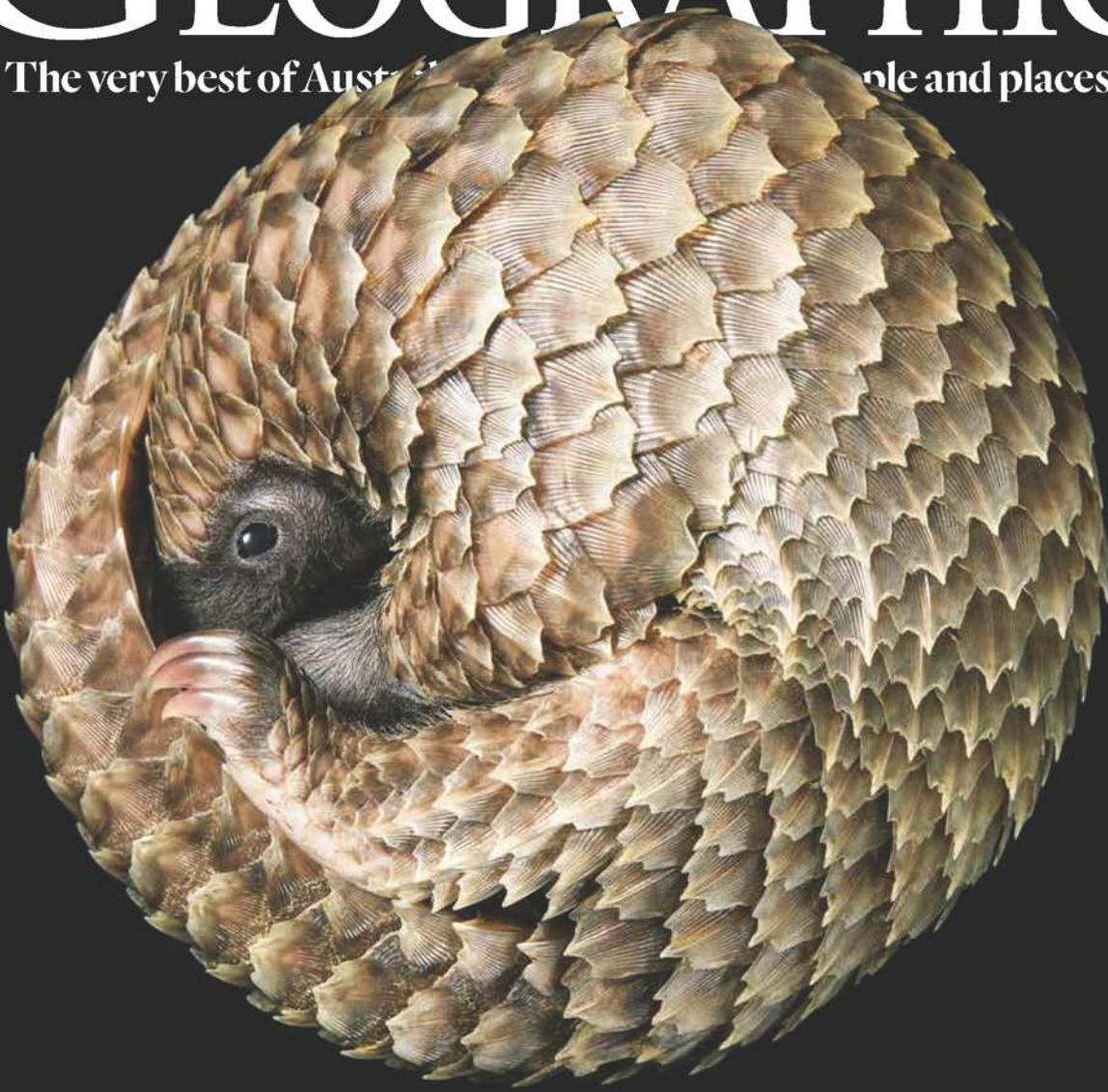


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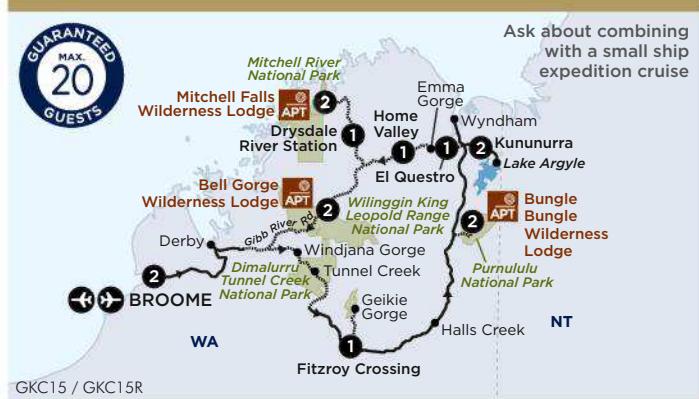


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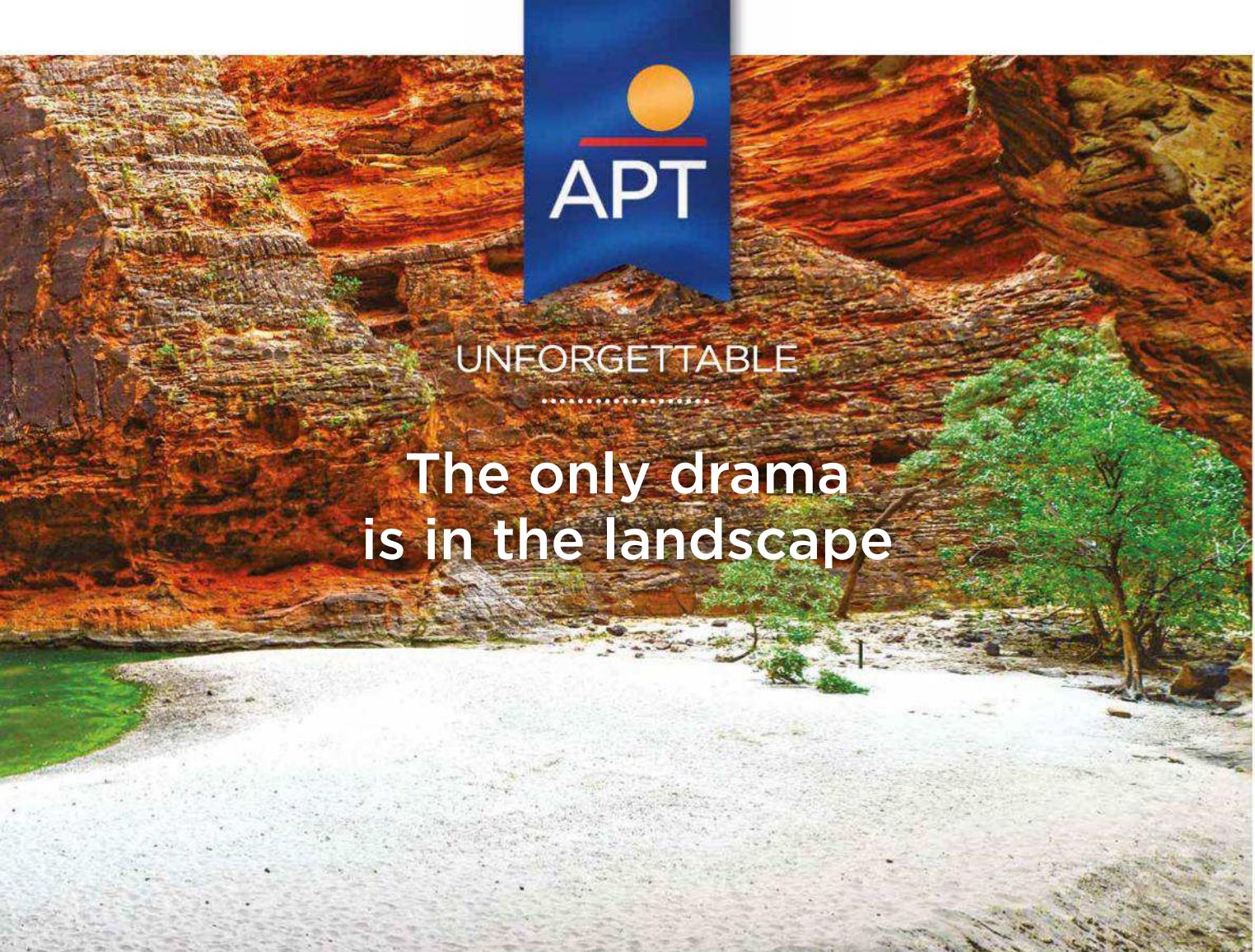
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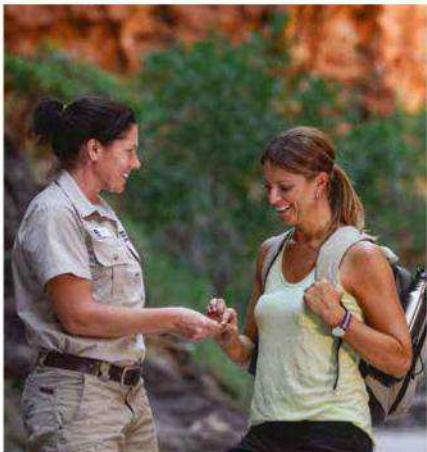
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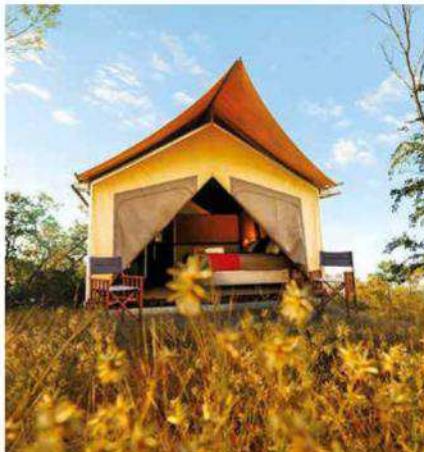
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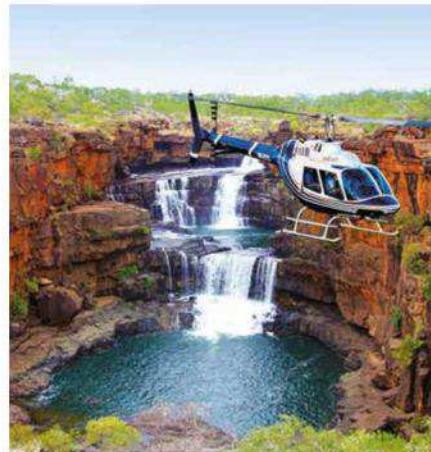
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National Travel Industry Awards

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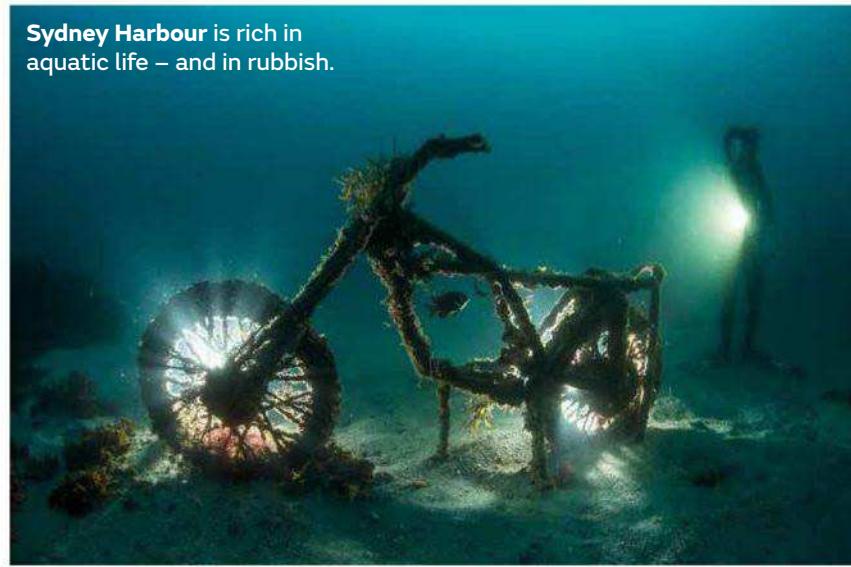
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Australian GEOGRAPHIC

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DONATE: Save the Bellinger River snapping turtle (p36).

SEE: Check out more stunning pictures of Sydney's underwater world by award-winning nature photographer Justin Gilligan (p66).

WIN: A copy of the Joseph Banks' *Florilegium* book (p31).

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

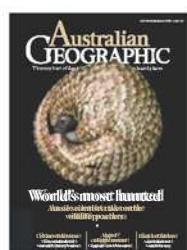


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See page **48** for more details

On the cover



CURLING INTO a ball is the main defence of the pangolin (*Phataginus tricuspis*) against predators (photographed here by Tim Flach). Given the strength of its scales, it's actually fairly effective. Sadly, it's their scales that human predators want – they're believed to cure illness by some traditional healers. These appealing creatures occur across Asia and Africa (p38).



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Celebrating science



PLEASE don't freak out when you discover our cover this month features a non-Australian animal! We haven't suddenly expanded our

editorial focus to encompass the rest of the world. This peculiar animal, the pangolin, is the first non-native creature to grace our unashamedly Australian magazine, and there's a good reason for that.

As we promote Australian Science Week in this edition, we're proud to publish the story of an inspiring multidisciplinary team of young Australian women scientists whose trailblazing research has the potential to disrupt the growing scourge of the global illegal wildlife trade (see page 38). The research, which was supported by you, our subscribers, through an Australian Geographic Society grant, has pioneered scientific methods to help identify the true source of animals, like the pangolin and many of our own unique native species, as they are unlawfully shipped around the world. The technology offers a simple and affordable solution to a growing crisis. We are always keen to shine a light on this kind of achievement in the hope it will encourage more young people, especially women, to consider a career in the sciences.

Australian science can trace its roots back to August 1768, when *Endeavour* set sail for the Pacific region carrying a group of naturalists led by wealthy botanist Joseph Banks under the steady and sure command of James Cook.

Cook's compass forms the logo of the AG Society because it symbolises that fateful fusion of exploration and science that ultimately led to the founding of modern Australia. We mark this milestone 250th anniversary with a feature about that early attempt to make sense of the world through detailed scientific enquiry (see page 50).

We will be honouring our modern heroes of science, conservation and adventure at the annual AG Society awards, in October. This year, however, we are ringing the changes with a different kind of event. We will hold a theatre-style evening rather than the seated gala dinner occasion of recent years. It's been a stellar year for big adventures and we have received many wonderful nominations for the various awards. I do hope you can join us on 25 October in Sydney (see page 32). Even if you can't get there, we're hatching plans to take the awards on the road throughout 2019 with a series of talks to be held around the nation, so we hope to catch up with you in your neighbourhood! Watch this space for more news on that front.

Chrissie Goldrick

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Notes from the field

MOST OF US with two arms would struggle to shear an unwieldy, writhing sheep. So, while shooting *Flocking back to wool* (see page 88), photographer Randy Larcombe was intrigued and inspired by **one-armed shearer Josh Talbot** (see page 4) at Hamilton Run stud in South Australia. "Josh lost his arm in a road accident when he was young," Randy explains. Becoming a shearer like his older brother was always Josh's dream, and it looked as if the accident was going to put paid to that.

But Josh's resourceful brother wasn't going to let that happen. He tied one arm behind his back and taught himself how to shear one-handed, so he could teach Josh. "I heard this story before I saw him do it and couldn't imagine how it could be possible," Randy says. "I still couldn't, even as I was taking the shots."

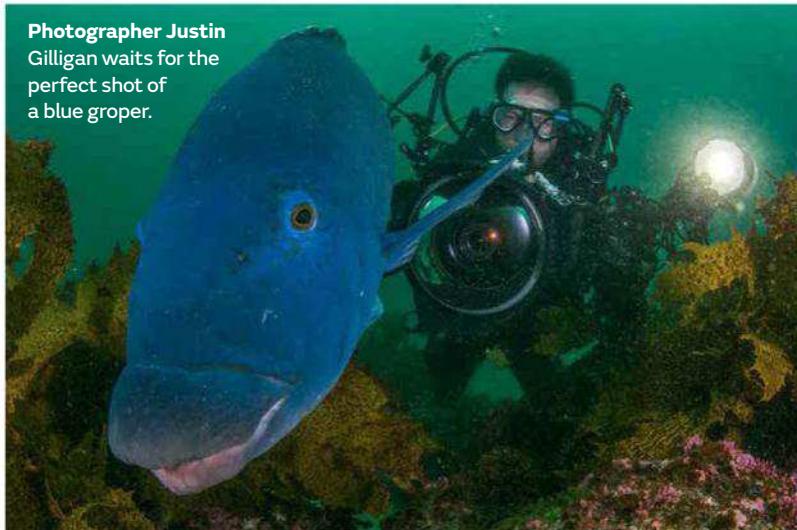
This tale of brotherly love did more than just warm Randy's heart. "Stories like this make you wonder how much of our human capacity remains untapped," he says, adding that it's meeting extraordinary people like this that motivates him as a professional photographer. "The real interest for me lies in the human stories I come across when doing this kind of assignment. There's something about the journalism and photography process that allows people to open up and reveal themselves. Everyone has a story and most people like it when someone else listens with interest. I hope through our work that readers are able to share in some of that as well." →



Notes from the field

Photographer Justin

Gilligan waits for the perfect shot of a blue groper.



Photographing Sydney submerged (page 66) also made Justin Gilligan reflect on bigger issues. While diving in the familiar waters of **Sydney Harbour**, he became most concerned by the plastic waste he saw flood the city's waterways after rain – a critical contemporary threat to urban waterways. But the pollution also provided opportunities for some outstanding photography, explains Justin: "It was critical to find scenes that combined urban and natural environments. One example was a blenny that created a home in a soft-drink can. It echoed the resilience of many species in these waterways that manage to live alongside urban development."

A major obstacle when shooting this story was the weather. "Rain and storms often interrupted clear, calm days, making underwater photography a challenge," Justin says. "I focused on portraits and landscapes during dark, moody weather, and worked under water when the clouds cleared."

It wasn't all hard work, though. Like Randy, Justin also met some extraordinary people while reporting this story. "I was inspired to meet passionate people working hard either to improve the understanding of our interaction with these waterways, or to directly improve the health of the waterways through their actions," he says. "In the end, it was important to focus on the positives."

We're also delighted to feature an exclusive article by botanist and former executive director of the Royal Botanic Gardens Sydney **Professor David Mabberley**, who's long been associated with AUSTRALIAN GEOGRAPHIC. David was closely involved with the publication last year of *Joseph Banks' Florilegium*, featuring the beautiful images created by Endeavour's botanical illustrator, Sydney Parkinson, more than two centuries ago. It's a remarkable scientific outcome from one of the 18th-century journeys of Cook, one of the world's great navigators and a true adventurer.

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Regular columnists: Dr Karl Kruszelnicki AM, John Pickrell, Fred Watson AM, Kel Richards

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MANAGING DIRECTOR Jo Runciman

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ADDITIONAL CARTOGRAPHIC CHECKING

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Email: society@ausgeo.com.au

ADVERTISING

BRAND AND PARTNERSHIP MANAGER Nicola Timm
0424 257 527, ntimm@australiageographic.com

SUBSCRIPTIONS AND SALES

SUBSCRIPTIONS CAMPAIGN MANAGER Thea Mahony
GPO Box 5252, Sydney NSW 2001, Phone: 1300 555 176
(in Australia), +61 2 8667 5295 (from overseas)
Email: magshop@magsop.com.au

EDITORIAL CORRESPONDENCE TO

Australian Geographic, Level 9, 54 Park Street,
Sydney NSW 2000, Australia
Phone: 02 9263 9813 Fax: 02 9126 3731
Email: editorial@ausgeo.com.au

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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.



Featured Letter

RECALLING AMY

The article *Feted flight* (AG 143) had special interest for me. After her groundbreaking, solo England–Australia flight, famed aviatrix Amy Johnson arrived in Goulburn on a wintry 14 June 1930, where a crowd of up to 5000 greeted the heroic young ‘girl pilot’ at the Aero Club. But not everything went to plan. On doctor’s orders, Amy didn’t pilot her plane Jason but flew in another plane piloted by Major de Havilland that headed first for Canberra to meet the prime minister. Heavy fog prevented that, so the plane turned back, landing at Goulburn at midday. Facilities weren’t ready so Amy had to wait in a car to arrive as planned at 4pm. An enthusiastic welcome followed and Amy was made an honorary member of the Aero Club. A dinner that night was followed by a ball. George Wright of Taralga was part of the celebrations and bought a souvenir brooch for his wife, Lillian. It was special: on that day she had given birth to their first child, me. Attached is a photo of the brass brooch of Jason shown alongside a 1930 English penny.

WILLIAM WRIGHT, GUNDAGAI, NSW

CULTURE CHECK

Thanks for your article *The last great expedition* (AG 142) on the 1948 scientific expedition to Arnhem Land. The introduction to the boxed item “A colonial legacy” (page 99) claims this was “a time when Christian missions sought to wipe out the ‘heathen’ customs of Arnhem Land’s Aboriginal people” and needs correction. In the 1940s, apart from a Methodist Mission at Maningrida, the Church Missionary Society had only three or four missionaries in Arnhem Land working among 5000 Aboriginal people. Although the missionaries longed to share the Christian faith, most of their time was spent in healthcare and serving the people in practical ways. When spiritual and cultural matters were raised, Aboriginal culture proved quite capable of deciding what to accept or reject from the Christians. The myth that Aboriginal people had no or little ability to understand and weigh up for themselves the claims of Christianity does them a disservice. Many understood, and rejected, this teaching, while others did come to faith. Even today, older Aboriginal Christians in Arnhem Land refer to this period as the ‘golden

years’ for their people. In the 1960s and 1970s, when Mission Societies accepted government money, they did become caught up in unwise policies to change Aboriginal culture. That is where criticism is due. But that’s another story.

GRAEME BEGBIE, GERRINGONG, NSW

WALKING FEAT

Congratulations to Terra Roam on her circumnavigation by land of Australia, sponsored by the Australian Geographic Society. My mum’s cousin Neville Westwood was the first person to complete the circumnavigation by motor vehicle, in a Citroën, in 1925. The restored vehicle is in a motor museum in Canberra. Sounds like Terra had a hard slog. Hope she gets the recognition she deserves. Mindfulness is good: I used to work in the bush and noticing the micro and macro helps mental health. Best wishes Terra and AG.

PETER GILLES, ALBANY, WA

BOTANICAL FIX

I always enjoy the magazine but have a bit of a backlog to get through because I’ve been overseas and then travelling a bit. So, I apologise if the following has already been pointed out. In AG 140,

the Big Picture is said to be a red and green kangaroo paw, which as the accompanying text says is the floral emblem of Western Australia. However, as a botanist from WA, I can inform you that the picture is not the red and green kangaroo paw *Anigozanthos manglesii*. It instead appears to be a cultivar of the tall kangaroo paw, *Anigozanthos flavidus*, a popular nursery plant. You can find out more information about *A. manglesii* at this page from the WA Herbarium’s website florabase.dpaw.wa.gov.au/browse/profile/1411

GRAHAM ZEMUNIK, OSBORNE PARK, WA

NOT DISAPPOINTED

Way back in 1986 when AUSTRALIAN GEOGRAPHIC was first published, my parents were so impressed with the publication that they took out a subscription for each of my three sisters and me – and continued the subscriptions until recently when my mother, Elaine, passed away. Now, 30 years later, we still look forward to AG. My sisters and I have always enjoyed reading the wide variety of articles in the magazine. And during the past months, when my mother was on

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Talkb@ck



In May, AUSTRALIAN GEOGRAPHIC online columnist **Bec Crew** profiled the bizarre Antarctic scale worm, an animal with a body that looks like it's made from rows of human teeth. Here's what you said:

JANET RICKARD

One of the creatures off the X-Files!

MEM OR

I haven't gone any further than the photo on the link...shudder.

RHIANNON THOMAS

All of sudden snakes don't seem so bad.

STEPH CRISP

I want it as a pet. Is that weird?

KATRINA LAVICTOIRE

I think it's kind of pretty with its golden tail.

CHRISTINA HARRIS

Looks like a very broken Golden Snitch.

KRISTEN DIRVEN

Never expected Goldilocks to be real and a worm!

CHRIS HARBROW

Just another reason to stay out of the ocean!

her own (after our father's death) and then living in care, I always took my copy of AG to her to read. I knew there would always be a number of articles she could relate to. She looked forward to me bringing it to her and despite her failing eyesight, she would read and re-read the magazine from cover to cover. When any of us would visit her, the conversation would quickly come around to something she had found interesting in the magazine. And so, a big thank you to AG, from my three sisters and me. Our mother passed away recently at the age of 93 and I have just received my May–June issue of the mag (AG 144), and again it hasn't disappointed. There were a number of articles that would have connected Mum and Dad with their life's memories, and I know I would have loved to share these with them. So, Mum and Dad, wherever you are, I hope you can get AG – because I know you won't be disappointed!

CHRIS HENDRY, RUSSELL ISLAND, QLD

ORCA ENCOUNTER

I was very interested in your article in AG 144 about attacks on humpback whales by orcas. I witnessed a frightening attack last October by two orcas off the coast of Nambucca Heads, on the NSW north coast. It was quite a way offshore and, of course, it was one of the few days I didn't have my binoculars with me! There was at least one humpback and the two orcas breached in unison and crashed down on the larger whale's back. I could not see if a calf was present but watched the attack for at least 10 minutes and I don't know how long it had been going on before I saw it. I have never

seen orcas here before and I was pleased to read that it is actually good news because I found it really quite distressing to watch! I have been a subscriber since AG 4 and have found something of interest in every issue.

HELEN ROBBINS,
NAMBUPCCA HEADS, NSW

WINE FIGURE

I love receiving your magazine every second month and I thoroughly enjoy the articles. Fantastic work! I am moved to write about the wine article in AG 144, in particular page 71. The figure in the red circle says total vineyard area in Australia is about 1350ha. The Wine Australia website (wineaustralia.com) estimates the area is about 135,000ha. I suspect someone has dropped two zeros from the figure! Anyway, keep up the fantastic work, I have discovered many areas of Australia after reading the magazine.

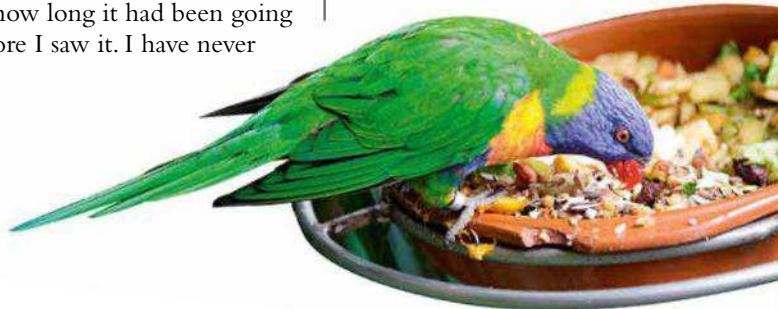
JOHN FRENCH, EPPING, NSW

Ed: Thanks for pointing this out to us, John. Yes, we certainly got this figure wrong and are very happy to correct it: as you said, the total vineyard area in Australia is 135,000ha, not 1350ha. Somehow a couple of zeros dropped off from that figure.

FOR THE BIRDS

I was heartened to read the sensible article on feeding wild birds in AG 144. It reflected the realities that so many Australians have observed over the years. I am tired of reading so many negative stories of human interaction with the environment, which this one wasn't.

KINGSLEY BARKER, TWEED HEADS, NSW



GEO**buzz**

An aerial photograph showing a pattern of agricultural fields with alternating light brown and dark brown diagonal bands. Several white, billowing smoke plumes are visible, particularly on the right side, suggesting burning or harvesting activity. A small cluster of buildings and trees is located in the center-right area where the fields converge.

July · August 2018



PHOTO CREDIT: SCOTT BRIDLE



Big picture

Lines of sight

Photographer and helicopter mustering pilot Scott Bridle captured this unusual elevated perspective of the Darling Downs, west of Toowoomba, Queensland. The area is renowned as some of Australia's best farming land, with rich, deep, fertile black soil. This photograph was taken early one morning when the air was crisp with low-floating clouds, which were a foil to the intriguing and precise 'stripes' produced by the farming methods used below. Scott became a chopper pilot at the age of 32 and moved to northern Queensland to begin mustering over country where he'd worked as a ringer, transferring his experience on the ground to the air. It was at this time that Scott began taking aerial photographs, producing rare perspectives of Australian landscapes.



Aussie 'otters'

Our biggest rat is a surprisingly endearing water creature with glossy fur and fabulous whiskers.

STORY BY GEOFF WILLIAMS

MENTION 'RAT' and Australians usually think of introduced black rats. But we have many native rodents that have been part of Australia's fauna for millennia (see AG 143). One of the largest is the water-rat, known also by the Aboriginal name rakali.

It's like a Down Under otter – an aquatic mammal well known in North America and Europe. Among the rakali's many appealing otter-like features are glossy fur and distinctive whiskers. It has a streamlined body and thick, tapering tail that acts as a rudder. Also like otters, rakalis are top-order aquatic environment predators, occupying the same ecological niche across Australia that's filled by otters in the Northern Hemisphere.

Rakalis feed mainly on prey from streams, creeks and dams – including fish, yabbies, mussels and aquatic insects. They also forage in muddy reed beds and on river- and creek-banks. In Queensland, rakalis have even learnt to eat cane toads by flipping these

noxious pests over to avoid ingesting the poison glands on their dorsal surface. Although mainly associated with fresh water, rakalis also inhabit brackish estuaries and even saltier bays and inlets, where they sometimes use moored boats as feeding platforms.

The rakali is difficult to study in the wild and hasn't traditionally attracted much research funding. Little is known about population trends, making it difficult to assess the species' local conservation status. Anecdotal evidence suggests habitat change has caused numbers to decline in some areas, such as irrigation districts where earthen channels have been lined with thick plastic sheeting to reduce seepage.

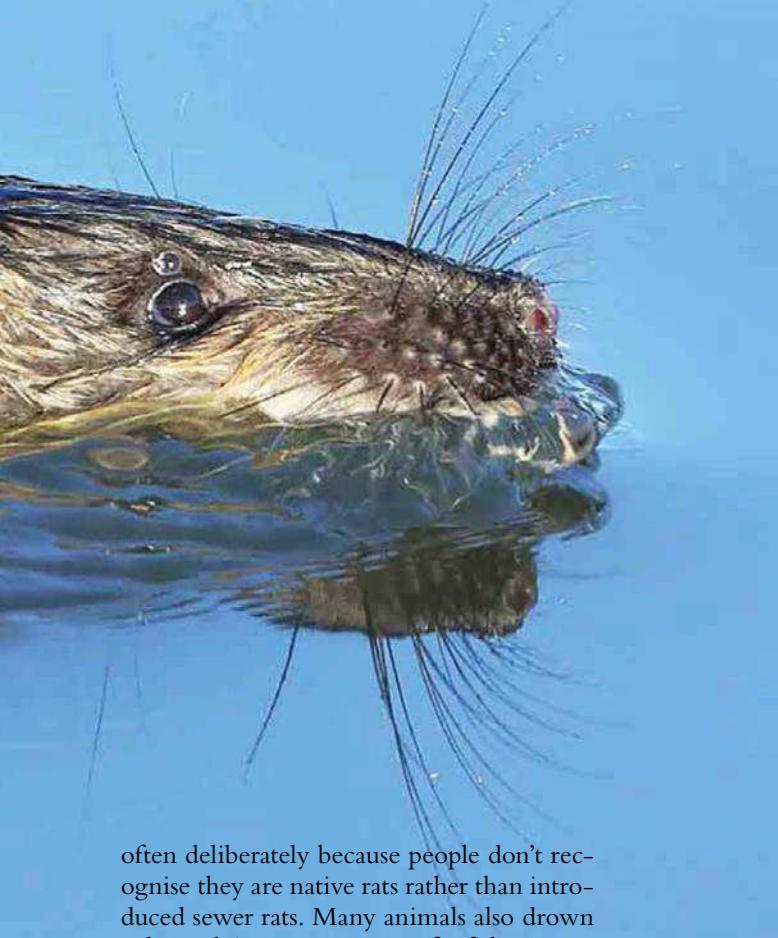
The rakali also continues to suffer direct human impacts. During the early 20th century, many thousands were killed annually for their pelts, with more than 50 needed to produce a single fur coat. Although now legally protected, water-rats still sometimes die after being trapped, poisoned or shot –

Surveying rakali

THE AUSTRALIAN Platypus Conservancy (APC) is asking the public to help conserve the rakali by reporting sightings. It's found in aquatic habitats from rivers, creeks, lakes and ponds, to dams, wetlands, estuaries and coastal areas. Adults weigh up to 1.2kg and have a white tip on the tail. They're most active early morning and late afternoon, although they can be seen at any time of the day, particularly in winter.

Report recent or past sightings to the APC website platypus.asn.au/report-a-sighting. Include details of how many animals were seen, the date and location, and give the name of the water body, latitude and longitude where possible.

ACT region sightings will be most useful, but reports from all regions are welcome.



often deliberately because people don't recognise they are native rats rather than introduced sewer rats. Many animals also drown as bycatch in traps or nets set for fish or crustaceans. Studies carried out in Western Australia and Victoria found more than 40 per cent of reported rakali deaths involved animals drowning in nets known as opera house traps set for marron or yabbies.

The Australian Platypus Conservancy (APC) conducted a community-based survey in 2017 of rakali in Victoria to improve understanding of the species' status. This achieved a 74 per cent increase in modern Victorian data on the species. Interestingly, the animal appears to thrive in many artificial water bodies, suggesting opportunities to create new rakali habitat when urban lakes or wetlands are developed. Management authorities are also being encouraged to retain existing habitat when lakes or channels need to be modified.

The APC is conducting a similar survey in the ACT in 2018–19. It'll be launched with a public talk at the Australian National University's Slatyer Seminar Room on 2 August. All data collected will be shared with Canberra Nature Map and the Atlas of Living Australia to ensure it's publicly accessible. Other talks and rakali-spotting sessions will be held to build public awareness about rakalis and encourage people to watch for them and report sightings.

Science Week events

All things science will be celebrated across Australia from 11 to 19 August. Find out more about what's happening near you at the Science Week website.

scienceweek.net.au

WESTERN AUSTRALIA

Future Climate and Food in WA

WHERE: Baskerville Hall, Baskerville

WHEN: 11 August

Discover what WA's changing climate means for food production, availability and quality, how local producers are responding and how supermarket shelves will look in 2050.



TASMANIA

Open Day at the Telescope & Grote Reber Museum

WHERE: Mt Pleasant Radio Telescope & Grote Reber Museum, Cambridge

WHEN: 19 August

Learn about the science of radio astronomy, take a tour of the facility and experience the Telescope Control Room during this open-day event.

QUEENSLAND

Saint Mary's Annual Science Fair

WHERE: Saint Mary's Catholic College, 10 Kent Street, Kingaroy

WHEN: 14 August

A day-long event where Year 7, 8 and 9 students will present their term science projects, alongside a science show presented by teachers and students.



NORTHERN TERRITORY

HealthLAB at Parliament House

WHERE: Parliament House, Darwin

WHEN: 14 August

The Menzies School of Health Research HealthLAB brings biomedical technology to Parliament House to show people what's under their skin (left) and give them a chance to take and understand their own health measurements.

SOUTH AUSTRALIA

Monarto Woodland Birds

WHERE: Frahns Farm Road, Monarto

WHEN: 11–17 August

Help scientists from the University of Adelaide trap, band and release woodland birds in the Monarto region.



ACT

Make Your Own Cheeky Neuron at Science in ACTION

WHERE: The Bus Depot Markets, Kingston

WHEN: 10–11 August

Learn about the brain from Nix & Nellie the Cheeky Neurons – then make your own neuron to take home.

Reef robocop rescue

Coral-killing starfish are in the sights of a new robot army that's being trialled on the Great Barrier Reef.

STORY BY DAVID LEVELL

DOZENS OF UNDERSEA robots could soon be combing the northern Queensland waters, taking on a major threat to the Great Barrier Reef – coral-eating crown-of-thorns starfish (COTS) plagues.

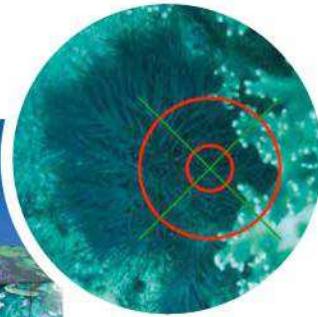
Crown-of-thorns starfish (*Acanthaster planci*) outbreaks are a leading cause of coral loss on the Great Barrier Reef (GBR), and in 2015 Matthew Dunbabin and Feras Dayoub, roboticists from the Queensland University of Technology, tested a promising solution – an autonomous diving machine called a COTSbot (see opposite). These can locate and identify the rogue starfish under water and kill them with toxic, but environmentally friendly, injections of bile salts.

Now trials are underway of a vastly improved version of the COTSbot called RangerBot, funded largely by a \$750,000 grant from Google's Impact Challenge program. And the early results look so good that plans are underway to substantially scale up the project.

The latest robot cruises at about 1.2m above the seabed, searching for the starfish by processing up to 10 photos a second. "We've got hundreds of thousands of images of starfish, and we've trained RangerBot to recognise only crown-of-thorns," Matthew says. "Our detection system is about 99.4 per cent accurate. We have very strict thresholds. If the machine has any doubt, it won't inject. Later we review the photos it doubted to further improve our system."

RangerBot swims lower than the prototype COTSbot, taking it closer to its starfish targets and improving the accuracy of its robot vision or 'image-based automated inspection technology'.

Rate of processing was a key challenge. "It requires serious computation but we're limited by the power we can



Roboticists (L-R) Feras Dayoub, Matthew Dunbabin and Peter Corke with their starfish-killing COTSbot that started the robot revolution now set to help control the crown-of-thorns starfish (above) on the GBR.

carry on board – even a laptop's too big," Matthew says. "We've had to optimise software and hardware to run in real time." Having identified a crown-of-thorns starfish, the robot hovers about 90cm above it and injects the solution, which kills the starfish within 24 hours. It injects for about a second then quickly retracts so it doesn't get caught on coral.

The original COTSbot was powered by a small, soft drink bottle-sized air cylinder that lasted for about 100 injections. "With RangerBot, the hydraulics use an electric motor, with sea water driving the inflation," Matthew says, "so you don't have to refill gas bottles."

An even bigger advance was replacing COTSbot's acoustic navigation sensors with a purely visual system. This makes RangerBot seven times cheaper to build, and much smaller. RangerBot's batteries are different, too. Matthew says, "With COTSbot we had to recharge batteries in situ, but the new RangerBot has removable battery pods. On a boat, you can take the battery out – without turning it off – and put another one in, which meets our goal of an eight-hour operational day."

Another innovation responds to the crown-of-thorns' lifestyle. "One of the big problems is there are not enough crown-of-thorns starfish visible during the day," Matthew says. "A lot of the time they're hiding underneath corals where we can't get them." RangerBot's inbuilt lighting means it can operate at night, when they come out to graze in the open.

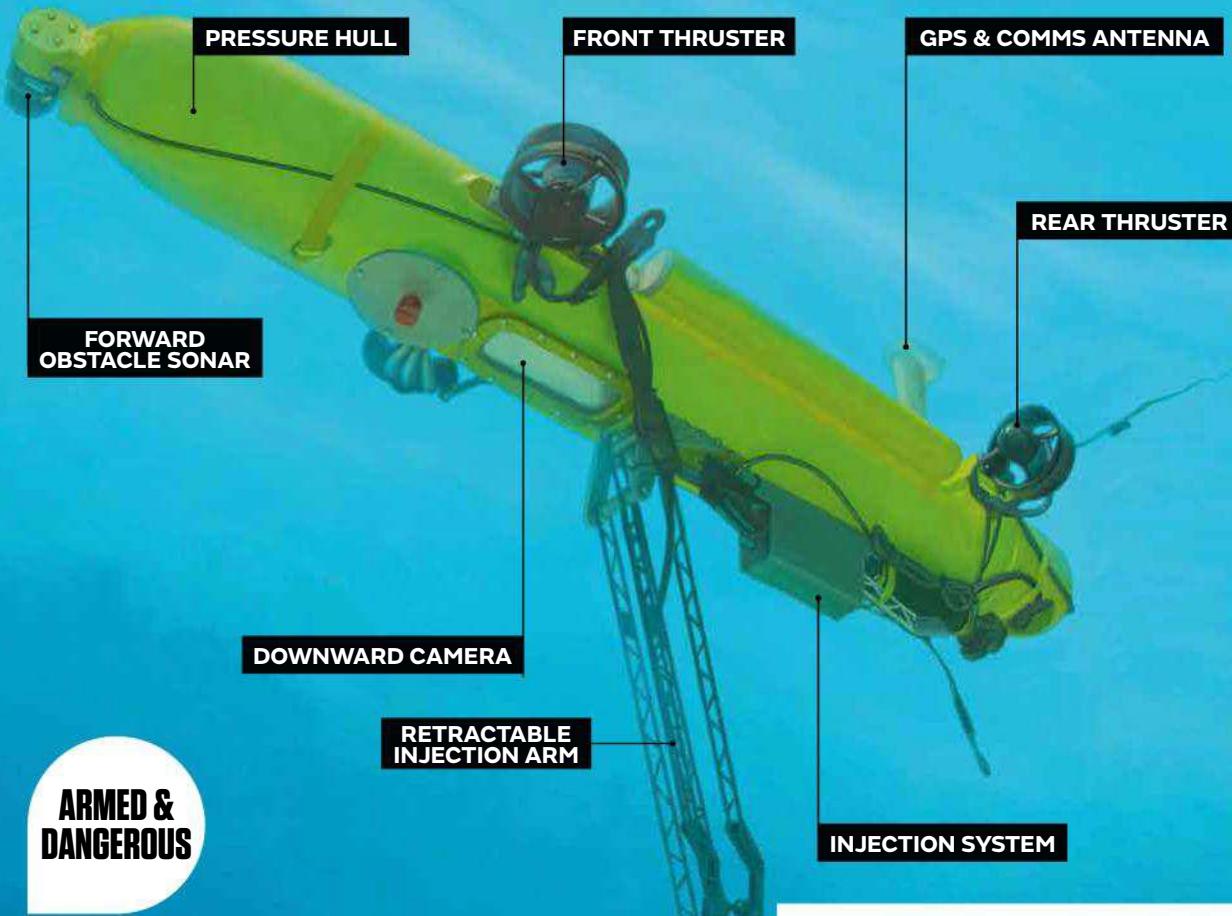
Built to dive to 100m, RangerBot can travel about 14km in an eight-hour day (with a battery change halfway). Its new single-shot injection was a prior invention, made in 2014 by James Cook University researchers, to replace the 20 or so injections previously needed to kill a single starfish.

That development alone meant COTS-culling human divers, who are still the main means of control for the starfish when they're in plague proportions, became 250 per cent more efficient.

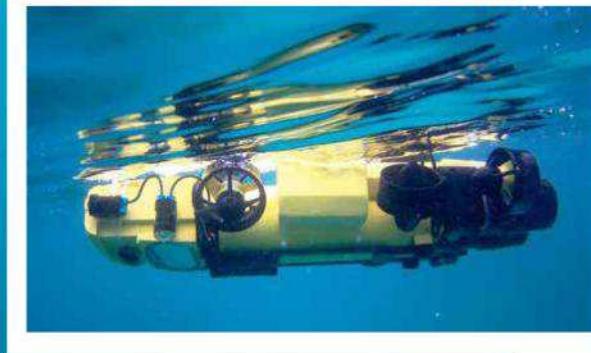
RangerBot's potential to support human divers targeting crown-of-thorns is obvious, but its capabilities don't stop at starfish-zapping.

Matthew says coral-health monitoring, water sampling and fish surveys are tasks RangerBot could also take on. **AG**

The original COTSbot

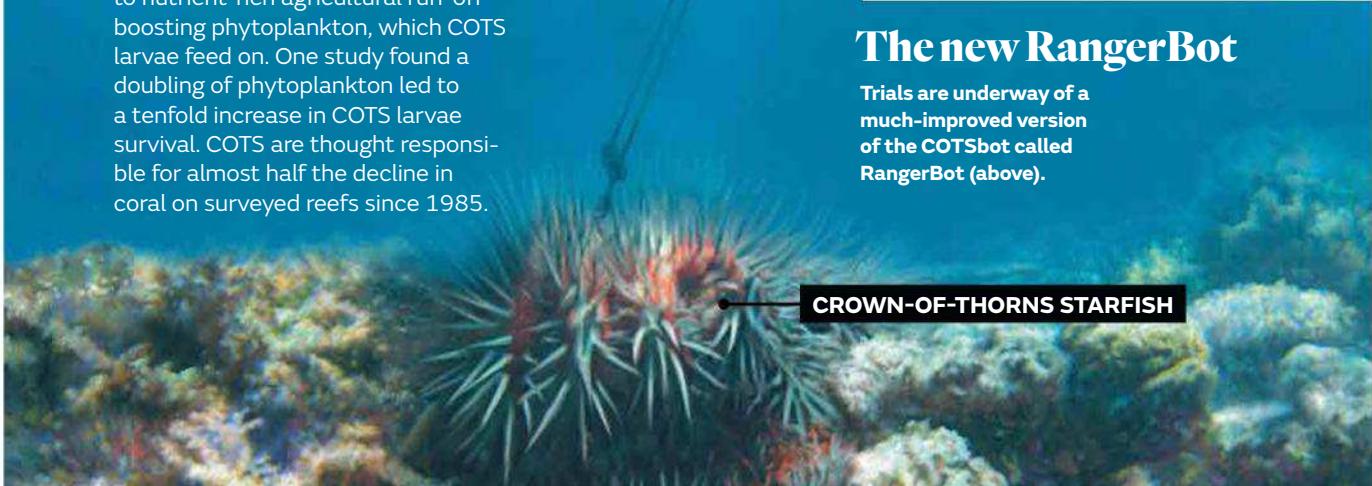


AT NORMAL NUMBERS (fewer than one per hectare), crown-of-thorns starfish help reef diversity because their dietary preference for fast-growing coral species helps slow-growing coral to build up. In plague numbers, however, COTS eat any coral, and do it at a rate faster than it can regrow. They're classified as being in plague proportions when a reef suffers net reduction, which typically happens when COTS reach 15 individuals per hectare. An increase in outbreaks has been attributed to nutrient-rich agricultural run-off boosting phytoplankton, which COTS larvae feed on. One study found a doubling of phytoplankton led to a tenfold increase in COTS larvae survival. COTS are thought responsible for almost half the decline in coral on surveyed reefs since 1985.



The new RangerBot

Trials are underway of a much-improved version of the COTSbot called RangerBot (above).



NEED
TO KNOW



with Dr Karl Kruszelnicki

Min Min mystery

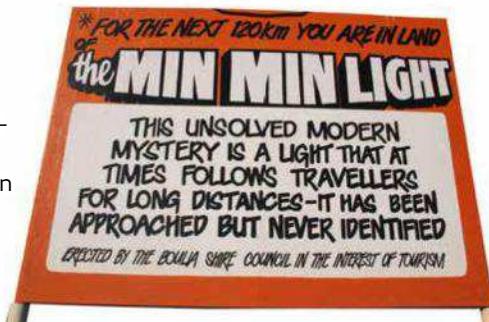
THE MYSTERIOUS MIN MIN lights appear after dark, of course. Weirdly, when you approach them, they always retreat. They were first noted near the now-abandoned western Queensland settlement of Min Min.

A typical Min Min light is circular, about one-quarter the size of the full Moon and has fuzzy, moving edges, like a buzzing bee swarm. Min Min lights are usually white, but can be green, yellow, red or rarely blue. The fuzzy orbs can dance around erratically left to right, up and down and back and forth. Occasionally, a single Min Min light can suddenly split into two separate lights.

Australian polymath and neuroscientist Professor John Pettigrew says he's solved the mystery. Indeed, he was even able to create his own Min Min light.

He says they are real, but distant, lights – a fire, or bright headlights.

Normally, you can't see them, because they're over the horizon, and too faint. But Professor Pettigrew has proved that a layer of cold air, sitting just above the ground, between the distant light and the observer, can trap light. This layer bends the light and keeps it close to the ground, so it can be seen over great distances. This layer of cold air can also concentrate the distant light and stop it from spreading – so it doesn't get weakened by extreme distance.



John Pettigrew used geometry to show a Min Min light was actually very bright truck headlights – 300km away! Another time, he drove 10km away and shone his headlights at the campsite. His companions reported via radio seeing a bobbing light just above the horizon, half the size of the full Moon, changing from vivid red, to orange, yellow then green. As Pettigrew switched his headlights on and off, the Min Min light disappeared and returned.

So these floating orbs aren't combusting marsh gas, swarming bioluminescent insects, or even aliens. But light trapped in cold air is spooky enough.

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

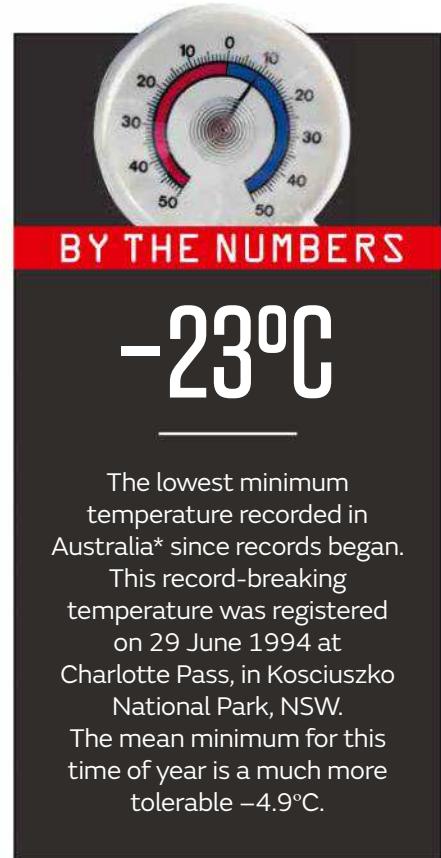
Ask an expert

William Arnold, zoologist in the School of Biological Sciences, University of Queensland

Q
A

How do so-called meat ants navigate to find their nests?

Most meat ant species are omnivores that scavenge plant material and invertebrate carrion. They also protect aphids and other insects from predators, in return for sugary excretions. Some species are solitary foragers that find their way via landmarks, path integration, or both. With landmark orientation, the ant (left) remembers snapshots as it leaves its nest. On return, it positions itself where its view matches the snapshots. For path integration, the ant tracks distance, by counting its steps, and direction, with a celestial compass that uses Sun position or atmospheric patterns of polarised light. Group foragers follow well-defined trails from the nest to a food site and back again. Workers will clear debris to allow easy passage and returning ants leave a pheromone trail that outbound workers follow. This ensures more workers are recruited to a good foraging site as the trail is reinforced by additional workers.





Download

Australian Red Cross First Aid

It's the life-saver in the palm of your hand. This first-aid app, developed by experts at the Australian Red

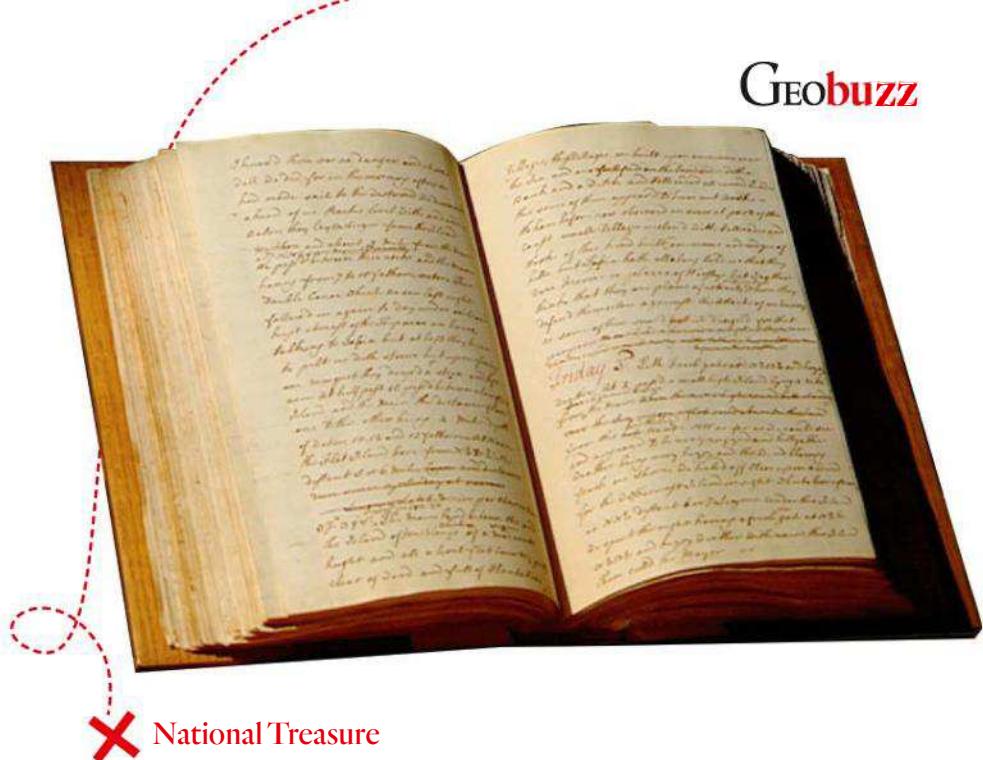
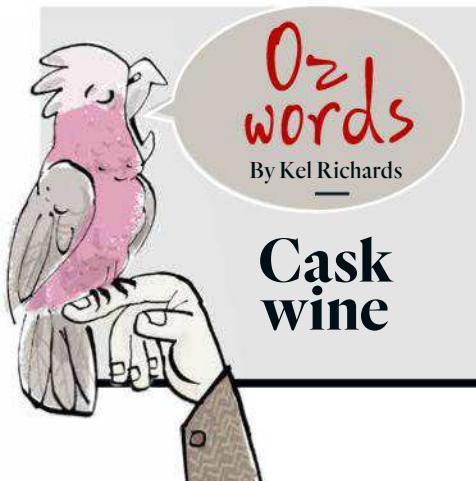
Cross, gives you instant access to the information you need to treat and handle the most common first-aid emergencies. With interactive simple step-by-step advice, including videos, the app can help provide vital, up-to-date treatment until medical help arrives.



Listen

Society & Culture

Inspired by the collections housed at the National Library of Australia, this podcast keeps you in touch with Australia's past, present and future. From talks discussing life in early settlements, battlefield memoirs and topics such as the suffrage movement in Australia, through to modern-day environmental studies, the hour-long podcasts provide insight into how our past has shaped our present and what it means for our future.



National Treasure

James Cook's journal

Held in the collection of the National Library of Australia

FOUNDING TREASURE of the National Library of Australia (NLA), James Cook's *Endeavour* journal gives Cook's personal account of his journey from England to Australia, which began 250 years ago.

Officially, this journal was meant to document Cook's observation of the transit of Venus across the face of the Sun. Unofficially, it was to become a record for Cook's top-secret mission to sail south in search of the mythic 'Unknown Southern Land' and claim it for Britain – a mission he completed on 29 April 1770 when he landed at Kurnell, in Botany Bay.

Written between 1768 and 1771, the journal consists of 753 pages that started out life as a series of folios, or

individual books (they weren't bound together until the 19th century). Its very fabric tells its own story: for example, when *Endeavour* ran aground on the Great Barrier Reef and was nearly wrecked, Cook must have been too busy trying to save the ship to write up the incident at the time, and had to stick in a piece of paper later that recorded the event.

The NLA (then the Commonwealth Parliamentary Library) bought the key historical document at auction for £5000 in 1923. One of the earliest written records of the Indigenous people of Polynesia, New Zealand and eastern Australia, it's the only document of the voyage in Cook's own hand.

ELIZABETH ARRIGO

Cask wine (a plastic bag in a cardboard box) is an Australian invention from the 1960s. This in turn inspired Australians to great verbal invention. Aussie slang very quickly came up with a string of names for cask wine starting with "Chateau Cardboard" and going on to call it a "handbag" or a "briefcase" often tied to a local place name. This gave us the Balga (Perth) or Bellambi (Wollongong) or Broadmeadow (Newcastle) or Dubbo (central NSW) handbag. Less inventive were names such as "boxie" or "box monster". And rather grimmer was the nickname "bag of death". Then it became a "goon" or "goon bag" or "goon sack" or just a "goonie". One type of moselle was nicknamed "lady in the boat" because of the picture on the box. And then there's my favourite: "vino collapso" (Aussie verbal invention at its best!).

OUR HISTORY

Flight of the medic

In the 90 years since the Royal Flying Doctor Service was established, it has transformed outback life.

UNTIL THE ADVENT of the Royal Flying Doctor Service 90 years ago, life in Australia's remote areas could be nasty, brutish and short. Injury or illness meant a trip on horse- or camel-back to the nearest town for help – a trip that could easily prove fatal.

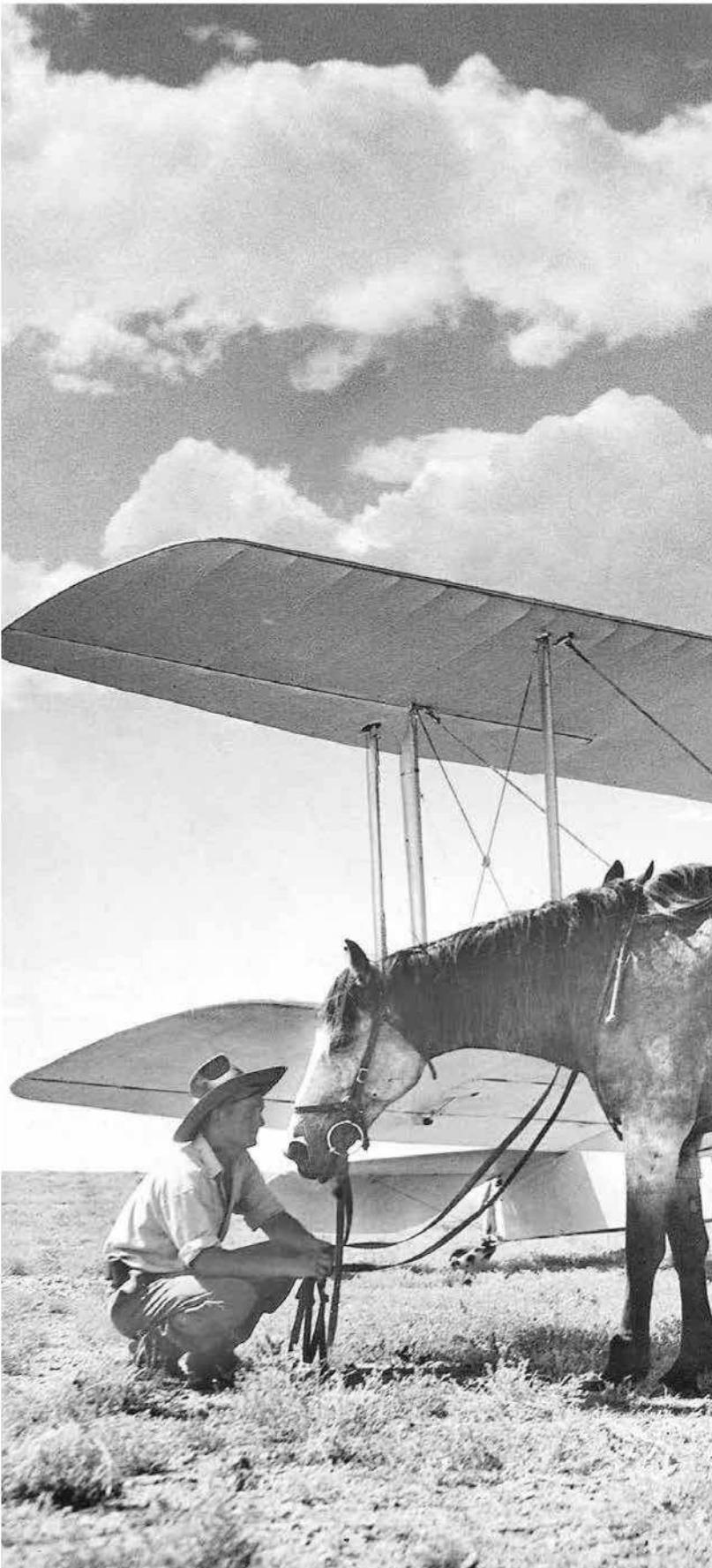
The Very Reverend John Flynn, who became known as Flynn of the Inland, was to change that. Born in Moliagul, Victoria, he became a missionary in 1911, aged 30, when he was posted to Beltana, in northern South Australia. He soon realised outback medical care was sorely lacking, and began to dream of creating a "mantle of safety" that covered remote Australia.

As head of the Australian Inland Mission (AIM), he established outback nursing posts and hospitals, but knew more care was needed. When he received a letter in 1917 from Lieutenant Clifford Peel, an Australian Flying Corps medical student, suggesting the use of aeroplanes to provide remote healthcare, Flynn's imagination was sparked, and he began a decade-long campaign for a flying doctor service. Thanks to a bequest from Sir Wilmot Hudson Fysh, the founder of the Queensland and Northern Territory Aerial Services (QANTAS), Flynn created the AIM Aerial Medical Service in 1928. QANTAS leased the service a De Havilland plane and Flynn's flying doctor dream was finally a reality.

Pilots flew in open cockpits, navigated using landmarks and landed in paddocks. Despite these trying conditions, the service treated 225 patients in its first year.

Flynn's likeness now graces the \$20 note, and his padre eulogised him at his 1951 funeral with these words: "Across the lonely places of the land he planted kindness, and from the hearts of those who call those places home, he gathered love."

HANNAH JAMES



The doctor, pilot and two station hands all help refuel a Flying Doctor plane for its return trip to Broken Hill on 8 December 1950.



DEFINING MOMENTS

1841: The New Zealand colony separates from New South Wales

FROM OUR shared ANZAC history to cheeky banter traded across the ditch, Australia and New Zealand have long had a sibling relationship. For a few months in 1840–41, our connection was even closer: New Zealand was an extension of the New South Wales colony.

Before this formal relationship, however, the two British outposts had entertained a decades-long association that began in 1788 with a sweeping proclamation from governor Arthur Phillip, defining the boundaries of the NSW colony.

This extended from Cape York, in Queensland, to South Cape, in Tasmania, encompassing all land west to 135 degrees longitude (just east of Alice Springs) and “including all the islands adjacent in the Pacific Ocean”.

For Phillip, NSW’s first governor, and his successors, this vague definition incorporated NZ. As a result, it became a de facto chunk of NSW territory. Governors encouraged economic and cultural activities across the Tasman. This included supporting a Church Missionary Society presence and appointing NZ’s first Justice of the Peace, Thomas Kendall, in 1814. However, in 1817, a British statute declared that NZ was not a British colony.

Circumstances shifted in the 1830s, with NSW residents going unpunished for nefarious incidents in NZ, highlighting the legal difficulties of controlling the activities of British subjects there. A growing humanitarian movement also became concerned about the fate of the Māori people after land-grabs and a huge influx of British settlers. The time had come for the Crown to take control.



Prime minister Joseph Ward declares NZ's dominion status on the steps of Parliament on 26 September 1907.

On 15 June 1839, official word came from London modifying the boundaries of NSW. The southern colony would now include “any territory which is or may be acquired in sovereignty by Her Majesty... within that group of Islands in the Pacific Ocean, commonly called New Zealand”.

This set the stage for newly appointed consul William Hobson to obtain sovereignty with Māori consent.

But before Hobson had even arrived in NZ or spoken to any Māori chiefs, he was also appointed the country’s lieutenant-governor.

On his way there, Hobson visited NSW governor Sir George Gipps, who swore him in to his new role and proclaimed that the jurisdiction of the NSW governor now officially extended to NZ.

On 6 February 1840, more than 40 Māori chiefs signed the Treaty of Waitangi. This laid the foundation for Hobson’s later official proclamation of

British sovereignty over NZ on 21 May 1840. Less than a month later, on 16 June 1840, the Legislative Council of NSW passed an Act extending NSW laws to NZ as well as establishing courts and customs duties.

However, this was only ever intended to be a temporary arrangement. The Charter for Erecting the Colony of New Zealand was issued on 16 November 1840, and stipulated that NZ would cease to be part of NSW on 1 July 1841.

In this way, the brief coupling of NZ and NSW ended, tweaking the course of the incipient Australian nation.

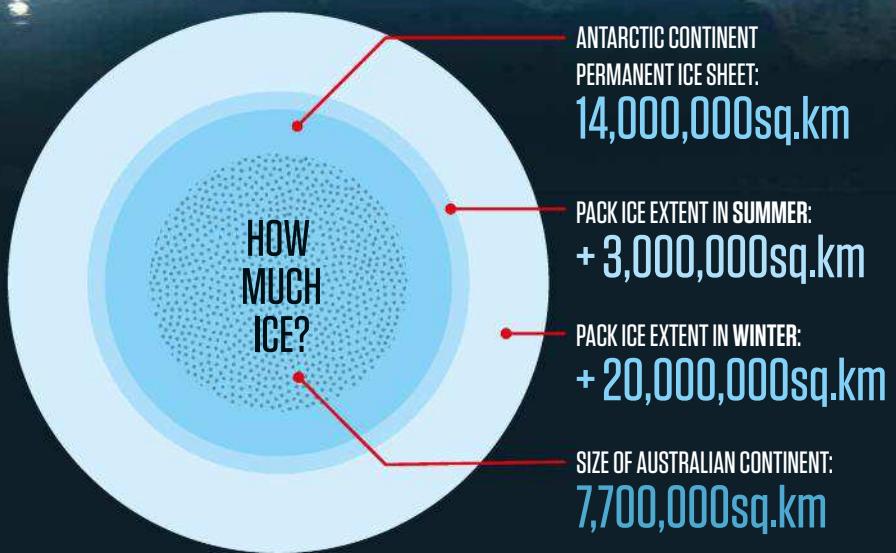
Later in the 1890s, NZ was invited to join the nascent Federation of Australia. It declined, partly out of concern for the welfare of the Māori.

Nonetheless, the Australian constitution still contains a clause allowing NZ to merge with Australia – just in case it decides it would like to become the seventh state of the lucky country.

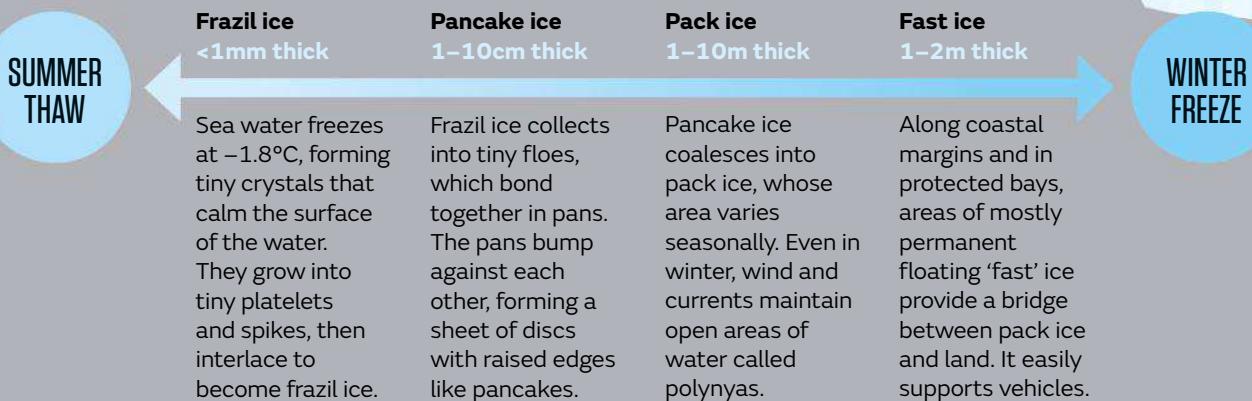
ELLEN RYKERS

Antarctic ice

THE STATISTICS never fail to confound: 90 per cent of the planet's fresh water is trapped in the 14 million square kilometres of Antarctic ice sheet – roughly 24.5 million cubic kilometres of fresh water. Since Antarctica's link with South America was broken 20 million years ago, the ice has grown, snowflake upon snowflake, transmuted over geological time to glacial ice. Gravity moves this ice towards Antarctica's coasts, where super-cooled salt water freezes, thaws and freezes, year on year, nearly doubling the surface area of Antarctic ice at its most northerly point. One time-scale is geological, the other seasonal. One is a freshwater phenomenon, the other marine. Together, they are the story of Antarctica's ice.



SEA ICE



FRESHWATER ICE

Ice shelves Size varies	Tabular icebergs Size varies	Glacial icebergs >300sq.m	Bergy bits 100-300sq.m	Growlers About 20sq.m	Brash ice <2sq.m
Ice shelves are flat expanses of thick floating ice formed from glaciers, ice streams and snowfall. The largest is the Ross Ice Shelf.	Calved from floating ice shelves, these bergs have flat tops and sheer sides. The largest ever recorded was more than 11,000sq.km.	Antarctica's ice sheet feeds a vast network of glaciers that calve into the sea as glacial icebergs and may carry erratics, rocks picked up on land.	Wind and wave action erodes icebergs, which become bergy bits when they're 1-5m above the waterline. They can also calve from glaciers.	Low-profile growlers are hard to see by eye or with radar, so are hazardous to ships. The name is from the sound they make against wooden hulls.	Brash ice is floating ice debris with pieces less than 2sq.m in area. It's formed from glaciers, icebergs and pack ice as it dissolves in summer.

LARGE SIZE

SMALL SIZE

James Cook didn't formally name Bare Island when he landed at Botany Bay, but he did describe it in his journals as a "small bare island" – and the name stuck.



TOP 10

Cook's legacy

James Cook left his mark on Australia in more ways than one. By Hannah James

IN THE 248 YEARS SINCE James Cook first sighted land after his circumnavigation of New Zealand in 1770, new generations have added layers of interpretation to that event. Once praised as a hero for his bravery and supreme navigation skills, Cook's colonial ambitions are now villainised by some. This is a historical debate that's living into the present, with treasurer Scott Morrison's announcement earlier this year of a \$3 million monument to Captain Cook at Botany Bay greeted with outrage by those who seek to highlight his legacy of violence and murder. Even Cook's naming and mapping of geographical features, wiping out their original Indigenous names, is also now problematic – but for good or ill, this too is now part of Australia's history. These are some of the places named by or for the man whose legacy is nothing less than modern Australia, in all its complexity.



1 CAPTAIN COOK STATUE, ▶ *Hyde Park, Sydney, NSW*

A crowd estimated to be 60,000-strong attended the unveiling of this statue in 1879. During the ceremony, reported the *Sydney Morning Herald*, the Duke of Edinburgh said, "There is no one among...England's heroes more deserving of this recognition on your part, and none whose career could be held up as a brighter example to every Englishman than that of Captain Cook." In contrast to this year's Cook monument controversy, this one was so popular with Sydneysiders that it was funded through public subscription as well as a government grant.



2 BOTANY BAY, *NSW*

The first of Cook's landings in Australia, Botany Bay was initially called Sting-Ray Harbour – for obvious reasons – in his journals. Joseph Banks and Daniel Solander, *Endeavour*'s botanists, collected so many plants there, however, that Cook changed the name. Its swampy nature led governor Arthur Phillip, when he landed in HMS *Supply* in 1788, to abandon it as a home for his new colony, heading to Port Jackson and what is now Sydney Harbour. Botany Bay wasn't settled until well into the next century.

3 POINT DANGER, *Tweed Heads, NSW*

The exact location of the spot Cook named Point Danger (for its offshore reefs) is still disputed. In 1823 government surveyor John Oxley decided that Cook had meant what's now called Fingal Head to be named Point Danger, but in 1828 naval officer Henry John Rous designated it as the current Point Danger. The second location is home to a lighthouse built in 1971 and a memorial to Captain Cook that's constructed from iron jettisoned from *Endeavour* when it struck a reef.

4 WHITSUNDAY PASSAGE, *QLD*

It wasn't Whitsunday (the Christian festival of Whitsun, on the seventh Sunday after Easter) when Cook saw the Whitsunday Passage in June 1770. He dated it as such in his journal, but this was before the International Date Line had been put in place, so he was a day out. Describing it in his journals, he wrote, "The land both on the Main and Islands especially on the former is tolerable high and distinguished by hills and Valleryes which are deversified with woods and Lawns that look'd green and pleasant."

5 CAPE TRIBULATION, *QLD*

When Cook gave this cape its name, he wrote in his journal, "because here began all our troubles". *Endeavour* had run aground on the Great Barrier Reef, within sight of this cape. He wrote: "We went to work to lighten her..we threw'd over board our guns Iron and stone ballast, Casks, Hoops staves oyle Jars, decay'd stores & C." This matter-of-fact account must have hidden considerable dismay, betrayed only by Cook's naming of the cape. Alone and unsupported as *Endeavour* was, its grounding could have proved fatal.

6 COOKTOWN, *QLD*

Located at the spot on the Endeavour River where Cook landed on 16 June 1770, Cooktown is a tiny town proud of its links with history. Every year, the residents hold a costumed re-enactment of the landing of *Endeavour*, which needed repairs after its grounding. Bad weather kept the crew at what's now Cooktown until 4 August, the longest period they were to spend anywhere in Australia. They filled their time with searching for botanical specimens and learning words in the local language of the Guugu Yimithirr people. So Cooktown became the first (albeit temporary) white settlement in Australia.

7 CAPE FLATTERY, *QLD*

Cook was unimaginative when naming features, honouring aristocrats and crew (Point Hicks, Cape Byron), or picking a characteristic (Red Point, Wide Bay). His rare flights of fancy can be hard to fathom: Pigeon House Mountain? A third category records events: Thirsty Sound, Weary Bay and Cape Flattery, where "We now judged our selves to be clear of all danger having...a clear open sea before us, but this we soon found otherwise and occasdiond my calling the headland...Cape Flattery."

8 JAMES COOK HISTORICAL MUSEUM, *Cooktown, QLD*

Located in a restored 19th-century convent, this museum dedicated to Cook has a collection of artefacts from that first voyage, including an anchor and a cannon he jettisoned while trying to free *Endeavour* from the Great Barrier Reef. It also tells the history of the town that grew up in the place Cook stopped to repair his ship, including its Indigenous past, Chinese heritage and stories of its maritime culture.

9 COOK ISLANDS, *South Pacific*

An entire island nation bears Cook's name – but these islands weren't named by Cook. He reportedly named them the Hervey Islands, after a British Lord of the Admiralty, and went ashore at Palmerston when he visited in 1773 and 1779. The Russian cartographer Admiral Adam Johann von Krusenstern renamed them to honour Cook in his 1835 supplement to his *Atlas de l'Océan Pacifique*. The islands were settled by Polynesian explorers in about the fifth century.



10 NASA'S SHUTTLES *DISCOVERY AND ENDEAVOUR*

Cook may have been born too soon to venture into space, but the inveterate explorer made it there anyway. Not only is there a Cook Crater on the Moon, but NASA named its third space shuttle *Discovery*, after the ship Cook commanded on his third major voyage. The shuttle went to space 39 times between 1984 and 2011, launching the Hubble Space Telescope. Space shuttle *Endeavour* was NASA's fifth shuttle and flew from 1992 until 2011, launching the first African-American female astronaut, Mae Jemison, into space.

SPACE

Diamonds are a world's best friend

The study of a small asteroid shows the high-pressure environment that led to the formation of the planets.

SOMETHING that has occupied astronomers' minds for centuries is the formation of the planets. How and when did it happen? Today, we have fairly reliable answers.

Radioactive dating of rocks and meteorites tells us the Solar System is about 4.57 billion years old. That tallies with independent estimates of the Sun's age and supports a model that has planets forming relatively quickly in the swirling disc of gas and dust that surrounded our star in its infancy. ('Quickly' means tens of millions of years.) According to the model, planet formation begins with space dust particles clumping together through electrostatic forces. That forms fluffy objects that stick together by gravity, and eventually grow large enough to collapse into solid lumps called planetesimals, a few kilometres in diameter. These collide, demolishing some and building up others to form protoplanets bigger than the Moon. Once again, the collisions continue, and you wind up with objects recognisable as planets.

A group of Swiss, French and German scientists has asked whether we can find physical evidence of the

existence of one of these protoplanets. And they believe they have. Their study centres on the small asteroid 2008 TC3 that exploded in the atmosphere over Sudan's Nubian Desert in 2008. Dozens of meteoritic fragments were recovered and turned out to be of an unusual type known as ureilites, which contain microscopic diamonds.

How were the diamonds formed? Until now, that has been an open question, but the scientists argue that, in 2008 TC3, the largest – which still only measures a breathtaking tenth of a millimetre – prove they can only have formed inside an object the size of a protoplanet, where the pressure would have been high enough. They also suggest that the object was itself demolished by a collision within the first 10 million years of the Solar System. In that scenario, 2008 TC3 is a remnant of a long-lost – and sadly nameless – protoplanet.



FRED WATSON

is an astronomer at the Australian Astronomical Observatory.

This artist's impression shows a Moon-sized celestial body slamming at speed into a body the size of Mercury. The planets are thought to have been formed by such impacts.

FRED ANSWERS YOUR QUESTIONS

Is there any proof the planets and stars in our Galaxy, and the Galaxy itself, has a top and bottom? Is it not that early writers came to this conclusion because the world, as known to them, was the Northern Hemisphere? Also, I've always been led to believe the Galaxy is a horizontal plane in space. Could it not be vertical, for instance?

John Williams, Creswick, VIC

You're quite right: what is 'up' in a cosmic sense is arbitrary, and the dominance of north as a preferred direction is because most people live in the Northern Hemisphere. On the largest scale, the Universe is the same in all directions, so there's no preferred direction. You're also right that the disc of our Galaxy is tilted almost at right angles to the plane of the Solar System (the ecliptic), and at about 63 degrees to the plane of Earth's equator.

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

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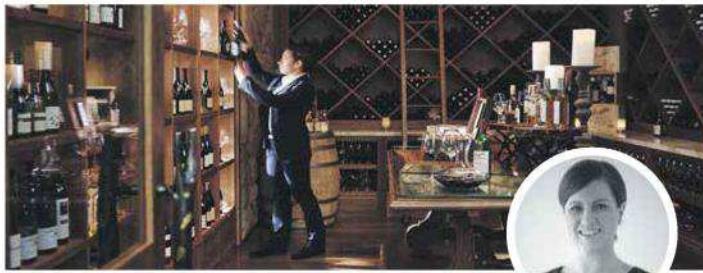
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Turtle troubles

A native turtle decimated by a mystery killer disease is being brought back from the brink of extinction with community help.

THE LOCAL COMMUNITY along the Bellinger River, on the NSW north coast, is proving to be critical in preventing the loss of a highly endangered native turtle species. It was the quick reaction of the same community three years ago that kept the freshwater Bellinger River snapping turtle (pictured above) from local extinction.

Back in 2015, the Coffs Harbour NSW Office of Environment and Heritage (OEH) began receiving frantic calls from people living along the river reporting that turtles were turning up dead and dying. Many had lesions on their bodies, inflamed eyes and other unpleasant symptoms. As more and more began appearing, it became clear the reptiles were being struck down by a highly contagious disease.

OEH scientists responded rapidly to relocate any unaffected turtles they could find. These animals were placed into quarantine under the joint management of NSW National Parks and Wildlife Service and Department of Primary Industries, Western Sydney University and Taronga Zoo.

Within about two months an estimated 90 per cent of the wild population was dead.

"We'd never seen anything like it," says Gerry McGilvray, project officer with the OEH. "It was so fast, had such a high fatality rate and caused such distressing symptoms in the turtles that we all had to act quickly."

The Bellinger River snapping turtle is known to occur naturally only along a 60km stretch of the river after which it is named. The 17 healthy turtles removed from the river after the 2015 event were placed into a captive breeding program run initially by Taronga Zoo and now continuing jointly with Symbio Wildlife Park, south of Sydney.

The program has already proved highly successful, with 21 hatchlings born at Taronga last year. When and how captive-bred hatchlings will be reintroduced to the Bellinger River remains unclear at this stage, because there is more to learn and understand about the disease.

The NSW government's Saving our Species program has a conservation

project in place for this species and plans to return it into the wild.

"Research into the disease, how it operates and the environmental conditions that may have contributed to the susceptibility of turtles has been at the forefront of the plan to save these turtles," Gerry explains. "Water-quality monitoring in the Bellinger River catchment has been important and the local community is proving to be essential for that."

The same community that alerted authorities to the turtle's plight have now become critical to its long-term future. Bellingen Riverwatch, launched in May last year, involves local community members and schoolchildren who record water-quality data that may help identify any problems occurring in the turtles' natural environment. It's one of several citizen science projects underway to help the turtles.

The Australian Geographic Society is also getting behind critical efforts to save this highly endangered turtle by raising funds to support these community projects. To contribute, see page 36.

ELIZABETH ARRIGO

Incredible India



How do you like your forts?
Ancient? Majestic? Or Mystical?

Amber Fort,
Rajasthan, 16th Century AD

Kumbhalgarh Fort,
Rajasthan, 15th Century AD

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Visit



Australian Geographic Nature Photographer of the Year exhibitions

24 August–11 November
South Australian Museum, Adelaide, SA

24 August–27 January 2019
Australian Museum, Sydney, NSW

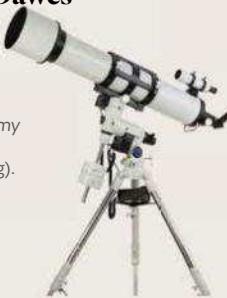
EXPLOR THE SUCCESSFUL entries from the 2018 Australian Geographic Nature Photographer of the Year competition in these prestigious exhibitions at two of Australia's most highly regarded cultural institutions. Packed with stunning images of the natural world, the exhibitions celebrate the unique bioregion of Australia, New Zealand, Antarctica and Papua New Guinea.

◀ STARRY BLENNY IN THE SPOTLIGHT

STARRY BLENNY, *Salarias ramosus*
Ross Gudgeon, NSW

looking up with Glenn Dawes

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



Naked eye

Five planets are visible to the unaided eye in the early evening sky. Bright Venus and Mercury are low in the west after twilight ends (Mercury in July only). At the same time Jupiter is due north and Saturn in the east, with Mars rising below the ringed world – splendid!



Binoculars

Near the 'spout' star of Sagittarius's teapot lies the centre of the Milky Way. Binoculars show the area is rich in dark clouds, scattered throughout with bright nebulae and star clusters. Check out the open clusters, M6 and M7, near the end of Scorpius's tail.



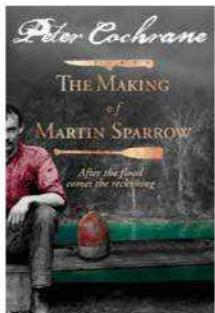
Small telescope

You can't miss Venus passing through Leo and Virgo. July opens with its phase like a gibbous nine-day-old Moon, which shrinks to a five-day crescent by the end of August. Reflected sunlight off the clouds shrouding the planet causes its brilliance.

Read

The Making of Martin Sparrow

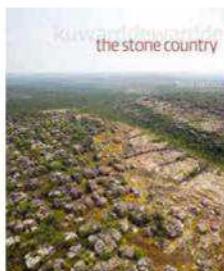
Peter Cochrane, Penguin Books, \$32.99



EX-CONVICT Martin Sparrow has had his livelihood washed away by the great 1806 Hawkesbury River flood. He faces a choice: stay, do the hard yards of rebuilding his farm, and try his luck at love, or strike out beyond the mountains to the unknown. Acclaimed historian Peter Cochrane's first novel is rich in utterly convincing period detail, and tells a powerful tale of desperate people in desperate times.

Kuwarddewardde: The Stone Country

David Hancock, \$60,
available from davidhancockphoto.com.au



IN HIS NEW BOOK, David Hancock (who wrote and photographed our story about seafood in Arnhem Land, see page 44) lovingly documents the Arnhem Land Plateau, an ancient sandstone tableland riven by gullies and waterfalls. The region has been home to the Bininj Aboriginal people, who know it as Kuwarddewardde, for 65,000 years.

Hancock worked closely with Indigenous people for 10 years to create this book, a remarkable insight to a remote, rugged and largely pristine environment populated by resourceful, resilient people.

Join

NAIDOC Week

8–15 July, Australia-wide

THE THEME FOR THIS YEAR'S NAIDOC celebrations (Because of her, we can!) celebrates the invaluable contributions that Aboriginal and Torres Strait Islander women have made, and continue to make, to Australia, our communities and our history. Celebrations and activities will take place across the country during the week-long event, with the National NAIDOC Awards Ceremony being held in this year's host city, Sydney, on 13 July. To find out what is happening near you, head to your local council website. For more information about NAIDOC Week, visit: naidoc.org.au



Mawson's Huts at Cape Denison in Antarctica, a replica of which is open to visitors in Hobart.

Visit

Antarctic Festival

2–5 August, Hobart, TAS

IT'S OFTEN SAID that Hobart is home to more Antarctic scientists than anywhere else in the world, and with several important Antarctic organisations based here, it's not hard to see why. This festival offers four days of fascinating Antarctic experiences, such as tours on board research ships *Aurora Australis* and *Investigator*, real-life accounts of what it's like to live and work in Antarctica, as well as a film festival and photographic competition. For more information, visit: antarcticfestival.com.au

Visit

Birdsville Big Red Bash

10–12 July, Birdsville, QLD

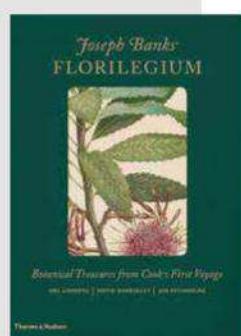
THIS UNIQUELY AUSTRALIAN experience draws thousands of people from around Australia, and the world, to the open skies of Australia's Simpson Desert to experience the world's most remote music festival. The concert and campsite grounds, called Bashville, are located on an organic cattle station called Adria Downs, in the dried-out bed of an ancient lake, with a giant red sand dune as a backdrop. This natural amphitheatre is the perfect setting for an outback concert. For more information, visit: bigredbash.com.au



Enter

Competition

WE'RE GIVING AWAY one copy of Joseph Banks' *Florilegium: Botanical Treasures from Cook's First Voyage*. This stunning compendium features some of the most precise examples of botanical illustrations ever created from the collection known as the Banks Florilegium, a set of more than 700 line etchings and engravings commissioned by Banks between 1772 and 1784. Joseph Banks' *Florilegium* is the first time a selection of these exquisite botanical illustrations has been available in book form.



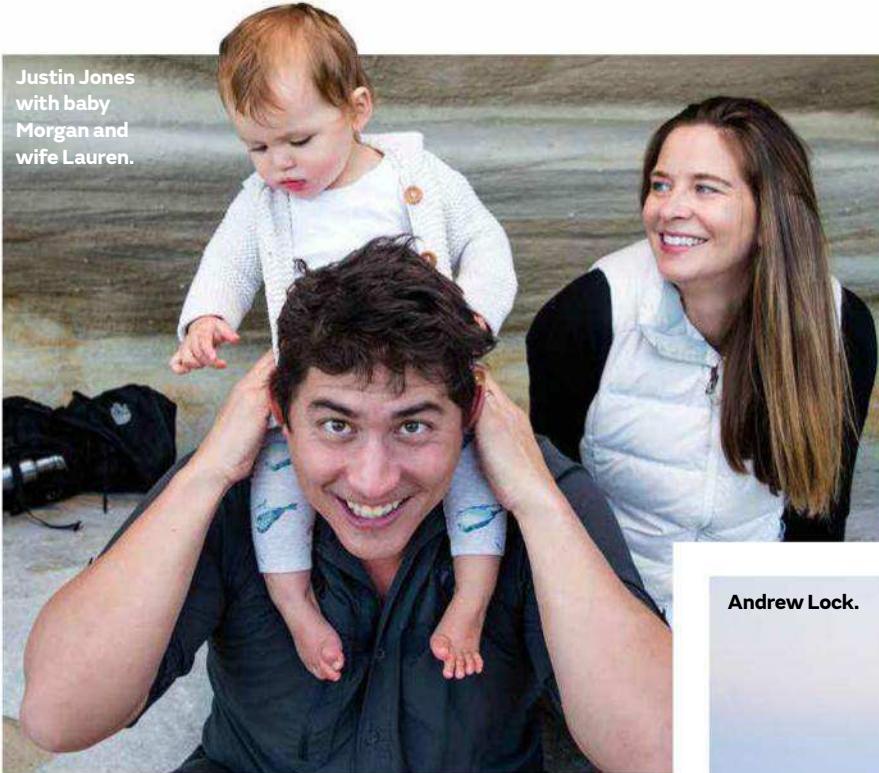
Enter at: australiageographic.com.au/issue145



July · August 2018

Your Society

Australian Geographic Society news and events



Australian Geographic Society Awards 2018

You're invited

WE ARE THRILLED to invite you to join Dick Smith AC and the trustees and council of the Australian Geographic Society, the staff of AUSTRALIAN GEOGRAPHIC and all our friends and family in the worlds of adventure and conservation for the announcement of the 2018 recipients of the Australian Geographic Society awards. The theatre-style event will be held on Thursday 25 October at 6.30pm in the Lend Lease Darling Quarter Theatre in Darling Harbour, Sydney.

We are just as excited to announce previous Spirit of Adventure and Young Adventurer of the Year winner Justin Jones (Jonesy of Cas and Jonesy) as our guest speaker as he recounts the highs and lows of the epic 1600km desert walk that he undertook with his wife, Lauren, and their tiny daughter, Morgan, in 2017. Joining the Joneses will be a line-up of the brightest and best in Australian conservation, environmentalism, science and adventure and a host of past winners. Tickets are \$45 for AG members (subscribers) and \$50 for non-members and will include light refreshments at the start of the event. See above for theatre location and details on how to book. Seating is limited so don't delay.

What: The 2018 Australian Geographic Society Awards

Where: Lend Lease Darling Quarter Theatre, Terrace 3 1–25 Harbour Street Sydney NSW 2000

When: 6.30pm, Thursday 25 October 2018

Ticket price: \$45 for AG members (subscribers), \$50 for non-members

How: Book now via our website australiangeographic.com/society or contact Rebecca Cotton on 02 9263 9813 to book by phone

Andrew Lock.



Adventure

Andrew Lock in Alaska

A SUCCESSFUL TRAVERSE of the Brooks Range in Alaska has again eluded Andrew Lock after a second attempt in March proved too dangerous to complete. Starting on the edge of the Beaufort Sea, which was frozen solid, Andrew skied for about 10 hours each day pulling a sled of about 80kg. At first conditions were quite varied, with snow about 20cm deep over a firm pack on the ground and metre-thick ice on the river. About 50km into the gorge, conditions started to become dangerous. Andrew broke through the ice on several occasions and had to stop to thaw and dry out his boots and other equipment. Deep, loose powder in other areas meant he could neither ski nor use snow shoes and was forced to push forward in boots only. By the time Andrew was 100km into the range and unable to reach his supply point, he made the decision to withdraw to avoid creating an emergency.



Sponsorship round-up

Around the world in a tuktuk

FIVE AUDACIOUS AUSSIE adventures and eight science and community projects have been the beneficiaries of the April 2018 round of Society sponsorships. Circumnavigating the planet are **Kevin Farebrother**, by yacht, and **Julian O'Shea** and team in a solar-powered tuktuk. **Danielle Cagnazzi** will be shedding light on the little-known Australian humpback dolphin in the Fitzroy River, Queensland, while **Lisa Farnsworth** will be engaging schoolkids with nature on the Winton Wetlands. **Marcus Foth** will evaluate new ways of treating wombats afflicted by devastating sarcoptic mange at the **Sleepy Burrows Wombat Sanctuary**, NSW, and AG will be presenting **Insects Alive!** under the Big Top at **Kids Wonderland** in Perth during the July school holidays. Bring the kids along to meet giant animatronic bugs.

CONSERVATION

Aussie Ark

► In November last year the Aussie Ark eastern quoll project with the Australian Geographic Society was officially kicked off with the release of eastern quolls – the first to be bred in NSW in almost a century – into a new AGS-sponsored sanctuary. The sanctuary complex includes eight enclosures equipped with natural vegetation, hollow logs, climbing structures and nesting boxes. From the initial five eastern quolls released at the site, the population now flourishes at 36 individuals, with an expected total of 70 by the end of the year. In recent months, an additional 10 new quoll breeding facilities

have been added at the site and construction of a 400ha property high in Barrington Tops is about to get underway. Aussie Ark plans to release 20 young eastern quolls in early 2019 into the area.

EXPLORATION

Deep diving

► In 1984 a team of cave divers explored a remote cave in Mexico known as Cueva de la Peña Colorado, but were limited by diving equipment capabilities of the time. They hypothesised that the cave is connected to Sistema

Huautla – one of the deepest cave systems on Earth. Thirty-four years later, an AGS-sponsored international team of 24 cavers returned, equipped with state-of-the-art dive gear. Sadly, the dream of discovering kilometres of cave passage was not to be. A mere 20m beyond the 1984 limit, they hit an impenetrable boulder barrier. The team did, however, discover fine silt and little flow, indicating the vast amount of water that flows through the cave is caused by percolation from the Peña Colorado Canyon located about 100m above.



Team leader
Dr Andreas
Klocker.



Madison Stewart

Production is underway on Madison Stewart's newest film, which will document her personal efforts to encourage a shift towards tourism as a key source of income for coastal dwelling Indonesians as an alternative to unsustainable shark fishing. Madison recently spent time with local fishers, gaining insights into the industry and surrounding issues.

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Who are the Australian Geographic Society?

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Rebecca Cotton

THE SOCIETY runs sponsorship rounds in April and November – during which it considers applications and disburses 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.

Lightning Ridge

Not too late to dig in

There's still time to join us for this year's fossil dig at Lightning Ridge in NSW.

Visit p122 for details of how you too can join this hearty and enthusiastic band of fossickers for the 2018 event held over two weeks in the second half of August.

Wild Australia

JULY · AUGUST 2018



Essential wildlife highlights that can't be missed



WA KURRAJONG AND KAPOK BLOOMING, ORD RIVER GORGE

At this time in the Dry, the kurrajong – or Kimberley rose (left) – has shed its leaves and scarlet blooms burst from bare branches. Enjoy these trees on the Ord River Gorge walk, from Lake Argyle Village. Yellow kapok flowers are now also out in the Kimberley. **More info:** Call the Kununurra Visitor Centre on 08 9168 1177 or see visitkununurra.com



Wild Australia with John Pickrell

Big picture

Snug retreat

By Luke Zeme

Kitchen Hut, near the northern start of Tasmania's acclaimed Overland Track, wasn't built for overnight stays but as short-term respite from the elements for hikers. Located at an elevation of about 1250m, the winds are icy cold up here in winter, and as soon as the sun drops behind the mountains the temperature plummets. This was shot at about 4pm. Waiting for sunset at 5.10pm would have been dangerous without the right gear because the hike back down to Dove Lake is at least 90 minutes even on the steeper track, which I took.



SA SEA LION CLOSE ENCOUNTERS, KANGAROO ISLAND

About 85 per cent of Australia's estimated 14,700 sea lions are found in 39 breeding colonies in SA. Now is the perfect time to visit those at Kangaroo Island's Seal Bay Conservation Park, where you'll see these mammals basking on rocks and sand in search of winter sun. Head to the beach and walk right through the colony on a 45-minute guided tour (adult \$35/concession \$28/child \$20). **More info:** Call Seal Bay Conservation Park on 08 8553 4463 or visit sealbay.sa.gov.au



SA SOUTHERN RIGHT WHALES CALVING, HEAD OF BIGHT

Australian southern right whales mate and calve in the shallow waters of the bays along the Great Australian Bight, with about a third of these whales beginning their lives here. July–August is the best time to spot these up-to-70-tonne mammals, particularly from the high cliffs of the Head of Bight lookout, where many mothers and calves can be spotted, often within 100m of the coast. **More info:** Call Head of Bight Visitors Centre on 08 8625 6201 or visit headofbight.com.au

AG Society fundraiser

SHELL OUT FOR A TURTLE

An outbreak of a mystery disease in northern NSW in 2015 decimated the Bellinger River snapping turtle population. As the disease spread, killing up to 90 per cent of these enigmatic reptiles, scientists scrambled to collect any healthy individuals they could find and place them in quarantine. Those turtles became part of breeding programs at Taronga Zoo and Symbio Wildlife Park to create ‘insurance populations’ to one day reintroduce into the wild.



A Saving our Species citizen science project is supporting water-monitoring programs to identify issues facing the turtle’s natural habitat. Please donate today to support this crucial project that will ensure these turtles can safely be returned to the wild.

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



NSW

LIVING LABORATORY, ROYAL BOTANIC GARDEN SYDNEY

Among the many free events for **Science Week** – on nationwide from 11 to 19 August – is the Living Laboratory in the Royal Botanic Garden Sydney. Here, visitors can: participate in experiments; visit state-of-the-art botanical facilities; meet horticulturalists, botanists and natural history illustrators; and explore some of the many botanical specimens stored in the gardens’ herbarium. **More info:** Call 02 9231 8134 or visit scienceweek.net.au/living-laboratory

NATIONWIDE PICK UP RUBBISH, KEEP AUSTRALIA BEAUTIFUL WEEK

Australians use 13–14 billion drink containers each year. Less than half of these bottles, cans and cartons are recycled, and along with other kinds of litter – such as cigarette butts and plastic bags – many end up along roadsides, on beaches and clogging up our marine environments. Help by taking the Keep Australia Beautiful Week pledge to pick up at least one piece of litter a day from 21 to 27 August. **More info:** Visit kab.org.au or email admin@kab.org.au

GOING WILD

You'll find two great experiences in this issue to inspire you to get out and connect with nature in our regular Going Wild section. Discover SA's spectacular Flinders Ranges in style on the Arkaba Walk (page 104). And leave your car at home to experience the coastal environment of Victoria's famed 12 Apostles on foot by taking the Great Ocean Walk (page 112).

NATURE

Ghosts of species past

New Zealand's majestic moas are long gone, but their essence lingers on in the islands' ecosystems.

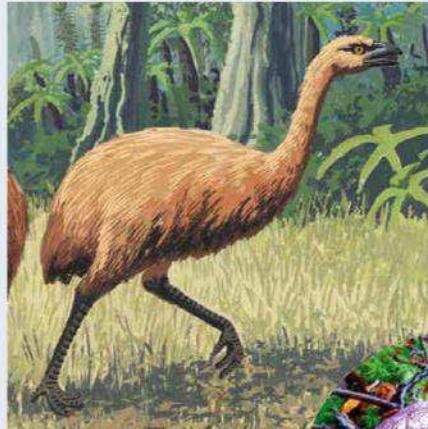


MOAS WERE nine huge flightless bird species – related to the emu, cassowary and kiwi – that once stalked the lush beech forests, shrublands and subalpine meadows of New Zealand. The biggest of these imposing avians was up to 3.6m tall, dwarfing even the largest kiwi species still found on New Zealand today.

When seafarers first arrived in NZ from Polynesia about 700 years ago, there may have been nearly 60,000 of these magnificent creatures, but within just 200 years all moa species had been hunted to extinction, along with more than 40 per cent of the islands' other native bird species.

Today, most of what we know of moas comes from bones, feathers, skins and other dried remains, sometimes found in remarkably good condition in cave environments. In recent years, experts have also been able to reconstruct the diet of giant moas from gut contents and many well-preserved coprolites – partially fossilised droppings.

The latest of these studies was published recently in the *Proceedings of the National Academy of Sciences*, by researchers including Alexander Boast of the Australian Centre for Ancient DNA at the University of Adelaide, and Jamie Wood at Landcare Research in Canterbury, NZ. From caves and rock shelters at eight South Island sites, the scientists collected 23 coprolites from four moa species and also the kakapo (a critically endangered flightless parrot that's been extirpated from most of NZ's islands). These fossil droppings ranged in age from 124 to 1557 years old.



Extinct moas may have eaten colourful fungi such as this purple pouch fungus (right) found today in NZ beech forests.



"Coprolites were actually more common than we'd thought, once we started looking for them," Jamie says. "And it turns out they contain a huge range of important information about past ecosystems."

The scientists were able to get moa DNA from the dung, information on pathogens and specialised parasites that afflicted these species, and clues to the birds' long-lost behaviour. One fascinating finding was that both the moa and the kakapo ate a wide variety of fungi and mushrooms that remain an essential component of NZ's beech forests today and have close symbiotic relationships with tree roots.

Many of these so-called ectomycorrhizal fungi are brightly coloured, possibly to mimic fruits and berries and look appetising to ground-dwelling birds. This would have encouraged moas to eat them and help distribute their spores across the islands' forests.

Colourful fruits and berries have often evolved to be eaten by birds or

primates, because many other mammals don't have full colour vision and only see the world in muted shades.

These fungi also have fruiting bodies that never open fully to release their spores, relying instead on animals – such as moas and kakapo – to eat and spread them.

The scientists report in their paper that "we provide evidence that moa and prehistoric kakapo consumed ectomycorrhizal fungi, suggesting these birds played a role in dispersing fungi that are key to NZ's natural forest ecosystems. We also provide the first DNA-based evidence that moa frequently supplemented their broad diets with ferns and mosses."

With the loss of these birds, the critical role they played in their ecosystems has also gone, with potential implications for the ongoing health of NZ's beech forests. This isn't the first time a lost ecological relationship in NZ has been found using fossilised dung. In 2012 Jamie was part of a team that used kakapo coprolites to prove these birds had once been an important pollinator for the parasitic 'flower of Hades' (AG 128).

During recent millennia, the extinction of many of our planet's large animals has left broken food chains, disrupted ecosystems and empty niches. But clever new methods, such as analysing DNA in coprolites, are allowing researchers to reconstruct lost biological relationships like never before.

JOHN PICKRELL

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



SOCIETY SPONSORED



Wildlife CSI

Australian science is catching up with illegal traffickers of precious wildlife.

STORY BY ANGELA HEATHCOTE

More than a million pangolins were estimated to have been illegally trafficked around the world during the 10 years to 2017, leading to an enormous decline in their wild population. Australian scientists are helping to put an end to the trade in these endearing anteating mammals.





◀ An echidna's quills hold a record of everything it's eaten. Scientists can analyse them to tell if the animal has been fed a commercial diet or eaten natural forage, indicating it has come from the wild.



▲ A Carnaby's black cockatoo can fetch \$30,000 on the black market. Australian scientists hope new tests they are developing to analyse feathers will one day put an end to the illegal trade of wild birds.

THE ILLEGAL WILDLIFE trade is a multi-billion-dollar industry worldwide and a huge threat to many endangered species, notably in Australia. Our birds and reptiles are particularly prized overseas for their uniqueness; a single black cockatoo, for example, can fetch upwards of \$30,000. But, as punishments increase and regulations tighten, poachers and wildlife traffickers are becoming more devious. That many animals can legitimately be exported if captive-bred has only recently been exposed as a major legal loophole and given rise to the phenomenon of illegal wildlife laundering.

It was this that saw Taronga form a taskforce to identify whether exported native fauna was wild-caught or legitimately captive-bred. Phoebe joined forces with Taronga colleagues Michelle Shaw, a zoo and wildlife nutritionist, and forensic wildlife pathologist Lydia Tong, University of New South Wales forensic biologist Dr Kate Brandis and Dr Debashish Mazumder from the Australian Nuclear Science and Technology Organisation have also since become major collaborators.

The team now leads the charge against the laundering of wild animals by using a combination of two complementary

techniques – stable isotope analysis and X-ray nuclear fluorescence. These identify permanent chemical signatures stored in keratin – a structural protein in human hair and nails that's also in feathers, quills and fur. Because it retains a record of everything an animal eats, Phoebe and her colleagues hoped to use the chemical signature to differentiate between animals fed an artificial diet and treated water, and animals foraging in the wild.

They put their theory to the test using short-beaked echidnas, which are prized overseas as pets. By examining chemical signatures in echidna quills, they successfully established a difference between captive-bred and wild-caught animals. The work has resulted in a valuable forensic tool for identifying illegally traded wildlife and attracted the interest of not only TRAFFIC but the UN's Convention on International Trade in Endangered Species (CITES) team. It puts Australia at the forefront of wildlife crime forensics.





Wildlife nutritionist Michelle Shaw with one of the Taronga Zoo echidnas that provide samples to develop tests aimed at stopping the illegal trade of these animals.



PHOTO CREDITS: FROM TOP: JAMES MORGAN; WA DEPT OF BIODIVERSITY CONSERVATIONS AND ATTRACTIONS. SCIENTIFIC NAME: TOP: *Tachyglossus aculeatus*

▲ The lucrative illegal wildlife trade sees our prized native wildlife smuggled in terrible conditions. This lizard, hidden in a sock and seized in WA, was fortunately caught before being taken out of the country, giving it a good chance of survival.

Join the fight



YOU CAN HELP battle the illegal animal trade by downloading and using Wildlife Witness, a free app created by Taronga Zoo and global wildlife trade watchdog TRAFFIC. If you encounter a questionable product or situation involving an animal you believe may be part of the illegal trade, take a photo, record your location and submit a report via the app. This information could help authorities enforce the law and understand how traders are operating. For more, visit wildlifewitness.net



Taronga Zoo conservation biologist Phoebe Meagher (above) is working closely with the zoo's head veterinary pathologist Lydia Tong (above right) to roll out a stable isotope analysis program in South-East Asian trafficking hotspots.



Phoebe and Lydia are passionate about animal welfare and conservation. Now both women are wielding their considerable professional scientific prowess as part of the Taronga-led team aiming to stop illegal wildlife trafficking.

THE SUCCESS of this project, sponsored by the Australian Geographic Society, is expected to have positive implications for other illegal wildlife trade victims. Recently, the Taronga group has focused on the world's most heavily trafficked mammal, the pangolin. A small, shy animal, whose main defence when threatened is to curl into a ball, the pangolin is an easy target for poachers. In Africa, its meat is a symbol of wealth and in Asia its scales are used in traditional medicines, although claimed therapeutic properties are unproven.

There are eight pangolin species, two of which – the Sunda and Chinese pangolin – are on the International Union for Conservation of Nature's critically endangered list, but all face illegal trafficking threats. "Because the Asian pangolin is very hard to find and the African pangolin is doing slightly better, we get African pangolins being sold in Asia as Asian pangolins. When it's just the scales, you can't tell where they're from, which is where stable isotope analysis comes in," Phoebe explains. "We want to know what trade routes are being used by poachers."

Stable isotope analysis is now being applied to wildlife conservation in other ways, too. Last year, Save Vietnam's Wildlife, one of many organisations dedicated to protecting species worldwide, rescued 400 pangolins from poachers. "And that's just the ones lucky enough to be found alive before they were taken from their home country," Michelle says.

From such large-scale rescues, challenges have begun to surface. An organisation saving 400 pangolins, for example, has

"Pangolins are sold by the kilo so traders pump their stomachs with a corn gruel that's like cement."

to be able to feed every one of those animals and it can cost \$50,000 a year just to buy ant eggs for them to eat. This will keep the animals alive, but doesn't compare with the diverse diet they have in the wild.

Michelle says learning more about these animals' diets through stable isotope analysis is helping develop more nutritious feed for zoo animals. "Live pangolins are sold by the kilo so traders pump their stomachs with a corn gruel that's like cement," she says. "It's not nutritious at all; it's just to make them heavier. It stretches their stomachs and causes serious health issues. When it finally passes through their digestive system they're left malnourished, with their stomachs in a horrible condition. Making them a feed that won't aggravate them while in that compromised state is critical to their care and rehabilitation." Stable isotope analysis is being used as part of in-depth research into the diets of wild animals and may – as a result – improve how zoo animals are fed globally.

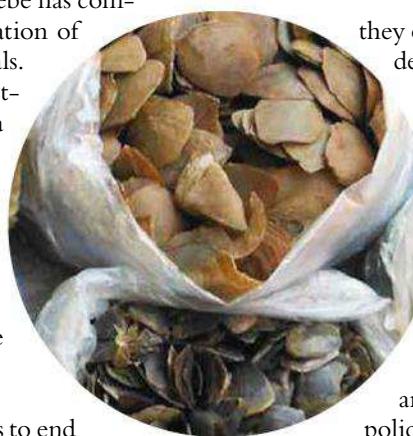


Lydia and Phoebe have also spent time exploring how the techniques they are developing can be rolled out in places like Cambodia, Vietnam and Indonesia, hotspots for the illegal wildlife trade. Lydia, a veterinarian by training, developed an interest in veterinary forensics when diagnosing abuse in animals for organisations such as the RSPCA. And Phoebe has completed extensive fieldwork in the conservation of Australia's most critically endangered animals.

"We're focused on the enforcement outcome through a thorough roll-out," Lydia says. "We intend taking samples from animals at key bottlenecks and collection points. These will be sent to our world-class facilities. The tests are very cheap, quick and considerably more effective than testing DNA. Each stable isotope test is only \$10. Those involved in the wildlife trade will have to have stocks certified."

THE TARONGA TEAM'S next mission is to end the illegal trafficking of exotic birds, starting with cockatoos in a project called Beyond Borders. Rather than looking at captive versus wild, the project hopes to identify *where* trafficked cockatoos have come from. Determining geographical origin by using feathers will help authorities identify where to focus their efforts, which would have a global impact on this illegal trade, Lydia says. Cockatoos are the most highly laundered animals from Australia and the Asia-Pacific region. Cruelly smuggled inside water bottles and small cages,

The mistaken belief by practitioners of traditional Chinese medicine that pangolin scales (below) cure cancer, malaria and other ailments sees wholesale slaughter of the animals (above) and removal of their scales, which are made of mainly keratin, the same substance that makes up our fingernails and hair.



they often perish before they even arrive at a buyer's destination. Trafficking has been fuelled by skyrocketing demand in the past decade for our exotic birds. "Social media is a new platform that can unwittingly glamorise the keeping of exotic pets, particularly birds, which may have been illegally or unethically traded," Lydia says. "It's easy to post one cute photo that hides all of this in the background. The owner may not have any idea either."

Recently, Instagram has begun cracking down on ways the illegal wildlife trade and animal cruelty have seeped onto its platform. Its policies already prohibit animal abuse and the sale of endangered animals, and it has recently added a new content advisory when users search a hashtag associated with wildlife exploitation. This is important, Lydia says, because we all have a part to play in ending the illegal wildlife trade.

"Publicity around the enormous conservation and welfare issues of the illegal wildlife trade is necessary to change people's way of thinking," she says. "Even as a person working in this field, it took work to educate myself to find out how bad it really is. We all need to talk about it as much as possible."



Fruits of the sea

To the people of Arnhem Land, shellfish and other sea creatures nourish a link to country and culture.

STORY AND PHOTOGRAPHY BY DAVID HANCOCK

As well as being nutritious, maypal – shellfish and some land invertebrates – provide spiritual links to generations past and future. This spiky chiton, known as galkiarr, is a popular snack that's readily gathered along the Arnhem Land coast.



A Yolngu man plucks a mud mussel, sought-after food known as a dhan'pala, from the substrate around the roots of mangroves in the intertidal zone in northern Australia. Hermit crabs (below), called gonjiya, are also a nutritious food common in mangroves. The lesser longbum (bottom) is a type of edible mud whelk, known by the Yolngu as barawara.



“As the seasons change we think of the old people, the ancestors, we think of gathering maypal.” – Djalu Gurruwiwi, Yolngu Elder

WHEN THE YOLNGU of north-eastern Arnhem Land look to the sea, they know the season from the direction and feel of the wind. One thing the wind communicates, they say, is when certain maypal are plump and ready to be gathered.

The term maypal covers many marine and some terrestrial creatures that have sustained generations of Yolngu for millennia. In one sense it means shellfish. But maypal include foods non-Indigenous Australians might not consider to be in that category, such as land snails, marine worms and insect larvae, including witchetty grubs. Maypal are fundamental to Yolngu culture. They are tasty and easy to harvest; just go down to the beach or among the mangroves. And they sustain coastal people not only physically, but also spiritually and emotionally.

Huge middens of shells along Australia’s northern coastline attest to the popularity of maypal: in some areas middens more than 30m high date back many thousands of years.

“In the north of Australia, we have an incredibly varied, rich and complex coastline, with a large number of ecological zones,” says Dr Bentley James, a Northern Territory anthropologist and linguist who lived in Arnhem Land for many years. “There are more than 1500km of coastline on the mainland and another 1750km on the islands, not to mention all the reefs and sand bars.”

He says the Yolngu recognise 15 ecological zones inhabited by 110 species of maypal. These are described by about 350 different Yolngu names with complex layers of kinship and connectedness entailing a highly sophisticated view of the natural world. Most maypal have multiple names in different clan languages and are celebrated in songs and traditional lore.

SO-CALLED INCREASE RITUALS practised by the many coastal clans ensure the fecundity of maypal, enhancing their fatness and abundance in the coming season. According to Yolngu woman Doris Yethun Burarrwanga from Elcho Island,

Doris Yethun Burarrwanga (right) has success finding longbums, called walawuny and nonda by the Yolngu, in the mangroves of Ban'thula on Elcho Island, off the Arnhem Land coast. Nutritious variegated venus clams, known as warrapal (below), and spiky chitons (bottom), are also found in the same area's intertidal zone.



maypal provide balanced nutrition and “everything a young person needs to grow... That is why children in coastal home-land centres have the best teeth in the country and infinitely better health outcomes in the long term.”

These kinds of shellfish and other invertebrate sources of protein are much loved by the local people, she says. “We sing for them. We care for them... We eat them and celebrate them and, in return, they give us life.”

Doris says maypal are a crucial part of life by the sea for Aboriginal kids, not just as a supplement to their diet, but also because they provide “a spiritual link and a physical and nutritious reconnection with country and kin”.

Bentley recently collaborated with Yolngu people to compile a bilingual identification guide to maypal. The knowledge was collected from conversations with traditional owners over many years. During the process, “we had to find the maypal, catch them, cook them, eat them and name them”, he says. “It was a great joy involving families from so many places.”

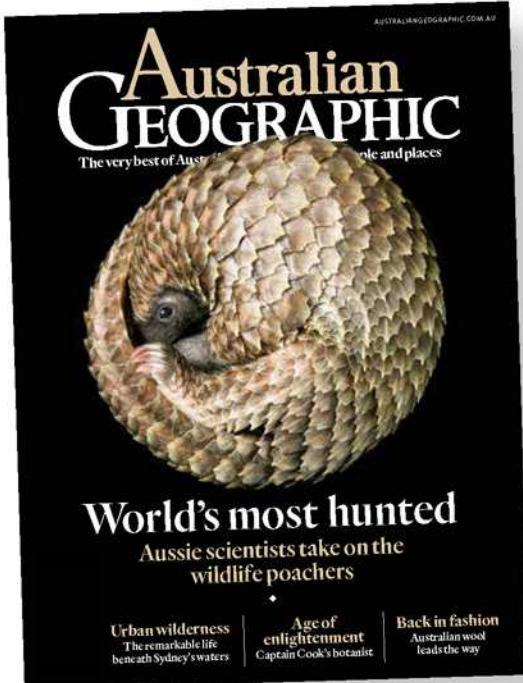
The book, entitled *Maypal, Mayali' Ga Wää: Shellfish, Meaning and Place: a Yolngu Bilingual Identification Guide to Shellfish of North East Arnhem Land* (NAILSMA, 2016), describes maypal in three languages: Yolngu Matha, English and Latin.

The process of publishing the book was consistent with the Yolngu way and lore, Bentley notes. More than 500 people across seven language groups were involved, ranging from toddlers to nonagenarians. The book will be distributed to schools in Arnhem Land and among eight ranger programs and eventually be given to libraries across Australia.

It offers local children “an opportunity to know the full spectrum of rare names and ecological knowledge of shellfish, hitherto kept safe by a tiny population”, Bentley says. “This knowledge stretches over thousands of years from one side of Arnhem Land to the other – from the eastern sunrise over Blue Mud Bay to sunset west of the Crocodile Islands.”

The book is a gift to future generations, he adds, “to help children walk in the footsteps of the ancestors”.

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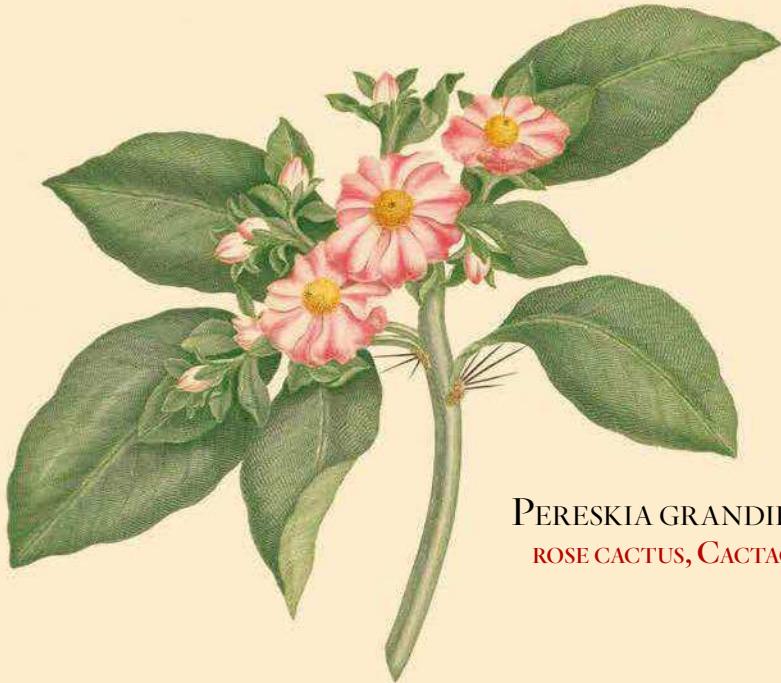
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This original specimen (right) of *Banksia dentata* is one of many from the Endeavour voyage preserved on herbarium sheets and stored in the Botany Department at the Natural History Museum, London.

The rose cactus (opposite) was drawn from a specimen collected secretly from Rio de Janeiro, when Endeavour stayed there in 1768 and Banks was denied permission to collect plants.



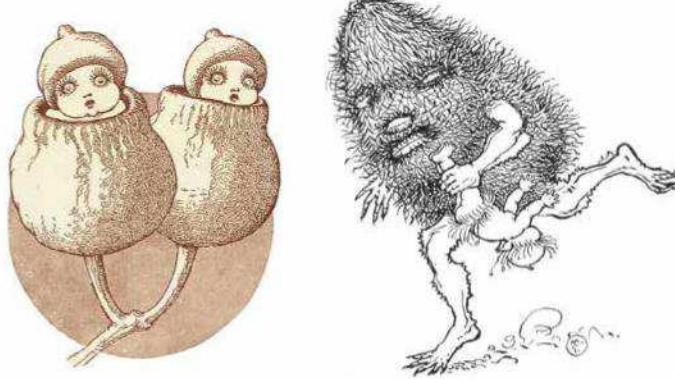
PERESKIA GRANDIFOLIA
ROSE CACTUS, CACTACEAE

◆ ◆

Sir Joseph Banks *and his* Florilegium

It has been 250 years since naturalist Joseph Banks sailed to the Pacific with James Cook aboard HMB *Endeavour*. During the voyage, Banks and his team made the first scientific collections of Australian flora. Their specimens were sketched by Sydney Parkinson, whose pioneering illustrations were published last year.

STORY BY DAVID MABBERLEY



The link between Lieutenant ('Captain') James Cook and the gumnut babies may not be obvious at first, but had it not been for Cook's 1770 visit to eastern Australia, May Gibbs' classic would have been rather different.

Tales of Snugglepot and Cuddlepie, first published in 1918, is the most famous book by English-born Australian illustrator and author Gibbs, who died in 1969. It is the first of her much-loved series featuring characters based on Australian plants, with the gumnut babies Snufflepot and Cuddlepie inspired by *Eucalyptus* species. The fruiting heads of the *Banksia* species became the "big bad" Banksia Men. So it was through Gibbs' book that generations of children first heard of *Banksia*, a plant genus found throughout Australia. Today some 171 species are known, 150 from Western Australia, Gibbs' home for many years.

The name *Banksia* was coined in 1782 to commemorate English landowner and naturalist Sir Joseph Banks, who travelled on Cook's first Pacific voyage. Among the plant specimens he collected were the first *Banksia* specimens seen in Europe. Indeed, his rich botanical haul led the great Swedish naturalist Carl Linnaeus to suggest New Holland, today's Australia, should also be called Banksia.

BANKS WAS the only son of a wealthy landowner. He had such a passion for botany that, as a University of Oxford undergraduate, he brought in his own botany tutor from rival university Cambridge. In January 1767, Banks returned from a Canadian expedition and spent the year as a dilettante naturalist and antiquarian.

Professor David Mabberley

is a renowned British-born botanist and former Executive Director of the Royal Botanic Gardens and Domain Trust in Sydney. He provided detailed commentary on the first full-colour publication last year of Joseph Banks' *Florilegium*.



SNUGGLEPOT AND CUDDLEPIE

Characters created by May Gibbs, such as this evil Banksia Man snatching Little Ragged Blossom (above right) and quintessentially good gumnut babies (above left), helped make 'the bush' a place of wonder for generations of young Australians.

During this year, he made many connections with people who were soon to play crucial roles in the very beginnings of scientific classification of plants in Australia.

Banks set up a house in London, the furnishings for which included work by upholsterer Stanfield Parkinson, whose brother Sydney was employed by Banks to draw animal specimens he had brought from Newfoundland. It is thought Sydney had been trained in natural-history illustration in his home town of Edinburgh.

In the mid-1760s, Sydney was employed by horticulturalist James Lee to teach his daughter Ann to draw flowers. It was an acquaintance of Lee's, physician and naturalist Dr John Fothergill, who helped shape Banks' ideas about what botany could be.

In 1762, Fothergill began making a botanic garden at Upton Park in Essex. He was particularly interested in plants of medicinal or other economic worth, and, on his garden's original 12ha, built greenhouses and hothouses some 80m long. He supported plant collectors overseas and amassed a huge collection of his own. As the interesting plants flowered, he had them painted.

This whole enterprise – plant collectors, living collections and artists – had an enormous effect on Banks. It may have spurred his travel and influenced him to take charge of the Royal Botanic Gardens, Kew – and set the ethos of botanic gardens ever since. ▶

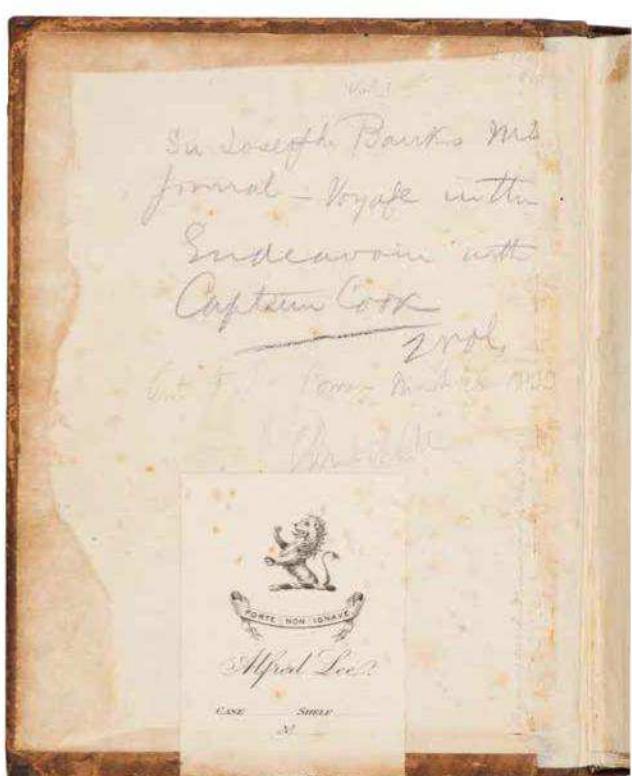
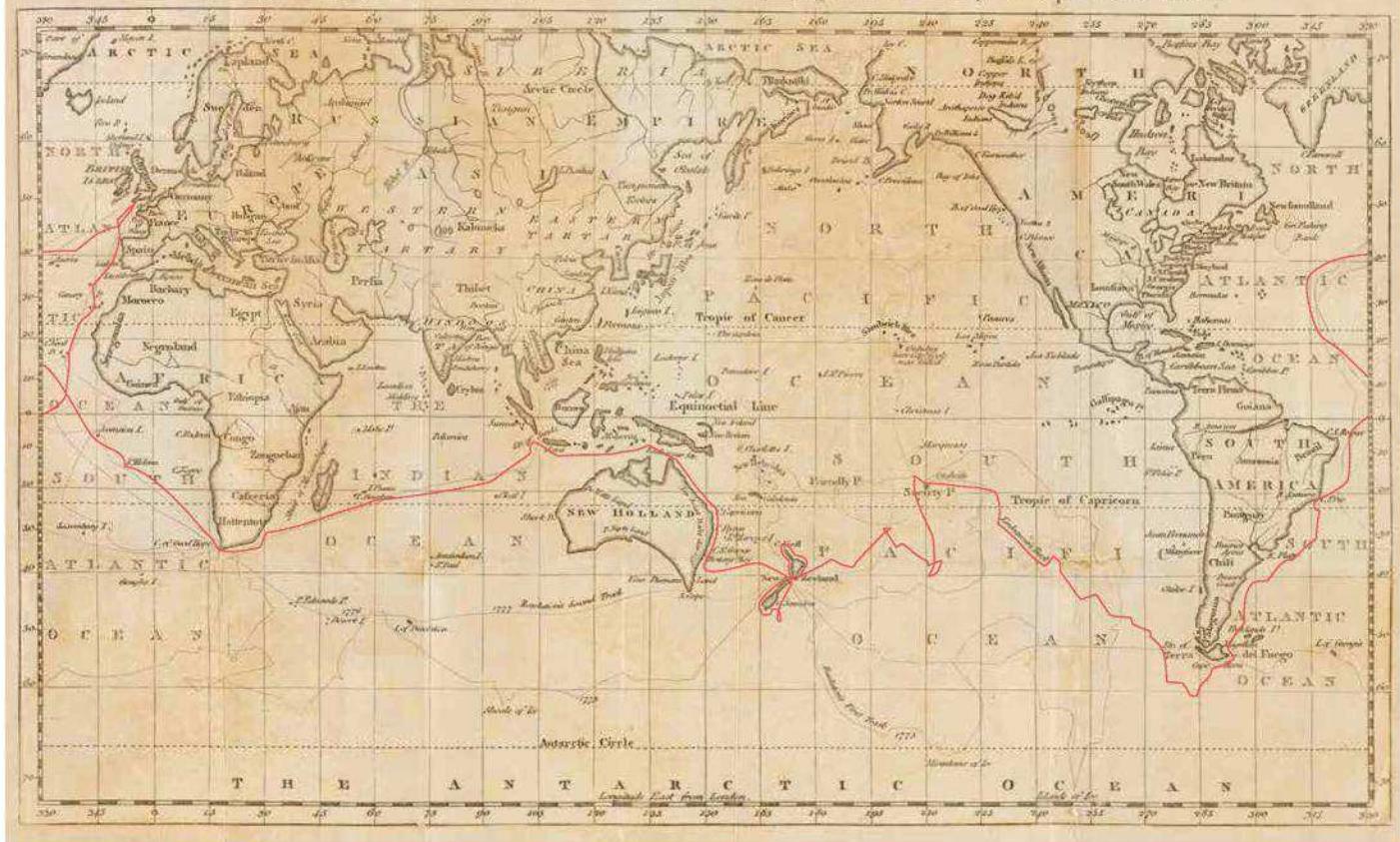


SIR JOSEPH BANKS

Born into a family of politicians, Banks, shown here in a portrait by Sir Joshua Reynolds from 1772, in the National Portrait Gallery in London, had a passion for plants, funded by an inheritance from his father. In Australia with Cook in 1770, he collected plants, birds, reptiles, fish, molluscs and insects and also took notes on the customs of Aboriginal people.

A CHART of the WORLD on MERCATORS PROJECTION.

Exhibiting the Discoveries made by Captⁿ. JAMES COOK in his Three Voyages, with the Tracks of the Ships under his command.



August 1763 Plymouth

25 After having waited in this place ten days, the
ship, a man being belonging to our being all that
service perfect ready to sail at a moment's
warning; we at last got a fair wind, & this day
at 5 o'clock in the morning anchored, & got
takings with an excellent health & spirits
perfectly prepared, in mind at least to undergo
with chearfullness any fatigues or dangers that
might occur in our intended voyage.

26 Wind still SSW, but very light breeze, was
this some sort of horse fish shark &c
particularly cold & drizzling by the sea men,
probably the Dolphin Shark of Linnaeus, as
their noses are very blunt.

27 Wind fair & a fair breeze; found the ship to be
but a heavy sailor, but probably the indecency
we could not expect her to be any other from
her built, so are duty to set her with the
manoeuvring as a sleeping consequence
of her form which is much more calculated
for sailing, than for sailing.

28 Little wind today, in time we were about
us taken in board to begin a new course
very small sea. First which is slender
is called by the name of Broad meant
In the evening very clear, with the small

ENDEAVOUR ROUTE

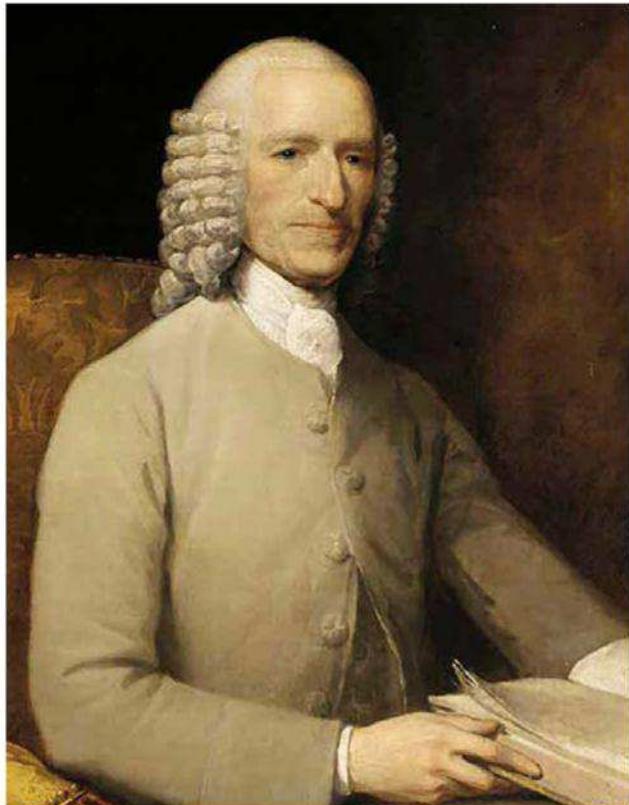
Cook's first voyage (left), aboard HMB *Endeavour*, was a combined Royal Navy and Royal Society expedition to the South Pacific, from 1768 to 1771, and the first of three Pacific voyages under his command.

SIR JOSEPH BANKS' 1768 JOURNAL

The extensive series of detailed journals kept by Banks (lower left) during the four years of Cook's first Pacific voyage began with an entry dated 25 August 1768. The final entry was dated 12 July 1771 and simply said: "At 3 O'Clock landed at Deal."

DR JOHN FOTHERGILL

As a Quaker, Fothergill (right) was excluded from university and turned to botany because it didn't require university training. The garden he began in 1762 grew into a resource Banks later regarded as second only to the Royal Garden at Kew.



In 1767 THE ROYAL Society, the scientific academy of which 24-year-old Banks was a fellow, recommended that the government send a ship to observe the transit of Venus in the "South Sea", which would enable the distance from the Earth to the Sun to be calculated.

Banks had been planning an expedition to Sweden to meet Linnaeus, but once approval for the Pacific voyage was given in February 1768, he set his sights south instead. Even before the full purpose of the voyage had been articulated, let alone a ship and commander chosen, he was committed. He persuaded the Council of the Royal Society and the Lords of the Admiralty that he should go along as a supernumerary, concentrating on natural history – and paying his own way.

So persuasive was Banks that although approval was granted for him alone, *Endeavour* eventually carried a party of nine civilians headed by Banks, including Sydney Parkinson and two servants – as well as Banks' greyhound. Last to join the team was Banks' friend Daniel Solander, a pupil of Linnaeus and an assistant keeper at the British Museum. Solander

was to work closely with Banks, collecting and describing; Parkinson was to draw natural history specimens; landscape artist Alexander Buchan was to sketch scenery and human portraits; and Herman Spöring, a protégé of Solander's, was to act as Banks' secretary. Fothergill thoughtfully provided *Endeavour* with apples that were to keep well for more than a year.

By now, the expedition was ostensibly "for the Promotion of Natural Knowledge" in astronomy, geography and natural history, part-funded by King George III, with the ship and crew provided by the Admiralty, and all supplemented by Banks' own considerable resources.

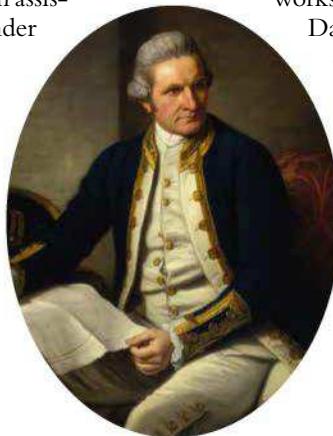
But the main instruction for Cook, named as commander of *Endeavour*, was "the Discovery of the Southern Continent", the hypothetical landmass by now long assumed to be south of the seemingly arid New Holland (Australia). Besides all the collecting and preserving materials, as well as guns for personal protection, Banks selected a library of more than 100 books, including works by Australia's first British explorer William Dampier, for the voyage. The baggage and equipment of Banks' team weighed 20 tons.

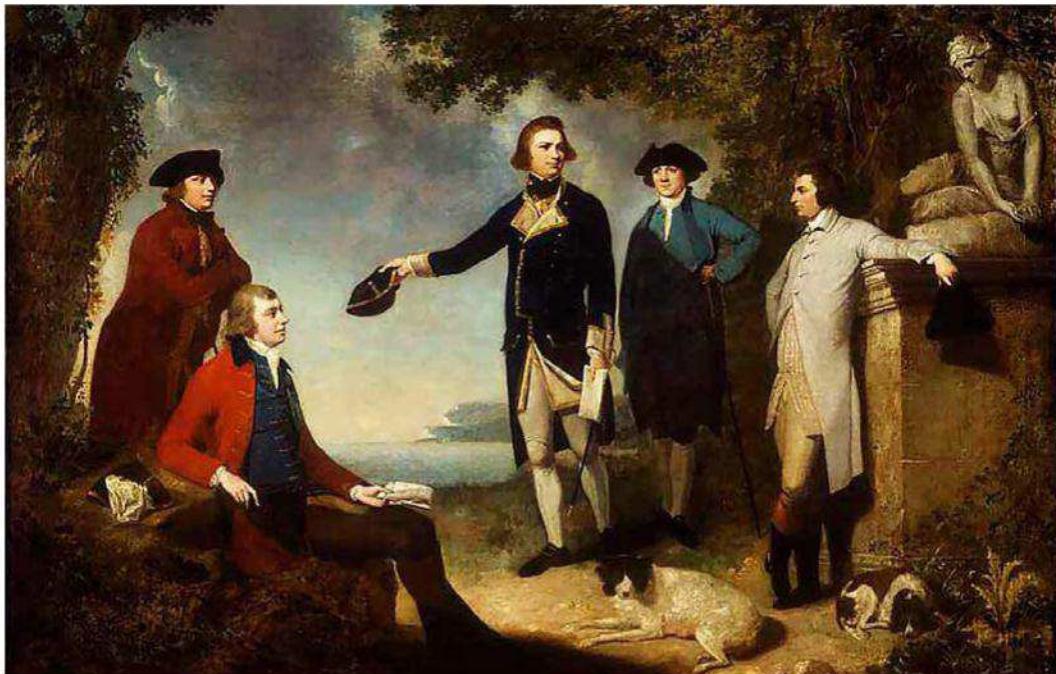
Banks' main focus was botany, but he was interested in all aspects of natural history. With the help of Danish zoologist Johan Fabricius, who had studied with Linnaeus, he also prepared for collecting animals, including insects.

On 25 August 1768 Cook sailed *Endeavour* from Plymouth Sound, in England, and by 12 September he had reached Madeira, off the north-west coast of Africa. There, Banks and Solander

JAMES COOK

"Curse the scientists and all science into the bargain!" a frustrated Cook wrote at one point in his journals. And yet despite social class separating the commoner Cook from the wealthy Banks, the two are said to have learnt much from each other. Cook reportedly treated Banks and the other scientists with much consideration and respect.





started their expedition herbarium, as Solander wrote: “By fair means or foul, got about 300 species of plants, among them several new.” These plants were described and drawn as the ship sailed south. However, at their next landfall, Rio de Janeiro, in Brazil, Banks and Solander were not allowed ashore to collect samples, because the ruling Viceroy suspected the expedition of having colonial, rather than scientific, aims.

Solander wrote: “Our few botanical Collections have been made by clandestinely hiring people; and we have got them on board under the name of Greens for our Table. Now and then we have botanised in the bundles of Grass that have been brought for our Goats and Sheep.” Despite the restrictions, two of Banks’ party made some gatherings, as did Solander (in the guise of the assistant of the ship’s surgeon), and, finally, Banks himself had a full day on shore, making up Latin names for the new plants to fit them into the European classification systems of the natural world.

Next, Cook made for the coast of Tierra del Fuego, an archipelago off the southernmost tip of the South American mainland. There, in what is now Argentina’s Thetis Bay, Banks and Solander collected more than 100 plant species in little more than four hours. Their next excursion, at the Bay of Good Success on Tierra del Fuego, led to Banks’ two servants dying from exposure.

The next landfall was the far more temperate Society Islands, in French Polynesia, where they anchored on 10 April 1769 – though even there Banks lost another member of his team, artist Alexander Buchan, of epilepsy. Parkinson – and to a degree, Spöring – took on his duties.

SCIENTISTS AND SEAMEN

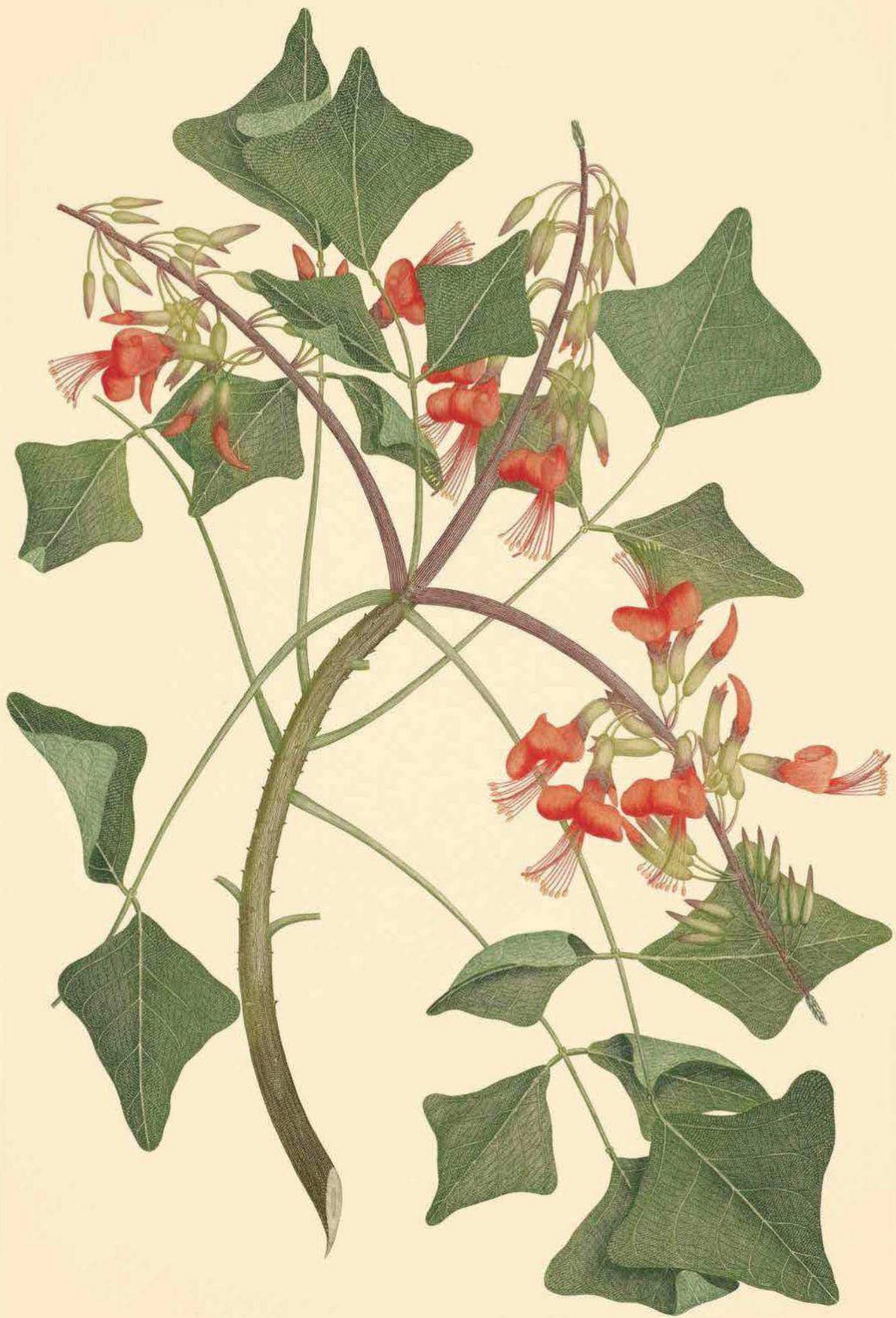
This unsigned c.1771 artwork – which shows (above, L-R) Solander, Banks, Cook (in his earliest known portrait), Dr John Hawkesworth and the Earl of Sandwich – is regarded as one of the most important paintings relating to Britain’s Pacific explorations.

YULBAH, LEGUMINOSAE

Restricted to northern Australia, yulbah (*Erythrina vespertilio*) (right) is a deciduous plant Solander noted “sometimes grew to a tree as much as a foot in diameter; and the natives, who, like Nature herself, may be said to do nothing in vain, had cut one down and carried off the whole of the trunk”. The wood was used for woomeras (spear-throwers), coolamons (vessels) and shields.

After observing the transit of Venus in Tahiti and making further collecting trips, Cook set off southwards to seek the fabled “Southern Continent”. He had been instructed: “With the Consent of the Natives to take possession of Convenient Situations in the Country in the name of the King of Great Britain; or if you find the Country uninhabited take Possession for His Majesty by setting up Proper Marks and Inscriptions, as first discoverers and possessors.”

On 7 October, Banks was collecting on what they at first took to be that continent, although it was in fact today’s New Zealand. By now, Parkinson was battling to keep up with the new collections being brought



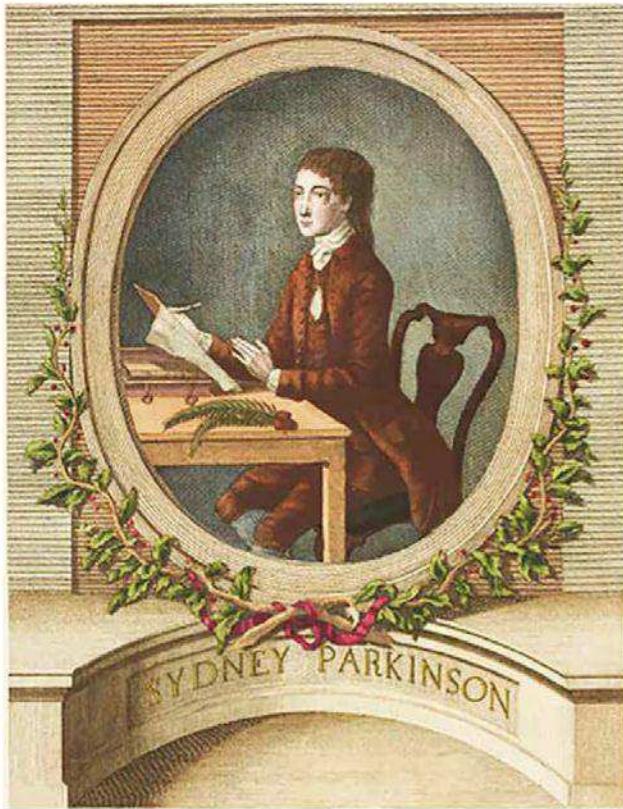


DEPLANCHEA TETRAPHYLLA, BIGNONIACEAE

This large northern Queensland rainforest tree (left) has leaves up to 60cm long. Birds perch on its spectacular flower heads, bending them down to feed on copious dark-brown nectar exposed in the spoon-shaped lowermost lobes of petals, which apparently act as a visual lure. In this way, the birds brush against the protruding anthers and stigmas with their throat or breast, picking up pollen.

SYDNEY PARKINSON

A natural history draughtsman employed by Banks, Parkinson (right) was the first European artist to draw Aboriginal Australians from direct observation, as well as Australian landscapes, plants and animals. He made at least 1300 drawings or sketches during the voyage and those that survive are in the collections of the Natural History Museum, London.



on board and, from then onwards, was unable to complete any more watercolours. He now made pencil sketches, sometimes part-painted, with colour notes.

With the weather against him, Cook had to turn back and made for Van Diemen's Land, today's Tasmania, abandoning the planned eastward route back via Cape Horn, the southernmost headland of Tierra del Fuego. This allowed Cook to investigate "the East Coast of New Holland" of earlier maps. It was this initially unintended survey that eventually led to the British conquest of Australia, beginning with the founding in 1788 of a prison camp at Sydney Cove, in Port Jackson.

ON 19 APRIL 1770, Banks saw what is now Australia for the first time. In his diary, he noted: "The countrey this morn rose in gentle sloping hills which had the appearance of the highest fertility, every hill seemd to be cloth'd with trees of no mean size."

From near today's Batemans Bay, in NSW, the company could see cabbage tree palms (*Livistona australis*) with their telescopes and made what was perhaps the expedition's first Australian botanical record. Unable to land, Cook sailed north, passing between what he called Cape Banks and Point Solander into Botany Bay (originally "Sting-Ray Harbour", later "Botanist Harbour" then "Botanist Bay" in Cook's journal (see page 21)) and the crew stepped onto the land of the Dharawal people.

Parkinson noted: "The country is very level and fertile; the soil a kind of grey sand; and the climate mild: and though it was the beginning of winter when we arrived, everything seemed in perfection. There is a variety of flowering shrubs; a tree that yields gum; and a species of palm [*Livistona australis*], the berries of which

are of two sorts; one small, eaten by the hogs, and the other, as large as a cherry, has a stone in it; it is of a pale crimson colour, and has the taste of sweet acid...for the number of curious plants we met with on shore, we called the bay Botany-bay."

Banks, Solander and their assistants made specimens of 132 plant species in six days at Botany Bay, the first scientific collection of Australian flora. Parkinson made drawings of some 84. Considering the time of year, with little in flower, it was remarkably comprehensive – so much so that it is possible to reconstruct the scene as they would have found it. Their observations on the openness of the vegetation are part of the huge corpus of literature and illustrations that make a compelling case for the very heavy fire management and ecological modification of eastern Australia by Indigenous people.

After leaving Botany Bay, they spent seven or so days collecting specimens at other landings along the coast. In all, Parkinson made 94 sketches in the 14 days after they landed at Botany Bay. Banks was later to complain how little time Cook gave to natural-history collecting, which made each landfall a scramble for new plants.

The next collections were made at Bustard Bay, south-east of today's Gladstone, in Queensland. Banks wrote: "Here we found a great variety of Plants, several however the same as those we ourselves had before seen in the Islands between the tropicks and others known to be natives of the east Indies, a sure mark that we were upon the point of leaving the Southern temperate Zone and for the future we must expect to meet with plants...part of which at least have been before seen by Europeans."

The following day, they were at sea again (and eating the eponymous bustard), before touching at Thirsty ▶



Sound, between present-day Rockhampton and Mackay. Banks, on 29 May 1770, maintained a stiff upper lip about the hazards of plant-collecting, writing: "Found several Plants which we had not before seen...one kind of grass...was very troublesome to us: its sharp seeds were bearded backwards and whenever they stuck into our cloth[e]s were by these beards pushed forward till they got into the flesh: this grass was so plentifull that it was hardly possible to avoid it and with the Musketos that were likewise innumerable made walking almost intolerable. We were not however to be repulsd..."

On 11 June 1770, calamitously, *Endeavour* struck the Great Barrier Reef. She was freed from the coral on 17 June, and Banks, appearing undeterred, noted: "In the meantime Dr Solander and myself began our Plant gathering." *Endeavour* was moved into the river now bearing her name, beached, and repaired. But the disaster allowed for seven weeks of exploration and collecting. On 21 June Banks recorded that he "began today to lay Plants in sand", or dry them for preservation.

Parkinson drew 141 plant species, but by 28 July, Banks had had enough. "Botanizing with no kind of success," he wrote. "The Plants were now intirely compleated and nothing new to be found, so that sailing is all we wish for if the wind would but allow us."

Shortly afterwards the weather did become favourable, and *Endeavour* picked its way through the reef, heading north to complete Cook's survey of 3220km of the Australian east coast, a coast he claimed for Britain and named New South Wales.

PAGODA FLOWER, LABIATAE

Endeavour arrived on 10 October 1770, in Batavia, now Jakarta, where Parkinson drew this shrub *Clerodendrum paniculatum* (right) that grows to about 3m tall. It has large lobed leaves up to 40cm long and 38cm wide. The striking flower heads, each up to 45cm long, have red or orange to pale lemon or cream flowers.

By 1809 it had been introduced into England and due to widespread cultivation is now found throughout Asia.

BANKSIA SPECIMEN

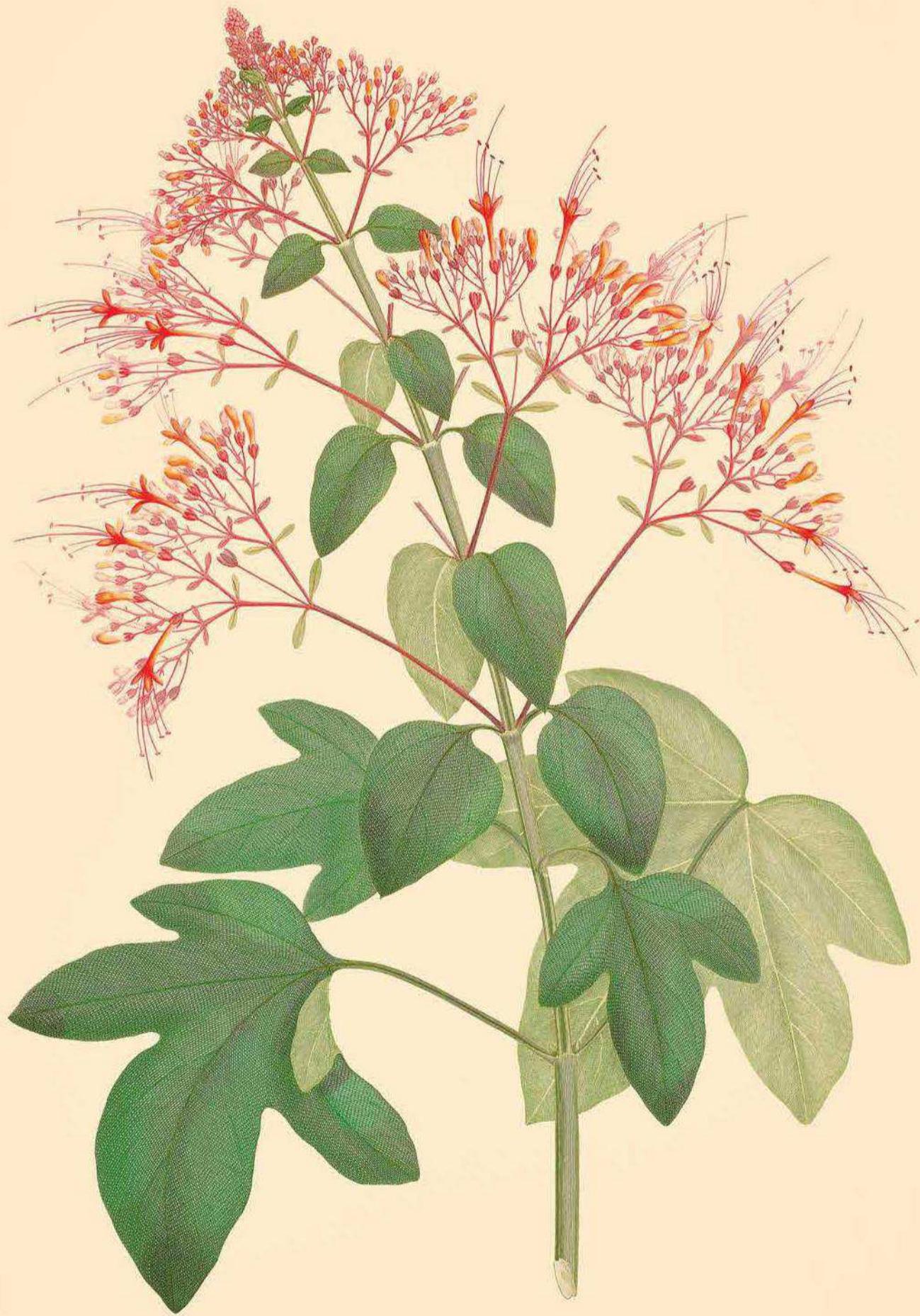
This specimen (left) was collected by Banks and Solander on the first (1768–1771) of Cook's Pacific voyages. The species was later scientifically named *Banksia serrata*, now known commonly as old man banksia and part of the genus named after Banks that contains 170 species from across Australia.

On 10 August, they sighted Lizard Island (Jiigurru), where, on 11 August 1770, Banks and Cook climbed the peak now known as Cooks Look to plan a way through the reef. Two days later they were at last "freed from all fears of shoals". Looking back at the expedition's rich collection, Banks wrote: "Of Plants in general the country afforded a far larger variety than its barren appearance seemd to promise. Many of these have no doubt properties which might be usefull, but for Physical and œconomical purposes which we were not able to investigate, could we have understood the Indians or made them by any means our friends we might perchance have learnt some of these; for tho their manner of life, but one degree removd from Brutes, does not seem to promise much yet they have a knowledge of plants as we plainly could percieve [sic] by their having names for them."

His summation of Australia in general was noted, perhaps presciently, as follows: "Upon the whole New Holland, tho in every respect the most barren country I have seen, is not so bad but that between the productions of sea and Land a company of People who should have the misfortune of being shipwreckd upon it might support themselves, even by the resources that we have seen. Undoubtedly a longer stay and visiting different parts would discover many more."

By October, the expedition reached Java, in modern Indonesia, where Parkinson drew 74 plants. While *Endeavour* was being repaired, the company began to succumb to disease. Two Tahitians Banks had brought along from Polynesia died in Batavia (Jakarta) and by Christmas Day, when the ship left Java, Banks, as well as Solander and several others, had contracted malaria.

Their voyage to the Cape of Good Hope, in South Africa, and on to St Helena, a remote volcanic outpost in the South Atlantic Ocean, saw the deaths of 22 of the company, including Spöring and Parkinson – probably from a combination of malaria and dysentery, while Banks may also have had typhoid. Of the 94 in the company that had set out with Cook, only 41 were to return alive to England, and, of Banks' original nine, just four survived: Banks, Solander and their two field assistants. ►



Early European botanical knowledge of Australia



Yellow plum.

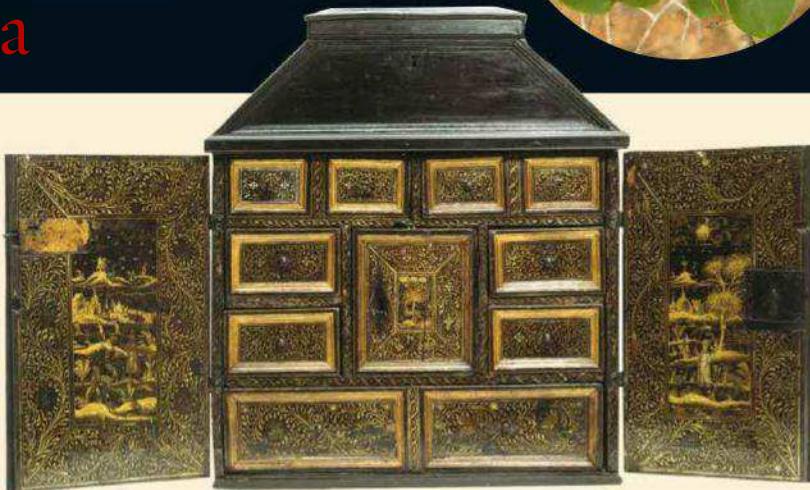
THE PLANT SPECIES Banks found in Australia were, of course, not new to Aboriginal people, nor to the Asian peoples who traded with them long before Europeans appeared here.

Such trade meant that even before Banks' voyage along Australia's east coast aboard HMB Endeavour, eucalyptus wood had reached Europe in the form of small japanned cabinets – although its Australian origin remained unknown. Dated between 1599 and 1625, two such cabinets are now in England, a third is in the National Gallery of Victoria, and a fourth is in a private collection.

The first western scientific record of an Australian plant seems to have been made by the Spanish in Torres Strait on 21 September 1606, during the South Seas expedition of Luis Vález de Torres. Two surviving manuscripts detail this part of the voyage. One, made by Don Diego de Prado y Tovar, records on Long Island (now Sasse Island) "many plum trees that are named after Nicaragua: they have large stones and little flesh".

He was referring to the pantropical yellow plum (*Ximenia americana*), a small, scrambling shrub that also occurs in tropical America. But this account was published only very recently, from Prado's manuscript preserved in the State Library of New South Wales, and no specimens seem to have been collected.

The oldest surviving preserved specimens confirmed from Australia were made almost a century later by Dutch captain Willem Hesselsz de Vlamingh and his crew aboard the Geelvinck. They explored what is now Rottnest Island and south-west Western Australia in 1697. On the mainland, they



found trees "dripping with gum", possibly an acacia species, and a eucalyptus with a trunk diameter of 5m, which was probably in what is now Kings Park. But Vlamingh's personal account, only known in a French translation, was not published until 1998 and his samples of cypress timber, tea-tree oil and gum have disappeared.

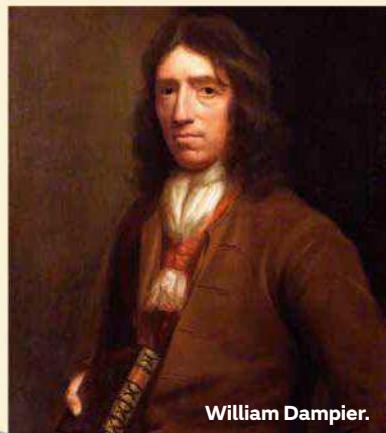
On 4 February 1697, however, Vlamingh used a cypress pine log at Cape Inscription, on Dirk Hartog Island in Shark Bay, to hold a pewter plate inscribed with details of his

▲ This early 17th-century cabinet, at the National Gallery of Victoria, incorporates eucalyptus wood that was 'japanned' – varnished with a hard black lacquer.

visit. The log is in the WA Maritime Museum and could be considered the oldest documented botanical specimen collected in Australia.

During his voyage, Vlamingh wrote: "We sent men ashore every day to cut wood and collect fresh herbs. We were often brought some which were unknown to us". A surviving specimen from one such foray is held in the Conservatoire et Jardin Botaniques in Geneva, Switzerland. It is one of two species notable for being the first plants restricted to Australia to be named according to modern conventions. Although these are technical firsts, no-one at the time knew where they were from.

Another small collection made in WA two years after Vlamingh's expedition was quickly described and mostly correctly attributed to Australia. This illustrated, bestselling book was the pioneering work of Englishman William Dampier and his HMS Roebuck crew, who collected plants while looking unsuccessfully for fresh water at Shark Bay in August 1699. Most of the surviving specimens, some 26 species, are now held in the Department of Plant Sciences at the University of Oxford.



William Dampier.

◀ In 1616 Captain Vlamingh put this plate on what's now Dirk Hartog Island, nailed to a cypress pine log now in a museum, arguably Australia's oldest botanical specimen.

Although Banks was never to benefit financially from Australia, the Pacific voyage made him a star.

BANKS' JOURNAL OF THE voyage ran to about 200,000 words and his plant collection included 30,000 specimens representing 3000 species, of which perhaps 1400 were new to science. Parkinson produced 18 volumes of plant drawings, leaving 269 watercolours finished and 673 unfinished. He also made 268 of the 298 surviving animal drawings, although few were finished by him. Marine animals are the most represented, no doubt because there were no plants to draw at sea, so time could be given to zoological subjects, which were never Banks' priority. The artists only drew four mammals and 32 birds during the whole expedition.

Indeed, there were very few tangible zoological results from the voyage as far as Banks himself is concerned, but in 1775, Danish zoologist Johan Fabricius, who'd helped Banks prepare for the voyage, published about 500 insect species from the *Endeavour* collection as new discoveries, apparently using the drawings as well as mounted specimens, while a few of the birds were described as new in Banks' lifetime.

On his return to England, Banks was lionised, and in 1771 he and Solander were bestowed honorary doctor of civil law degrees by the University of Oxford. Although Banks was never to benefit financially from Australia, the Pacific voyage made him a star. He became a baronet, President of the Royal Society, adviser to both king and government, and an international patron of science. Not least, he gave natural history social as well as scientific prestige.

The voyage and his association with Cook turned him from an inquisitive botanist into a fervent advocate of the colonial model and he used the Royal Garden at Kew as an economic instrument. He played a critical role in the globalisation of crop plants for the good of Britain by transporting species from one part of the world to another, most famously the Polynesian breadfruit to the West Indies as food for slaves. He also sent cotton seeds from India to the Caribbean, tea from

China to India, and cochineal insects from South America to India. Another of his causes was to promote New South Wales for white settlement.

As early as November 1771, Banks was said to have put aside £10,000 to publish the botanical results of the *Endeavour* voyage in 14 volumes. He began to prepare for printing with considerable energy, commissioning artists to produce watercolours of Parkinson's pencil drawings so they could be engraved ready for publication, along with the watercolours he had managed to complete. The next step was to employ engravers to create copperplate line engravings from the completed watercolours, and 753 plates were made.

Then the work stalled. In November 1784, Banks was still optimistic about the project, writing, "It can be completed in two months if only the engravers can come to put the finishing touches to it."

But by 1791 nothing further had been accomplished, although Banks was still planning on issuing the book in parts, laying the blame for the delay on his work at Kew. In reality, his income from wool and other agricultural interests was falling, thanks to a slump following the American War of Independence (1775–1783). As President of the Royal Society and after becoming a married man, his declining interest and, perhaps more importantly, his constrained resources are generally held to be the true reasons for his not completing the project in which he had invested so much.

Some engravings were eventually run off and distributed – and a set even reached Linnaeus – but unfortunately, the *Florilegium* was never printed in Banks' lifetime and he ended up bequeathing the engraved plates to the British Museum.

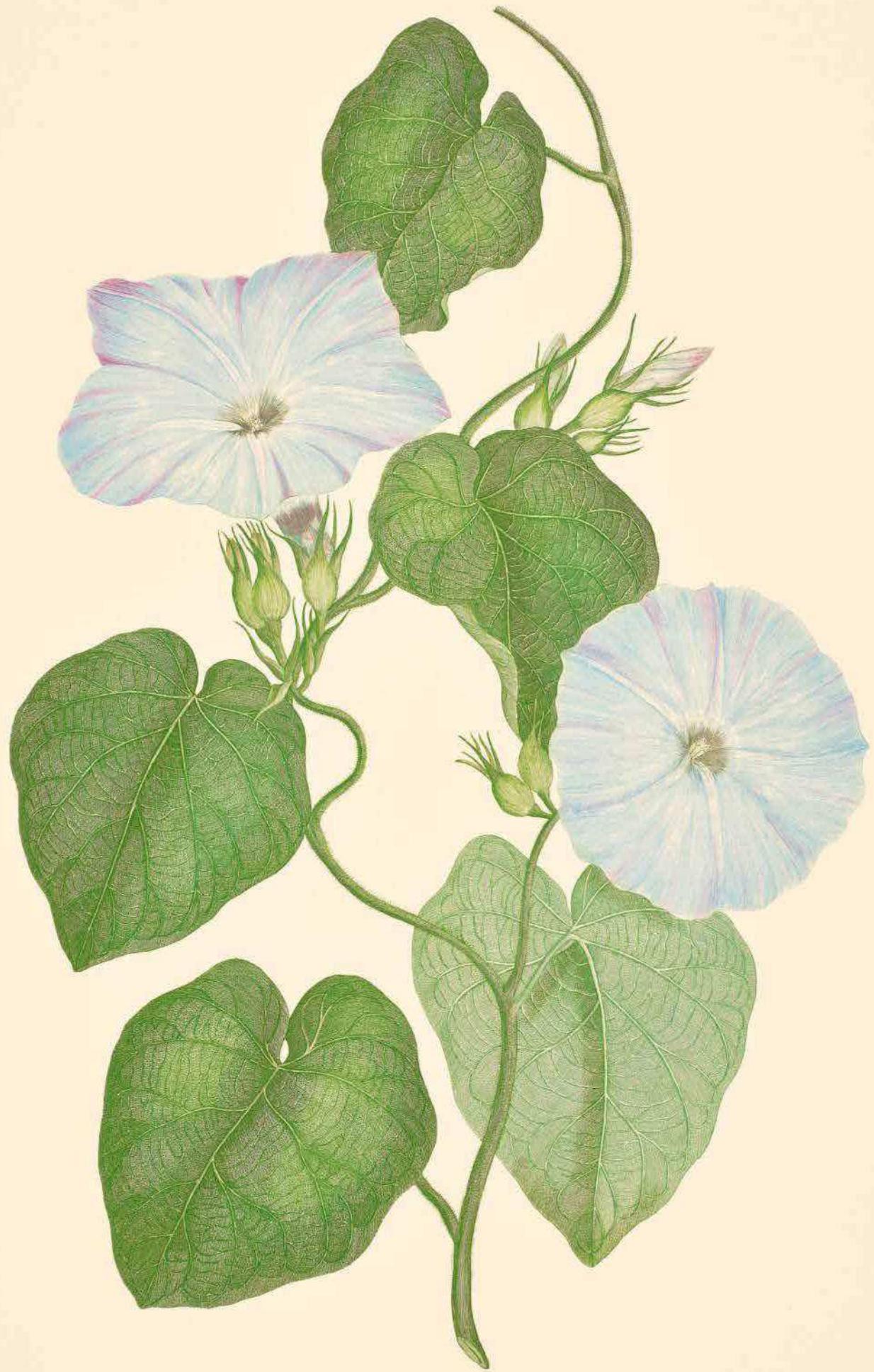
ONLY AT THE TURN of the 20th century, 130 years after they had been executed, were some of the drawings made from materials collected on Cook's first voyage published – as 319 uncoloured lithographs. In 1900–1905, the British Museum published the lithographs in a collection edited by botanist James Britten, with the title *Illustrations of Australian Plants Collected in 1770 During Captain Cook's Voyage Round the World in H.M.S. Endeavour*.

Britten had intended to include plants from New Zealand and possibly more plants from different places, too, but this project was also abandoned after the sum of £837 had apparently been spent on it over the five years.

JOHAN FABRICIUS

A Danish zoologist who studied under the legendary Carl Linnaeus, Fabricius specialised in insects. He is now recognised as one of the great entomologists of the 18th century and named more than 9700 new insect species, including about 500 collected on the *Endeavour* voyage to the Pacific.





Perhaps he thought it best for science to allow the savants of Europe access to the collections, rather than keeping them hidden.

Only in the 1990s, with the publication of Banks' *Florilegium*, a collection of unmounted prints published by Alecto Historical Editions in collaboration with the British Museum (Natural History), were all of Parkinson's engraved drawings published for the first time, albeit in a rather exclusive way. Using the original engraved plates, the prints were coloured using the authentic techniques of the 18th century, notably the *à la poupee* method, in which individual colours are worked into the copper plate using a twist of cloth (the *poupee*, or 'doll', AG 90).

Just 100 sets were printed – loose, without any accompanying commentaries, and costing more than £100,000 to purchase. Unsurprisingly, they were sold only to institutions and well-heeled collectors. This meant the general public was still denied access to the intellectual fruits of what was perhaps the most significant botanical exploration in history.

It was not until 2017 that the best of these drawings were widely reproduced, in full colour and complete with accompanying commentaries and general essays about the voyage and printing processes.

With the publication of Joseph Banks' *Florilegium* (Thames & Hudson, 2017), the most extraordinary of Parkinson's illustrations were at last made available to the general public for the first time, almost 250 years after *Endeavour* first set sail for the Pacific, along with commentary on the prints and a history of the printing.

By contrast with Cook's *Endeavour* voyage (1768–1771), the botanical results of his second voyage to the Pacific (1772–1775) were published rapidly. That these findings appeared before those of the first voyage has meant that many of the plants of the South Pacific, notably New Zealand, were named from the collections made by others on the second voyage. As that expedition only touched at Norfolk Island as far as Australia is concerned, knowledge of the botany of New Zealand advanced ahead of Australia.

Despite the continued non-appearance of the long-promised publication, Banks' desire to ensure England got the glory – and any economic gain – for his

work meant that for many years, he refused to allow European scientists access to all the material he had collected. In later life, however, he relented.

Perhaps his nationalistic sentiment had been overcome by his scientific curiosity. It might be that Banks, who became deeply involved with matters in Iceland and many other diversions following his return from the Pacific, as well as only having ever seen Australia as a sideshow in the *Endeavour* voyage – an expedition successful in observing the transit of Venus but unsuccessful in finding the fabled “Southern Continent” for England, and equally unsuccessful in yielding anything of commercial interest for England – felt there was now nothing to be lost by such magnanimity. Perhaps he thought it best for science to allow the savants of Europe access to the collections, rather than keeping them hidden.

Whatever his reasoning, this resulted in other people using Solander's excellent Latin descriptions from his manuscripts, and printing his unpublished plant names. It was largely in these ways that the Australian treasures seeped into the scientific milieu, although this European work has been largely neglected in the assessment of the influence of the Cook voyage collections.

Indeed, as the years passed, the scientific outcome of the Cook voyages, whatever Banks' thinking and apparent procrastination, was remarkably paradoxical when their initially nationalistic intent is remembered.

Work on the *Endeavour* botanical collections by European scientists – combined with leading Spanish taxonomic botanist Antonio Cavanilles writing up and lecturing in Madrid on the results of the Spanish voyage by Alessandro Malaspina to the Pacific (1789–1794) – meant that Britain had by now largely lost the initiative. (The preliminary work of English botanist James Edward Smith on First Fleet plants was an exception.)

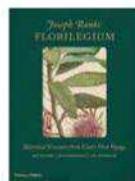
This leadership role was only finally regained thanks to the excellent work of Scottish botanist Robert Brown on the collections from Matthew Flinders' voyage aboard HMS *Investigator* at the beginning of the 19th century (1801–1803).

The success of that was to be the result of the intervention of no less than Joseph Banks himself. But that is another story!

AG

BLUE MORNING GLORY, CONVOLVULACEAE

Parkinson's note on his drawing of this perennial climber (*Ipomoea indica*) (left), seen in 1770 near the *Endeavour* River, captures the colours in detail: “the flower pale blue [with] a cast of pink appearing like a lilac colour turning very pale at the tube which is white outside and in capsula fresh green at the edges and very pale green in the middle”.



Further Reading

For more expert commentary and a full selection by David Mabberley of prints featuring plants collected during Cook's first Pacific voyage, see *Joseph Banks' Florilegium*, published by Thames & Hudson. See page 31 for how to win a copy.



Sydney submerged

There's a wild world thriving in the meandering waterways and coastal strip of our largest city.

STORY AND PHOTOGRAPHY BY JUSTIN GILLIGAN



WHITE'S SEAHORSE

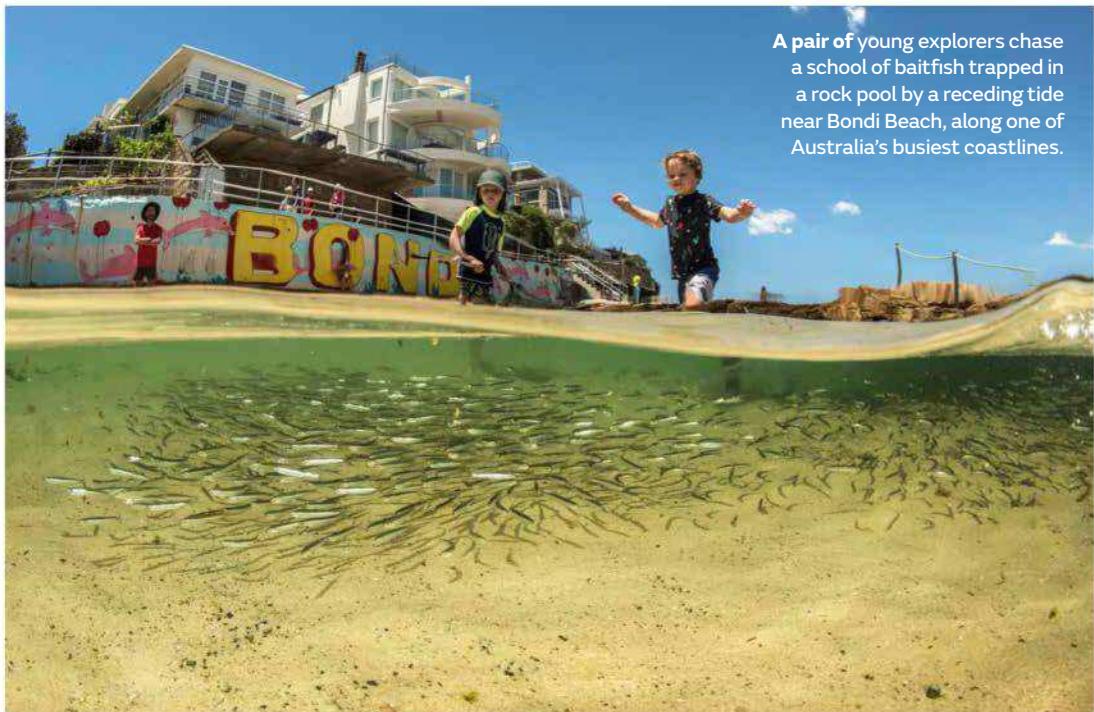
Some fish species, such as White's seahorse, which is often seen holding on to the nets of swimming enclosures, have managed to survive surprisingly well in Sydney's altered marine environments.

COMMON KELP

Sunset reveals a diverse marine milieu – including this stand of common kelp, usually hidden from view – beneath much-loved landmarks, such as the Sydney Harbour Bridge.







A pair of young explorers chase a school of baitfish trapped in a rock pool by a receding tide near Bondi Beach, along one of Australia's busiest coastlines.

IHAVE A SUNRISE DATE WITH A SEAHORSE. It's at Manly Cove, so I'm up early, driving across Sydney Harbour Bridge, racing the rising sun. The traffic is already a headache; Google Maps shows a further delay in my predicted arrival time; and I still need to find a car park, get my dive gear together, check my camera and locate my muse – potentially tricky considering its tiny size and cryptic appearance and behaviour.

As an underwater photographer, I work mostly away from major urban centres. But here I am, turning onto the notoriously hectic Military Road and driving with barely enough elbow room towards Sydney's populous Northern Beaches. I arrive as the pastel pink and blue hues of first light colour the sky and quickly enter the water. Finning along the sandy bottom towards the net of Manly Cove's swimming enclosure, the water is surprisingly clear as blue swimmer crabs and harvest cuttlefish hustle for my attention.

Minutes later I find my quarry – a charismatic creature, just 15cm long, covered in hard body armour and grasping the net with its prehensile tail. The stress of the morning rush hour melts away with the rising sun as I capture a portrait within the last shafts of dawn light.

Sydney's sun-spangled waters are central to the city's national and international reputation. But I've often wondered how much life lies submerged, hidden away from the above-water pressures of Australia's biggest city and its ever-sprawling human population. So now I've seen proof of the city's growing reputation as a seahorse

haven. But what else is veiled from view beneath the opaque surface of the waters near some of our most iconic landmarks, beaches and headlands?

GEOLOGICALLY, SYDNEY HARBOUR is a river valley that was drowned as the sea level rose about 11,000 years ago at the onset of the present interglacial period. But from a marine ecology perspective it's one of the world's most modified estuarine systems. Along with Port Hacking, Botany Bay, Pittwater and the Hawkesbury River, the harbour is one of a series of deep waterways in the Sydney Basin that drain along a shallow coastal strip between Palm Beach and Cronulla.

These waters support habitats strongly influenced by wave energy, water depth, bottom type and salinity. Exploring them is like swimming through storybook pages filled with a fascinating cast of colourful characters.

A series of rocky reefs along Sydney's coast lies separated by vast swathes of mobile sediment that withstand large and powerful waves. In the shallows, these are covered in seaweed forests (see AG 139) sheltering common seadragons feeding on swarms of tiny mysid shrimp.

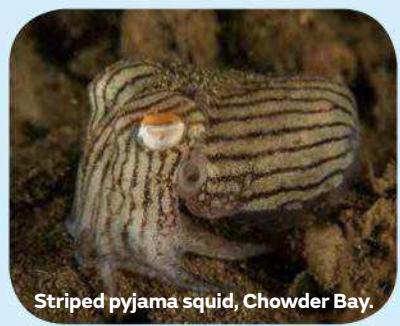
Also here are giant cuttlefish, with pigment organs – chromatophores – in their skin that change instantly, both in colour and texture, to transform these behaviourally complex creatures from flamboyant billboards to masters of disguise. Down in deeper waters, these reefs are covered in a living veneer of colour created by gardens of sponges, ascidians and tunicates in all shapes and sizes. ▶



EASTERN BLUE GROPER

This male blue groper, with a tiny clingfish attached to its flank, patrols a vibrant sponge garden in its territory at Kurnell, Port Botany.

Many of Sydney's resident gropers have been affectionately named by adoring locals.



Underwater delights

Slip on a face mask, snorkel and fins and go for a swim with Sydney's marine wildlife.

1 Fishermans Beach, Long Reef

The sheltered nature of the beach here makes it ideal to see sedentary invertebrates such as feather stars and sea urchins, as well as more active nudibranchs (sea slugs).

2 Manly

The last mainland breeding site of little penguins in NSW is at Manly, where these aquatic birds come ashore to nest in tunnels from May to February. They can, however, also be seen foraging elsewhere in the waters of Sydney Harbour and along the Sydney coast from Botany Bay to Narrabeen.

3 Shelly Beach

This site is at the south-eastern end of Cabbage Tree Bay Aquatic Reserve. Expect to see fiddler rays, Port Jackson sharks, wobbegongs, flounder, goatfish, old wives, flathead and more.

4 Chowder Bay

There's a surprising range of fish life to see at this inshore harbour location; from pipefish, frogfish, goatfish and leatherjackets to bottom-dwelling blennies and striate anglerfish. There's also a great array of invertebrates, from sea hares to cuttlefish.

5 Clovelly and Gordons Bay

Clovelly is famous for its resident blue gropers. You should also be able to see starfish, sponges, urchins, anemones and cuttlefish here. And follow the shore southwards to Gordons Bay where you'll find octopuses, moray eels, schooling fish, spotted goatfish, garfish and Port Jackson sharks.

6 Bare Island, La Perouse

The strange-looking red Indian fish is a star attraction here: look for them sheltering within colourful sponge beds and rocky reefs. You can also see pufferfish, gurnards, seahorses, stingrays, sponge crabs and nudibranchs (sea slugs), and if you're lucky you might spot juvenile green turtles.

7 Kurnell, Port Botany

Slip into the water at Silver Beach, snorkel eastwards and you should soon encounter seahorses, lots of weedy seadragons, giant cuttlefish, moray eels and Port Jackson sharks.

8 Oak Park Pool, Cronulla

This stunning rock pool leads to an underwater world where the featured highlights are blue gropers, moray eels, weedy seadragons and giant cuttlefish.



As crayweed forests are restored along Sydney's coast, species such as this pink sea urchin and other invertebrates seek shelter in the habitat created by the fronds.

Blue gropers are a recurring and much-loved part of coastal Sydney, famed for their tame behaviour, large size (up to 40kg), blubbery lips and peg-like teeth. One or two dominant males are usually in an area, along with several females. When a male dies or leaves, the largest female changes sex to become a replacement male. Many of Sydney's resident gropers have been affectionately named by adoring locals – such as Bluey off Clovelly Beach.

Seven aquatic reserves protect Sydney's most accessible and biologically diverse coastal areas. Cabbage Tree Bay Aquatic Reserve at Manly is one of the most popular, where snorkellers can spot southern eagle rays, dusky whaler sharks and crimson banded wrasse, all occasionally swimming around discarded junk like old motorbikes.

Within Sydney Harbour's estuarine environments, waters are generally shallower, more sheltered and prone to the influences of tide and salinity. Here, softer sediments are perfect habitat for bizarre molluscs, polychaete worms, echinoderms and crustaceans. Three aquatic reserves also afford protection for some of Sydney's estuarine habitat at Towra Point in Botany Bay and Shiprock in Port Hacking.

Stands of marine vegetation – including mangroves, seagrass and saltmarsh – provide oases for wading birds such as stilts and pelicans, and habitat for juvenile fish and marine invertebrates. Several species of seagrass are found in Sydney Harbour, with most at shallow depths in the outer harbour. Mangroves are a declining habitat worldwide, so it's reassuring to learn Sydney Harbour's mangrove cover has increased since European settlement. In contrast, saltmarsh has fallen dramatically due to foreshore development. Only an estimated 37ha remain.

These days consideration of the marine environment is now required through the planning and approval process for the installation of marine infrastructure. Developments, for example, over marine vegetation are heavily regulated, with significant penalties for unauthorised harm to aquatic plant species.



Use #AGsydneyunderwater to share your best snaps of underwater wildlife around Sydney on Instagram and tell us where you were at the time.



IT'S A DARK, SHADOWY world in Sydney's swimming enclosures and beneath jetties. Differences in shade, orientation and water flow are strong drivers of marine plant and animal life around these artificial habitats. Such places have proved beneficial for species such as seahorses, which thrive on swimming enclosure nets because they increase food and provide refuge from predation.

Deep in Sydney Harbour, the calm waters around Chowder Bay are home to striate anglerfish. Perfectly adapted to the soft sediment and low-lying sponge habitat here, this species has exquisite camouflage and uses its fins like feet to walk along the sea floor. It also has a built-in lure for attracting prey and a large mouth to eat them. Common Sydney octopuses are here too, their distinctive white pupils and rust-coloured arms emerging from lairs under rock ledges.

Sydney's marine environment is exposed to most threats faced globally by coastal cities, including habitat loss, foreshore development, pollution, stormwater run-off and introduced pests. But many plant and animal inhabitants appear not only to be coping with the shortcomings, but finding their own strongholds.

Since coastal ecologist Professor Peter Steinberg was appointed Director and Chief Executive Officer of the Sydney Institute of Marine Science (SIMS) in 2009, he's become acutely aware of the critical role played by an organisation such as his in ensuring the health of Sydney's estuarine and coastal ecosystems by providing local research that supports their management.

"I get reminded of the importance of our work every time I look out my office window," he says. "There are people sailing, people fishing, transport vessels, cruise ships, not to forget all of the houses and foreshore infrastructure that line the coast – it's the perfect visual for the work we do."

COMMON SYDNEY OCTOPUS

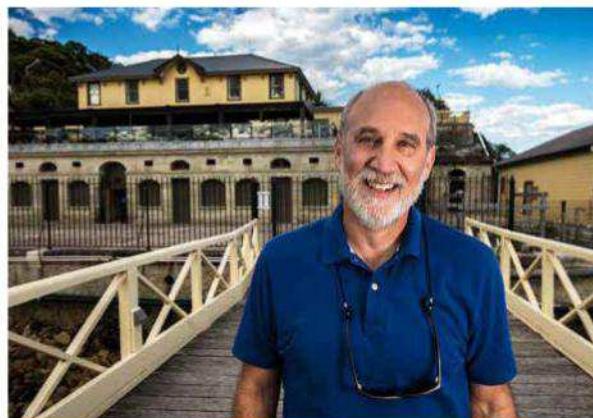
A pair of common Sydney octopuses find a home among debris beneath the Clifton Gardens jetty at Chowder Bay.



Human-based threats to and impacts on Sydney's waterways are relentless and increasing as more people are drawn to the city's waterways. "It is ironic that we can potentially love our waterways to their detriment," Peter says, "so at SIMS we are trying to understand what people think, what they value about the waterways and what that means about how you manage it."

To address some urban threats, SIMS researchers are now taking steps towards practical ecological interventions to improve existing infrastructure. "The reason is that if we don't get in there and start doing things now, then it might be too late very soon," Peter explains. "I think there has been a big shift in environmental science globally to interventions, and that takes on a whole bunch of forms – from restoration ecology, to rehabilitation ecology, to green or eco-engineering."

Sydney Harbour, for example, is extensively modified, with more than half the shoreline replaced by artificial structures such



Coastal ecologist Professor Peter Steinberg, Sydney Institute of Marine Science Director and CEO, heads research to improve management of Sydney's marine environment.

Design of these ecologically friendly seawalls makes them more like natural rocky intertidal areas.

as seawalls, jetties and piers. "We initially built structures that didn't look like natural habitats, but we can now construct things that facilitate natural marine communities," Peter says. "We are starting to deploy prototypes and designs in Sydney Harbour to better connect the man-made environment with the natural environment."

An example is designing seawalls with niches and crevices to increase colonisation by marine species such as seaweed, oysters, fish and crabs. Design of these ecologically friendly seawalls makes them more like natural rocky intertidal areas, with increased habitat complexity and a gradually sloping face to dissipate wave reflection.

"One challenge is trying to find cost-effective ways of retrofitting existing, smooth-surfaced vertical seawalls that don't integrate well with the natural environment," Peter says. "We're having some success using tiles created by our collaborators with a 3D printer, which can be attached to pre-existing seawalls and allow us to introduce complexity and structure to the surface."

Having seen positive results of SIMS' work in the Sydney area, Peter realised the model could be applied to similar urban harbours elsewhere. The World Harbour Project (WHP) resulted from SIMS-led work and was launched in 2014 at the IUCN World Parks Congress, held in Sydney. It began with 14 partners and has grown to include 31, a global initiative based on the idea that ►

▼ A fanbelly leatherjacket in Chowder Bay carries evidence of an encounter with a recreational fisher, probably off the local jetty here.



Sydney's issues are shared by other coastal cities worldwide. "All these cities are facing the same problems, so we are working together to arrive at collective solutions," Peter says, explaining that the WHP focuses on up to four themes. "One is water and sediment quality. We are interested in pollutants, including increasing plastics, but also interested in microbial contamination and its consequences to public health and water treatment."

Peter sees his SIMS' team as stewards of Sydney's marine environment. "We want to do the work that enables us to understand and enhance that environment," he says. "I am by nature an optimist, and I think we have already done some really great things to enhance Sydney's marine environment. But there are some significant challenges ahead, so we are committed to keep working hard to ensure people keep appreciating our beautiful waterways."

SYDNEY'S ESTUARINE habitats have historically been polluted by industry, particularly shipping, resulting in a legacy of residual toxins trapped in sediment, notably in low-energy sheltered bays with limited tidal turnover. Some impacts have been so severe they still need to be managed today, such as a fishing enclosure cordoned off in Homebush Bay to prevent people catching and consuming fish from that area.

The quality of Sydney's waterways improved significantly in the early 1990s with the relocation of coastal sewage outfalls to deeper offshore water. But it didn't

come soon enough for some species. Researchers believe that poorly treated sewage and stormwater led to the disappearance of a brown seaweed known as crayweed from Sydney's coastline.

The species occurs in shallow water, grows to a height of 2.5m and forms dense beds of spindly lime- and yellow-coloured fronds. Historic photographs, herbarium records and early research observations suggest the species formed underwater forests between Palm Beach and Cronulla as recently as the 1960s and '70s.

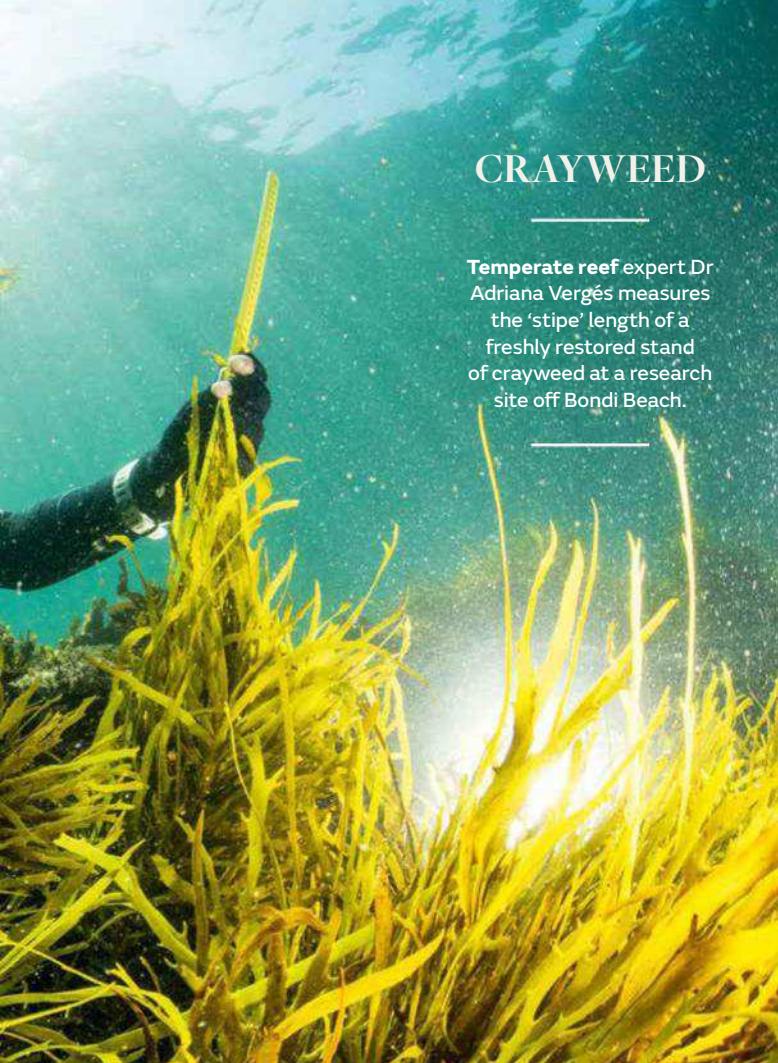
"It used to be abundant, but disappeared around the 1980s," says Dr Adriana Vergés, a leader of Operation Crayweed, a collaboration of researchers, students and volunteers working to restore this remarkable underwater habitat to coastal Sydney. "And it took a long time for anyone to categorically say that it had disappeared. If this happened with a plant or a tree on land, it wouldn't have taken so long to notice. It just goes to show that we know a whole lot less about the marine environment and there just aren't many people out there noticing the changes."

Adriana grew up in Barcelona and studied habitats off Ireland's west coast. She's passionate about temperate reefs and came to Sydney to do research on seaweed following the work of SIMS' Peter Steinber, with whom she worked during her PhD.

As a first step towards restoration, Operation Crayweed began investigating the species' role as a habitat for an important ecological community. "In other areas of NSW

CRAYWEED

Temperate reef expert Dr Adriana Vergés measures the 'stipe' length of a freshly restored stand of crayweed at a research site off Bondi Beach.



further south, we found there was up to 10 times more abalone associated with crayweed, rather than with other seaweed species,” Adriana says. “We also found that it supports a unique community of invertebrates, and that their absence is likely to have flow-on effects to other species in the ecosystem.” The team’s findings were supported by evidence from Victoria that greater numbers of rock lobster are associated with crayweed compared with other seaweeds. Recognising the importance of this marine plant, the team is now working to restore it along Sydney’s coastline. “We’ve found that transplanted adults can survive and even more importantly that they can successfully reproduce,” Adriana says.

Since they began in 2011, Adriana’s team has observed that crayweed is now making its own way back to the shallows. “We are now finding it in exactly the same habitat where it would have occurred in natural populations, so it has been a very successful project,” she says.

IT’S A TESTAMENT to the health of the city’s marine environments that Sydney’s waterways support the last mainland colony of little penguins in NSW. Up to 70 penguin pairs arrive at North Harbour, near Manly, between May and February each year to nest. It’s one of about 10 NSW sites where the species breeds, along with Lion Island in Pittwater.

Libby Hall, manager of Taronga Wildlife Hospital, says penguins prefer to hunt close to their nesting sites

Sydney’s waterways support the last mainland colony of little penguins in NSW.



▲ **Libby Hall**, manager of Taronga Wildlife Hospital, holds a juvenile hawksbill turtle undergoing rehabilitation before its planned release back into Sydney waters.

when they have chicks, although they will move further afield depending on food availability. “They are very faithful to their burrow sites,” she explains. “Even if they travel all the way down to Victoria in search of food, they will return to the same place to breed.”

Not only do these little birds breed at Manly but they also undergo their annual moult there. To prepare for moulting – a highly stressful activity during which they replace all their feathers and are particularly vulnerable to predation – penguins need to feed intensely to build energy reserves. They’ll then come out of the water and hide in rock cavities at the Manly site for about three weeks. Moulting, Libby explains, is clearly a critical driver in penguin biology. It is, she says, essential that the birds have a healthy marine environment with plenty of small fish around to ensure they don’t need to travel far to build up their energy stores for moulting.

A major threat not only to penguins in Sydney’s waterways, but to all the marine wildlife around the city that ends up in the hospital’s care is ocean debris. The facility regularly receives marine turtles that have swallowed plastics, and shorebirds that have ingested discarded fishing hooks, or have them embedded in their bodies or wings. “And we see all types of plastics inside the intestines of turtles, such as plastic shopping bags – both single-use and biodegradable bags – and small plastics such as lids and ring-pulls, bait bags, balloons, and balloon string,” Libby adds. “We also see microplastics ▶

“Surprisingly, we have found that the green turtles in particular spend a lot of time up in Sydney’s estuaries.”

and have tiny turtles come in that fit in the palm of your hand that are already pooing plastic!”

She says that the marine debris threat appears to be increasing: “Anything associated with human impact on wildlife appears to be on the increase in the Sydney area. There are more plastics in the harbour and also more boats to collide with marine life. It’s a fairly simple equation; with more humans come greater human impacts.”

If the marine turtles that come to the wildlife hospital can be rehabilitated to the point of release, they are fitted with a satellite tag to monitor their survival and movement. “We aim to get information on their migratory paths and determine habitat usage,” Libby says. “Marine turtles are considered indicators of marine debris pollution and can be monitored fairly easily. We want to identify vital feeding grounds and resting areas for these threatened species – information that can later be used to influence managers and protect important habitats.”

Marine turtles don’t return to their nesting beaches in tropical waters until they are more than 30 years old. The hospital’s tagging work has shown where and how these young turtles around Sydney spend their time before reaching maturity. “Surprisingly, we have found that the green turtles in particular spend a lot of time up in Sydney’s estuaries,” Libby says. “I guess we were expecting them to head north back to the Great Barrier Reef and into warmer water. They actually went up into Pittwater and up the Hawkesbury River, where they stayed for quite a while. We had no idea that those areas were important feeding and resting areas for marine turtles.”

COMMUNITY GROUPS HAVE also recognised the significance of the marine debris issue around Sydney and have passionately begun taking action into their own hands.

Operation Straw is a volunteer-based citizen science project that collects plastic straws from Manly Cove, a popular dive site and hotspot for marine debris. “We want to clean up the site and also collect data so that we can work with businesses and provide motivation for them to change their practices in regards to straws and other plastic items at the source,” says Harriet Spark, Operation Straw’s founder.

The initiative was born when Harriet began noticing discarded straws and plastics building up at her local dive site. “The site is amazing,” she says. “There are seahorses along the nets and it’s really beautiful when it’s not full of rubbish. We started to find hundreds of plastic straws and so I put a couple of photos up online and people were really shocked.”

Harriet finds straws are the perfect starting point to convey the importance of reducing single-use plastic. “When I break the message down using straws at a basic level and then work up to other single-use plastics from the bottom up, the message is a lot clearer and therefore more effective,” she says.

This initiative extends beyond straws, with volunteers collecting all rubbish they find during Operation Straw events. However, it’s only the straw data that are entered through the Tangaroa Blue Foundation database – a national record that enables volunteers and organisations running beach clean-up events to document and collate data on what they find. “We count how many straws there are, separate them into categories, and then send off the data,” Harriet explains.

Operation Straw began last summer with 12 clean-ups held during the 2017–18 season. “We’ve collected about 2000 straws in total,” Harriet says. “We see a lot of McDonald’s straws and there is a McDonald’s just nearby on the wharf in Manly. There are also a lot of black straws, which are used by bars and cafes. So it seems the straws come from all those places, along with people dropping them on the beach and there are also stormwater and other sources around the broader Sydney Harbour.”

The initiative has been embraced by the local community, which has been a surprising outcome for Harriet. “When we initially started I was just going to try and do it myself with a couple of friends because I didn’t know how many people would want to get involved on a Saturday,” she says. “But the uptake has been so good that towards the end of the summer we had about 50 people coming along to join us, from teenagers to young families and older people.”

Harriet believes it’s possible to live without straws and single-use plastics: “If you have a medical condition then that is an exception, but most of the time we don’t need to use a straw.” And she also has a strong commitment towards ensuring a healthy marine environment for Sydney’s waterways in the future.

“The Cabbage Tree Bay Aquatic Reserve is a testament to what can be achieved through protection,” she says. “There are a lot of other places around Sydney that have marine debris issues and I think we could make better decisions as consumers and do more as a community to protect these beautiful areas.”

AG

 **TO SEE MORE STUNNING** pictures of underwater wildlife encounters around Sydney by AUSTRALIAN GEOGRAPHIC award-winning nature photographer Justin Gilligan, go to australiangeographic.com.au/issue145



BROWN SABRETOOTH BLENNY

Rubbish occasionally turns into treasure: this discarded can is transformed into a home for one Sydney Harbour resident at Chowder Bay.



► **Harriet Spark** founded Operation Straw, a volunteer-based citizen science project that collects plastic straws polluting Manly Cove.



▼ **A southern eagle ray** and school of mados shelter off Shelly Beach in Cabbage Tree Bay Aquatic Reserve on Sydney's northern beaches.





On day seven of my journey to the historic seaplane stranding I could, for a moment, forget the salt-spray and stress as I filled up on much-needed fresh water.



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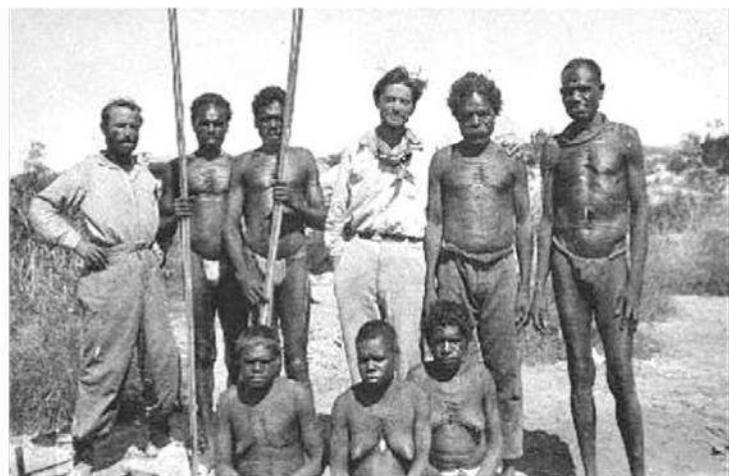
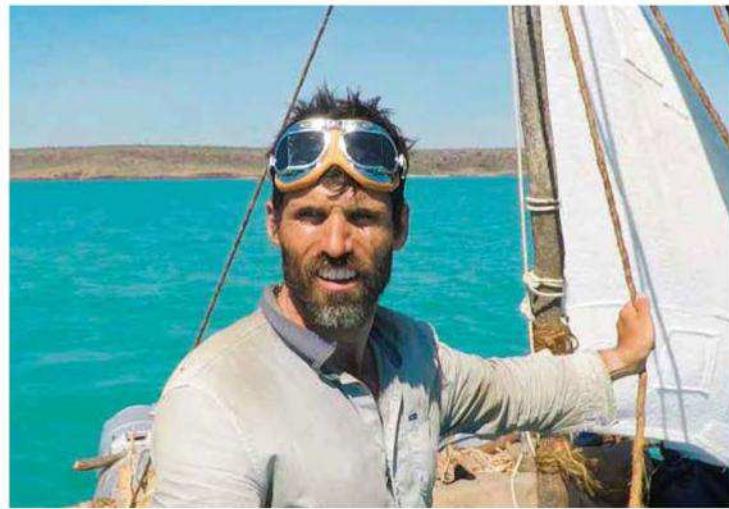
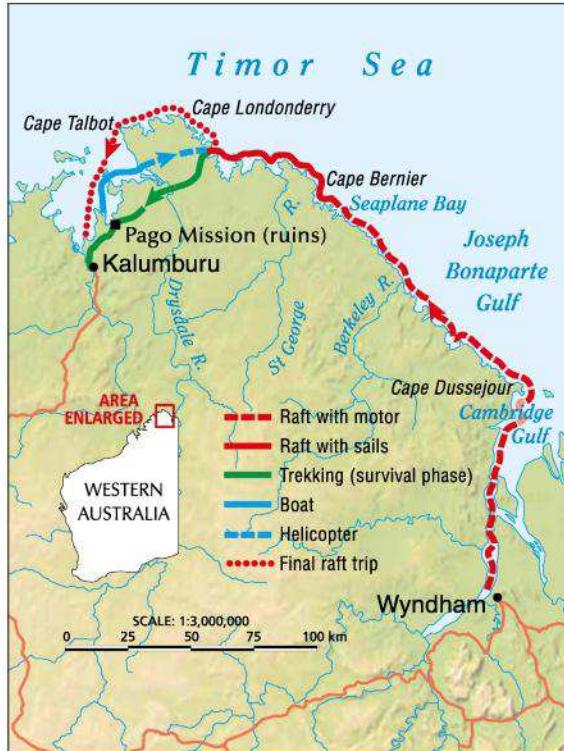
Surviving the Kimberley

To experience the predicament that almost killed two stranded German aviators in 1932, a modern-day adventurer sets off solo into the Kimberley with only minimal supplies.

STORY AND PHOTOGRAPHY BY MICHAEL ATKINSON

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▼ My four-week solo Kimberley journey recreated the 1932 experience of stranded German aviators Hans Bertram and Adolf Klausmann, but in addition, I made my way to their crash site and back, covering 490km of motoring, sailing and hiking.



▲ After 11 days into the survival phase (top), I felt dizzy and weak much of the time. Right down to the goggles, my clothes replicated those of the stranded aviators Adolf Klausmann (above far left) and Hans Bertram (above centre), seen here with their Aboriginal rescuers.

ACROC'S GONNA rip you straight off that raft, mate!" These were the not-so-encouraging words of a local in Wyndham, 2200km north-east of Perth, who farewelled me as I prepared my vessel for departure into the remote Kimberley.

It was nerve-racking setting off on this four-week solo expedition into the West Australian wilderness, to place myself in the same situation as two German aviators – Hans Bertram and Adolf Klausmann – who had been stranded in the Kimberley in 1932. I wanted to see if I could survive my way out of their historic predicament, with only the materials that had been available to them 85 years earlier.

After running out of fuel on their flight from Europe to Australia, these pioneering aviators made a raft using one of their seaplane floats and attempted to sail back to civilisation. After five weeks of hell – lost, with little food and water – they'd given up, but were rescued, on the brink of death, by local Balanggarra people.

I wondered if they might have had more success if they'd used two floats, instead of one, and roped them together to make a catamaran. To test this idea, I welded up mock seaplane

floats out of 44-gallon (200L) drums, with bush logs lashed across the top, and attached an outboard engine so I could motor around to the remote bay where the seaplane had been stranded, near Cape Bernier.

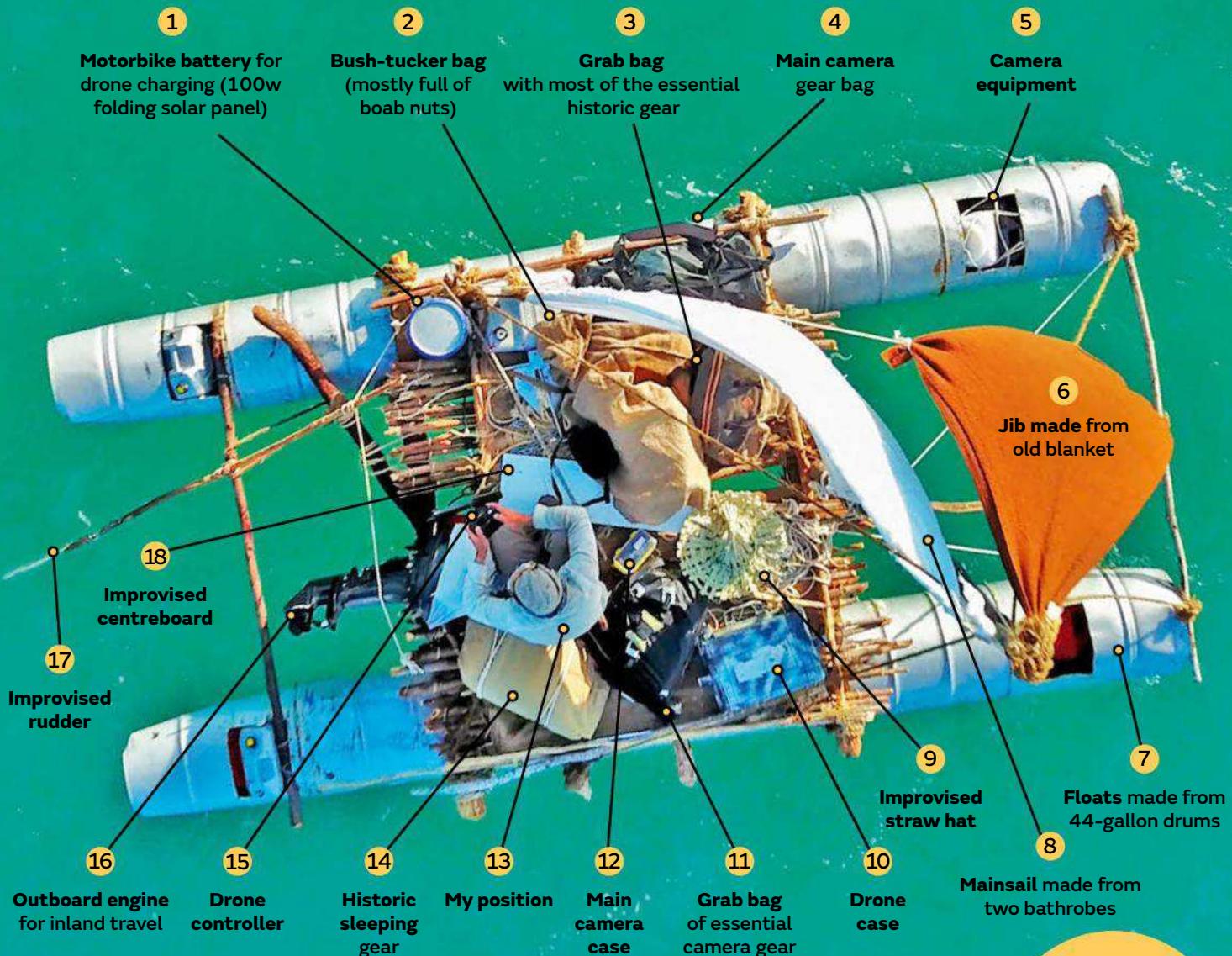
I didn't want to diminish what Bertram and Klausmann had achieved in 1932. They did an excellent job with their knowledge at the time. But I had a distinct advantage as a former military survival instructor with NORFORCE, an Australian Army Reserve unit mostly made up of Aboriginal people that patrols the Top End. I'd also been a military pilot with extensive survival training and tested my skills on many private expeditions.

So, on 7 June 2017, after 11 days of full-time raft construction, I set off from Wyndham for the ocean via the turbulent, croc-filled Cambridge Gulf. It took me eight days to motor the raft just 200km north-west to my journey's starting point. It wasn't easy. Strong trade winds created large waves that threatened to smash me up against exposed cliffs, and my shiny new engine began to quit and splutter.

I camped ashore each night amid the spectacular Kimberley surrounds to troubleshoot the problems. A complete strip and reassembly of various parts – mostly at night on beaches with ▶

The raft

Average speed was often less than 4km/h, due to light winds during the journey's sailing phase.



FACT

Adolf Klausmann was confined to a psychiatric institution for the rest of his life after his Kimberley ordeal.



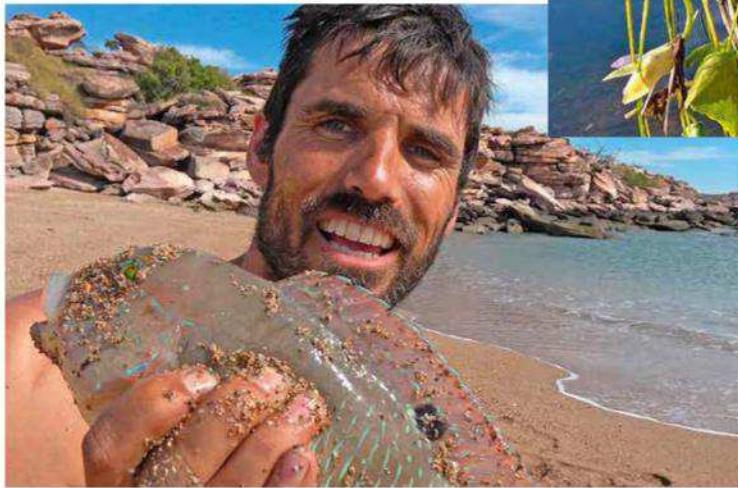
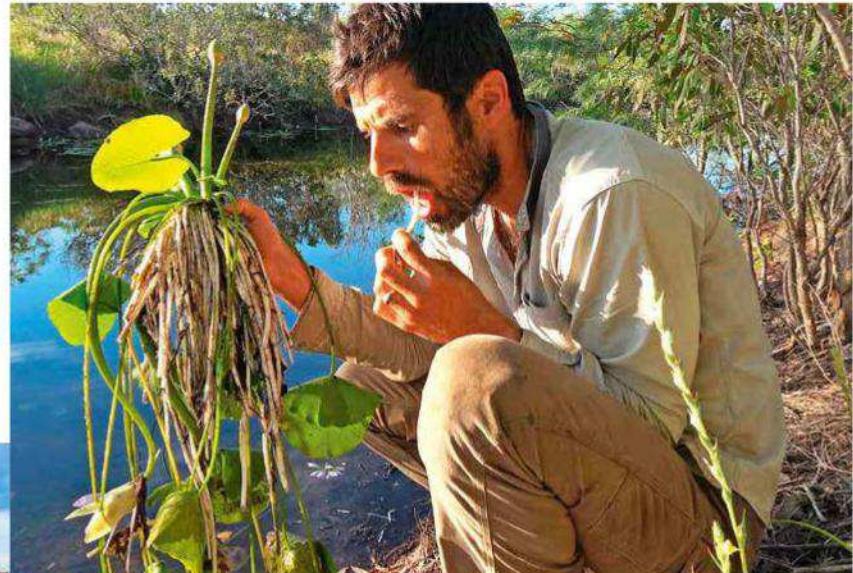
▲ A generous local in Wyndham, the Kimberley's oldest and most northerly town, lent me the use of this shed and tools to build the mock seaplane floats.



▲ My 21st-century raft was constructed only from natural and man-made materials available to the 1930s aviators at their Kimberley stranding site.

► Almost every part of the water lily – from the roots and stems to the flowers and seeds – is edible. This waterhole saved the lives of the aviators after their raft was blown out to sea for five days.

▼ The joy of catching a fish was so much greater when my survival depended on it. These edible berries called 'dog's nuts' (below right) tasted better than they sounded.



I sewed two bathrobes into a sail...and watched a massive saltwater crocodile cruise past the back of the raft.

plenty of hungry crocs lurking – eventually saw an improvement in my engine's performance. After eight days, I finally motored into Seaplane Bay, named after the aviators. I can't think of a more remote stretch of coastline anywhere in Australia. From here on, I began to survive solely on bush tucker, with only the materials available to the aviators. I knew precisely what items they'd had because Bertram wrote a book in 1936 about the ordeal called *Flight Into Hell*.

I HAD TO solve three major problems these aviators struggled with. First, they couldn't find drinking water. Using my northern Australia survival experience, I found it after a 40-minute search by following a nearby creek upstream until I discovered a pool.

Second, they couldn't find food. During my seven days at Seaplane Bay I found enough to sustain me indefinitely. My staple diet was 20 hand-sized scallops a day plus cockles, oysters, mud snails and fish caught on an antique linen fishing line. I ate boab nuts both raw and mashed into a porridge, bush cucumbers, kurrajong seeds, berries known as 'dog's nuts', pandanus seeds, kapok flowers and native mint plants.

I even made a tasty green-ant tea by dunking nests into a billy of boiling water and straining out the floaty bits. This had the added benefit of reducing the number of biting green ants in my camp site – something anyone camping in Australia's north can relate to.

The third issue was that Bertram and Klausmann were hopelessly lost. They could have found their latitude by measuring the angle at which Mintaka – one of the three bright stars of Orion's Belt – rises or sets. I marked where Mintaka crossed two lengths of string placed parallel to the horizon and compared it with vertical by hanging a rock next to it.

This gave me an angle of 14 degrees. Along this latitude, the only section of Australian coastline with an east-south-east orientation is that of the northern Kimberley, making it clear where I must be.

I hatched an escape plan to the nearest civilisation, which, back in 1932, was the now-abandoned Pago Mission. It was inland and about 90km away over rough terrain, so it made sense to use the raft and sail close along the coast before setting off on foot for the final section. I sewed two bathrobes into a sail, as the aviators had done, and watched a massive saltwater

My last line of defence against crocs was harsh language and this pole. I held it at the ready a couple times, but the reptiles never came closer than a car-length or two.



crocodile cruise past the back of the raft where it was anchored on the beach. I made a note to remain alert and keep a large pole at hand when on the water.

I still didn't know if my catamaran idea would work when I hoisted the sails for the first time. But to my great relief the raft pulled forward, my beach home for the past week slowly became smaller behind me and I was off.

I sailed along the coast for four days, covering another 70km. The strong winds eased and I made reasonable progress each day. It was difficult keeping straight with my improvised rudder, but the trade winds helped blow me in the right direction.

I'd taken three camera drones with me to capture both video and still images of my journey – and any encounters with crocs – from the air, and hand-launched them from the raft each day. It was dangerous with the spinning blades, so I always wore my aviator hat and goggles to protect my face. Plenty of people have needed surgery to faces and fingers when catching drones on dry land in calm conditions, so it was always a relief to get them safely back on deck.

Anchoring at one point, a few days later, a large croc approached, so I dropped everything and picked up the pole I

kept handy for such occasions. The reptile dived below at close range and didn't reappear, so I disembarked gingerly, trusty pole at the ready. During a midday stop on another day, I looked for the cave where Bertram and Klausmann had finally given up hope after repeated attempts to sail and trek out. They had waited out their last days before their rescue in a sandstone cavern overlooking the waves.

I eventually found it using Bertram's book and notes taken from the WA Maritime Museum, in Fremantle. Sitting down and looking out to sea from the cave, I felt a link with these two brave airmen, despite the 85 years separating us. A lack of food and extreme isolation amplifies emotions and sharing similar circumstances with them channelled my empathy.

I later interviewed a direct descendant of the rescuers, Matthew Waina – a Balanggarra man who lives in Kalumburu. His account, passed to him long ago by elderly relatives, precisely matches the aviators' story after 85 years, a testament to the accuracy of Aboriginal oral history.

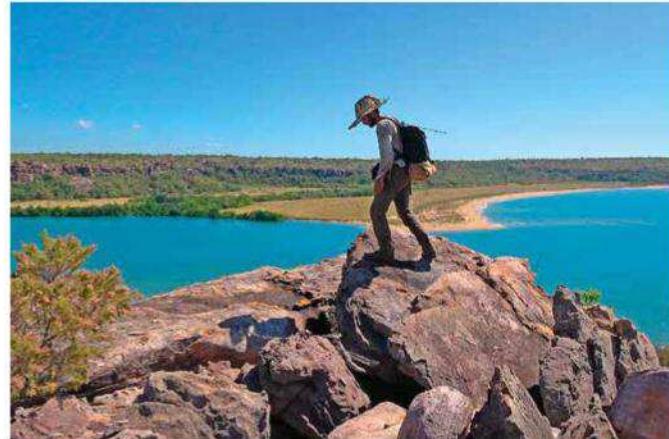
One afternoon, towards the end of my voyage, a bunch of small tourist boats appeared out of nowhere, and when I rounded the next cape I found the mothership, *True North*. Its chopper ►

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▼ This jump across the croc-filled Drysdale River was right on the limits of my physical abilities. I later had to swim back to fetch my remaining gear.



▼ The beginning of my overland walkout was uncomfortably tough and it didn't get much easier. It was rough country to walk, but the view wasn't too bad.



pilot, Alan Carstons, who'd seen my expedition reported on ABC News, motored out to meet me. He kindly offered food and drink, which I reluctantly declined. It's one of the great things about going into remote areas that people are always kind, courteous and generous. Apart from an Australian Coastal Surveillance Organisation ship, which sent some officers on inflatables to check me out, these were the only souls I saw for many weeks.

Fishing was difficult with my antique gear, but I managed to catch three fish in total; one was a good-sized wrasse. I had limited time to forage because I was on the raft all day, so, other than bush passionfruit, boab nuts and the odd fish, I wasn't eating much. The tides were too high for collecting shellfish. As a result, I started to feel lethargic and dizzy and saw stars when I stood up.

FINALLY, ON 25 JUNE, I sailed close enough to Pago Mission to start my 70km hike overland. I lightened my gear for the walk out, because I knew the terrain would be difficult. The first 50m involved climbing a sandstone cliff with loose rock and dead trees threatening to slip off and take me with them as I clambered from ledge to ledge.

I used the Sun to maintain a rough 250-degree heading to the abandoned mission. I had no way of carrying water, so, when the creeks weren't running in the right direction, I gambled and struck out over dry ground. These short cuts paid off, but I got very dehydrated at times.

I ate pandanus, cabbage palm, bush almonds, lily roots, bloodwood galls, grubs and raw fish scooped up with my bare hands from drying creek beds. I carried 10kg of modern camera equipment and a small swag of historic survival gear that weighed about 5kg and included a blanket, billy and strip of canvas. The weight of all this, combined with up to 30km of walking a day over punishing uneven terrain, played havoc with my feet.

While walking, I had plenty of time to reflect on the treatment of the Balanggarra rescuers of Bertram and Klausmann. Astoundingly, before the aviators were found, the Australian

authorities had already assumed that Aboriginal people had murdered them. This led to nine of them being chained up in the search party. Despite the indignity of this inhumane treatment, they searched on and eventually found the lost Germans.

These Aboriginal men were valuing the lives of others, even as their own lives were not being valued. The generosity of the Balanggarra people of the northern Kimberley continues today. After so much has been taken from them, they still very kindly allowed me to access their land for this adventure.

After jumping from bank to bank and an unplanned swim across the croc-filled lower reaches of the Drysdale River, I eventually reached Pago Mission, exhausted but relieved. The mission is now abandoned, so I walked on into the night (on a track, what luxury!), hoping to find a camp site I could hitch a lift from to get some real food. A wide creek cut the track and a pair of croc eyes was visible, so I slept nearby until sunrise and continued the next day. I eventually got to a bigger dirt road and hitched a ride with the first four-wheel-drive that appeared. On 29 June I was dropped at the township of Kalumburu, where I downed three iced coffees and devoured a Cherry Ripe chocolate bar. My shrunken stomach was filled to breaking point.

It took me four more days to go back and recover the raft. This involved hitching rides in a boat, car, helicopter and even a mail plane – as well as another 100km stint on the raft, which is now proudly on display at the Kalumburu Mission Museum.

So, is the Kimberley hell or paradise? I'm going with paradise. My trip was hell at times, but that's my fault for deciding not to take any food...not to mention floating about on a wind-battered coastline on a dodgy raft. All up I had sailed, motored and hiked about 490km.

But I believe I came back with a better idea of the ordeal that Bertram and Klausmann had faced – and I had proved to myself that it was possible to survive unaided, which is exactly what I had set out to do.

AG

◀ **LEARN MORE** about Mike Atkinson's extraordinary adventure at outbackmike.com.au, where you can follow the release of his upcoming film about his experience.



These sheer cliffs were stunning,
but the risk of being smashed
against them by a strong onshore
wind was constantly on my mind.



Flocking back to wool

When our Test cricketers run onto the pitch they wear wool grown in the Flinders Ranges of South Australia. The region's hardy flocks and their enterprising producers provide a neat snapshot of today's Australian wool industry.

STORY BY **AMANDA BURDON** PHOTOGRAPHY BY **RANDY LARCOMBE**

A close-up photograph of a flock of sheep. In the center, a sheep with a thick, light-colored coat looks directly at the camera with a neutral expression. Behind it, another sheep's face is partially visible, also looking forward. The background is filled with the heads and shoulders of many more sheep, all facing towards the right side of the frame. The lighting is bright, highlighting the texture of their wool.

Lustrous, lightweight wool has never gone out of fashion, but high meat prices at livestock sales such as this one in Jamestown, South Australia, have heavily impacted production levels in recent years.



IN THE STONY COUNTRY east of Jamestown, in southern South Australia, sheep paddocks are as big as skies. It's dry here, beyond Goyder's Line, which indicates reliable rainfall and separates cropping and grazing lands.

Summer is bearing down, forcing Geoff Power to begin hand-feeding the 3000 sheep on his 5040ha property, Sambas. "They're all on natural pastures," he says, "but we got no winter rain and the kangaroos have been killing us."

In an industry steeped in tradition, Geoff is something of a弪ay. He grew up in Melbourne, with no farm experience or wool connections. "It was always my dream, ever since I was a little fella, to grow wool," he says. "It's taken 50 years to get to where we are today, slowly accumulating land and sheep. It's a challenge when the weather is out of your control, dogs are on the prowl, there are animal welfare issues to deal with and

fashions change 16 times a year. But I love sheep and wool is such a versatile product."

Even Geoff's dedication, though, was tested by the Millennium Drought, which lasted from 2001 to 2009. With wool prices flat-lining and sheep carcasses worth little more, he decided something had to change. The wool that other Flinders Ranges growers were producing was clean and green, yet synthetic fibres had a stranglehold on the textiles industry internationally.

"At the end of the day, wool is a commodity and we needed to find a point of difference," says Geoff, the former president of Livestock SA. "For us, that was where and how we grow that wool in an ethical and sustainable manner."

So Geoff and eight fellow producers banded together to establish best-practice group Flinders Merino. "We benchmarked against each other, and started identifying our ➤

Jim Kuerschner releases a mob of ewes after drafting lambs at Mitchylie, south of Orroroo. Discerning buyers are already paying premiums for wool from non-mulesed sheep such as this.



◀ **Geoff Power** and his offsider, Alley the sheepdog, take a welcome rest after yarding a mob on Geoff's property, Sambas, east of Orroroo. A select few of Geoff's fleeces find their way into Test cricket jumpers – a proud achievement for this former social cricketer.



▲ **Australia's sheep flock** is slowly recovering from years of poor wool prices and drought, ensuring spirited bidding for merinos, especially, at livestock sales like this at Jamestown.

strengths and limitations,” he explains. “Some of us have since altered our shearing times, and our ewes now lamb in June or July when there is more green feed about. We’ve increased our lambing percentages and we’re value-adding by shearing the sheep we sell for meat. We’ve got two barrels loaded all the time.”

Famously, wool from Flinders merino growers now knits its way into Test cricket jumpers and vests, in what Geoff calls a “proud marketing opportunity”. Others in the region have dipped their toes in the Australian Football League uniform market. Typical of woolgrowers the country over, Flinders producers are working hard to improve their sheep management and capitalise on new outlets for their beautiful product.

The lustrous superfine fleeces from Australia’s eastern states and Tasmania tend to command the most attention, especially among Italy’s notable suit-makers. But it’s sheep like Geoff’s that make up the lion’s share of the Australian flock – a flock that had been steadily declining. The demand for sheep-meat, a string of poor seasons in the 2000s and wild dog attacks led many producers to switch from wool production to wool and meat production or to abandon the industry altogether.

Only this year are national sheep numbers and the wool clip expected to begin recovering from historic lows (see page 73). It’s been a boon for the true believers who have stuck with wool, with tight supply producing record prices in recent months. Our country may never again ride on the sheep’s back, but the industry celebrated in our music, art, literature and architecture is as enduring and robust as the merinos on which it was founded.

AT NORTH ASHROSE, ONE of Australia’s most prestigious merino studs, a regal ram known affectionately as Horse strikes a fetching pose. “He’s a very upstanding ram,” says fourth-generation stud breeder Matt Ashby of the two-year-old elite sire. “You can pick it as soon as they are ►

A great many breeding decisions, and some genetic magic, combine to produce elite ewes and sires, like North Ashrose Impact from the merino stud North Ashrose.



A large, brown, horned sheep stands on a wooden floor in front of a weathered brick wall. The sheep has thick, textured wool and prominent curved horns. The background shows a rustic brick wall with some missing mortar and a wooden floor with visible planks.

**“It’s like the Holy Grail
to produce the perfect
sheep, but the process
takes years.”**



Showing their stud stock, and collecting a few accolades along the way, is an important marketing tool for Kate and Nick Wadlow (above), from the Old Ashrose merino stud, near Hallett, where Anthony French (left) has been a senior station hand and ram shed manager for 33 years.

“It’s a passion; it’s what we have been born and bred to do.”

born – their structure, overall outlook, body weight and the quality of their wool. Merinos breed true to type. The softness of the nose and ears indicates quality, soft wool.”

Horse, indeed, has soft ears, and was 2016 Grand Champion Poll Merino Ram at the Royal Adelaide Show. But he’s coveted for other, more obvious, pendulous features. For the foreseeable future he will be treated with loving care as part of the stud’s world-class breeding and artificial insemination program, servicing hundreds of ewes and supplying semen for flocks as far afield as Chile, Argentina, Uruguay, New Zealand and China.

“The merino is a true dual-purpose animal, with great attributes of wool and meat production,” Matt says. “It’s a heavy, large-frame, easy-care sheep with the ability to cut a high-value fleece of nice long, white, deep-crimping wool. Producers are always looking to improve their wool styles and types and to get into some new genetics. It’s like the Holy Grail to produce the perfect sheep, but the process takes years. It’s a passion; it’s what we have been born and bred to do.”

It’s the end of what has been a busy ram-selling season. North Ashrose sells up to 1100 rams each year into the pastoral areas of SA, western NSW and central Queensland. In April, it even dispatched a shipment of 160 to China.

“In a lot of Australian mixed farming enterprises, farmers are making more per hectare from their merinos than any other part of their operation,” Matt says. “Through the dry 2000s,

lots of people got out of merinos and went into more exotic sheep-meat breeds. But wool prices are now going gangbusters and the demand for our rams internationally has been incredible. Those wool producers still in merinos are doing extremely well.”

Greg Andrews at Hamilton Run, near Jamestown, is one of those. He has added a larger-framed South African merino breed (the dohne) to the mix, and the stud comprises two-thirds poll merinos and one-third dohne sheep. “I am more commercially oriented,” says the third-generation farmer. “I want my rams to produce good-eating lambs. Wool is a natural product and the global population is growing. Wool prices may fluctuate, but there will always be demand for meat.”

Growers such as Greg are increasingly turning to technology to improve the genetics of their flocks. Many use tools such as Australian Sheep Breeding Values (ASBVs) when making breeding and selection decisions, to project how well their sheep’s offspring will perform.

It’s also now possible to test and record fleeces from individual sheep in real time in the shearing shed. With shearing about to start, well-travelled sheep consultant Ian Bradtke has taken up residence in the Hamilton Run shed with his Sironan Fleece-scan. In just half a minute, this machine can core (sample) and weigh the fleece, then wash and test a sample for its micron (the wool fibre thickness) – an important guide for the wool classer when separating fleeces into micron lines. ▶

The Australian clip today

Demand for our wool is heavily influenced by market forces and international fashion trends.

A USTRALIA'S WOOL production now accounts for about 20–25 per cent of global supply. However, our sheep numbers were in steady decline until recently. The Australian flock crashed to a 100-year low of 68 million sheep in 2009, following years of poor wool prices that culminated in a huge wool stockpile and the scrapping of the reserve price scheme.

However, a rise in global demand, and consequently prices, has seen Australia's wool production lift in the past year. The Australian Wool Production Forecasting Committee predicts shorn wool production will grow by 1.4 per cent in 2017–18 on the previous year, to 345 million kilograms, and the national flock is also expected to rise to about 76.6 million this year.

Sales from Michell Wool, one of Australia's largest wool processors, to clients all over the world were up 10 per cent for the period from July to October last year. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) predicts the value of wool exports from Australia could rise by up to 20 per cent in 2017–18 to \$4.3 billion.

Although many superfine woolgrowers have direct sales contracts with their customers, the bulk of wool produced by Australia's 35,000 woolgrowers is still sold at auction. Some 70–75 per cent of that wool is bound for processing in China, and either exported to other countries from there or used by its burgeoning and increasingly affluent population.



▲ Logistics operator John Laleggio inspects a sample from one of thousands of greasy wool bales received yearly by Michell's from all over Australia.

Shift leader at Michell Wool's Adelaide factory, Chris Levi, inspects carbonised lambswool before it's pressed for export. Carbonising, which Michell's has been doing since 1870, removes impurities such as grease and dirt.





▼ **The back-breaking job** of shearing remains little changed from centuries ago, except that narrow combs on mechanical gear have replaced blade shears.



▲ Like many families in the industry, the Kuerschners have made wool production an intergenerational affair. Uncle Terry (far right) still keeps a close eye on nephew Jim (far left) and his sons Sam and Tom (L-R), sixth-generation wool producers at Mitchylie. Their family first took up land in the district in 1874.

“It’s a natural fibre and there’s a feeling with sheep that you are working with nature.”



“People use this objective clip testing to differentiate and prepare their wool clip,” Ian says. “It’s very accurate, and an even greater tool when used in combination with body weight, ASBVs and visual classing.

“Most of my work is for commercial woolgrowers and in merino studs. In some flocks it has helped to increase fleece production by 1–1.5kg per sheep, which is a lot more wool if you have 5000 sheep, and especially worth doing if a premium is being paid for finer wools.”

Greg says the dohne breed, favoured equally for its meat and wool, is well suited to his country. “We got into dohnies because they don’t require as much mulesing as the merinos; it was a marketing decision,” he says.

“The labour saving is also important and they’re a tough breed. We sell 350 merino and 250 dohne rams a year and rarely need to drench or feed our sheep. Buyers know that the animals that come from Hamilton Run will survive the toughest conditions because they are born in pastoral country we lease north of Orroroo. We still mules our merinos, because we have so much clover burr, but we’d eventually like to stop.”

FOR ALL THE CURRENT optimism in the Australian wool industry, mulesing remains the elephant in the shearing shed. This long-held practice of cutting skin from a sheep’s backside, which significantly reduces the possibility of flystrike, has come under increasing scrutiny from animal activists and consumers in recent years. Wool brokers are reporting growing demand for non-mulesed wool from mills moving to satisfy discerning markets, and it can command a premium in the auction room.

“The sustainability of the farmer, care of the environment, and their animal welfare and labour practices are increasingly important to buyers of wool in northern and western Europe, Japan and the USA,” says executive director of Michell Wool, David Michell, whose family have bought, processed and traded wool since 1870 (see page 79).

Public pressure has seen growing numbers of wool producers either cease mulesing or give sheep pain relief before and after the procedure. Many have turned to genetics for answers and some have developed private certification schemes to underline their animal husbandry.



▲ Shearing is in full swing at Toolangi, where Russell Sleep (foreground) and Daryl Growden (rear) keep a steady flow of fleeces up to classer Jack Napper.

Fifth-generation Flinders woolgrower Jim Kuerschner and his wife Gaye, on Mitchylie at Black Rock, south of Orroroo, stopped mulesing their merino sheep in 2007. They buy their rams from a stud that doesn't mules and are actively selecting and breeding sheep to eliminate any future need to mules.

"We went to a plainer-bodied, easier-care sheep," Jim says. "We get rid of any sheep that gets fly-blown on this place because research has shown that susceptibility to flystrike is hereditary. With just 2500–3000 sheep, it's easier for us to manage our sheep this way than producers in the pastoral country, who might only see their sheep two or three times a year. We didn't stop mulesing because it was bad for the welfare of the animal, but because consumer ignorance about animal welfare on farms will mean that mulesing may eventually have to be phased out."

A former shearer, Jim is the eldest of nine siblings, three of whom grow wool. "I don't know what the breeding value is for that," he says, laughing, but he's clearly proud to see his granddaughter Sophie now taking her first steps around the property. As well as their merinos – which produce about 90

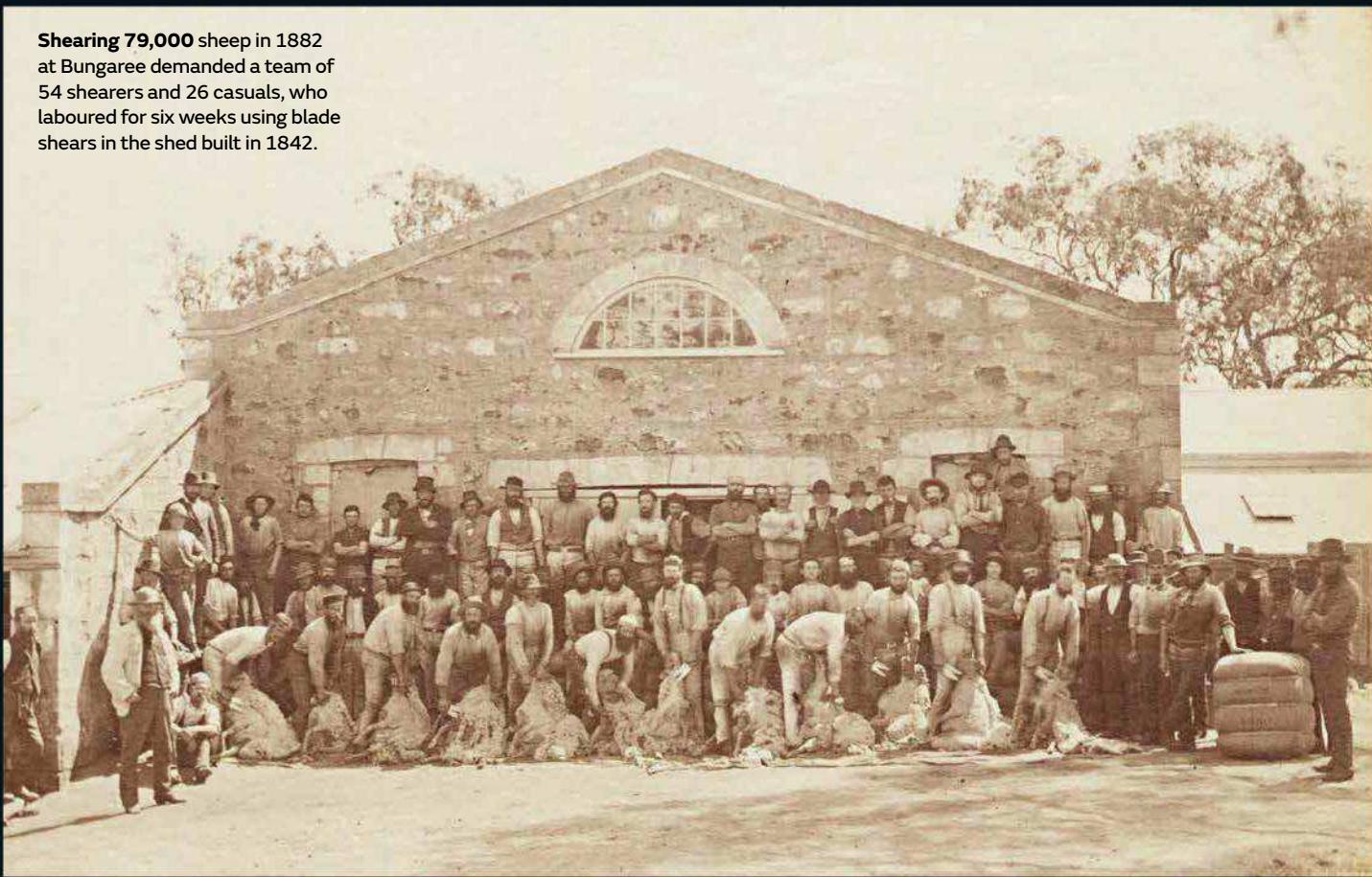
bales of wool a year – the family enterprise includes fat lambs, cattle and cropping across 2630ha. Jim and Gaye's sons, Tom and Sam, need to derive additional, off-farm income, but today they're in the yards drafting lambs on land their ancestors first took up in 1874.

"Sheep are a very important part of our operation; it's a natural fibre and there's a feeling with sheep that you are working with nature, not against it," Jim says. "Even if you have a really bad year and lose a lot of money on failed crops, you will never lose money on sheep."

THE PACE IS FRENETIC in the shearing shed at Toolangi, a property in Hallett, south-east of Jamestown. Amid the buzz of handpieces and the blaring radio, four shearers perform their awkward yet well-practised routines. Fleeces fly and hooves clatter on timber.

"Disorganised harmony is what I call it," says wool classer Jack Napper. For about 20 years he's been a member of Daryl Growden's contract shearing team, and today's line-up is a close-knit group more like family than workmates. *Continued page 100* ►

Shearing 79,000 sheep in 1882 at Bungaree demanded a team of 54 shearers and 26 casuals, who laboured for six weeks using blade shears in the shed built in 1842.



175 years of Bungaree Station

This historic sheep station is steeped in wool-growing heritage.

ONE OF Australia's largest and most influential merino flocks evolved from historic Bungaree Station, north of Clare, in South Australia. Established by brothers George, James and Charles Hawker in 1841, Bungaree began with 2000 sheep and four shepherds. At its peak, the station ran 100,000 sheep, employed about 50 permanent staff and used an extra 80–100 blade shearers and shed staff for the annual shearing.

As one of SA's most northerly settlements for a time, Bungaree developed into a village with a grand sandstone homestead and shearing shed, church and graveyard, station store, district council chambers, blacksmith's forge, carpenter's workshop and staff accommodation.

The sheep bred on the station, "in tough country for tough conditions", were described by author of *The Australian Merino*, Charles Massy,



► Bungaree's current-day custodians, Sal and George Hawker, proudly protect the station's history and welcome back people who worked on the property. "Many say it's like coming home," George says.

as "great survivors". The same could be said for the Hawkers, who have continued to produce a dual-purpose sheep (for wool and meat), despite market fluctuations. "We've kept Bungaree in the family, preserved our heritage, and maintained a sentimental attachment to sheep," says George Hawker, great-grandson of his namesake.

Bungaree remains home to fourth-, fifth- and sixth-generation Hawkers.

These days, cropping and tourism are mainstays of their business and just 4000 sheep are shorn each year. Last October they celebrated 175 years of wool production, and invited the public and past employees to revisit the station's glorious past. There were shearing, blacksmithing and stonemasonry demonstrations, and guests were chauffeured to the woolshed in 1927 and 1929 Whippet motorcars.

Aged 88, Johnny Bruce made it back for Bungaree's 175th celebrations. Born at North Bungaree in 1930, he began working for the Hawker family at 13, eventually rising to the ranks of North Bungaree manager, a position he held until retiring in 1992.



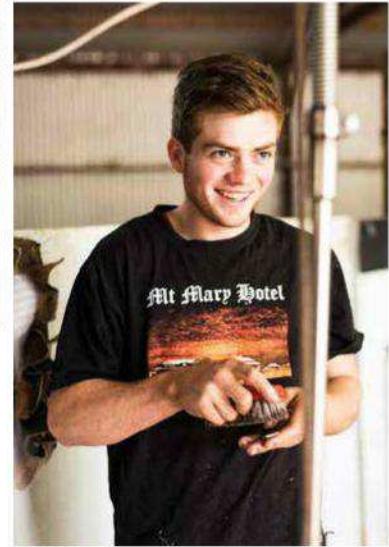
▲ **Fleeces fly** in Bungaree's historic shearing shed while the rest of the flock patiently await their turn (far left).

◀ **Sal Hawker** deftly wields blade shears demonstrating how shearing was done for more than a century.



◀ **The latest** model struts the catwalk in the Toolangi shearing shed, owned by Brad and Tessa Tiver. “I just love growing wool,” Brad says. “You are always trying to improve it and every year is different.”

▼ **Shearer Beau Growden** cleans his comb between sheep at Toolangi. Shearing schools teach you how to make every blow count, he says. “It can take 12 months to apply what you’ve learnt.”



Wool prices are certainly a cut above what they've been for decades.

“Team harmony is very important,” says Daryl, who has been shearing for 35 years. “We spend more time with each other than with our wives. Some weeks we’re together seven days just to keep up. But you get to visit different places and see how other people live. Shearing is a great foundation for life; it’s a hard job and it takes its toll on your body, but you soon learn to value a dollar.”

His son Beau was not an enthusiastic convert at first. “I was encouraged to work in the sheds with Dad as a kid and I hated it,” the 20-year-old says. “Then it grew on me and now I love it. You have freedom and can work at your own pace. Every shed is different, and if you work hard, the results show.” How many others his age in rural Australia already own their own home, as he does?

Although many aspects of the Australian wool industry have changed during the past two centuries, shearing is not one of them. It still requires the same skilled labour force it ever did and efforts to modernise wool-harvesting – from sheep cradles to robotic shearers – are yet to bear fruit.

But at Toolangi, the installation of a raised circular shearing board improves the workflow for Daryl and his crew. And, unlike the older generation of shearers, youngsters Shane Chase and Beau regularly benefit from expert tuition at shearing schools. “I learnt to get the fleeces off with brute force,” says Daryl, belying the elegance and economy of his blows (single cuts) and daily tally of 180–200 sheep. “But now Beau teaches

me a thing or two. He reckons he will make a shearer out of me one day.” And every blow and centimetre of wool cut counts.

It’s too early to describe it as a boom, but wool prices are certainly a cut above what they’ve been for decades. At Toolangi, owners of the Mount Razorback Pastoral Company, Brad and Tessa Tiver, are enjoying seeing the soft, creamy fleeces come off the boards. “I just love growing wool,” Brad says. “You are always trying to improve it, and every year is different. That’s what keeps you going, through good years and bad.”

As the good times roll, woolgrowers in the Flinders Ranges are investing in gleaming new sheep yards and long-awaited improvements to their shearing sheds, even looking to expand. “It’s the best it’s ever been,” reports Geoff Power. “With prices holding firm, we can actually start to budget, and you definitely sleep better.”

From Test cricket jumpers to underwear, shoes, outdoor wear and even the distinctive striped apparel of Venetian gondoliers, wool is being used today in all sorts of new and traditional products. If the growers of the Flinders have their way, it will be used in many more.

They have a great ally in wool processor David Michell, who is now producing woollen garments of his own. “I can’t help myself,” he says. “It’s a renewable product that is warm and yet can breathe, is fire-resistant and soft to handle. People still don’t understand how good wool is. It’s a matter of getting it out there and on their backs.”



A Test jumper in the making

The iconic cable-knits worn by our national cricket teams are the pride of Flinders wool producers.

ABOUT 100 BALES of select Flinders merino wool are needed to produce Test cricket garments each year. This wool is sold direct to Michell Wool, in Adelaide, where it is blended, but differentiated from other wools at all stages of processing.

The first step is for a sample of the greasy wool from each bale to be sent to the Wool Testing Authority for assessment of fibre diameter, yield and length. "So we have a good idea of how it will perform," says David Michell.

The wool is then scoured (washed) and carbonised. This is a complex chemical process used to remove vegetable matter (such as grass seeds and burrs) and other waste material (such as grease) from the wool.

The clean wool is then shipped to Michell factories in Suzhou, China, for combing, super-washing and spinning, before returning to Adelaide, and the small uniform manufacturing company Silver Fleece, as woollen yarn on spools. There, staff machine-knit some 320 bespoke cable-knit cricket jumpers and vests for the male and female cricketers representing Australia.

"We have been doing this for 40 years and I guess it's been our little secret," Silver Fleece owner Cathy Barton says. "In the early days we actually met the likes of Rod Marsh and legendary fast-bowler Dennis Lillee.

These days, people are thrilled to learn there is still some wool manufacturing going on here in Australia, because so much of it has gone offshore. We are up against big competition from imported products, mostly made in China and Sri Lanka, but ours is a great story of traceability."

1. Spools of woollen yarn feed the knitting machines to begin our home-grown sporting garments. **2.** Once the jumper components have been knitted, machinist Ying Yeung sews them together by hand. **3.** The final step is for Marija Turkalj to press the garment, ready for a national representative to wear in the Test arena.



It takes six months to produce the woollen yarn for Silver Fleece. "It's like terroir in wine; Test jumpers are a uniquely South Australian story," David Michell says. "It's a tight, transparent supply chain that gives wool producers a real connection with the end product and a great source of pride."



AUSTRALIAN MERINO WOOL NATURE'S MIRACLE FIBRE

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Explore | Escape | Discover

P112 Great Ocean Road

P104 Flinders Ranges trek

Relentlessly pounding
waves and wind chip away at
the famous limestone cliffs
along the Great Ocean Road.

PHOTO CREDIT: COURTESY TWELVE APOSTLES LODGE WALK

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

GOING WILD

Arkaba adventure

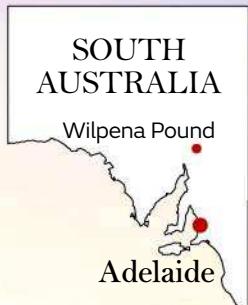
Rimmed by spectacular ochre-coloured cliffs and wending its way past ancient red gums and through wildflower-studded grasslands, this four-day Flinders Ranges walk is a captivating must-do.

Story and photography by **Justin Walker**





On top of the Red Range at golden hour, you can look out past the grass trees, across Wilpena Pound towards the Elder Range.



Nobody would dispute the fact that South Australia's Flinders Ranges are spectacular.

This region's rugged terrain, rolling hills, deep valleys and ancient waterways offer a sense of true remoteness. Wilpena Pound and neighbouring Arkaba Conservancy are two of the ranges' most popular destinations – particularly for bushwalkers – with a variety of short, long and very long tracks to follow, allowing experienced walkers the chance to really immerse themselves in this region of Australia. But that doesn't mean those with less time, fitness or walking experience can't enjoy exploring these areas. In fact, joining a guided walking adventure here can lead to a richer experience...which is exactly what I discovered on the Arkaba Walk.

STEP INTO GREATNESS

Crossing some of Australia's most spectacular and varied terrain, the fully guided and supported Arkaba Walk takes four days and three nights, staying at historic shepherd and station camps. It winds its way from the beautiful natural amphitheatre surrounded by mountains known as Wilpena Pound, and heads across the forested interior of the Pound itself, before traversing the private Arkaba Conservancy wilderness (see page 110) and finishing at the restored Arkaba Homestead.

Arkaba, located on a property that used to be a 24,000ha working sheep station, is just less than five hours drive from Adelaide. If you're flying into Adelaide, take a connecting private charter flight to Hawker air-strip, from where you will be transferred via shuttle bus to Wilpena Pound and the start of the Arkaba Walk.

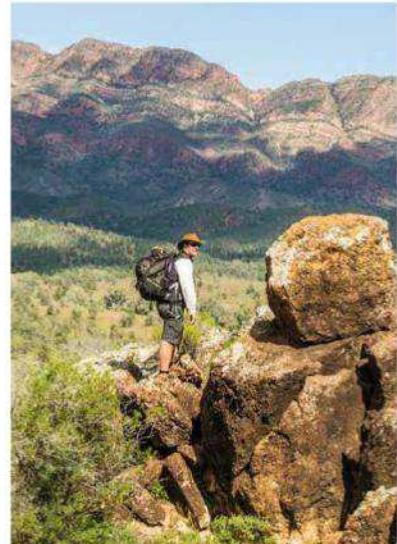
With knowledgeable guides who relate the area's history and describe the native fauna and flora in detail, you'll finish the walk with a heightened appreciation for why the Flinders Ranges is so highly regarded by adventurers and nature lovers.

The fact you only carry light daypacks while the rest of your gear is transported between camps, and indulge in three-course meals, hot showers and luxury swag accommodation at the end of each day's walking all goes to enhance the experience.

Part of the Arkaba Walk's route follows sections of the long-distance (1200km) Heysen Trail. But mostly ▶



A midday pause for lunch atop a rocky rise, looking across to the immense ramparts of the Red Range, with native cypress trees clustering at its base.



it goes its own way, taking you through terrain that ranges from dry creek beds, rocky ridge lines and wide grasslands, to rolling hills and native cypress pine forests, all while passing numerous ancient river red gums that are ubiquitous in the area.

For a region synonymous with dry, red-rock landscapes and rugged ranges, the beginning of the Arkaba Walk does a great job of throwing such preconceptions out the window. During my visit, the arrival at Wilpena Pound, after a 45-minute road transfer from Hawker airstrip, saw our small group (there are never more than 10 walkers on any trip) confronted by a landscape surprisingly green, due to a late and very prolific rainy season.

So be ready for the totally unexpected, which in my experience made for an unforgettable sight. You will, of course, still see plenty of the area's iconic red rock throughout the four full days of the walk – in the form of the red ribbon of dirt that you follow and the always looming ranges. But you may get lucky and have this glowing red pathway to the never-never surrounded by vibrant green vegetation.

THE EARLY DAYS

The first camp is a day's walk away, at the 'other end' of Wilpena Pound, just below its western rim. Thankfully, there's no rush and your guide will fill you in on some of the surrounding ecological marvels, a commentary that recurs throughout the trip. The guides truly are incredible fonts of knowledge of both fauna and flora along the entire walk.

Then it was time to throw on the daypacks and start hoofing it. The magic began instantly as we made our way through a gap in the Pound's eastern rim. The rugged landscape was still just that – there were plenty

The magic began instantly as we made our way through a gap in the Pound's eastern rim.

of large rocks poking their heads out from beneath the grass, and twisted, gnarled trees surrounding the track itself. Abundant birdlife supplied many and varied songs as a tuneful accompaniment to our walk. The track itself was well graded and its undulating, winding route soon took us through Pound Gap and into the bowl of the Pound itself.

For those Europeans who arrived in this region more than a century ago, the landscape must have been daunting. It's hard to have anything but admiration for their stoic approach to eking out a living in this tough land. This view is reinforced not more than an hour or so into the walk when you follow a sidetrack to the site where the Hill family of Hawker built a small cottage in 1905 as part of their wheat-growing lease over the Pound itself.

Even allowing for how green it was when I was there (and noting the creek below the cottage), it's jarring to read the SA Parks' info board and learn that the Hills gave up on this place in 1914 due to flooding and not the lengthy droughts usually synonymous with these harsh outback areas.

The restored cottage is excellent, as is the climb up to Wangara Lookout. The track upwards starts beside the cottage and is a must-do because the expansive views from the lookout across the Pound's floor are fantastic. Plus, the lookout is perfect for morning tea. ▶



START WALKIN'

Getting there

Qantas and Virgin fly direct to Adelaide from most cities. See qantas.com and virginaustralia.com. If you opt for the Arkaba Walk ex Adelaide, you'll fly private transfer to Hawker, and then be transported to Wilpena Pound. You'll return to Adelaide by private bus, touring the beautiful Clare Valley wine region along the way.

Cost

The Arkaba Walk, ex Adelaide, costs \$2500 per person, and that includes the flight from Adelaide to the Flinders Ranges and lunch in the Clare Valley on the final day. Also included are all meals and drinks, as well as accommodation for the three nights of the walk experience.

The walk

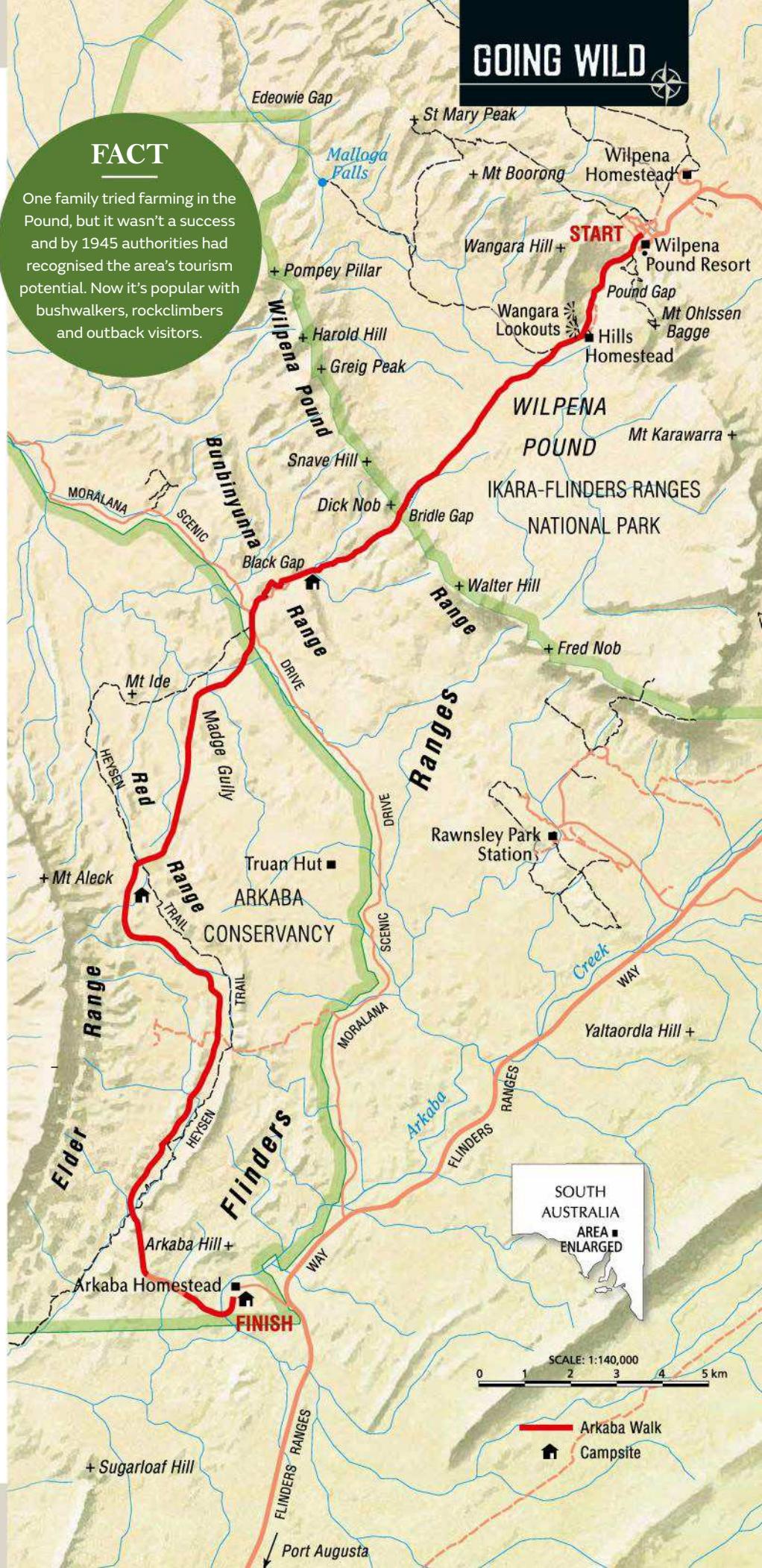
The Arkaba Walk is a three-night/four-day experience that departs Thursday or Friday through March to October. For three days, you'll walk between 13 and 16km, over undulating and sometimes rough terrain. It is part of the Great Walks of Australia (greatwalksofaustralia.com.au), a collection of 13 walks located at different destinations around the country.

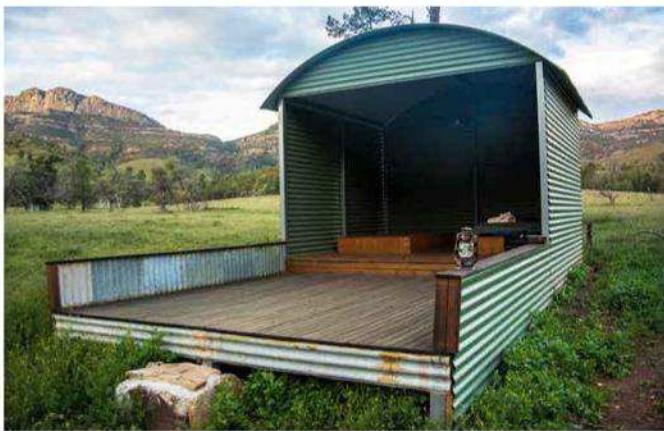
Fitness

The walk is graded intermediate and we'd recommend a decent level of hiking fitness to maximise enjoyment. For extensive info on the walk and recommended gear, see arkabawalk.com.

FACT

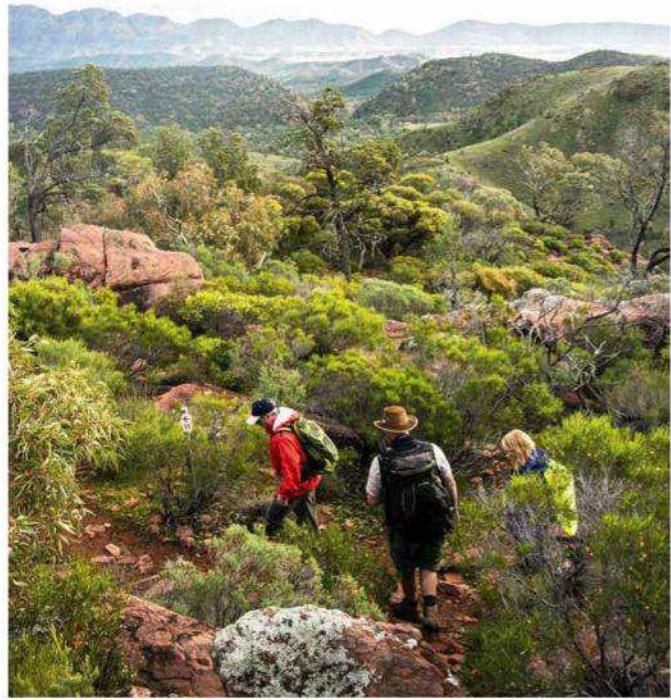
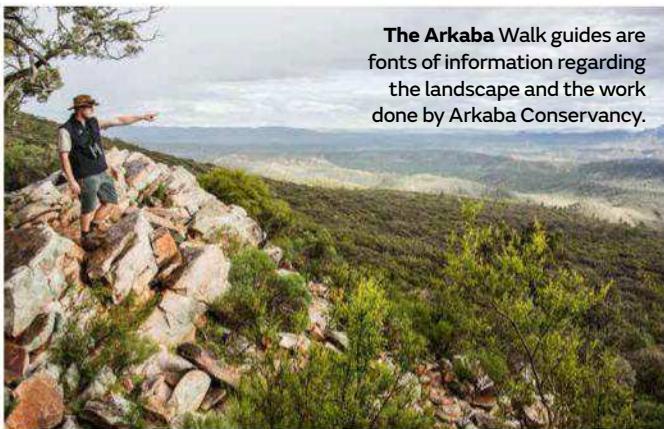
One family tried farming in the Pound, but it wasn't a success and by 1945 authorities had recognised the area's tourism potential. Now it's popular with bushwalkers, rockclimbers and outback visitors.





► **The sheltered swag** accommodation each night is a highlight of the Arkaba Walk. Or you can get even closer to nature by sleeping out in a swag under the stars.

▼ **Traversing rocky country** on the descent off the lip of Wilpena Pound to Black Gap Camp. The site was once occupied by a shepherd, whose ruined stone chimney still remains.



ANOTHER WORLD

Leaving the Hills' site, you return to the main track and start the long walk across Wilpena Pound's floor. The landscape here alternates between scrub and open areas that reveal the extent of clearing by early colonisers. Impressively, the native flora has bounced back, with the stately river red gums looking like tall beacons in a sea of tea-tree and cypress pine as walkers move steadily upwards toward the crossing point of Bridle Gap.

Here, the terrain becomes very rocky with a few steep pinches. The pace is kept leisurely by our guide: rest stops are common, ensuring you actually look at the gobsmacking landscape you're travelling through. You don't come to these magical places to power through them at race speed. To do so would mean you miss the subtle changes in topography and vegetation.

Topping out at the rocky ledges of Bridle Gap, you will cop your first view of the Bumbinyunna and Red ranges and, in the distance but still clearly visible owing to its incredible size, the Elder Range. After five hours and about 10–12km of walking, it's the perfect reward for effort, and only matched by the reassuring glimpse of your campsite. Appearing from above the steep descent of Bridle Gap's western cliffside and the rolling hills beyond is the glint of metal in the sun that signals the large shed/dining area at Black Gap Camp.

It's upon arriving at this first camp that you'll experience the difference a guided luxury walk affords – in

You don't come to these magical places to power through them at race speed.

both the figurative and monetary senses. Any unpleasant memories you may have of lugging your own food and cooking over a compact hiking stove will be erased as you indulge in a three-course meal and beverages (all transported to camp via four-wheel-drive). Yes, I still call it camping, even though the campsite has showers – hot, via heated water fed into a shower bucket above you and enough for a nice five-minute wash – elevated eco-toilets and, to top it all off, warm comfy swags to ensure you get a great night's sleep.

These aren't the swags most outback travellers would be used to roughing it in. They're housed within corrugated iron shelters that each contain two separate swags. And they offer a star-filled night on the open lower timber deck – yes, the shelter is split-level – if you so desire. Or you can choose the added protection of a roof on the upper deck in case of rain – and you can still see the stars.

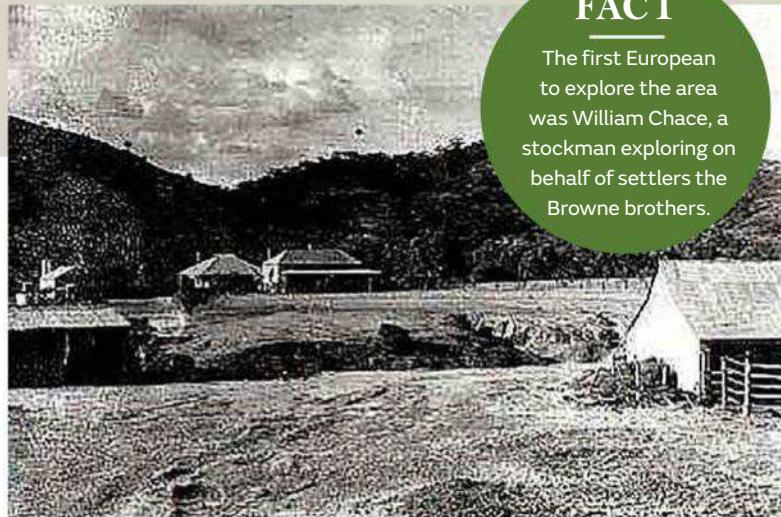
Oh, and just in case you aren't quite comfortable enough, the swag contains a heated water bottle. You'll never question the term 'luxury walk' again. ▶



The landscape changes continually throughout the walk, with rolling hills and rugged red cliffs giving way to dry and still-running creeks that cut through the ancient landscape.

Conservation success story

TOURIST OPERATOR Wild Bush Luxury bought Arkaba Station in 2009 with the aim of creating a unique wilderness experience: Arkaba Conservancy. As part of this, conservation programs have helped return the old sheep station (sheep had been run on the property from 1851) to its former, natural state wherever possible. So far, conservation programs have focused on feral animal eradication and reversing the impact of decades of grazing. All sheep were removed by 2013 and both feral predators (such as foxes) and herbivores (sheep) have also been reduced in number or eliminated from the property. This has brought a huge increase in native birdlife. For more extensive information on Arkaba's conservation work, see arkabaconservancy.com/conversation-at-arkaba



FACT
The first European to explore the area was William Chace, a stockman exploring on behalf of settlers the Browne brothers.

THE TRACK GOES EVER ON

The Arkaba Walk is not about rushing through the countryside, and our second day heralds another dramatic change in topography and vegetation. You will start moving through a series of dry or still-running creeks, shadowed by immense river red gums, as you continue south-west, initially following a section of the long-distance Heysen Trail, before making a left turn and heading through Madge Gully.

It is another 12km day of varied terrain explored at a leisurely speed, allowing us to enjoy the surrounds while listening to the guide's talks on particular plants, animals or the region itself, not to mention discussion of the vital rehabilitation work being done here by the Arkaba Conservancy.

A morning of winding through creek beds is followed by a gradual climb over grass-covered hills to another lookout that does duty as a meal stop and offers closer views of the craggy red cliffs of the Elder Range.

This night's camp is nestled at the foot of the range, and is still a further few hours away from this impressive vantage point. The immense size of the range's big cliffs becomes more and more apparent as you get closer to camp and a repeat of the previous night's indulgences.

Nothing beats an outback sunrise, so make sure you set your alarm early and psych yourself up to quickly leave the comfort and

warmth of your swag to watch the rising sun paint the ochre cliffs of the Elder Range. It really is a sight to behold. A wonderland, indeed, and on this last full day you face another striking combination of contrasting terrain as you weave your way through the cypress pine forest, with its underbelly of lush green grass, and head out and down through mallee country, with plenty of rock and open space.

Arkaba Conservancy's efforts are paying off here, evidenced by the expansion of native vegetation into this area that was previously overrun with noxious introduced plants.

For this last day you also rejoin part of the Heysen Trail, which has a creekside section highlight with dense cypress pines and long green grass making it feel as if you're walking in a totally different part of the world.

The landscape changes again towards the end of our day as we move through and then up and out of a valley section that includes a walk along the dry Dorothy Creek. Then we climb up a far drier hill (with contrasting green-clad ranges behind us) and finally spot the end goal: Arkaba Homestead.

A FAIR DEAL

The final hour of the walk is a descent over rocky, sparsely vegetated terrain, before a pleasant wander along Arkaba Creek's green-clad banks and then up a small rise to the homestead itself.



Here, you are met by staff with a welcome warm face-washer, before the sight of the homestead's drinks fridge invariably sees walkers undertake a quite dignified fast shuffle to grab celebratory beverages.

For those who might regard a luxury walk as all gloss and no grunt, the Arkaba Walk defies that view. Yes, this outdoor experience is more expensive than an independent hike, but the added benefits are many.

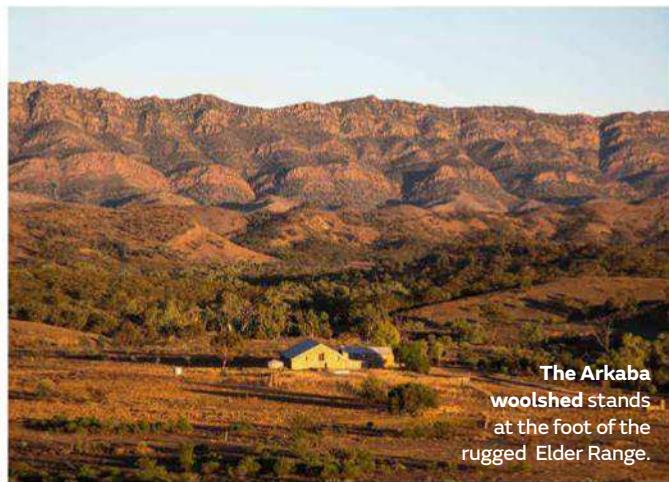
Transport, food and logistics are all taken care of and you get to experience an otherwise inaccessible part of this country – plus witness how those who own and manage it have succeeded in restoring it to its natural state, after decades of farming and invasive plant and animal species.

And then, of course, there's the informed commentary and insightful expert appraisal of the surrounding natural environment.

When you consider that the money you spend on this walk is mostly reinvested into the continued conservation work you see, the Arkaba Walk doesn't seem quite so 'expensive' after all.

It's what most of us would consider a sound investment, both in terms of achieving conservation goals, and the fact that the walk itself is an absolute cracker, taking you on a memorable journey through one of Australia's most magical landscapes.

AG



The Arkaba woolshed stands at the foot of the rugged Elder Range.

More multi-day hikes

Fraser Island Great Walk, QLD: 90km

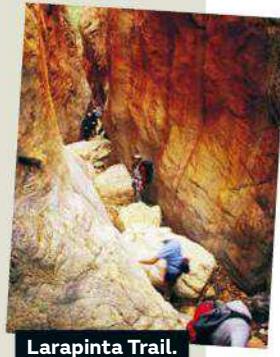
Enjoy the world's largest sand island on this easy-rated walk that takes 6–8 days to complete.

More info: npsr.qld.gov.au/parks/great-walks-fraser-island

Larapinta Trail, NT: 223km

Running along the West MacDonnell Ranges, this walk takes between 12 and 21 days.

More info: nt.gov.au/leisure/recreation/bushwalking-hiking/larapinta-trail



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National Parks
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Creating parks, saving species

Credit: Allan Honor



GOING WILD

Great Ocean Walk

From cliff-top vistas to surf-pounded beaches and eucalypt woodlands, this multi-day trek showcases the best of coastal Victoria.

Story by John Pickrell



Dwarfed by the limestone stacks of the Twelve Apostles, walkers proceed along a section of beach at the bottom of Gibson Steps in Port Campbell NP.



The anchor from the Marie Gabrielle wreck, on Wreck Beach at Moonlight Head, hints at the turbulent seafaring past of this stretch of coastline.



SNAKES. TYPICALLY, I COMPLAIN that I rarely spot them, despite my frequent hikes through the Aussie bush. But what awaited us that day certainly made up for the long wait since I'd last spied one racing swiftly away from me on Rottnest Island in Western Australia.

As the cool of the morning turned to the heat of midday, we encountered not one, but two, three, four tiger snakes – among Australia's deadliest reptiles – all peacefully sunning themselves on the track. We were walking from Milanesia Gate to Moonlight Head, on the second and most challenging day of our four-day guided hike along coastal Victoria's Great Ocean Walk (GOW). On each occasion we waited for the creature to slowly rouse from its slumber and slither off the track.

"This time of year, they love to get out in the sun and warm up," said our guide Mitchell Wilson, a laid-back 31-year-old with red dreadlocks. "January and February are the peak temperatures, so they just want to come and take as much sun as possible before the end of March and April, when they get ready to hibernate."

A series of wonderful wildlife encounters is what really struck me during the 56km walk, which I tackled as part of a small group in late February. Earlier on that second day, we were greeted by some 50 eastern grey kangaroos as we headed from Johanna Beach to Milanesia Gate. On another occasion, a wedge-tailed eagle swooped down right in front of our transfer vehicle's windscreens and glided along, just ahead of us, for a thrilling handful of seconds.

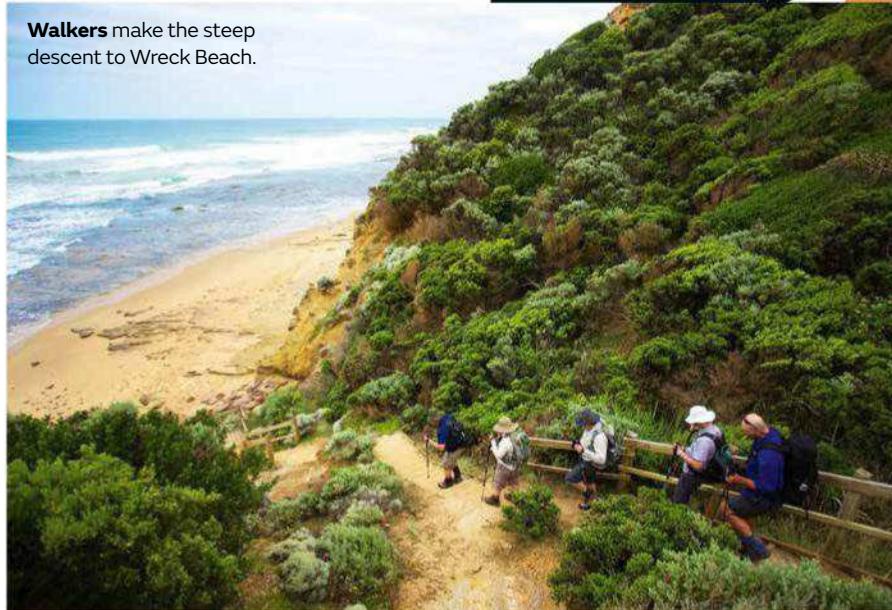


▲ Walkers tackle the Milanesia Gate to Moonlight Head part of the track. This section is graded hard but offers spectacular views to the Cape Otway Lightstation.

We were doing the 'cheat' version of the GOW (see Exploring the coast in comfort, page 118): an experience that's suitable for anyone who doesn't have the time or inclination to do all the planning, gear prep and grunt work required to manage the full 100km on a solo basis. We'd begun the day before, at Castle Cove, and were each day doing slightly different stretches to the official sections that make up the full eight-day GOW (see map opposite).

The entire GOW starts at Apollo Bay, 150km southwest of Melbourne. The track clings to the coast along ▶

Great Ocean Walk: official sections and walking distances



Section 8: Devils Kitchen – Twelve Apostles (16km, 5hr 10mins, easy/medium)

Section 6: Johanna Beach – Ryans Den (14km, 5hr 30mins, medium/hard)

Section 5: Aire River – Johanna Beach (14km, 5hr, medium)

Section 2: Elliot Ridge – Blanket Bay (12km, 4hr, easy)

Section 1: Apollo Bay – Elliot Ridge (10km, 3hr 45mins, medium)

Total length approx 100km

SCALE: 1:140,000

0 2 4 6 8 10 km

Getting there

Apollo Bay, 150km south-west of Melbourne, is about a three-hour drive via Geelong and the Great Ocean Road. It can also be reached over the Otway Range via Colac.

Where to stay

The Great Ocean Walk has seven purpose-built campsites – with composting toilets and rainwater tanks – accessible to walkers (Elliot Ridge,

Blanket Bay, Cape Otway, Aire River, Johanna Beach, Ryans Den and Devils Kitchen). These each have spots for eight tents, with up to three people in each tent. Bookings are required for camping by calling 13 19 63 or visiting parkstayvic.gov.au/great-ocean-walk-bookings. There are also campsites that can be reached by car at Johanna Beach, Blanket Bay, Parker Hill and Aire River and listings for more comfortable accommodation options at visitgreatoceanroad.org.au.

More Info

Great Ocean Walk
greateoceanwalk.com.au
 Great Ocean Road
visitgreatoceanroad.org.au
 Apollo Bay Information Centre,
 visit 100 Great Ocean Road, Apollo Bay or call 03 5237 6529. Open 9am to 5pm, 7 days a week.
 Great Ocean Walk map booklet: get an official guide from Parks Victoria by calling 13 19 63.

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For the Wild

Walkers along the broad yellow sands of Johanna Beach often have the place to themselves, although the waters here are popular with surfers.



the Otway Range, through patches of eucalypts and rainforest, then up over undulating cliff tops and hills, and down to wind- and wave-battered beaches. Everyone walks in a westerly direction towards the walk's iconic end point at the Twelve Apostles. The most spectacular views are found in these western sections, where walkers climb to some of Australia's highest sea cliffs at Moonlight Head and spy remnants of the many ships sunk along this tract of the Shipwreck Coast at Wreck Beach.

THE BEAUTIFUL AND varied walk is notionally split in two – the ‘mild side’ in the east, from Apollo Bay to the Aire River campsite; and the more dramatic scenery of the ‘wild side’ in the west, from Aire River to the Twelve Apostles. We began a short way into the wild side at Castle Cove, and on our first afternoon spent four hours walking 6.5km to Johanna Beach. “A lot of people think the last four days are the best, and constantly walking towards the Apostles is the way that people want to do it,” Mitchell said.

Castle Cove is the only place along the route where the Great Ocean Road and GOW meet. Although the two follow the same stretch of coast, much of the road is inland, meaning the walk offers a distinct advantage.

“The difference between what you see from a car and when you’re walking is chalk and cheese,” said Julie Henry from Pacific Palms, NSW. Julie did the walk with her sisters, who ranged in age from 52 to 63, to celebrate her 60th birthday. “When you drive you come to little vantage points. You jump out, have a look, take a couple of photos and get back in the car. You don’t see the coastline at all, until you come to another viewpoint. But when you walk it, you’re actually walking along the coast...it’s magical.”

One of the benefits of the GOW is that it’s a relatively easy track, which makes it suitable for hikers of different levels, from novices to experienced bushwalkers. Julie had never attempted a multi-day walk before, but, despite having had a hip replacement, she had little trouble carrying out the walk.

The guided version offers a 40km option, as well as the 56km version that includes added ‘endurance’ sections each day. This means walkers of different abilities can experience the GOW together, while choosing options to suit their abilities.

The walk’s proximity to the Great Ocean Road offers another benefit. You can do things solo – carrying your own food, water and gear, and staying at the basic campsites along the way – or you can go with one of the guided options and get dropped off at the track and then picked up each day, and driven to local accommodation.

The beauty of this walk “is that it’s accessible to everyone, from someone who wants to carry 30kg and their own tent, right through to somebody who just wants to carry a 4kg daypack and have a bit of luxury”, Mitchell said.

“The difference between what you see from a car and when walking is chalk and cheese.”

Exploring the coast in comfort

If you don't fancy carrying a heavy pack, the Twelve Apostles Lodge Walk guided version may be the thing for you.



DURING FOUR DAYS, starting on the second half of the track, the Twelve Apostles Lodge Walk covers 40–56km of the Great Ocean Walk. It offers experienced and knowledgeable guides, as well as comfortable private rooms and excellent food in a small ecolodge near Johanna Beach. From here, walkers are ferried back and forth to the track each day.

"I've wanted to walk more and explore western Victoria," says Karren Morris, 66, from Melbourne, who did the Twelve Apostles Lodge Walk last year. "But I'm a small build, so I didn't like the idea of doing a walk where I had to carry everything myself. The fact I could carry a small daypack and come back to beautiful accommodation really appealed to me."

The lodge provides all the required walking gear, including a daypack, water bottle, raincoat, gaiters, walking poles and a daily lunchbox. The only things you need are a sturdy pair of bushwalking boots that won't give you blisters and some comfortable, practical walking clothes. Group size is limited to 10 and there's a free transfer to and from Melbourne's CBD.

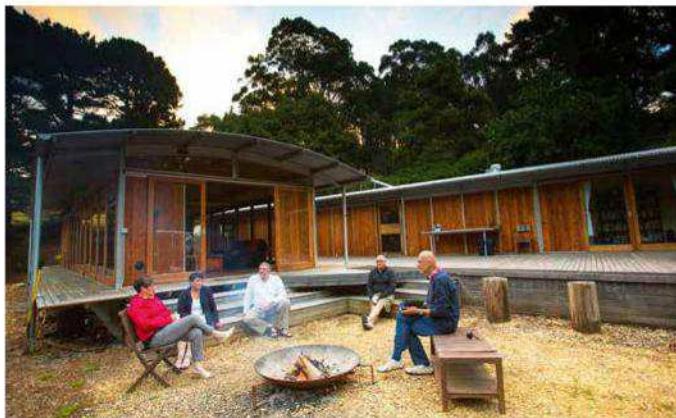
More info:

The Twelve Apostles Lodge Walk experience starts at \$2125pp and includes all meals, accommodation and national park fees – as well as a scenic helicopter flight. Call 1300 767 416 or visit twelveapostleslodgewalk.com.au to learn more.



▼ Walkers enjoy a well-earned rest around the campfire at Twelve Apostles Lodge near Johanna Beach.

▲ Between Milanesia Gate and Ryans Den the reinforced track proceeds along the cliff tops in sections.



Walkers are ferried back and forth to the track each day.

Sweeping coastal vistas define the The Great Ocean Walk, which alternates between beach sections and walks along the cliff tops.



Shortly after Castle Cove, we passed Dinosaur Cove, where important fossils have been found by Museums Victoria scientists, painting a picture of life in Australia 115 million years ago during the Early Cretaceous. We finished our first day at Johanna Beach, where we walked barefoot alongside the breaking surf and spotted flocks of shorebirds.

This beach is one of the numerous spots along this coast linked to tales of disaster. Here, in 1843, a barque called the *Joanna* was grounded while sailing from Launceston to Port Fairy. Nobody was killed and the crew survived the eight-day walk to Geelong with help from local Aboriginal people. However, a subsequent disastrous salvage operation to reclaim the *Joanna*'s cargo of brandy, sugar and flour did result in two deaths. The beach and river here came to be known as 'Johanna' following the error of a sign writer for the now defunct Johanna Post Office.

Johanna Beach is a highlight of the walk and its fearsome swells make it an ideal spot to hold the famous international surfing competition normally held at Bells Beach, on the rare occurrence that conditions aren't suitable there. Taking the full force of waves that roll in from Bass Strait, it's easy to see why none of the beaches we pass is suitable for swimming.

THE SECOND DAY of our walk brought the snakes and the challenge of covering more than 20km, much of it up and down hill through rugged stretches with windswept headlands. I enjoyed walking through damp gullies with prehistoric-looking

tree ferns, and taking in spectacular coastal views at Ryans Den as we ate our packed lunches.

But the third day was by far my favourite. Starting at Moonlight Head, we walked to The Gables and finished for the day swimming, or simply soothing tired feet, in the cold but refreshing waters of the Gellibrand River, near the settlement of Princetown.

This section took in many different views and vegetation types. In the morning we spent an hour and a half walking through dense gum forest with ribbon bark and messmate before popping out unexpectedly on headlands with great coastal views. Amid these eucalypts we found lovely pinky-purple rosy hyacinth orchids in full bloom. Also along the track were blackwoods, myrtle beeches and *Xanthorrhoea* grass trees. Sadly, the *Xanthorrhoea* along this coastline have been badly hit by root rot fungus, necessitating boot-washing stations. Occasionally we spotted kangaroo apples, bush tucker once buried by local Aboriginal people in the sand to stop birds from eating it.

Reached by descending 350 steps, Wreck Beach is yet another reminder of the more than 600 ships that have come to grief along the Shipwreck Coast. If the tide is low enough you can see, wedged in the rock, the anchors of both the *Fiji* and the *Marie Gabrielle*, wrecked in 1891 and 1869, respectively. The *Marie Gabrielle* was a French vessel carrying tea from China, while the wreck of the *Fiji* is infamous for the deaths of a group of sailors who were swept away by the roiling waters.

Stopping for lunch at Devils Kitchen, we spied brilliantly blue male fairy wrens bouncing about in the



Snack-sized adventures

You don't have to do the entire Great Ocean Walk to get a taste of the coastal delights on offer here – there is a whole series of shorter walks, too.

1 SHELLY BEACH CIRCUIT 2km circuit, 45mins, easy

From Shelly Beach follow the rugged coast to the Elliot River, then head back inland through moist, green gullies and stands of blue gums along the bottom of the Otway Range. Watch for koalas and yellow-bellied gliders.

2 CAPE OTWAY TO AIRE RIVER 10km one way, 3hr 45mins, medium

Starting at Cape Otway Lightstation, wind through dunes, coastal scrub and limestone cliffs to where the Aire River opens to the sea. An option is a 3km-return side trip to the delightful Rainbow Falls.



Path to Moonlight Head

3 AIRE RIVER TO JOHANNA BEACH 14km, 5hr, medium

Starting at the Aire River information shelter, enjoy a long and varied walk including heathland studded with wildflowers and pleasant ocean vistas, before ending up at Johanna Beach. Keep your eyes peeled for peregrine falcons.

4 THE GABLES LOOKOUT 800m return, 20mins, easy

The stroll from The Gables car park passes through a casuarina grove to a lookout over the reefs around Moonlight Head. You are atop some of Australia's highest sea cliffs, a place to spot seabirds and (June–September) migrating whales.



Johanna Beach

5 WRECK BEACH 2km return, 90mins, hard

This challenging walk starts at the Wreck Beach car park in Cape Otway National Park. A tough climb down 350 steps brings you to the beach that features the remnants of two 19th-century shipwrecks.

6 PRINCETOWN TO THE TWELVE APOSTLES

5.5km one-way, 2.5hr

Starting near the Gellibrand River, this final stretch of the GOW passes through low heath and coastal scrub, offering fabulous views as you edge towards the Apostles. Look out for kangaroos on the cliff tops and dolphins out to sea.



The Twelve Apostles

foliage. At other points we heard the distinctive squawk of yellow-tailed black cockatoos flying high overhead.

ON OUR FOURTH and final day we were on the home stretch with a pleasant and none-too-taxing 8km stroll from the Old Coach Road, near Princetown, to the Twelve Apostles. Along the way we passed through windswept scrub, with tea-trees and coastal wattle; and also sections with ground-hugging cushion plants and native rosemary.

Early on we spied the famous sea stacks, some as tall as 20-storey buildings and etched into my mind from a thousand photographs. They passed in and out of view with the undulations of the track. There was a viewing platform before we reached Gibson Steps that provided a good opportunity to get selfies with the Apostles as a backdrop.

These steps were perhaps created by Kirrae Whurrong Aboriginal people, but they were carved into the cliff in their modern form in 1869 by settler Hugh Gibson, who built nearby Glenample Homestead. The 86 steps brought us to a beach where we marvelled at the 70m cliffs and two limestone stacks – dubbed Gog and Magog – that are not officially part of the Twelve Apostles.

For the first time in our four days on the GOW we were sharing the trail with large numbers of other walkers, who had headed out on the 1km track from the Twelve Apostles Visitors Centre. For the members of my walking party, the relative solitude we'd experienced on the track until this point was a real highlight. "There aren't hundreds of people out there in your way, you might just see a couple of people to say hello to, but you felt as if you owned the track," said Karen Morris, 66, from Melbourne. "The views are just spectacular, and it was peaceful and quiet."

But now, less than a kilometre out from the sea stacks – only seven of which remain above the waves – the time for reflection was over. We had one final highlight left to enjoy, however: a scenic helicopter flight over the Apostles and the neighbouring coast. Dancing through the waves beneath us was a pod of dolphins – sleek, beautiful creatures, offering us one final, delightful wildlife encounter to savour on this memorable few days spent exploring the Victorian coastline.

AG

THANKS: John Pickrell and AUSTRALIAN GEOGRAPHIC thank the Twelve Apostles Lodge Walk and Visit Victoria.



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DATES: 3–5 October 2018

WHO: Devil Ark

COST: \$1500pp*

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WHO: APT

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BOOKINGS: kimberleywilderness.com.au/cruising



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WHO: Aurora Expeditions
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BOOKINGS: auroraexpeditions.com.au



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DATES: 13–24 September 2019

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BOOKINGS: reservations@whalesunderwater.com

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DATE: 2–11 November 2018
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BOOKINGS: travel-associates.com.au



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WHO: India Tourism
DATE: Travel year-round
COST: Visit website below for travel options

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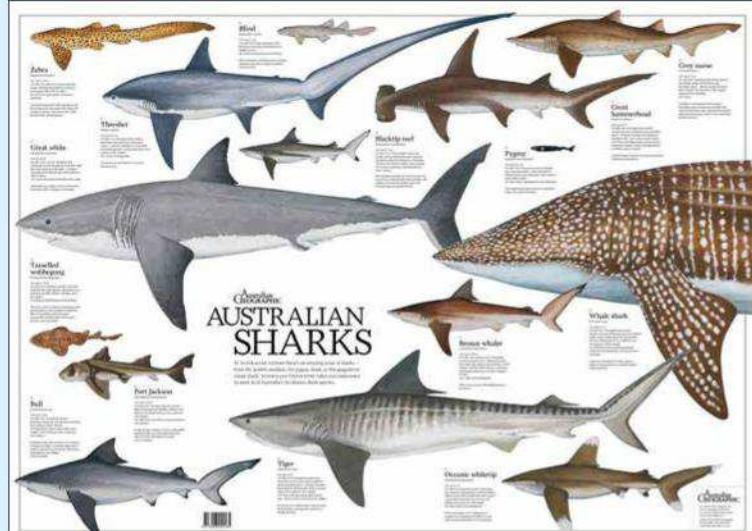
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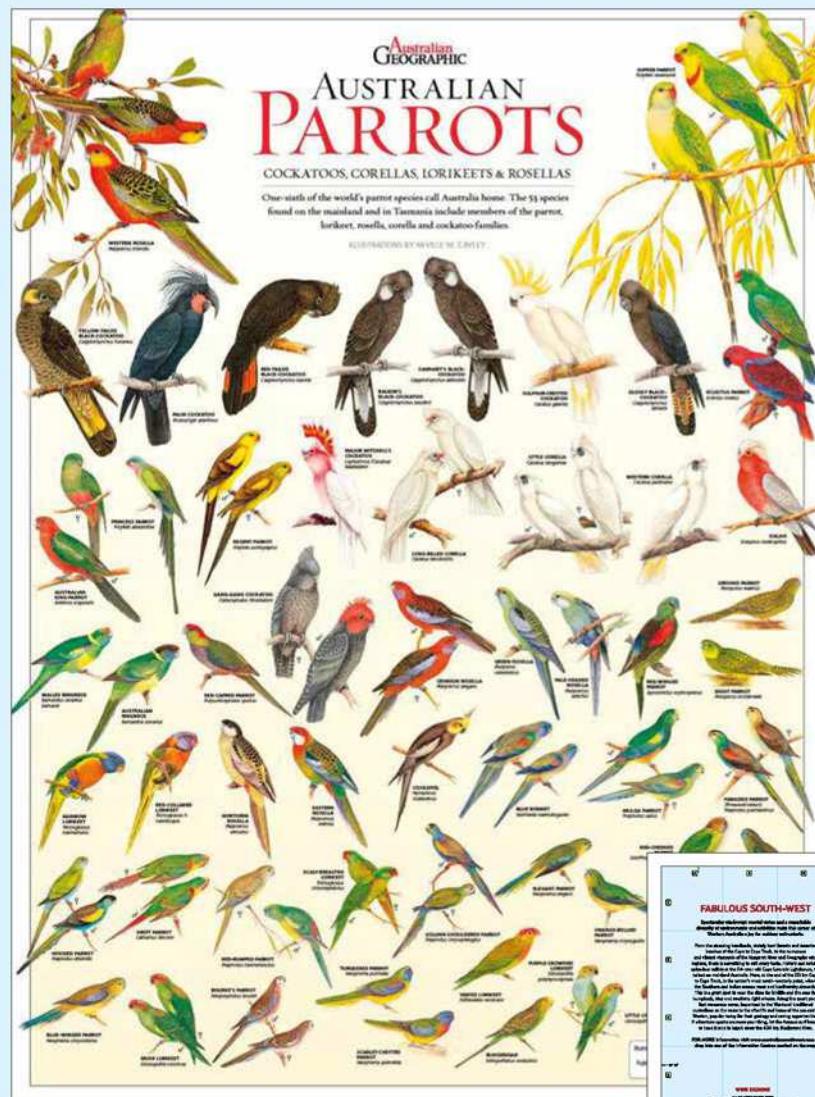
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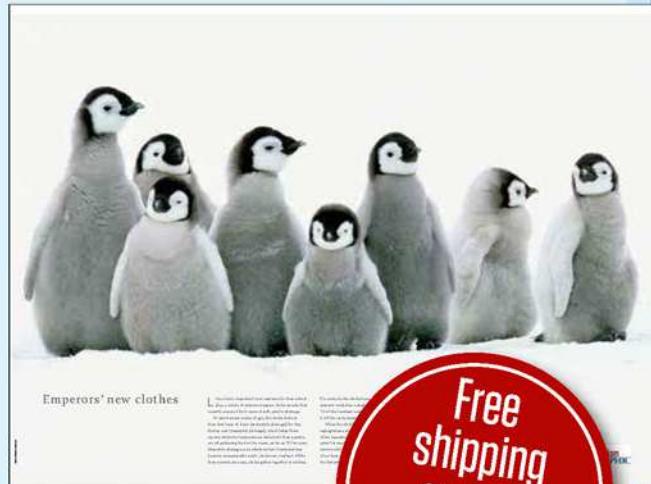
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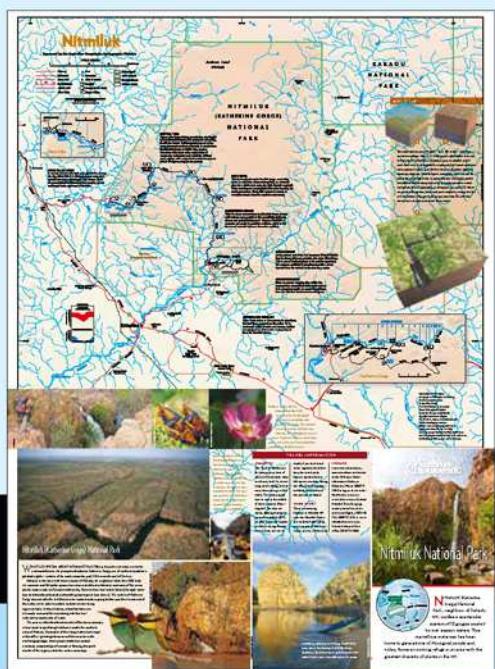
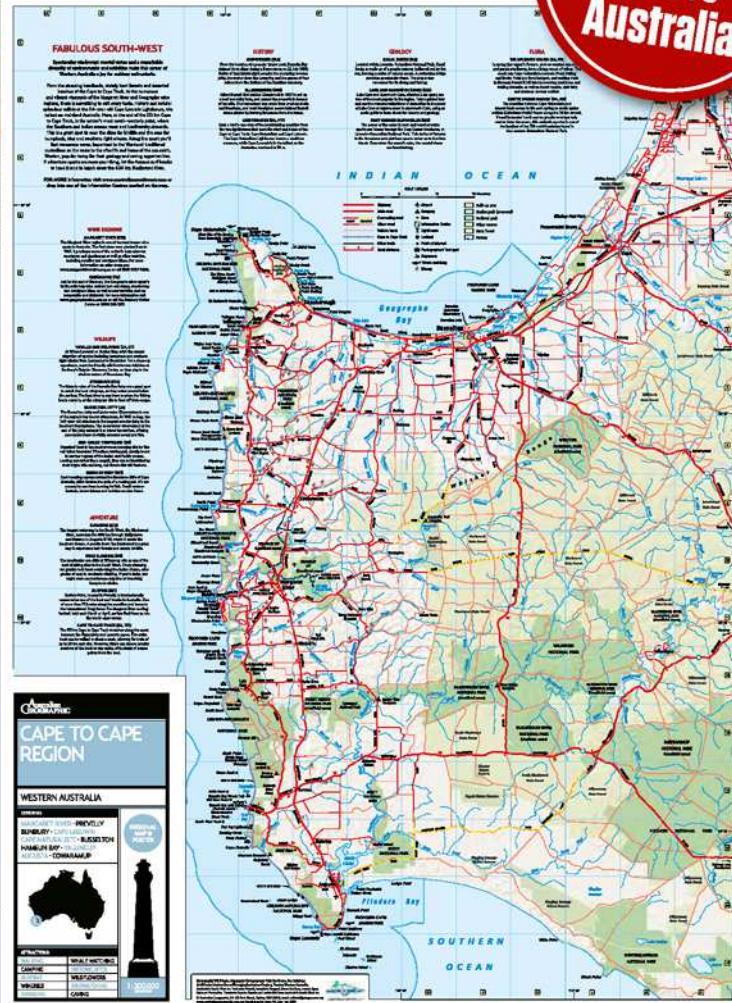


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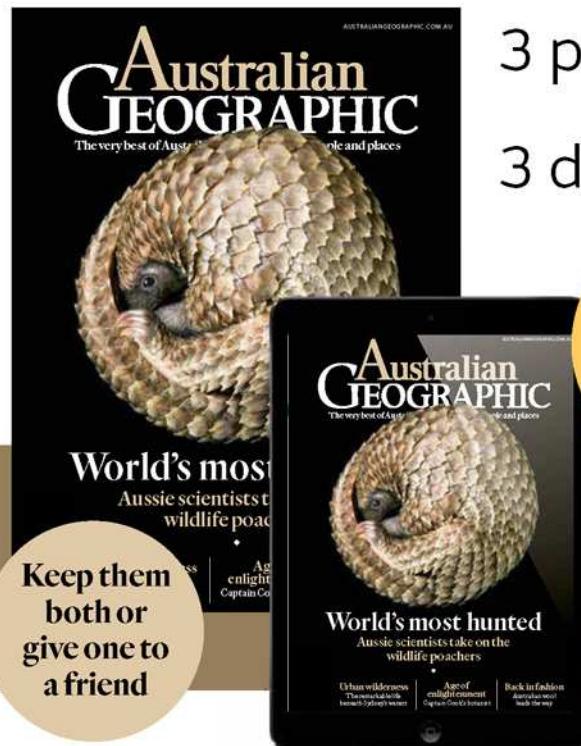
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MY FAVOURITE PLACE
STORY AND PHOTO BY
GREGORY PAUL EDWARDS

Nullaki Peninsula

Western Australia



“I WOULDN’T GO there,” warned the crusty old gentleman chatting in the WA town of Denmark about nearby Nullaki Peninsula. “Somebody got bitten by a blue-ringed octopus!” I was shocked because I’d walked on the reef there many times wearing just thongs.

Octopuses aside, I love the Nullaki. Located on the southern side of Wilson Inlet, 350km south of Perth, it’s a pristine finger of land that looms large with dramatic limestone cliffs tapering into the thundering Southern Ocean. Shallow reefs, cascades and crystal-clear natural aquaria dot the area. The Bibbulmun Track – a famed 1000km walking trail – also traverses there.

The peninsula is a 36km drive on a sealed road around the inlet away from Denmark. The area is protected by a high fauna fence and entry is via a huge motorised meshed gate, which keeps out feral predators such as foxes and cats.

Access is easy at Anvil Beach car park where you’re greeted by a glorious vista

of stunning sandy beach, shallow reef and long lace-like rolling waves. Walking 200m eastwards and clambering over two rocky headlands you’ll discover beautiful tidal pools, channels and rocky outcrops and plateaus. The reef is like stepped layers of chocolate melting in the sun, with champagne waterfalls everywhere.

One of my favourite things to do is walk on the reef at low tide when there’s little swell. There are plateaus of water with criss-cross lines of algae that seem to meander towards the horizon. These crazy patterns are a delight to photograph. At sunset, a golden glow beautifully silhouettes Anvil Rock – so named because of its shape – 50m from shore.

I love coming here because there are no crowds. People snorkel and swim here,

but be warned, this is an unpatrolled beach and there are dangerous currents. The fishing is good, too. Camping is not permitted on the Nullaki. But if you’re looking for nearby accommodation, try the Denmark Visitor Centre website: denmark.com.au

I researched the venomous blue-ringed octopus and discovered it’s the size of a golf ball and carries a powerful neurotoxin – enough to kill 26 people – against which there’s no antivenom. It’s shy and doesn’t bite unless aggravated: note that the blue rings become more visible when it’s angry. Records show only two deaths have ever been registered in Australia. But I’ll certainly be wearing my running shoes on the reef next time and watching my step.

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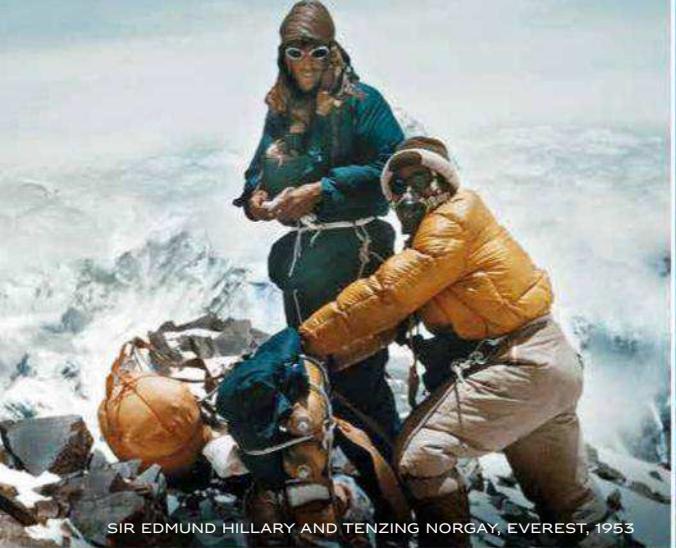
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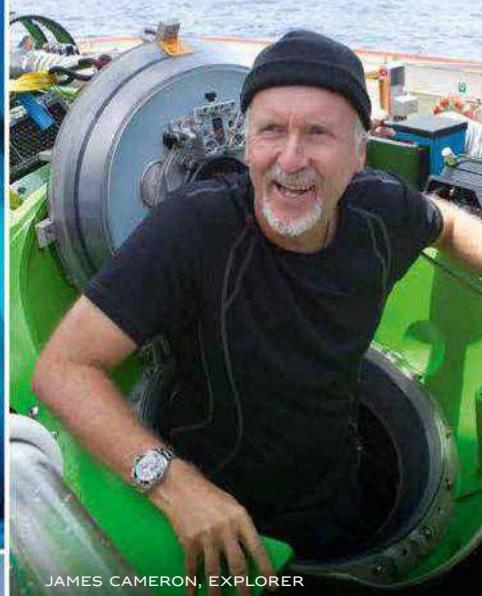
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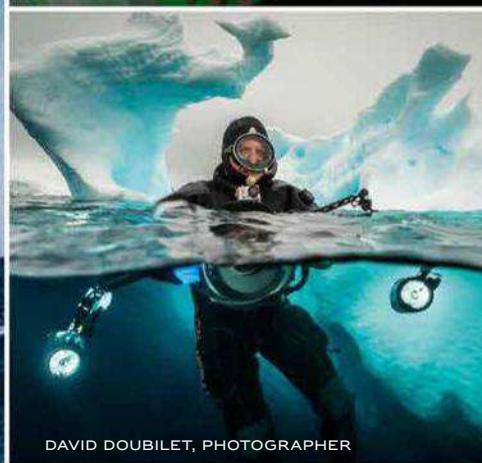
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