Australia is a continent and one of the world's largest countries. Were it divided, like Europe, into smaller countries, those snails and kookaburras in Perth would count as foreign – as would lyrebirds, taken to Tasmania during the 1930s to conserve them. 'Foreign' may not be the correct word, but the mud snails in Perth qualify as an introduced species and feral pest.

The rainbow lorikeets around Perth, descended from cage birds that managed to win their freedom, have been declared a state pest for the damage they do to stone fruits and other crops. Australian plants often appear on regional weed lists, sometimes as species banned from cultivation. Advocates for native gardens usually specify 'local natives' to clarify that native and Australian aren't the same.

Birds and bats that travel under their own wings aren't thought of as introduced, although those that cross the sea, including the nankeen kestrels that reached Christmas Island, are sometimes called 'self-introduced'.

Some of these movements take place without any cause for concern. No-one speaks badly about crested pigeons and butterflies thriving in new locations. Everyone likes the white terns that colonised Lord Howe Island after finding that its planted Norfolk pines offer good nesting sites.

But many arrivals do acquire a bad name. Eradication campaigns are mounted in Perth whenever Queensland fruit flies ▸

PHOTO CREDIT: IAN WALDIE/GETTY
SCIENTIFIC NAME: *Latrodectus hasselti*

BLACK FLYING FOX

Pteropus alecto

FROM: woodlands and paperbark forests across Australia's northern fringe

TO: south-eastern QLD, and down as far as Sydney in NSW (it's now the most common flying fox in southern QLD, having partly displaced the grey-headed flying fox)

PHOTO CREDIT: RICHARD THWAITES/AUSTRALIAN GEOGRAPHIC
SCIENTIFIC NAME: *Pteropus alecto*

LAUGHING KOOKABURRA

Dacelo novaeguineae

FROM: throughout eastern Australia

TO: deliberately introduced in TAS and south-western WA, where it competes with local mammals, birds and reptiles for tree-hollow nesting sites

Introduced lyrebirds are a high risk to the Tasmanian Wilderness World Heritage Area, worse than cats.

turn up, as they did in 1989 and most recently in 2016, probably via smuggled fruit; they are also a problem in Victoria, SA and NSW. Redbacks in eastern Australia aren't welcome, nor are those mud snails in the Swan.

To make matters worse, the snails brought a parasite with them – a trematode worm that infects people who swim in the river, burrowing into their skin and causing dermatitis.

Unloved as well are the giant northern termites that appeared recently on the Gold Coast in south-eastern Queensland, and fungal diseases from the eastern states that blight WA blue gum plantations.

Ecological fallout from some travellers can be huge. Sugar gliders taken to Tasmania as pets during the 1850s now prey on endangered swift and orange-bellied parrots at their nests. In some remnant forests, no swift parrots are raising young and about half the females that attempt to nest are eaten each year.

Introduced lyrebirds are a high risk to the Tasmanian Wilderness World Heritage Area, worse than cats and starlings, because they disturb soil and litter when they scratch around on the ground to feed – up to 200 tonnes per hectare each year. A fence was built around the only known colony of the endangered myrtle elbow orchid to stop lyrebirds scraping it into extinction.

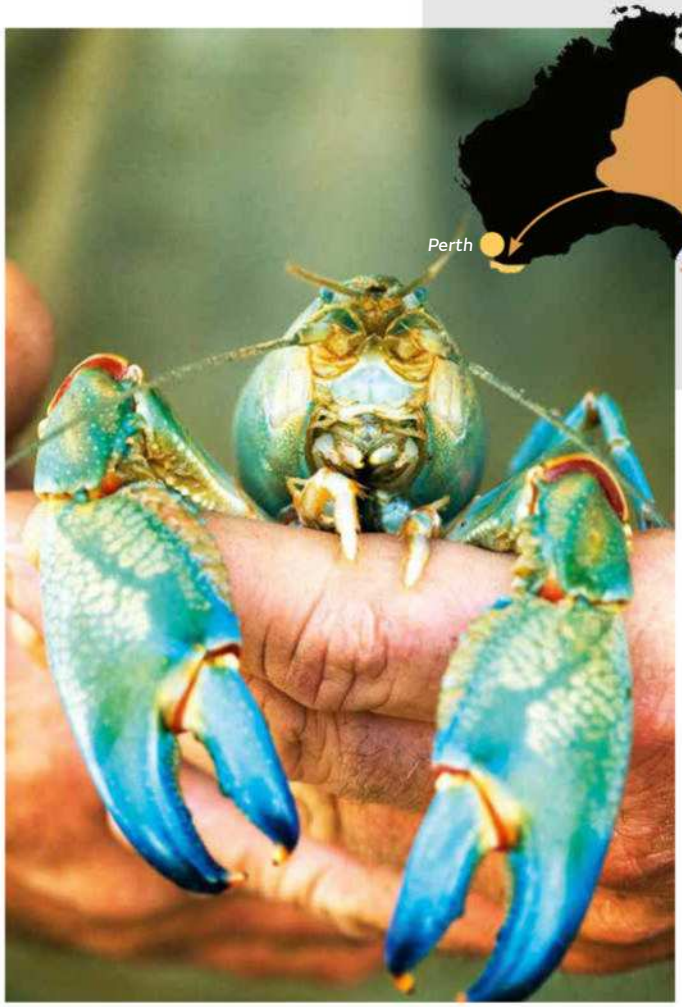
Tasmanian platypuses sometimes die from a fungal infection, mucormycosis, which evidently reached the island on frogs coming from Queensland or NSW.

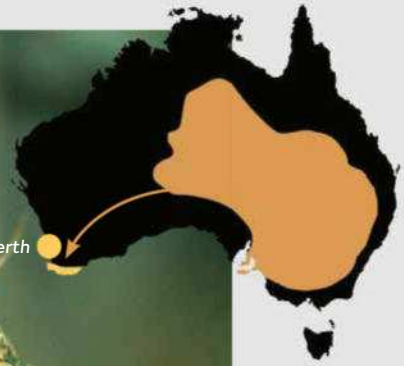
On the mainland, yabbies from inland wetlands are now the main concern for the critically endangered Fitzroy Falls spiny crayfish, having colonised the one stream in NSW the crayfish inhabits. In some pools, yabbies outnumber it 25 to one and crayfish show signs of yabby attacks. South of Perth, the smooth marron, a widespread crayfish in south-western WA, is taking over from the critically endangered hairy marron after it was released into Margaret River.

On the Atherton Tableland in northern Queensland, the Lake Eacham rainbowfish vanished after four species of Australian fish, including the predatory mouth almighty, were introduced into the lake during the 1980s by persons unknown. Fortunately, the rainbowfish was found in a few nearby streams.

Other problems, of which there are many, include introduced koalas over-browsing and killing trees on Kangaroo Island; and sweet pittosporum, a rainforest tree from eastern Australia, shading out rare orchids around Adelaide.

PHOTO CREDIT: DAVID DARE PARKER/AUSTRALIAN GEOGRAPHIC
SCIENTIFIC NAME: *Dacelo novaeguineae*





COMMON YABBY

Cherax destructor

FROM: a natural distribution in inland rivers west of the Great Dividing Range that includes VIC, NSW and southern QLD

TO: WA, where in 1932 it was first introduced to the wheatbelt town of Narembeen; it now threatens the state's marron industry

Cootamundra wattle has spread well beyond its native south-eastern Australia, and is considered a weed in VIC and the ACT after ornamental planting increased its range.

MANY MORE MOVES can be expected as climate change becomes an important driver. Although the southerly spread of flying foxes is often linked to rising temperatures, scientists have shown that black flying foxes advanced far more rapidly than climate change alone can justify, by 123km a decade. Urban trees, including Moreton Bay figs in parks, support the bats pouring south, as well as figbirds and koels.

Climate change does fit some changes already detected in the sea. In recent decades, reef fishes such as the one-spot puller, snakeskin wrasse and southern Maori wrasse have spread from Bass Strait to Tasmania's east coast, where the sea is warming noticeably. Another newcomer is the long-spined sea urchin, which, by browsing seaweeds on Tasmania's underwater rock shelves, is converting dense kelp beds into 'urchin barrens' of bare rock. Biologists estimate 150 kelp-loving species are losing out, including the black-lip abalone, an important commercial species. Urchin culling has been trialled, and new limits have been imposed on the harvesting of rock lobsters, which are urchin predators.

Climate change has emerged as a new reason to move species to save them, but caution is called for. Tasmania's urchins, sugar gliders and lyrebirds show us that southward shifts can be bad for other species. Biologists agree that nothing should be moved south until the risks are assessed.

But some of the species that have moved give cause for optimism. Cootamundra wattle, native to a small area around the town of Cootamundra in southern NSW, escapes so freely from gardens that it's now a weed in every Australian state – and overseas as well. It's a tree that shouldn't be grown near bushland. Although plants with small distributions are said to face disaster from climate change, Cootamundra wattle has spread into much hotter and drier places than it came from, showing that a small distribution need not necessarily denote a high risk from climate change.

Coastal tea-trees now grow hundreds of kilometres further north than before, and long-billed corellas from Victoria now live in Cairns, more than 2000km away, adding to the evidence of life's adaptability. This is good news, given the risks entailed in moving anything, although it may not apply to most species. Climate change provides a compelling reason to study examples such as these.

The animals and plants on the move are so many and so varied they give us much to wonder about. Because threatened species require so much attention, we don't hear enough about the reverse situation – species that have gained some advantage from our influence. Some of them, including redbacks, galahs, crested pigeons and various wattles, are probably doing better today than ever before.

We should never neglect the losers, including those doing worse because of the 'winners', but there's some comfort to be had from knowing that some species in Australia are thriving from the changes people have made. AG

PHOTO CREDITS, FROM LEFT: CATHY FINCH/AUSTRALIAN GEOGRAPHIC; ESTHER BEATON/AUSTRALIAN GEOGRAPHIC
SCIENTIFIC NAMES, FROM LEFT: *Cherax destructor*; *Acacia baileyana*

A culture of pearls

Since the late 19th century, the pearling industry has transformed Australia's north-west coast into a multicultural hub with the town of Broome at its heart.

STORY BY **AMY RUSSELL** PHOTOGRAPHY BY **DAVID DARE PARKER**

A South Sea pearl is delicately extracted from a pearl shell oyster at Cygnet Bay Pearl Farm, north of Broome. Technicians train for years to master this technique without damaging the oyster.

"Some legends say that pearls are created by bolts of lightning striking the water. Others believe they are the eyes of saints. The Chinese tell of mermaids weeping tears of pearls. The Hindus say that on still nights, dew dropping from overhanging leaves solidifies in the moonlight and rolls into the open mouths of shells gathered to collect them."

– **John Bailey, *The White Divers of Broome***

PEARL HAMAGUCHI'S HANDSOME timber house reflects a style that was popular with the Europeans who came to make their fortunes in Broome, in the Kimberley region of Western Australia, from the 1870s. The central rooms open out onto a wide verandah that allows cool air to drift in. "This," she says, "used to be old Broome."

The aptly named Pearl was born in Broome in 1940, in an area known then as Japtown. It was a maze of stores, cafes and boarding houses that was a bustling hub for the Asian community who arrived to crew pearling boats and dive for shells during the early years of Broome's pearling heyday. Pearl's mother was an Aboriginal woman and member of the Stolen Generation. Her father was Japanese/Chinese. "You had four races on pearling boats sometimes," Pearl says. "Chinese words, Japanese words, Aboriginal words all mixed up."

Today, although the noodle houses and gambling dens have been replaced by juice bars and clothing stores, some of the original archways and buildings in Japtown (which is now called Chinatown) remain, making it a popular tourist spot. You can still find a cafe serving a spicy curry or chicken satay, but, Pearl says, nothing compares with the flavours of her childhood. "It had atmosphere," she says. "There were different cultures, and people walking around in sarongs or men with woven baskets under their arms."

Pearl's late husband, Hiroshi, was a skilled diver from Japan's Wakayama Prefecture. He came to Broome in the 1950s to skipper pearling boats, but he and Pearl eventually founded their own successful business when the industry shifted from shell fishing to cultured pearl farming. It's estimated that between the 1880s and the outbreak of World War II, more than 80 per cent of the world's pearl shell came from Broome. With the introduction of plastics in the late 1940s, however, the demand for shell plummeted. Many pearl shell businesses went under, while others moved into farming cultured pearls.

Hiroshi was the first non-Caucasian to be granted a pearl farm licence, Pearl says proudly, pointing to old photographs of her family sorting pillowcases full of pearls in their living room. "I grew up in the pearling age when life was a gamble," she adds. "You didn't worry too much, otherwise you'd be worrying all the time."

TO THE UNTRAINED EYE, a pearl shell oyster could seem unremarkable. Its hard, dull shell blends in to the sea floor. Clasped shut and covered with growth, nothing about its appearance suggests it contains anything valuable. But a pearl diver knows differently. Finding a bed of pearl shell oysters after drifting for hours in a lonely, quiet ocean will make all the difference to their salary that week.

For inside, pearl shell oysters are luminous. Their inner shells are coated in a substance called nacre, or mother-of-pearl. Tilt one up to the sunlight and an iridescent rainbow flashes across its surface. Yet their value doesn't end there. If a foreign organism disturbs the oyster's mantle tissue, the oyster secretes nacre, coating the alien particle over and over, producing a pearl.

These saltwater 'jewels', and indeed mother-of-pearl shell, have been a source of wonder to cultures worldwide for thousands of years. Fishing for shell had an irrevocable impact on north-western Australia, in particular. The tropical waters ▸

Hard-hat divers (top) were working in north-western Australia from the late 1860s. The suit, with its waterproof canvas and oxygen hose to the surface, allowed divers to descend deeper and tolerate cold water longer than skin divers. Reportedly, many divers couldn't swim; they were pulled along by currents or walked the sea floor, increasing air in their suits to lift themselves. Raised in Broome, Pearl (above left and right, at left), and husband Hiroshi Hamaguchi (above, at right), a pearl diver from Japan, founded the first Asian/Aboriginal pearling company. "Thank God we had six sons," she says. "Four joined Papa in the business."

PHOTO CREDIT, TOP: NATIONAL LIBRARY OF AUSTRALIA

Indigenous people have engraved pearl shell for millennia. Bruce Wiggan (below), a Bardi elder from north of Broome, is a master pearl shell carver whose work (right), known as riji (carved shell), features in collections worldwide.

Pearls (below) that grow naturally without an implanted bead, or nucleus, are known as keshi. These are pure nacre and often irregular in shape – no two are the same and in some markets these seedless pearls are considered to be extremely valuable.

Their giant shells produce high-quality nacre and some of the world's finest pearls.

from Shark Bay to the Torres Strait are home to six species of *Pinctada* oysters, including *Pinctada maxima*, the largest saltwater oyster and perhaps the most coveted.

One of only a few molluscs that produce nacre, *P. maxima* is the most common species found in Australia's north-west. Exposed to the strong tidal movements and currents of the pristine Kimberley environment, these filter feeders process vast amounts of nutrients – one reason that's given for their large size. Their giant shells produce high-quality nacre and some of the world's finest pearls (known widely as South Sea pearls).

Aboriginal people from the Kimberley coast collected, carved and traded pearl shell for thousands of years, long before European pearlers set up camp in the 1870s at what was later named Broome. The seabeds adjacent to Eighty Mile Beach, 251km south of Broome, produce abundant stocks of *P. maxima*, and, within a few decades, the west Kimberley coast had transformed: pearling boats lined the foreshore alongside hastily built jetties and makeshift camps. Pearl shell, used to make buttons, was fetching a high price in international markets, and Broome became the hub for this young fishing industry.

Early pearlers used local Indigenous people, who were forced into service first to collect shell from beaches and later as skin divers when shells could no longer be found on the shore or in the shallows. Indentured workers from Indonesia were also brought in to crew pearling boats and dive with the Aboriginal labour force. Later, when hard-hat diving technology was introduced, pearlers employed divers and crew from Asia – including Japan, China, the Philippines and Sri Lanka.

"Not much has been written about these stories," says anthropologist Sarah Yu, from the University of Notre Dame's Nulungu Research Institute. "And really, the Indigenous people's connection to pearl shell is a World Heritage story that's 20–30,000 years old and continues today." Broome-based Sarah is lead curator of *Lustre: Pearling & Australia*, an exhibition at the National Museum of Australia in Canberra until mid-July.

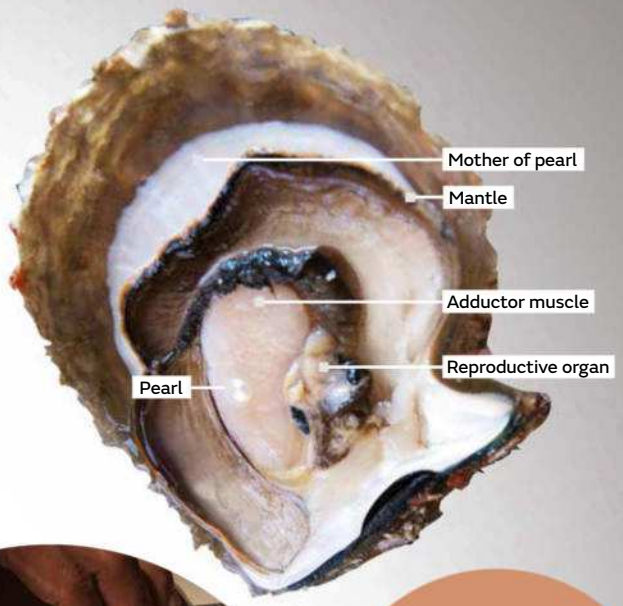
Lustre highlights how integral Aboriginal people were to the industry, as well as the contribution of Asian immigrants, who brought the customs and flavours of their home countries. By the turn of the 20th century, Broome was a vibrant mix of cultures, at the heart of which lay the search for pearl shell.

Today, it is greatly changed; the pearling masters and boats are gone and Broome is largely a tourist town welcoming more than 180,000 visitors a year. But the legacy of those early multicultural years lives on in the locals who weathered all the ups and downs of the pearling industry and still call this frontier Kimberley town home.

As pearling evolved, the ability to adapt was essential. Kim Male, now in his 80s, was a third-generation pearler. His grandfather Arthur was a partner in Broome's first pearling company, Streeter and Male, which also built many of Broome's original buildings and its first jetty. The Males were involved in most aspects of pearling – from exporting shell to boat building. Trading as Pearls Proprietary Limited (PPL), they were also partners in Broome's first cultured pearl farm, set up in Kuri Bay in 1956.

How to make a pearl

A natural pearl is formed when some kind of irritant (a piece of shell, for example) enters a pearl shell oyster and irritates its mantle tissue. To protect itself, the oyster secretes nacre, which coats the particle over and over, producing a pearl.



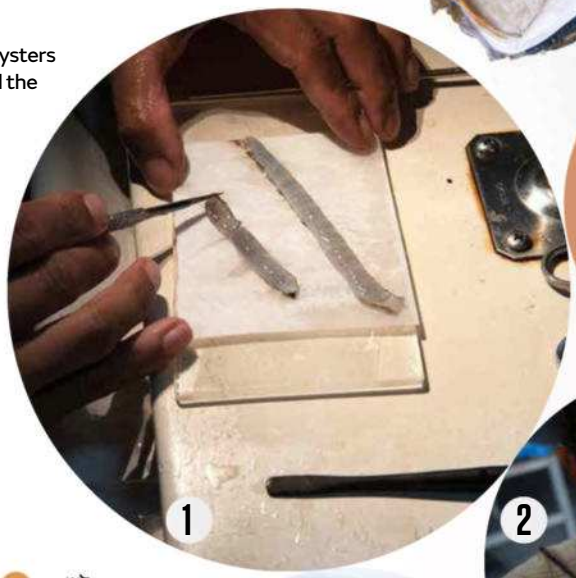
1 The likelihood of finding a natural pearl – of good size, shape and quality – within a wild pearl oyster is very low: one in 5–10,000 for *P. maxima*. This is why most pearls today are 'cultured' or farmed, a process where a technician implants a nucleus – a round bead often made from mussel shell – and a grafted piece of mantle tissue from a donor oyster, which has the ability to lay down nacre. This tissue has to grow around the bead and completely seal it in a 'pearl sac' before it can begin laying down nacre crystals.

2 The pearl inherits certain characteristics, such as shape and size, from the shell it grows within. Lustre and colour is determined by the donor tissue.

3 After oysters have been seeded they are returned to a pearl farm, where they are hung in net panels under water. It normally takes two years for a pearl to grow to a marketable size. After a pearl is removed, a healthy oyster can be reseeded several times to produce more pearls, each usually larger than the next.

4 During the years a seeded oyster is submerged at a farm, it is regularly brought to the surface and cleaned on small farm boats. Removing algae and growth from the shell ensures an oyster can process vast amounts of water and nutrients, allowing it to thrive.

5 After a crop of oysters is harvested and the pearls removed, each pearl is graded – they are judged on their size, shape, colour and lustre (or radiance). Various factors will impact the market value of a pearl, but a single pearl could be worth anywhere between $300 and $3000.



FACT

The most expensive pearl was found inside a giant clam by a Filipino fisherman. Weighing more than 34kg and longer than 66cm, it is valued at more than $100 million.

VISIT *LUSTRE:* *Pearling & Australia*, an exhibition at the Australian National Maritime Museum, Sydney, until 13 August and at the National Museum Australia in Canberra until 22 July. Developed by the Western Australian Museum with Broome's Yawuru Aboriginal corporation, it illuminates the people behind pearls. Visit: *anmm.gov.au*

▼ **Kuri Bay Pearl Farm** (below), north of Broome, is one of 20 such facilities run by pearling company Paspaley. The Kimberley's pristine environment is thought to contribute to the quality of Australian pearls.

▼ **"Each site has** its challenges," says Tony Thiel (below), Paspaley's manager of pearl production. "If we have a big cyclone season and take substantial losses, we know it's going to be tough."

Ask Kim what aspect he appreciated most and there's little hesitation. "I enjoyed the mixture of people I worked with," he says, seated across the road from the Streeter and Male store on Broome's Short Street. Built in 1900, it was the original Male headquarters and they still manage non-pearling businesses there today. (PPL and Hamaguchi Pearls were both eventually bought by Paspaley, a family-run pearling company founded in 1935.)

Kim speaks particularly highly of the Japanese divers, skippers – including Hiroshi Hamaguchi – and technicians they employed. "They had real precision," he says. "And where some people could get bored, they stuck to the task all day."

Boat building was another highlight, Kim says. Luggers were vessels constructed specifically for pearling. Traditionally, these timber ships with two masts were made from West Australian hardwoods such as jarrah and karri, as well as spotted gum from New South Wales. They carried crews to the pearl beds and, in a good season, returned home piled high with pearl shell.

Shipwrights and carpenters built the Male luggers, one of which is housed at Broome's Pearl Luggers museum. The *Sam Male* was acquired by the Shire of Broome in 1977 and later restored. Standing next to the vessel named after his father, Kim – dressed in a white shirt and shorts, with socks pulled up to his knees – looks like a seaman. "In our heyday, or my father's, because I was in school, we were building three a year," he says.

Another restored Male lugger, the *John Louis*, is on display at the Australian National Maritime Museum in Sydney. Completed in 1957, it is one of the last traditional Australian-built luggers. When hard-hat diving came to an end in the 1970s, the *John Louis* was refitted to service the pearl farming industry. At that time, lighter dive equipment and advanced technologies were being introduced and divers adopted a different diving style.

David Appleby, one such recruit, was a commercially trained diver from Newcastle, in NSW, who moved to Broome as a 20-year-old. "The techniques we were using were…so successful that after three seasons the Japanese hard-hat divers had no choice but to copy," he says. "Everyone went into drift diving. This means holding on to a line and being towed by the boat, which is the technique you still see now."

David went on to train other divers and, in the late 1980s, was employed to install and operate a hyperbaric chamber in Broome's hospital (AG 35), where divers could be treated for the bends. David left the industry more than 15 years ago but

PHOTO CREDIT, TOP MIDDLE: BOURNE COLLECTION, COURTESY WA MUSEUM

◀ **Luggers like this** took divers to the Kimberley's wild pearling beds. They were built to withstand the demands of their unpredictable environments and were often grounded in creeks to shelter from storms.

▼ **Kim Male was** a third-generation pearler. He's pictured here at Broome's Pearl Luggers museum, next to the lugger *Sam Male*, built by his family's business and named in honour of Kim's father, who died in 1976.

"This whole area, from Broome, right up to the Dampier Peninsula, really is pearling's home."

remained in Broome. Standing on Streeter's Jetty, as the setting sun paints the mangroves in its warm glow, he points to where the luggers used to pull in. "I remember arriving here and thinking, 'This is where I want to be,'" he says. "There was a beautiful mix of Aboriginal, Filipino, Chinese, Japanese, all blended in. I met my wife here. Her mother was Aboriginal/Japanese and her father was Aboriginal/Indian. We've been married for 32 years."

THIS VIBRANT MIX OF cultures has greatly influenced Broome's heritage and many of the town's longstanding locals. Indigenous musician and Bardi man Stephen 'Baamba' Albert grew up in a Japanese boarding house, in the days when everyone still worked in pearling. His people are saltwater people whose traditional lands are about 160km north of Broome. Baamba, also an actor and radio presenter, says his music reflects the many musical genres and languages he heard as a child.

His songs describe life growing up in Broome. "As kids, we'd sit on top of Kennedy Hill and wait for the boats to come home," he says. "When the tide's up, you can see a rock that looks like a ship. There used to be a lighthouse on it and that was the winning post. We'd be betting on who'd be sailing in first. Broome is a betting town, you see."

Sharing old stories is important, says local guide Bart Pigram, founder of Narlijia Cultural Tours and a Yawuru man whose people are the traditional owners of the lands in and around Broome, as well as a marine park in Roebuck Bay. Standing on Kennedy Hill, Bart points to thousands of shell middens left by his ancestors. "People only get to see a fraction of what Broome has to offer, and usually it's all the touristy things," he says with a laugh.

One of Bart's first jobs was mending and stacking pearl shell panels for Paspaley in a nearby boatshed, but he was always interested in history. Bart, along with Maya Shioji – daughter of one of Broome's last Japanese hard-hat divers – worked with Western Australian Museum curators and Sarah Yu to create the *Lustre* exhibition. They also developed an app, Jetty to Jetty, which takes listeners on a historic walking tour of Broome. "There's so much richness around here, in terms of heritage," Bart says. "This whole area, from Broome, right up to the Dampier Peninsula, really is pearling's home." ▸

Before WWI, pearl divers in Australia were mostly Japanese.

Australia's early pearling industry relied on Asian dive and lugger crews.

Broome's early 20th-century European community profited from healthy international prices for in-demand pearl shell, while mixed-race dive and lugger crews worked hard in tough conditions for less than what white men demanded. More than 2500 indentured workers from Asia assembled each year to work on pearling grounds from Shark Bay to King Sound, wrote John Bailey in *The White Divers of Broome* (2001), and with a white population of fewer than 700, "there was a firm system of social and legal controls to provide security for the ruling whites".

There were racial tensions, with clear segregation between whites and others – but the migrant crews were vital. The Commonwealth Government's White Australia Policy was being developed and in 1901 the Immigration Restriction Act was introduced to limit non-white immigration and allow for deportation of 'undesirables'. Broome, as a tiny frontier in Australia's far north, remained immune because the European pearling masters relied heavily on indentured workers. But by 1911 the government was no longer satisfied with claims that work on pearling luggers was too hard for white men. To test this, 12 British Navy divers were brought over from the UK and employed in Broome.

The pearling masters were right that diving for shell was gruelling. Many hard-hat divers, irrespective of race, died from the bends, and many were also affected by poor nutrition. Several of the British divers died after trips out of Broome, while others were unable to find and collect shell in numbers comparable to their Asian counterparts. The government later admitted white divers were unsuited to the work.

Historic landmarks, such as the *Women of Pearling* statue (left) and Japanese cemetery (below), mark Broome's rich heritage.

▲ **Bardi man Terry Hunter** – here with a net panel that is used to contain the oysters under water after they have been seeded – introduces tourists to pearling history at the Cygnet Bay Pearl Farm on the Dampier Peninsula.

TODAY, THERE ARE less than a handful of pearl producers left in north-western Australia. The pearling industry faced a sudden market downturn following the global financial crisis in 2008 and, during the past 15 years, a debilitating mystery disease has caused devastation to pearl oyster crops in Australia.

And yet South Sea pearls continue to be considered incredibly valuable. Globally, Australian-sourced pearls make up less than 1 per cent of pearl production, but account for about 25 per cent of sales. In Australia, pearling is one of WA's most profitable fishing industries – in 2014 its value was $67 million.

In order to survive, the pearling businesses that remain have had to diversify, incorporating tourism and science into their operations. Although wild shells are still collected in great numbers (up to 500,000 units every year) by drift divers from pearl beds in the Kimberley and Pilbara regions, pearl oysters are also being bred and reared in hatcheries.

Once the wild or hatchery oysters are seeded by technicians, they are moved to farm sites and hung under water in net panels. It can take up to three years for a pearl to reach an appropriate size; during this time the oysters are regularly brought

PHOTO CREDIT, TOP LEFT: NATIONAL LIBRARY OF AUSTRALIA

▲ **Broome-born** actor and singer Stephen 'Baamba' Albert grew up at a time when almost everyone in the town was involved in pearling in some way. Broome's multicultural roots heavily influence his music.

▲ **James Brown manages** Cygnet Bay Pearl Farm, where his family has been involved in pearling for decades. "Today we're a pretty young team... starting to look to science to tell us where to go from here," he says.

onto small boats and cleaned, to allow for a constant flow of nutrients for these filter feeders. Once harvested, a good-quality oyster can be reseeded, and may produce up to three pearls in its lifetime.

"Pearling has always required lots of labour. That is especially true now we have opened our farm to the public," says James Brown, a marine biologist and manager of Cygnet Bay Pearls. The Brown family has been involved in pearling at Cygnet Bay, 200km north-east of Broome on the Dampier Peninsula, for more than 70 years. What began as a small seeded oyster crop has evolved into a 16-nautical-mile farm, with 50,000 seeded oysters.

All of the Browns' operations – from the hatchery to the oyster-seeding and pearl-harvesting – are done on-site, and often in full view of the tourists who visit. To educate the public on the long history and excellent quality of South Sea pearls, James began operating farm tours in 2009. He also built the Kimberley Marine Research Station, a base for scientists to study the local environment.

Today, you can take a boat tour from Cygnet Bay to experience the powerful Kimberley tides, listen to members of the local Bardi mob share their histories, and learn how pearls are sorted and graded.

Australia's Marine Stewardship Council classified the industry as sustainable – a first for any gem fishery in the world.

"Tourism on the Dampier Peninsula has grown incredibly organically," James says. "I'd like that to continue, and for the Kimberley to become known for its pearls, just as Margaret River is known for its wine."

Raising the profile of Australian pearls is also a priority for Paspaley. Arguably the most well known Australian pearl brand, the family-run company is today responsible for about 70 per cent of Australia's pearl crop, and operates 20 farm sites off the north-west coast.

Among the company's fleet of ships are farm vessels – which are home to crew who clean the oysters and service the farms – diving boats and harvesting/seeding ships. Premier Paspaley clients are sometimes flown out to visit farm sites, such as the Osborne Islands, about halfway between Broome and Darwin. A tour of the sleek 35m farm ship leaves a lasting impression, especially once I learn that below the surface of this pristine stretch of ocean lie almost 70,000 seeded pearl oysters.

But encouraging buyers to purchase Australian pearls is just one of the challenges facing producers today. Pearl shell drift diving continues to be challenging – and sometimes dangerous. In 2012 a young Paspaley drift diver named Jarrod Hampton drowned after suffering an air embolism during his eighth dive of the day.

Then there's the unpredictable nature of the Kimberley environment – a pearl farmer could do everything right, and still yield a poor harvest. Powerful cyclones have been known to destroy entire crops, while disease and water temperatures are a constant threat.

"Pearling is full of contradictions," says Paspaley's manager of pearl production, Tony Thiel."We joke some years that you couldn't kill the oysters with a hammer, but that's when water temperatures are warm. Other years when it's cold, they don't do so well." And yet despite these pressures, the Kimberley's wild pearl shell beds continue to regenerate. In 2016 Australia's Marine Stewardship Council classified the industry as sustainable – a first for any gem fishery in the world.

"That helps me sleep at night," says Paspaley skipper Brett Smith. "Although we are taking things from the ocean, it's a sustainable industry. We have to work closely with nature for us to be able to produce a pearl. It's such hard work – we put everything into it – and it's not until the end of the harvest that we know if we have a pearl – a nice pearl, a pearl we can sell." AG

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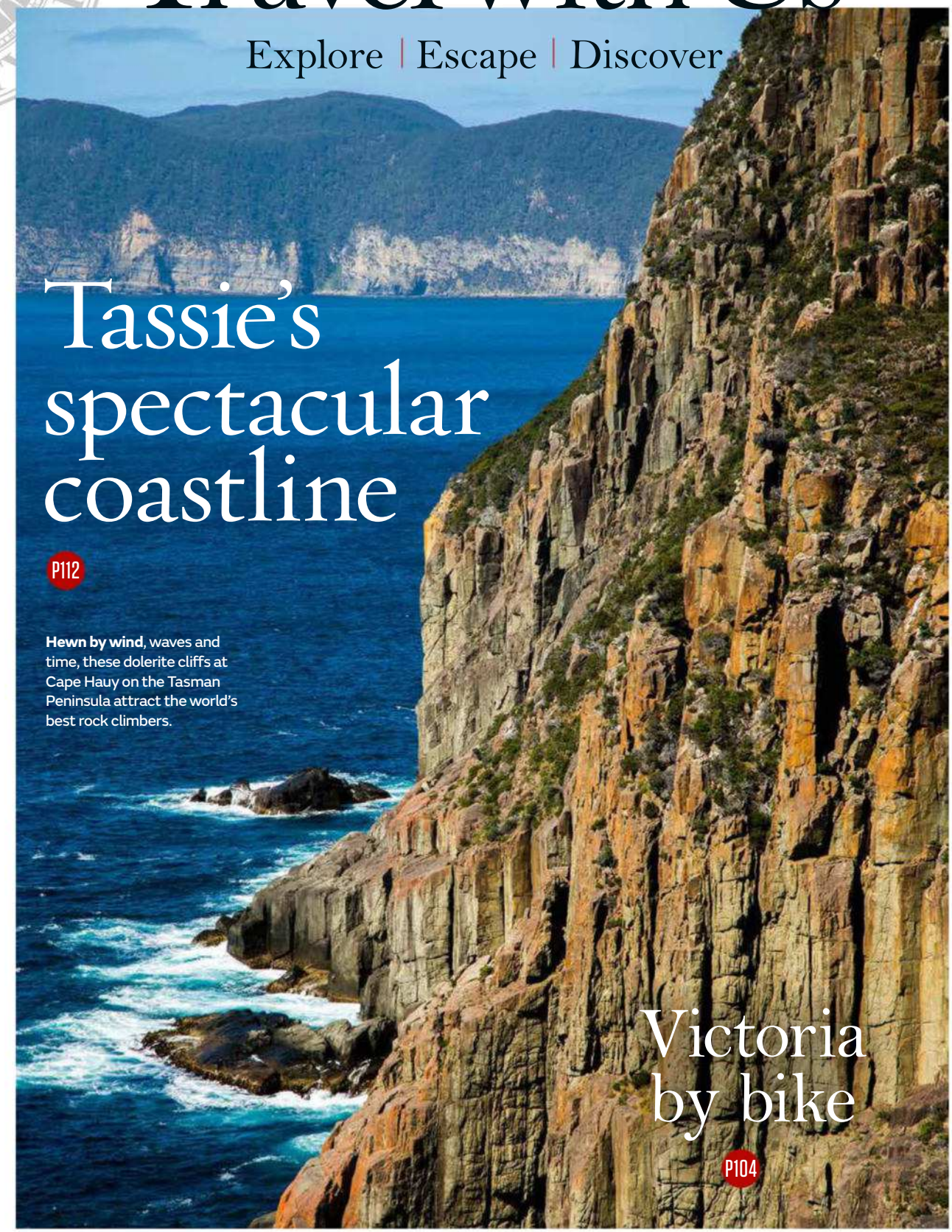


Tassie's spectacular coastline

P112

Hewn by wind, waves and time, these dolerite cliffs at Cape Hauy on the Tasman Peninsula attract the world's best rock climbers.

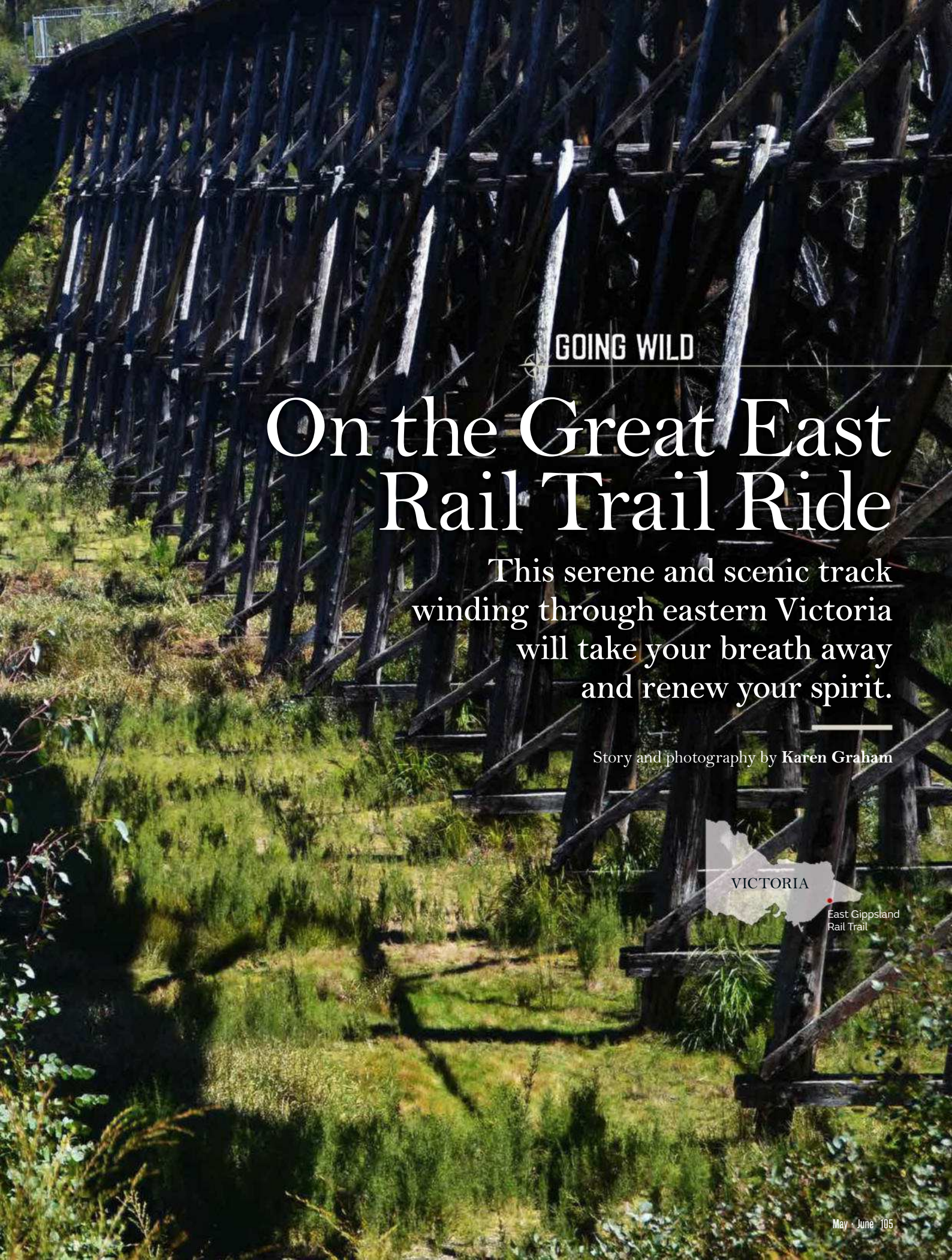
Victoria by bike

P104

PHOTO CREDIT: CHRISSIE GOLDRICK

Australian Geographic Society expeditions • Going wild • Road trips • Recommended travel • Expedition diary • My favourite place

Riders are dwarfed by the 276m-long Stony Creek Trestle Bridge, just west of Nowa Nowa and a highlight of Day Two. Built in 1916, the bridge was in service for more than 60 years, with the last train crossing in 1988.



GOING WILD

On the Great East Rail Trail Ride

This serene and scenic track winding through eastern Victoria will take your breath away and renew your spirit.

Story and photography by **Karen Graham**

Early morning in Bruthen at the start of Day Two, and riders cycle from overnight cottage accommodation back to the rail trail.

▶ **Between Nicholson** and Bruthen on Day One, there are several dark and interesting old railway tunnels to cycle through.

▼ **Renowned for high-quality** bream fishing, the Tambo River flows through Bruthen towards its mouth at Lake King.

There's something very special about rising at dawn on a brisk spring morning to see the surrounding hills and forests shrouded in mist as the sun slowly rises and spreads a golden light across adjacent farmlands – particularly when you're watching it unfold from the seat of a bicycle.

I quickly came to appreciate this when I joined Snowy River Cycling's annual Great East Rail Trail Ride, which meanders 100km along the East Gippsland Rail Trail from Bairnsdale to Orbost in eastern Victoria.

Following an abandoned railway corridor, the ride takes in big rivers, historic railway bridges and the picturesque towns of Nicholson, Bruthen and Nowa Nowa. Participants cycle through verdant farmlands, peaceful valleys and diverse forests – blue gum, red box, casuarina, stringybark and southern mahogany – that are home to kangaroos, wallabies, wombats and goannas, and echo to a chorus of birdsong.

Liz Mitchell, who runs Snowy River Cycling, gave up a career as a vet in 2010 to lead cycle tours in the region. The Great East Rail Trail Ride, which includes food, accommodation and full support, was added in 2014.

Social enterprise (f)route – a global network based in East Gippsland, VIC, that brings together art, fruit, conversation and slow travel – provided Day Two's breakfast from its food truck.

DAY 1

Bairnsdale – Bruthen 30km

The first day begins with the promise – from my not particularly reliable weather forecast app – that the wind and rain will clear. I join other eager participants for the trail's start at Howitt Park in Bairnsdale and the first of Liz's entertaining ride briefings. She asks the children joining the event if they will "look after their adults" – especially if they get over-excited – and then gives us a run-down of the route.

The first 10km of the trail is sealed, so it's a gentle introduction to the ride, and it brings us to the historic Nicholson River Railway Bridge, the first of several wooden trestle bridges we'll see on the ride.

From there, we divert off the trail and onto quiet country roads for our first real challenge – a couple of short, but very steep, hills – to our lunch spot at the Nicholson River Winery. The reward at the top is a chance to sample wines, gourmet rolls, homemade cakes and a selection of fruit. The views across the vineyard, river and valley are stunning.

After lunch, we get to freewheel back down to the trail and from there it's 20km to Bruthen. We pass through a few old railway tunnels and see the remains of another trestle bridge. In the Tambo River Valley, we pass dairy and beef farms, and watch horses gallop in paddocks.

The pastures here are vivid green, thanks to rain that falls year-round. Fortunately for us, today it's a light shower that is lovely in so many ways. The strong scent of eucalypt hits us as we ride through sections of forest and the birds are delightfully loud, which always makes me smile. Any stresses I'm carrying from my day-to-day life quietly slip away as the day goes on.

We reach Bruthen by mid-afternoon, so there's ample time to see the tiny town with its galleries and craft shops. There's also the Bruthen Bakery for delicious pies and pastries, Le Café for coffee in the garden and the Bullant Brewery for a sample of craft beers.

Dinner is at the Bruthen Inn Hotel, where we are entertained by the Bruthen Arts and Festival Council. There's singing and trivia, with the most difficult questions relating to the age of participants on the ride.

This year's ride has 110 participants from six to 73 years old, which Liz says is the widest age range to date. "The event definitely favours families and older riders," she says. "It's not designed for super athletes but for those who are moderately fit."

Each day, there is also the option of completing the 'extra sweat', which adds 15–20km to the route. It's perfect for those who enjoy cycling longer distances or want the additional physical challenge. Continued page 108

'Extra sweat' highlights include a network of trails just outside Bruthen; an on-road detour that gives riders great views of the sea, mountains and the Snowy River; and the Nowa Nowa Mountain Bike Park.

DAY 2

Bruthen – Nowa Nowa
27km

The ride starts in the morning with a gentle climb through the Colquhoun/Boyanga Gidi State Forest to reach the trail's highest point. Although it's not steep, it is tiring and the morning tea spot is a welcome relief.

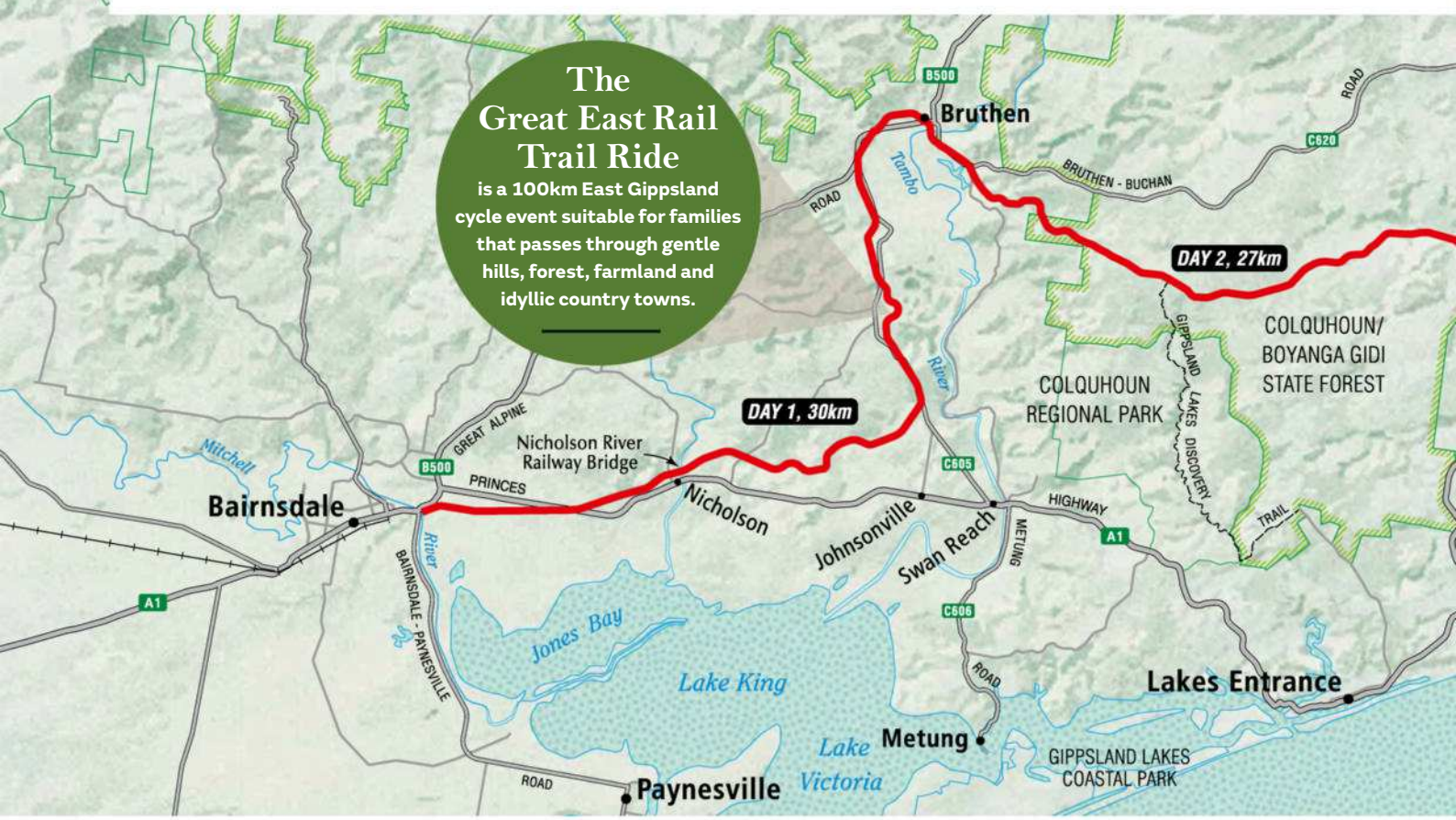
Over a cuppa, I chat to Natalie Thorne, who is from Warragul in Victoria and is riding in a group of six adults and six children. "We like taking our children outdoors and doing things that challenge us and the kids," she explains. "This ride is great, because it's so well supported. Having all the food provided, snack and drink stops, timings arranged and support for the difficult sections means there is no pressure. We'll just do what we can and enjoy the time with our kids."

The reward for the climb over the mountain is a glorious section of downhill and, for a short time, I find myself alone, freewheeling through the forest. The birds are loud and I wonder if I may be hearing lyrebirds. They frequent this forest, mimicking rosellas, wattlebirds and currawongs as part of their mating ritual – but they are hard to spot. In the distance, I see a kangaroo that must have waited for a lull between cyclists to put in an appearance.

Riders stop west of Nowa Nowa to admire the Stony Creek Trestle Bridge, listed on the National Trust's Victorian Heritage Register because of its historical and architectural significance.

Now that I'm not straining uphill, I fall into an easy rhythm, enjoying the cooling breeze and a moment of blissful solitude – before I arrive at the spectacular Stony Creek Trestle Bridge. In the early 1900s, the building of the railway track and bridges was a marvellous engineering feat – with four major rivers, valleys and sections of dense forest to negotiate.

The Stony Creek Trestle Bridge was finished in 1916 and, at 276m long and 18.6m high, is Continued page 110



A place where waters mix

Among the surprises of the event were the number of non-cycling options we were able to fit into the weekend, particularly on the second day in Nowa Nowa where we finished riding at lunchtime.

Nowa Nowa is situated where freshwater Boggy Creek merges with the salt water of Lake Tyers, and means 'the place of mingling waters' in a local Aboriginal language. There is an easy hike up to Nowa Nowa gorge and a sculpture walk alongside the lake. At Mingling Waters Cafe, there is the Ramsdell Collection of exotic Australian timbers and polished gemstones. This includes a giant tree root, known as Ra – the ancient Egyptian sun god – which is on display in a timber pyramid house adjoining the cafe.

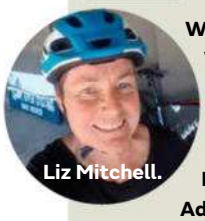
Activities organised by Snowy River Cycling include:

- yoga sessions
- **bike maintenance workshops**
- 'gears without tears' skills sessions
- **canoeing and kayaking on Lake Tyers (for a fee)**
- 30-minute relaxation massages (for a fee).

Liz also hosts a singing session to "make some sweet harmonies together". She is a firm believer that "if everyone in the world cycled and sang together it would create lasting peace". Fortunately, no prior experience or tunefulness is required for this session.

Orderly tents (but less organised bikes) at our Mingling Waters campsite in Nowa Nowa.

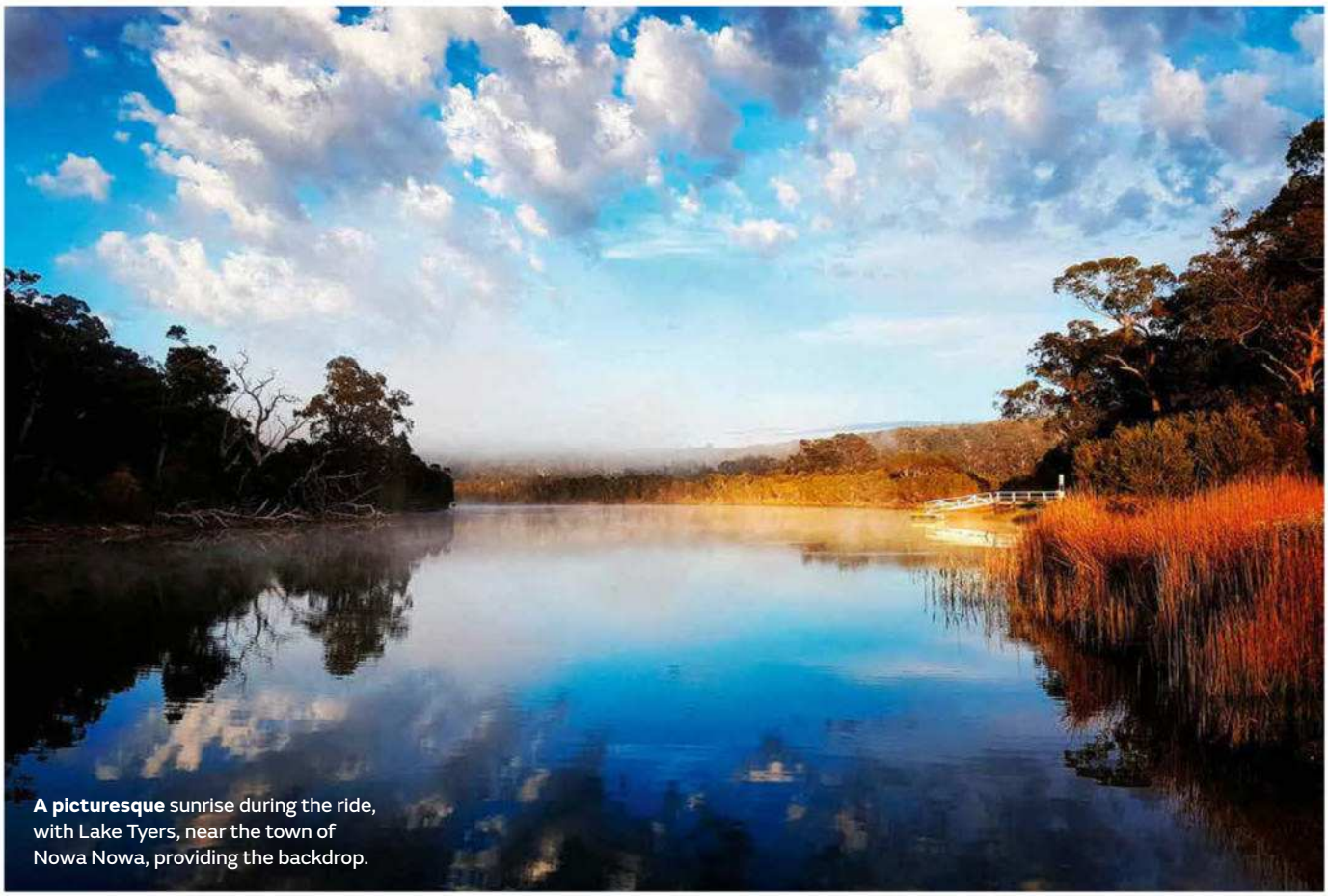
More information: Snowy River Cycling



Liz Mitchell.

What: The Great East Rail Trail Ride
When: Annually in early October
Participants: Up to 120
Contact: Liz Mitchell
Phone: 0428 556 088
Email: ride@snowyrivercycling.com.au
Address: 7 Forest Rd, Orbost VIC 3888
Website: *snowyrivercycling.com.au*

Snowy River Cycling also offers small group cycle tours from two to six days, bike hire, bike transfers and self-guided tours.



A picturesque sunrise during the ride, with Lake Tyers, near the town of Nowa Nowa, providing the backdrop.

the longest and highest remaining timber trestle bridge in Victoria. It's an impressive sight, especially as we get to see other cyclists dwarfed by the structure.

Today, the 'extra sweat' leg takes in the Gippsland Lakes Discovery Trail, which follows an old tramline down the valley of Mississippi Creek in the direction of Lakes Entrance. It's an exhilarating ride along a narrower trail that is hemmed in by a forest of stringybark and silvertop ash.

"Riding through the forest on the 'extra sweat' was so tranquil," says Melburnian Tamara Paton. "For the first 10 minutes, I rode through forest that showed signs of bushfire, with blackened tree trucks and bursts of greenery re-emerging. Then the path dropped into a valley that was much lusher with trees, ferns and bushes surrounding the route. As a lone rider, it felt quite serene!"

In Nowa Nowa, the main camp is at Mingling Waters, but a few of us stay at the quirky Nowa Nowa Camp and Caravan Park. Here there are several 1950s-era caravans, a retro camp kitchen, free-range chickens and a friendly dog. It's close to Nowa Nowa Gorge and some picturesque walks alongside Lake Tyers.

Dinner is at the warm and hospitable Mingling Waters Cafe, where we sit at wooden tables, share stories and dig into a plate of homemade lasagne and salad. Afterwards, there's sticky date pudding and some cycling-themed documentaries to enjoy.

After riding for about 20km, I am about to cycle over a small branch when I suddenly realise, too late, that it is a brown snake!

DAY 3

Nowa Nowa – Orbost
43km

The following morning, as I cycle down to breakfast at Mingling Waters, I notice mist rising from Lake Tyers. I detour to take some photographs and the scene takes my breath away. Sunlight streams through the mist and there's a reflection of the forest on the still waters. I take a moment to stand on the pier in silence, all alone, just to appreciate what a beautiful country we live in.

We also cycle here through denser sections of forest where there is a lot more debris on the track. I'm cautious on the downhill sections, looking out for obstacles, and, after riding for about 20km, I am about to cycle over a small branch when I suddenly realise, too late, that it is a brown snake!

In the split second I have to react, there is no time to change direction. I hit the snake and the bike flips. I'm

not exactly sure what happens next, but I suspect the snake gets caught in the wheel. I land heavily, taking the brunt of the fall on my forearms and knees.

After many years of cycling, this is the first time that I have ever fallen off my bike and I'm upset with myself, particularly because I've been riding with an injury – a torn meniscus in my knee. My first thought is for it and whether I've done any further damage, and then I feel the snake move.

It's right beside me or partially underneath me – and it's true what they say about adrenalin, because I've never been so nimble. I'm on my feet in a flash, standing about 2m from the snake that is now poised and ready to strike.

Fortunately, as I back slowly away, it slithers off into the undergrowth. The problem is, I don't know with 100 per cent certainty if I've been bitten.

So I flag down the next rider, who calls for support. I lie down on the track, motionless, while other riders check my body to see if they can spot puncture marks.

Liz is on the spot within 15 minutes, the ambulance arrives shortly afterwards and following blood tests in hospital I'm given the all clear. It's all very surreal.

Just before my unfortunate altercation with the snake, I saw Natalie and her daughter Olivia taking a break and I joined them. She told me they'd had a wonderful weekend. "I love watching my kids overcome their own doubts about whether they can get up a particular hill, or make it the last few kilometres," she said.

"I also love the buzz of the event. There is a real camaraderie between the riders, on the trail and at meal times," Natalie continued. "The kids are very proud of themselves – and they are already asking when we can do this again." AG

More multi-day rides

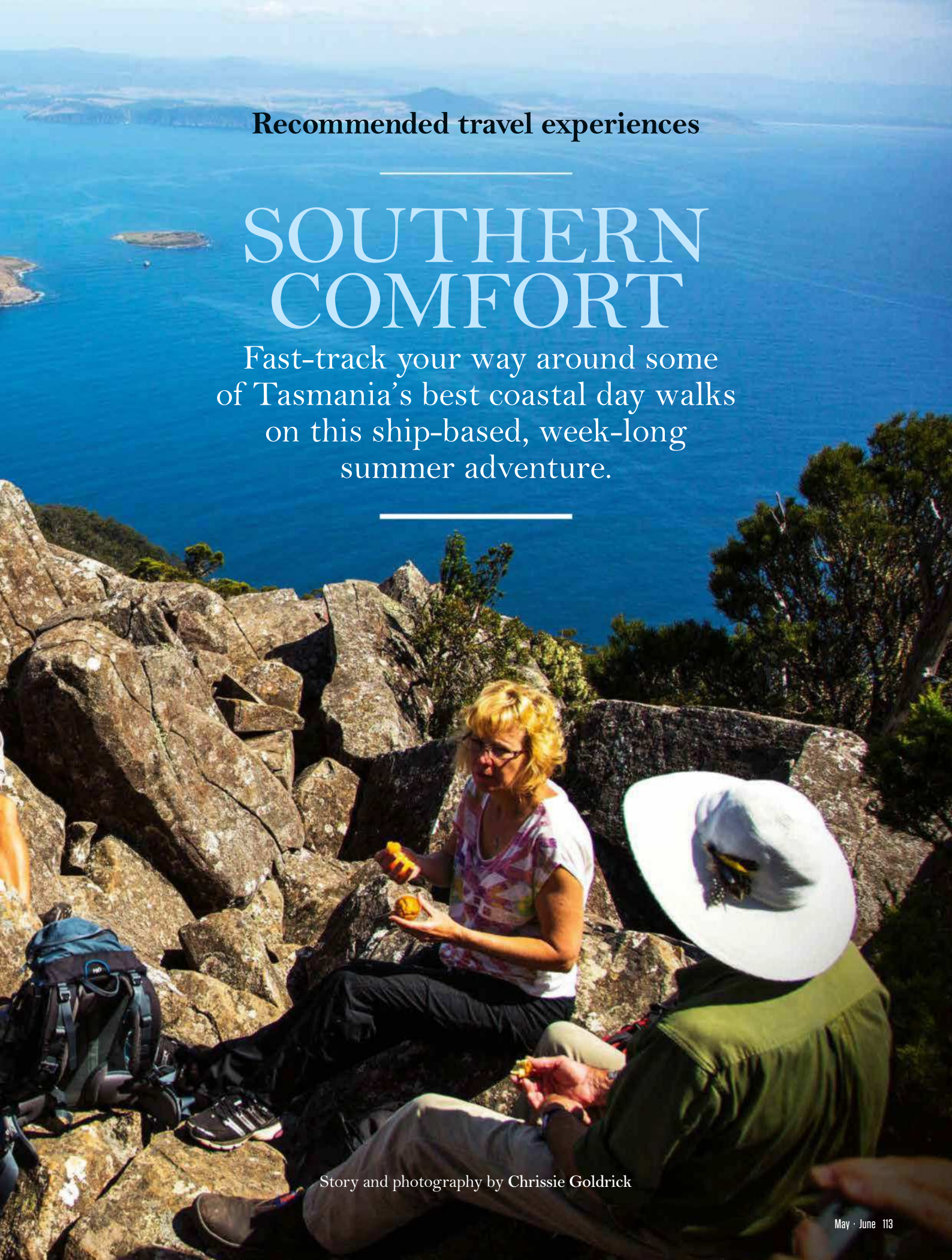
Velothon Sunshine Coast, Mooloolaba, QLD
A winter-time event where you can opt for a one-day ride of either 90km or 152km or a three-day ride over a total of 361km. 20–22 July 2018.

Outback Odyssey, Mawson Trail, SA
A 900km, 15-day adventure ride from Adelaide to Blinman in the Flinders Ranges, taking in the vineyards of the Barossa and the SA outback. May 2019.

Mawson Trail.

PHOTO CREDIT: BILL HATCHER/AUSTRALIAN GEOGRAPHIC

A well-earned break just below the summit of 599m Bishop and Clerk reveals a jawdropping vista that includes Maria Island's Fossil Cliffs and the Tassie mainland across the Mercury Passage.

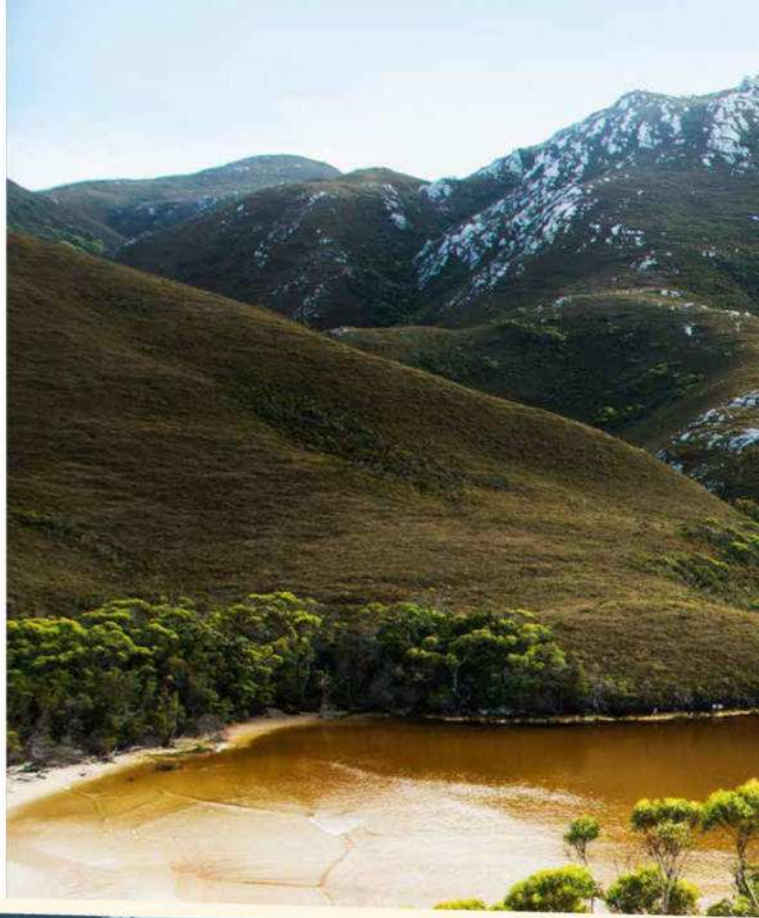


Recommended travel experiences

SOUTHERN COMFORT

Fast-track your way around some of Tasmania's best coastal day walks on this ship-based, week-long summer adventure.

Story and photography by **Chrissie Goldrick**



TASMANIA IS REGARDED as a bushwalkers' paradise, and arguably boasts Australia's highest concentration of internationally renowned short and multi-day walks. But if you're new to walking the Apple Isle, it's not always easy to pick the most suitable track to get you started, especially if you're unsure of your own fitness and suitability to tackle the famously rugged terrain and unpredictable weather conditions.

You can, of course, take your chances and simply jump in, boots and all (and you're unlikely ever to be disappointed). But it's possible to sample a variety of Tassie's superb coastal trails on a special itinerary run by Coral Expeditions from the comfort of their 72-passenger Australian vessel, *Coral Discoverer*, without the need to rough it.

Coral Discoverer gleams in the early morning light at Fortescue Bay on the Tasman Peninsula on Day One of our week-long coastal cruise.

I'VE STOPPED FOR a quick breather on a narrow, wombat-maintained track on the upper slopes of Mt Milner. I spy *Coral Discoverer* far below, dwarfed by distance and the encircling rugged ranges. She's moored in Port Davey, a deep breach in Tasmania's wild and remote south-west coast through which the Southern Ocean roars until it meets the Breaksea Islands, a bulwark of rocky islets strung across the harbour that protect it from the turbulent waters beyond. I'm on the last day of a voyage aboard *Coral Discoverer* that began in Hobart seven days ago, when I was far less walking fit than I feel today as I scramble up the mountain with comparative ease. That such a dramatic improvement to my fitness can happen in a relatively short time is testament to the demanding nature of some of the walks on offer during this trip.

Ultimately, the itinerary is at the mercy of the prevailing sea and wind conditions and is necessarily flexible. On this mid-summer voyage, we begin a week of sailing and hiking with the two most strenuous walks of the entire trip. It's the perfect baptism of fire to set a cracking pace and modify any inclination to over-imbibe at dinner or tarry too long at night gazing up at those star-studded southern skies from the ship's top deck.

After sailing south from Hobart on a windy and choppy but sunny January evening, we're woken early the next morning to tackle a section of one of the island's newest walks, the Three Capes Track on the Tasman Peninsula. It opened for business in December 2015 and features a well-constructed track in excellent condition. We trek from Fortescue Bay to Cape Hauy and back again, a moderately rated hike of 4–5 hours that starts from the boat ramp near the bay's popular campsite. All the walkers are shuttled ashore across calm waters in *Coral Discoverer*'s spacious tender, which is launched via an ingenious lift system at the stern of the ship. The mother ship's glistening white hull remains in view for a while as we skirt the coastline through thickets of casuarina and coastal banksia before the track turns inland and rises sharply. We labour up hundreds of stone steps through dense dry sclerophyll forest and are grateful for the shade as the sun climbs ever higher and the temperature with it. The track finally emerges from the trees to steeply descend even more steps to a series of saddles that undulate towards the fluted cliffs and vertigo-inducing dolerite stacks of the headland.

The views revealed by the low-lying coastal heath vegetation are spectacular. It's just possible to make out the peaks of Maria Island far away to the north. To the south Tasmania's verdant landmass comes to an abrupt end, plummeting down to the

The track to the top of 186m Mt Milner rises sharply from the tea-coloured waters of Bramble Cove, Port Davey.

▼ **Coral Expeditions'** walking guide Mark Steadman leads the bushwalkers up Mt Milner high above Port Davey, the broad bay that leads to Bathurst Harbour. This region can only be reached by boat, small aircraft or on foot, a tough hike of more than seven days.

▼ **Mts Graham and Freycinet** provide the southern backdrop to Hazards Beach and the aquamarine waters of Promise Bay. The beach and range of pink granite peaks to the north are believed to be named after Captain Richard 'Black' Hazard, a 19th-century whaler.

Guide Katharine Byrne explains the origins of the Tessellated Pavement at Eaglehawk Neck on the Forrestier Peninsula.

There's a palpable sense of achievement among the walkers as a few whoops and cheers go up.

sea in a row of dramatic cliffs relentlessly pummelled by white-capped breakers at their base. Our party crowds onto a fenced lookout perched high on Cape Hauy, where we snap away at endless blue vistas and enjoy a brief rest and a snack before heading back to the ship for a late lunch and more leisurely afternoon exploring the coastline by ship as we continue north towards Maria Island.

THE DISTINCTIVE TWIN peaks of 599m Bishop and Clerk dominate the northern end of Maria Island and are Day Two's main objective. It's a tough hike so the party splits into two. Some take the option of exploring the island's famous fossil cliffs while my group tackles the 12km return hike to the summit. The climb looks daunting and I'm uncertain if I'm going to make it the whole way, but fear of missing out is as good an incentive as any to propel me onwards and upwards. The track runs perilously close to the edge of the denuded cliff tops of Skipping Ridge, climbing higher into the casuarina and Tasmanian blue gum forest towards the start of the scree field and final ascent to the top. The track zigzags up through a steep slope of loose rocks that become larger towards the top and I find it safer to scramble up this section on all fours.

Our group pauses just below the summit to feast on freshly baked muffins and admire the superb view across the Mercury Passage, which confirms just how high we've all climbed. I struggle to get a toehold on the last big step just below the summit but a helpful shove from behind by my companions propels me up the giant boulder and suddenly I'm there. There's a palpable sense of achievement among the walkers as a few whoops and cheers go up. With a few Instagram-style extreme poses in the bag we set off down the mountain. This is often the riskiest part of any big hike with tired legs and gravity to contend with, but we all get down without a hitch and I'm grateful for my trusty walking poles, which keep me vertical on more than one occasion.

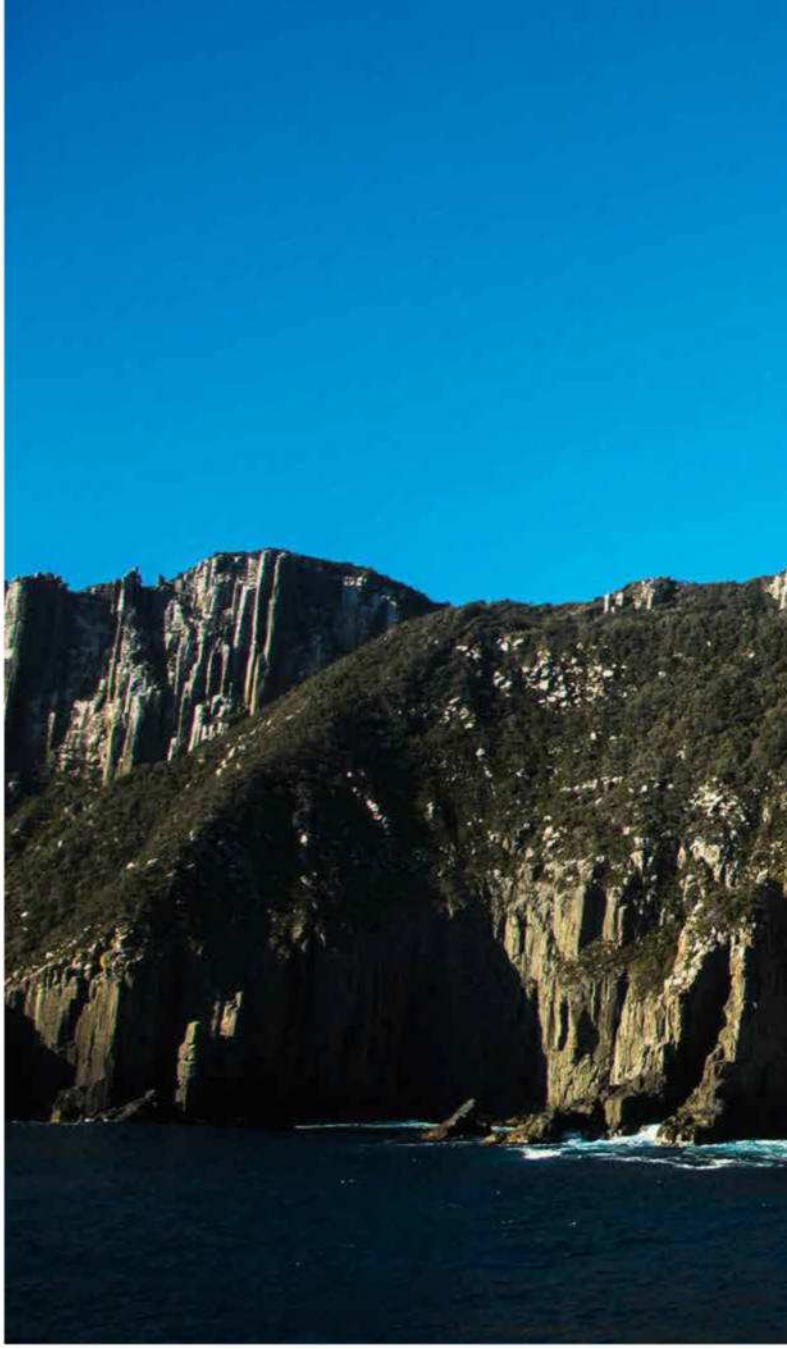
We return through Darlington, an assortment of ruins, restored huts and heritage buildings that make up the island's main settlement and are maintained by Tasmania Parks and Wildlife. Sparkling waters lap a crescent of pale golden sand in the bay so it's boots off and the blessed relief of cool sea water on hot tired feet. We re-board the ship exhausted but elated.

Each evening, in the ship's lounge, we are treated to informative lectures by the ship's expert guides and crew, but on this particular night, it proves hard to stay awake.

The track to Cape Hauy descends to the exposed cliff tops via a stone staircase. This is a section of one of Tassie's newest multi-day walking experiences, the Three Capes Track.

To book this Coral Expeditions trip with an AG readers' discount, **see page 125.**

▼ **The precise route** is weather-dependent and subject to change but includes the Freycinet Peninsula and Port Davey at either end of this action-packed, seven-day itinerary.



NEXT MORNING WE arrive at Coles Bay, tucked under the towering pink granite peaks of the The Hazards on the Freycinet Peninsula. We hike up to the famous Wineglass Bay lookout with the usual crowds but we're early enough to avoid the worst of the daytripper traffic. We continue down the other side of the saddle via a steep track towards the bay's celebrated arc of white quartzite sand. Today, big breakers are smashing onto the beach and only the very strongest swimmers among us brave the wild waters and swarms of bluebottles on this otherwise perfect summer morning.

We traverse the peninsula past Hazards Lagoon along the flat Isthmus Track towards Hazards Beach, from which point the ship's tender will eventually pick us up. The beach is almost empty apart from the occasional family group and a few pied oystercatchers dabbling in the shallows. While some of us are keen to explore outcrops of orange lichen-covered rocks at the northern end of the beach, others change into swimmers and plunge into the calm and inviting waters of Promise Bay or simply stretch out on the sand and soak up the warm sun.

The following day we turn south again, rounding the Tasman Peninsula's southernmost capes, passing the Southern Hemisphere's highest cliffs – the Cape Pillar Sea Cliffs – and eventually arrive at a small township at the head of Bruny Island's Adventure Bay. Here we scale 272m Fluted Cape. It's a loop track, steep in parts, that ascends through stands of casuarina and then hugs the unprotected cliff edge on the way down. There's no fenced lookout at the top and the sheer drop to the ocean below sets more than a few pulses racing, including mine.

The pretty bay is home to the privately run Bligh Museum that commemorates numerous European maritime explorers who landed here, including William Bligh who arrived in 1777 when he was sailing master aboard Cook's ship *Resolution*. Those not climbing the cliff have time to visit the museum while another group explores the coastline from the tender.

With each passing day, the walks become easier and a delightful beach walk at Recherche Bay towards the southernmost tip of the mainland is no exception. The South Coast Track starts here – a challenging 85km, 7–10-day walk that ends at Melaleuca Inlet, our final destination by ship. Even though I'm becoming fitter and relishing every step on these daily walks, I'm happy to leave this hike to the truly hardcore bunch of serious adventurers that this testing track usually attracts.

THE SOUTHERN TASMANIAN coastline bears the full brunt of the Roaring Forties but our sea passage to Port Davey is relatively peaceful. This final chapter of the voyage ▶

MAP OF TASMANIA REPRODUCED COURTESY OF CORAL EXPEDITIONS

The ship navigates the dramatic strait between Tasman Island and the mainland at Cape Pillar where fluted dolerite cliffs soar 300m up from the pounding ocean below.

Guide Katharine Byrne (left, at left) identifies features that can be seen from atop Fluted Cape on Bruny Island. The towering cliffs at the southernmost tip of the Tasman Peninsula (above) are the tallest in the Southern Hemisphere.

The tender heads down the Bathurst Narrows after dropping off walkers to climb Mt Beattie, which affords panoramic views of Mt Rugby.

> "Port Davey would have to be the highlight… you don't get the chance to come here every day."

has everyone excited, including experienced bushwalkers Denise and Ian Mackey from Bowral in New South Wales. "Port Davey would have to be the highlight; it's so remote and you don't get the chance to come here every day," Ian says. "You could fly here in a couple of hours, but then you're only here for an hour or so. But to be here for two days and be able to do all those walks is an opportunity of a lifetime."

Former maths teacher Denise and retired businessman Ian and have undertaken some of Australia's toughest treks including the 250km Great North Walk, in NSW, and Tassie's famous 65km Overland Track. But they find this trip more to their taste these days. "It's a privilege being here," Denise says. "The opportunity to visit so many different national parks and enjoy such a great variety of bushwalking among like-minded people and then have all that luxury on the ship as well – I can't think of any other way of being able to do all that in just seven days."

Tassie's south-west is true wilderness, remote and difficult to get to, accessible only by sea, private air charter or multi-day hike. Access to Port Davey by big cruise ships is strictly controlled, but 63m *Coral Discoverer* with her shallow draught is small enough to navigate the broad bay.

For two glorious days we explore Bathurst Narrows and Harbour in the ship's tender, passing close to manicured grassy banks kept neat by grazing wombats and wallabies. We climb the quartzite peaks of 276m Mt Beattie and 186m Mt Milner, where we're treated to sweeping panoramic views of an infinite network of channels and lakes in which the dominant peak here, 772m Mt Rugby, is perfectly reflected.

We marvel at the blindingly white quartzite airstrip hand-built by legendary bushman Deny King who lived at Melaleuca for 55 years and who was instrumental in having the region designated as a national park. We learn about the Needwonnee people at Melaleuca and try in vain to spot critically endangered orange-bellied parrots from the observation hut.

After a week of walking in the clean fresh air of Tassie, I'm feeling fitter, not fatter, despite the abundance of delicious food on offer. I wouldn't describe myself as a hardcore bushwalker, but since returning home I've walked regularly and I'm hatching plans to return to south-west Tassie soon. This time I've got the summit of Mt Rugby firmly in my sights. AG

Chrissie Goldrick travelled as a guest of Coral Expeditions.

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Expedition diary

AG SOCIETY HOSTED EXPERIENCES

Come on an adventure with us while raising funds for the AG Society at the same time.

Neil and Elizabeth Beverley noodling in a mullock heap.

See p31 for how to become a patron of the amazing new Australian Opal Centre.

Elizabeth (above) proudly displays the plesiosaur tooth she unearthed from a mound of tailings. A example of opal-bearing rock (below) and an opalised fossil (left).

LIGHTNING RIDGE

AG Society Scientific Expedition 2018

Participant Neil Beverley reflects on the 2017 AG Scientific Expedition to Lightning Ridge.

"THAT'S A PLESIOSAUR TOOTH!" Elizabeth exclaimed, and suddenly 10 or more participants on the 2017 Lightning Ridge Fossil Dig gathered around our table to feast their eyes on the real thing. It was just one of many exciting moments during my week on the dig. Each of us discovered our own pieces of the palaeontological puzzles thrown up by the opal mines here. It was a great privilege to participate in leading scientific field research and to be guided and taught by such amazing people. Our contributions were treated with great respect by a seriously talented group of experts, all of whom possessed major academic qualifications. We met many other marvellous local characters too.

I've visited Coober Pedy many times, and from the moment I saw that flash of opal colour in a mine wall I was smitten. My love of opal, combined with a keen interest in fossils, meant that reading Australian Geographic's flyer made this trip as irresistible to me as it clearly was to the rest of our group who had travelled from all over Australia to share in the fun.

The journey from our home in Adelaide took us through 'the back of Bourke', which was part of the adventure. We stayed right in the middle of town from where we could walk to the Australian Opal Centre. Our days were varied: in addition to fossil hunting I loved the noodling and the polishing, while others loved hunting gemstones in the Cumborah Gravels or searching for leaf fossils among Tertiary outcrops. I spent one afternoon with dentistry tools and a magnifier alongside Dr Phil Bell cleaning up a beautiful dinosaur eye socket that had tumbled from the specimen bag that day. I hope to find out whether it has been identified and if it is a new species.

There are so many wonderful memories from this really exceptional experience.

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DATES: 20–25 August 2018 or 27 August–1 September 2018

(Week 2 is available for return participants only.)
Cost: $2200pp includes all activities and most lunches and dinners
BOOKINGS: Call 0427 904 587, email *dig@australianopalcentre.com* or visit *australianopalcentre.com*

POSTSCRIPT The photo of Fiona Ruck photographing birds on page 122 of AG 143 Mar–Apr 2018 was taken by Karla Hazeldine.

PHOTO CREDITS, CLOCKWISE FROM TOP LEFT: JENNI BRAMMALL (JB); JB; GRAHAME MCCONNELL/AUSTRALIAN GEOGRAPHIC; JB, JB

DATES: 6–16 September 2018

Kimberley coast 11-day cruise

APT presents an exciting voyage along the Kimberley coast from Broome to Darwin. You will get ashore, meet the traditional owners, see rock art, spot wildlife and be fully immersed in the grandeur of this ancient place. Hosted by AG Society councillor Todd Tai.

WHO: APT
COST: From $13,395*pp twin share, companion flies free*
(*terms and conditions apply)

BOOKINGS: *kimberleywilderness.com.au/cruising*

DATES: 22–27 October 2018

Lord Howe Island scientific expedition

Survey biodiversity with us in the South Pacific. Run in partnership with Pinetrees Lodge, CSIRO and the Lord Howe Island Board, this is a rare chance for readers to help scientists search – in paradise – for insect species new to science. Many species on the island are undescribed or unrecorded, so you could help make a significant contribution to conservation.

DATES: 22–27 October 2018
COST: From $3770pp twin share, subject to availability
INCLUSIONS: 7 nights accom., 6 days field research, training from scientists, all meals, island airport transfers
BOOKINGS: Call Pinetrees Travel on 02 9262 6585

BOOKINGS: *info@pinetrees.com.au*

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DATES: 20 March–6 April 2019

Antarctica in Shackleton's footsteps

On this special voyage to South Georgia and the Antarctic Peninsula, you'll retrace Shackleton's famous journey from Elephant Island to South Georgia and take in the extraordinary landscapes and creatures of the Antarctic region. Mention the AGS Partner Voyage code: ASG77

WHO: Aurora Expeditions 18 days. Ex Ushuaia, Argentina
COST: From US$14,320pp in a twin public cabin (normal price US$17,900)

Book before 30 June 2018 to receive this exclusive saving of 20% only for AG subscribers.

BOOKINGS: *auroraexpeditions.com.au*

DATES: 13–24 September 2019

Swim with the humpbacks of Tonga

Join Canon Master photographer Darren Jew and his team for another unforgettable adventure with humpback whales in Tonga's Vava'u group of islands in 2019. This 12-day tour includes local activities and optional photo sessions with Darren and co-host Jasmine Carey.

WHO: Darren Jew's Whales Underwater
COST: From US$7550 ex Vava'u, Tonga

BOOKINGS: *reservations@whalesunderwater.com*

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WHO: Exodus Travels
DATES: Departures from 22 April 2018 to 29 December 2019
COST: From $2655pp twin share
BOOKINGS: Call 1300 131 564, email *australiasales@exodustravels.com* or visit *exodustravels.com*

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COST: From $8690pp
Bookings: Call 1800 637 688, email *info@auroraexpeditions.com.au* or visit *auroraexpeditions.com.au*

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WHO: Coral Expeditions
DATES: 1, 8, 15, 22, 29 January 2019 (Coastal trek itineraries depart 8 & 15 January. See page 112)
COST: From $4990pp
BOOKINGS: Call 1800 079 545 (mention AG Society to get 10% discount)

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BOOKINGS: *coralexpeditions.com/au/cruises/tasmania/7-night-hobart-hobart/*

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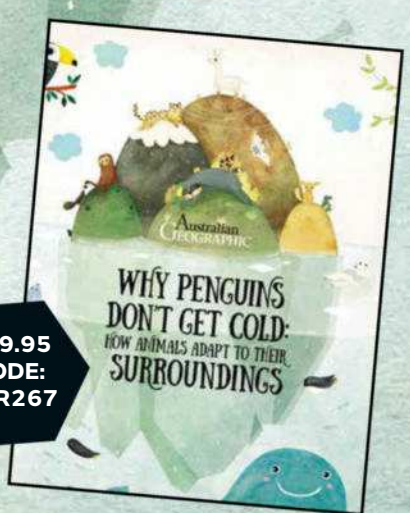

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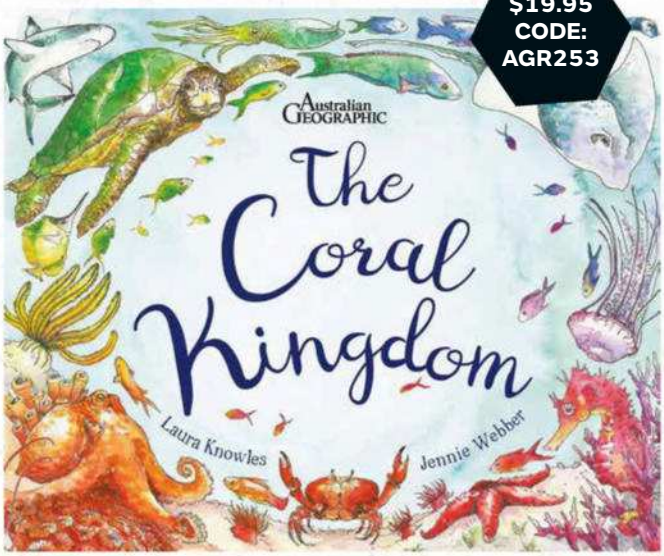

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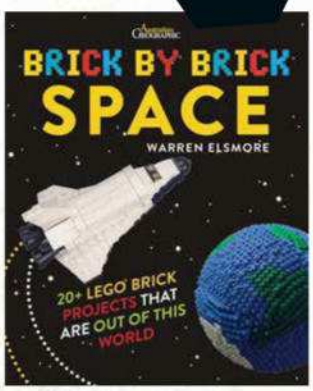

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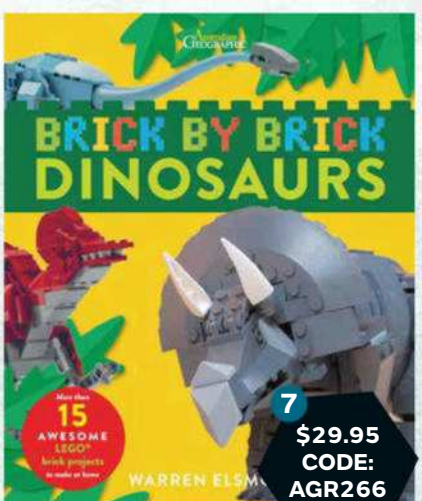

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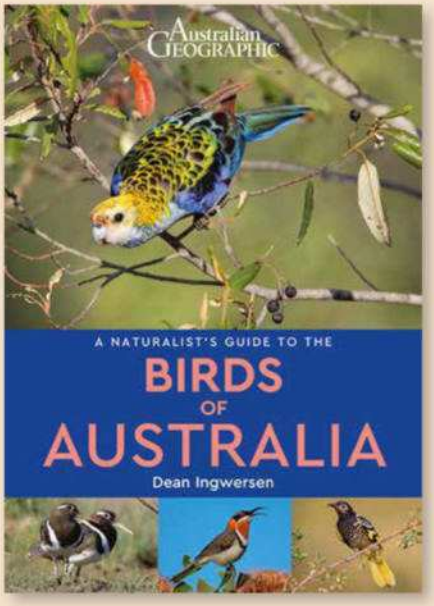

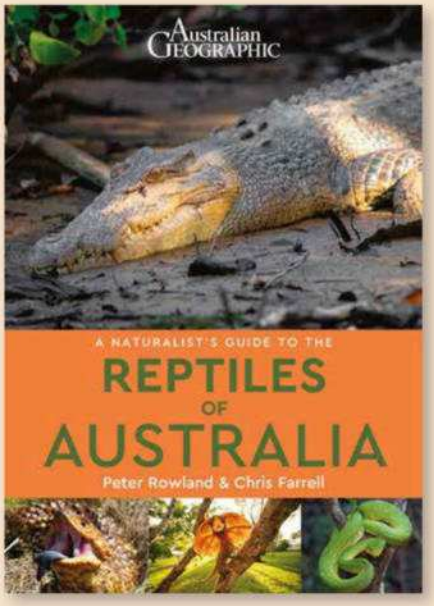

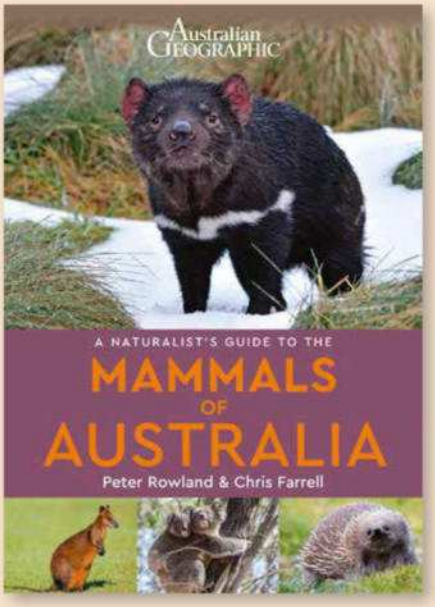

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This easy-to-use identification guide to 280 bird species in Australia, including the most commonly seen and rare endemic species, is perfect for residents and visitors alike. Dean Ingwersen has worked in various conservation roles at BirdLife Australia, and currently manages their Woodland Birds for Biodiversity project. He believes that quality photography of the natural environment is one of the strongest ways to engage the community in conservation and sustainability.

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This guide covers the threats to reptiles, their types of habitat, the anatomy of reptiles, and details of orders and families. Images from Australia's top nature photographers are accompanied by detailed species descriptions, which include nomenclature, size, distribution, habits and habitat. Also included is an all-important checklist of all of the reptiles of Australia encompassing the common and scientific name for each species and its International Union for the Conservation of Nature (IUCN) status.

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This guide to the 300 mammal species most seen in Australia includes high-quality photographs from Australia's top nature photographers, accompanied by detailed species descriptions of nomenclature, size, distribution, habits and habitat. Peter Rowland is a wildlife conservationist, educator and nature photographer, and worked at the Australian Natural History Museum for 30 years. Chris Farrell is a nature and landscape photographer who's spent 32 years behind a camera capturing the natural world.

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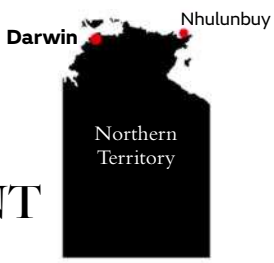
PHOTO CREDIT: JUSTIN GILLIGAN
SCIENTIFIC NAME: *Hippocampus whitei*



MY FAVOURITE PLACE
STORY BY ALEX PAYNE

Wanuwuy

Cape Arnhem, East Arnhem Land, NT

ALTHOUGH IT IS SMALL and not well marked, it's worth taking a moment to walk out to the lookout at the top of the four-wheel-drive-only track leading to the Wanuwuy beaches. First, the view is of a magnificent array of mangroves that sprawl towards the azure sea, only to be stopped short of the beach by towering sand dunes. Second, it gives you a chance to catch your breath before taking the final, alarmingly steep, descent that brings you to the water's edge. Fortunately, our battered LandCruiser is piloted by Yolngu rangers from the Dhimurru Aboriginal Corporation, who have made the trip many times before and chat easily as we inch our way down.

Wanuwuy is in East Arnhem Land, and sits within the Dhimurru Indigenous Protected Area (IPA), 50km south of Nhulunbuy. The rangers are responsible for caring for the country and managing it sustainably, because it's part of an IPA. To assist with this, all visitors require an access permit that can be purchased from the Dhimurru website or the office in Nhulunbuy. Permits are easy to get and the beaches are equally popular with locals on weekend getaways and interstate visitors on 4WD adventures. Despite this, it isn't difficult to find a beachside campsite that's completely deserted.

Today the rangers' work involves clearing the beach of discarded fishing nets and a lifetime's supply of rubber thongs that wash up from Indonesia each dry season with the changing winds. It's hard, hot work, but with the waves crashing nearby and white-bellied sea eagles soaring overhead, the morning passes surprisingly quickly.

Soon it's time for lunch and we pile into the vehicle for a short trip to nearby mangroves where the rangers spear mud crab and mangrove jack and show me how to spot mud mussels buried between mangrove roots. It's an engrossing task, but I can't help but keep a sharp eye out for saltwater crocodiles, despite the rangers' assurances.

It's obvious the rangers are proud of their country, as they take time to explain the significance of Wanuwuy as a whale dreaming site. They point out bush fruits that are ripening, tracks where turtles have hauled themselves from the water to lay eggs, and red-flowering kurrajong, whose blooms signal that baby sharks are ready to be hunted. Although the views and beaches have been hard to beat, it is these insights that have made the trip such an unforgettable experience.

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PHOTO CREDIT: DAVID HANCOCK

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