WA's conservation, parks and wildlife magazine

LANDSCOPE

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Dancing peacock spiders

Shannon and D'Entrecasteux national parks

Mount Augustus dragonflies **Outdoor universities** Two Peoples Bay Nature Reserve



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Department of
Environment and Conservation


Jürgen Otto


Lynne Whittle

contributors

Jürgen Otto studied biology in Germany and, after migrating to Australia, developed a passion for wildlife photography. In 2008 he became the first to observe and photograph the remarkable courtship display of the peacock spider *Maratus volans* and, since then, has devoted most of his spare time to the study and documentation of Australian peacock spiders. Jürgen's photographs have become well known through internet and hardcopy publications, and recently he has published several popular videos about peacock spiders on YouTube. He currently lives in Sydney and encourages those who see peacock spiders to get in touch.

editor's letter

Just over two decades ago 12 cargo containers fell off a merchant ship in the north Pacific and dislodged their contents, including a consignment of 29,000 floating bath toys, into the sea. The resulting diaspora of colourful plastic ducks, turtles, beavers and frogs—some of them travelling tens of thousands of kilometres before hitting land—made headlines around the world and was an oceanographer's dream come true. Scientist in the US tracked the progress of the toys over a period of 15 years and were able to use the data to support their modelling of ocean currents. As predicted, the strange flotsam would wend its way to Alaska, back to Japan, through the Bering Strait and across the Arctic to the North Atlantic and the shores of Great Britain. Some of the toys were caught up at the edge of a gyre that carried them to the south Pacific, making landfall in eastern Australia and Chile.

But the quirky story has a sinister side. Two months ago while I was holidaying in Canada, large amounts of debris were washing up on the shorelines of British Columbia from the tsunami that hit Japan in March 2011, more than a year earlier. Giant pieces of styrofoam, rusty propane tanks, and plastic fuel cans, some still containing petrol, were swamping pristine beaches and turning them into landfill sites. A 20-metre concrete dock appeared on an Oregon beach, coated with foreign marine life, including a voracious sea star. And this is just the beginning. The same oceanographic expertise that charted the journey of the bath toys has now predicted that the real peak of tsunami junk hitting land in North America will happen in 2013. Volunteers are already organising themselves in massive beach clean-up efforts, but more importantly, environmental agencies in both Canada and the United States are working on mounting a massive coordinated response to tsunami debris. This is not a bonanza for beachcombers, but a serious global environmental problem, demanding, and getting, an urgent global response.

In this issue, frequent *LANDSCOPE* contributor Ann Storrie looks at the problem of waste from the point of view of the marine life we dump it on ('Refuge in refuse', page 39). There is much to marvel at in the way living organisms respond and adapt to such assaults on their habitat. Crustaceans, molluscs and worms will set up household in all manner of debris. Many fish will use it to shelter from predators. In fact, marine life has been finding ways of making human detritus habitable since the earliest days of seafaring and the first shipwreck. This is in no way excusing pollution, but a prompt to consider how the impact of human activity on ecosystems can have effects beyond what we may imagine.



Madeleine Clews
Executive Editor

Lynne Whittle is a senior graphic designer with the Department of Environment and Conservation (DEC) where she works on *LANDSCOPE* and a range of departmental publications. Lynne revels in the opportunity to bring her interest in Western Australia's natural areas together with her work, and takes any opportunity to escape from the city. She loves exploring WA's natural areas—a pastime fostered by her family while growing up—and particularly enjoys surfing and taking part in ocean swims off the south coast.

Melinda Moir is a research associate for the School of Botany at the University of Melbourne. Based in WA, she has worked for the past five years on co-extinction—the extinction of organisms that rely on another for their survival (such as herbivorous insects on plants). Before this, Melinda worked for the Western Australian Museum on the biogeography of short-range endemic invertebrates of the south coast region of WA, including taxa such as millipedes, snails and spiders. Her recent work involves investigating how to conserve organisms threatened with co-extinction when management of the host animals or plants involves translocations to different areas.

Janine Guenther is from Hamburg, Germany. She has always been interested in the environment but has developed a strong affinity for Australia since her first visit in 1995. In 2005 Janine co-founded '360°'—a publishing business that develops Australian travel guides that focus on nature and history, for the German-speaking market. She also works as a freelance writer and photographer in Australia and enjoys the opportunity to promote awareness and increase the understanding about the continent's unique environment. She plans to settle in WA in spring 2012 and get more involved in environmental projects that help to protect the state's fragile ecosystems.


Melinda Moir

Also contributing …

Andrew Brown, Rhianna King, Juliet Wege, Alan Kendrick, Glenn Hyndes, Ann Storrie, Samille Mitchell, Emma O'Leary, Aberline Attwood and John Hunter.


Janine Guenther



Cover illustration by Gooitzen van der Meer
Banksia peacock spiders (*Maratus mungaich*) live in the banksia, marri and jarrah mixed forests of south-western Western Australia. Male banksia peacock spiders use their colourful pair of wing-like extensions or 'flaps' on their abdomen to attract females as part of an elaborate courtship dance. The spectacular colours of the male peacock spiders are in stark contrast to the females, whoes colours are drab. Banksia are one of nine species of peacock spider that occur in WA.
Illustration reference photo by Jürgen Otto

Back cover photo by Rob Neave
Bluff Knoll, Stirling Range National Park.

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Department of
Environment and Conservation









In early spring, the fringes of granite outcrops across south-western Western Australia are transformed into a carpet of colour as thousands of small herbs begin to bloom. Forming an important part of this enchanting floral display are species related to the horn triggerplant (*Stylidium petiolare*)—a group of tiny geophytes that cope with the region's hot, dry summer months by dying back to a small, shallowly buried and nutrient-rich corm. The corms are capable of significant desiccation, becoming almost fully dehydrated by the start of summer, but rapidly rehydrating following autumn rains. These remarkable herbs, which are typically less than 10 centimetres high, are known as microgeophytic triggerplants and they are unique to south-western WA.



New discoveries

Microgeophytic triggerplants grow in winter-wet swamps as well as on granite outcrops. Different species can grow intermixed at any given site and although each species can be separated using floral features, such as the shape and colour of the corolla lobes and the structure of the throat appendages, it takes a keen eye to distinguish one species from another. Following good winter rains, the microgeophytic triggerplants can form colourful swards that have been likened to a floral 'milky way'. Navigating through the taxonomy of this group has been a recent mission at the WA Herbarium—one that has doubled the number of known species from seven to 14, and has included some exciting new discoveries.

The glistening triggerplant (*Stylidium scintillans*) was unearthed in 2007 during botanical surveys of mining tenements in the Yalgoo region, east of Perenjori, and has since been listed as 'threatened'. Its recognition and scientific description is an important step towards ensuring its



New discoveries *charted in* floral 'milky way'

A galaxy of tiny triggerplants bloom across the south-west each spring. And now, some stellar new species are being recognised as part of ongoing research on this fascinating genus.

by Juliet Wege

Above Department of Environment and Conservation senior research scientist Juliet Wege photographing the glistening triggerplant.
Photo – Ryonen Butcher

Opposite page
Left Glistening triggerplant.
Photo – Juliet Wege/DEC

conservation in a region that is under significant pressure from exploration and mining for iron ore. Named for its unusual shimmering appendages in the centre of the flower, it is the only microgeophytic triggerplant that occurs in this region and grows in highly localised populations.

A second new find is the little wildebeest (*S. cornuatum*), discovered in 2008 during a search for a different triggerplant in swampy bushland near Eneabba. Its scientific name means 'horn-shaped' and was chosen because its upper corolla lobes resemble the horns of wildebeest. Its common name follows in the footsteps of Rica Erickson, who created imaginative names while researching these species in the 1950s, including the pantaloon triggerplant (*S. periscelianthum*) and thumbelina triggerplant (*S. pulchellum*). The little wildebeest is known from just a few sites, but it is hoped that an increased awareness of this species will lead to the discovery of additional populations.

Although ongoing botanical surveys are vital to documenting WA's biodiversity, there are also new species awaiting discovery in the collections at the WA Herbarium. One example is the little yellow triggerplant (*S. xanthellum*) which has, until recently, been overlooked as a distinct species, despite being collected on a number of occasions, including by colonial botanist James Drummond more than 170 years ago. As part of the taxonomic review of the microgeophytic triggerplants, hundreds of herbarium collections were painstakingly examined and sorted—a process vital to understanding what species we have, where they grow, when they flower and how common they are. Some species were found to be more common than previously thought, such as the deceptive triggerplant (*S. decipiens*, formerly known as *S. emarginatum* subsp. *decipiens*). This species was previously only known from the Cranbrook area but examination of herbarium collections, combined with field research, uncovered 20 populations



Left Deceptive triggerplant.

Below left A floral 'milky way'.

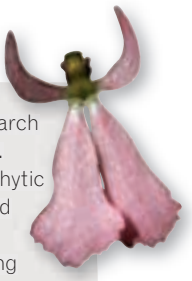
Below Little wildebeest.
Photos – Juliet Wege/DEC

distributed over a north–south range of more than 800 kilometres. In contrast, some species were found to be of conservation concern, including the star triggerplant (*S. asteroideum*) and the apron triggerplant (*S. rubricalyx*)—two valid species named by Rica Erickson but, until now, disregarded as distinct species.

Managing for the future

Several microgeophytic triggerplants require further survey in order to determine appropriate conservation actions. Although populations can consist of thousands of plants, they tend to grow over a very small area, making them vulnerable to threats such as digging by feral pigs, inappropriate off-road vehicle use and mining. It is hoped that the updated taxonomic framework will help people identify these tiny triggerplants, and lead to a renewed appreciation of their diversity. So why not take part in some star-gazing of a different kind this spring—plot a course to a granite outcrop and marvel at the miniature galaxy growing at your feet.





Dr Juliet Wege is a senior research scientist at the WA Herbarium.
Her research on the microgeophytic triggerplants was jointly funded by the Australian Biological Resources Study, Karara Mining Ltd and through the Department of Environment and Conservation's Special Nature Conservation Project program.
Juliet can be contacted by email (juliet.wege@dec.wa.gov.au).

*For more information about microgeophytic triggerplants, contact Juliet to obtain a copy of her article 'Navigating the floral milky way: the taxonomy of the microgeophytic triggerplants (*Stylidium petiolare *and allies:* Stylidiaceae*)', published in* Australian Systematic Botany *25.*

Kevin Kenneally

During a career that spans more than 50 years, Kevin Kenneally has sought to foster an appreciation of the natural environment in others. In doing so, he has touched the lives of thousands of Western Australians and conducted important science along the way.







People in profile

Story by Rhianna King

As far as good yarns go, Kevin Kenneally has got more than a few. But it's not just his aptitude for storytelling that makes them great. It's the diversity of the work he's done, the places he's been and, in particular, the colourful people he's met along the way that make his experiences special, and very entertaining.

Despite always having an interest in the environment and knowing from a young age that he wanted to work in conservation, Kevin treasures the 'people' aspect of his work above all. His work and affiliation with various organisations has seen him directly and indirectly touch the lives of thousands of people: local and overseas colleagues, those he's met through 17 years of *LANDSCOPE* Expeditions, and members of the community, many of them young and many of them in the remote Kimberley Region.

Kevin believes that successful conservation relies on developing and nurturing partnerships and sound community education, as well as fostering community appreciation for the environment, particularly in youth. And it's been his life's work to achieve this is in a range of contexts across Western Australia. But, like all good stories, Kevin's also include a raft of hilarious anecdotes, a good dose of fascinating science and even some crime and intrigue. If you're concerned you might feature in one (or some) of his stories, don't worry, he's too much of a gentleman to disclose actual names. Most of the time.



Previous page
Top Kevin Kenneally and Daphne Edinger at the Sale River, Kimberley, in 1986.
Photo – Kevin Coate/DEC
Bottom Kimberley botanical survey, Mitchell Plateau, 1981. (Left to right) Quentin Richards, Kevin Kenneally and Edward Schneider.
Photo – Bruce Maslin/DEC
Inset *Cleome kenneallyi* a Kimberley plant was named after Kevin.
Photo – Greg Keighery/DEC

Left Kevin making his first plant collection.

Below left Studying historical WA plant collections at the Geneva Herbarium in 1975.

Below Kevin (far left) instructing students in clinical pathology.
Photos – Courtesy of Kevin Kenneally

Start of a career

As a young boy, Kevin was captivated by the natural world and he knew he wanted to study and work in the environmental field. He recalls that at Hollywood High School he met lifelong friend Ken Adcock, who later became president of the WA Palm and Cycad Society. They shared an interest in pigeons and show poultry as well as in native plants. This time spent learning about WA's flora probably formed the foundations for what has been described by others as Kevin's 'encyclopedic knowledge' of WA's flora, vegetation and natural history.

After leaving school, Kevin worked for 18 months as a laboratory assistant in a private industrial laboratory looking at flour milling and stock feed. In 1963 he was appointed to a research assistant position at The University of Western Australia's (UWA's) Medical School, which was located at Royal Perth Hospital, working in the Microbiology Department under Professor Neville Stanley, father of eminent Western Australian medical leader Professor Fiona Stanley. In 1964, Kevin moved to UWA's Botany Department where he worked under Professor and mentor Brian Grieve. Brian—who wrote *How to*











Top left Kevin (centre left) with environment conservationist Dr Dom Serventy (centre right) leading a junior naturalists' excursion at Alfred Cove in 1978.

Top Kevin identifying a cannabis plant.
Photos – Courtesy of Kevin Kenneally

Above (Left to right) Kevin Kenneally, Daphne Edinger and Tim Willing receiving the 1996 CSIRO External Medal for Excellence in Research Achievement.
Photo – Irene Ioannakis

know WA Wildflowers, an important series of books that provides illustrated keys to the vascular plants of southern WA—fostered Kevin's interest in WA's botany. He also facilitated Kevin's completion of part-time studies while working. Kevin said this provided an opportunity for an apprenticeship of sorts, where he gained practical experience on the job while learning the theory behind the science in lectures.

In 1967 Kevin was called up for National Service during the Vietnam War. For the next two years, he served with the Royal Australian Army Medical Corps and was posted to Queensland as an instructor in clinical pathology, where he trained staff for hospital laboratories in Vietnam on how to diagnose tropical infections and diseases.

Then, on his return to WA, Kevin resumed work at the Botany Department before being appointed to a botanist position with the WA Herbarium in 1973. This role saw him work on a number of biological surveys, including ones throughout the Kimberley. It also required him to work with a team of people to identify illicit drugs under the Misuse of Drugs Act. This lead to Kevin being called out to identify plants *in situ* and give evidence as an expert witness in trials. According to Kevin this work was thoroughly interesting but had a few 'hairy' moments, particularly one occasion when evidence was stolen; evidence that had his name and signature all over it, identifying him as the certifying officer. Fortunately the loot was recovered and Kevin's safety was not compromised.

Exploring the Kimberley

Kevin first visited the Kimberley in 1974. He spent a month there as part of a biological survey of Prince Regent River Nature Reserve during which time he fell in love with the area. He has since taken part in every major biological survey of the Kimberley, which he numbers vaguely at 'dozens', across most of the region. For many of these trips he was involved in organising and coordinating the logistics, which required him to negotiate the challenges presented by the Kimberley's remoteness and the expense of carrying out surveys there.

It was in the Kimberley that Kevin developed a deep appreciation for WA's Indigenous cultures. He spent considerable time building partnerships with Aboriginal communities and, in doing so, developed an admiration for them.

"We always tried to include the communities of the areas we were surveying, even before it was common practice to do so," he said.

"Over the years we've spent a lot of time talking to elders to find out what's appropriate and what's not. They're always happy to tell you things and share their knowledge with you. We can learn, and have learnt, a lot from these communities, which are the oldest cultures in the oldest landscape. In particular we can learn about resilience and attachment to the land."

Of all his accolades, which includes an Order of Australia and a Pride of Australia medal, Kevin names the CSIRO External Medal for Excellence in Research Achievement as the one of which he's most proud. He received this in 1996 with long-time volunteer Daphne Edinger and Broome Botanical Society member Tim Willing for their work on the Dampier Peninsula. Spanning 10 years, this work included biological surveys of the area, the development and publication of *Broome*





Above left Kevin in the Kimberley.

Above Tony Raudino took part in a *LANDSCOPE* Expedition which fostered his interest in conservation.
Photos – Courtesy of Kevin Kenneally



Left Kevin Kenneally (centre) with the 1984 Purnululu National Park botanical survey crew.
Photo – Daphne Edinger

and Beyond and extensive work with local Aboriginal people.

LANDSCOPE Expeditions

Another of Kevin's greatest career achievements was setting up and running the Department of Conservation and Land Management's (CALM's) *LANDSCOPE* Expeditions. Kevin ran this pioneering program for nearly two decades, first with CALM and later with the Department of Environment and Conservation (DEC). Marrying science with tourism, the program was a highly successful venture that saw 82 expeditions, involving more than 1,000 volunteers, achieve important research for science.

Unlike anything offered by commercial tour operators, *LANDSCOPE* Expeditions gave paying volunteers the opportunity to contribute their time and money to a range of science projects around the state. These volunteers made significant contributions to fieldwork in a number of studies, working alongside local, national and international scientists. And their financial contributions facilitated work that would otherwise not have been possible. In particular, the expeditions were responsible for the discovery of various new species and research work that formed the basis of a number of published scientific papers. The program even formed the foundation for two doctoral theses into nature-based tourism. In addition, the venture provided the opportunity to introduce the lay person to science and the work of the department. In some cases it even led to volunteers pursuing a career in science. DEC land management officer Tony Raudino is one such example.

Tony took part in an expedition to the Kimberley as a 15-year-old where his desire to work for the then CALM was solidified. "The expedition opened my eyes to the variety of work that the department did," he said. "It also exposed me to national parks other than those found in the Albany and Denmark area where I lived. The work we carried out on the expedition was awesome experience for me and counted towards my Year 10 work experience and towards my Bachelor of Science at university." Following his studies, Tony joined the department's Graduate Development Program and has held a number of roles around the state.

Kevin credits the willingness and interest of all the volunteers for the success of the program, and says it was an example of the benefits that could be achieved when members of the community get involved with science. "*LANDSCOPE* Expeditions attracted people from all walks of life. We had farmers, builders, dentists,

Right Daphne Edinger.
Photo – Bruce Maslin/DEC

doctors and veterinarians, just to name a few professions, from WA, other parts of Australia and other parts of the world," he said.

"There was a diverse range of backgrounds as well as personalities but it's amazing how quickly people weld into a team when there's a common purpose. They shared a passion for the environment and a desire to get involved in science, and generally everyone worked well together. In fact, some long-term friendships have come out of the trips. Of course we had a few interesting discussions at night over the campfire from time to time."

Getting in early

Fostering an appreciation for, and interest in, the natural environment has underpinned many of Kevin's professional undertakings. In 1979 Kevin was awarded a Churchill Fellowship, which enabled him to travel for five months to Britain, Europe and North America to investigate techniques to involve children and amateurs in collecting scientific data. The insight he gained formed the basis for him establishing the WA Herbarium's volunteer program, which continues to operate and provide as many as 1,625 hours, from 32 volunteers, each year.

Kevin believes the key to fostering support for science and conservation is to get people involved, and particularly from a young age. As the President of the WA Gould League for the past 27 years, and an honorary life member of the WA Naturalists' Club, Kevin has seen first-hand the benefit of engaging young people.

"It's so important to open young people's eyes to nature's wonders. We need to capture them when they're full of enthusiasm and their minds are open. The idea isn't to convert everyone into a scientist—it's to promote curiosity and interest. This way, when they're making decisions later in life, they're doing so armed with an appreciation for the natural environment," he said.

Timeless teamwork



A very regular character in Kevin's anecdotes, and one whose name he's not afraid to disclose, is his long-serving volunteer Daphne Edinger. In fact, when asked what he considers his greatest professional achievement, Kevin says it was finding Daphne and convincing her to work with him because, he says, he would never have been able to achieve all he has without her.

Kevin and Daphne first met in 1983 when Daphne was a newly retired science teacher. She first worked with Kevin as a full-time volunteer with the WA Herbarium and, after a few years, was offered an honorary research scientist position. It was during this time that Daphne and Kevin undertook a decade of intensive fieldwork in the Kimberley. Daphne has also undertaken botanical surveys of former pastoral stations acquired under the Gascoyne Murchison Strategy and has contributed to 4,000 plant collections to the WA Herbarium and processed thousands more.

During their years working together, Kevin and Daphne forged a productive working relationship and a strong friendship. Kevin credits Daphne's goodwill and good humour for making her such a valuable team member.

"She inspires everyone who meets her with her tireless enthusiasm and she is very highly regarded among all those who have had the pleasure of working with her," he said.

"While Daphne has reduced her work these days, she still remains a good friend."

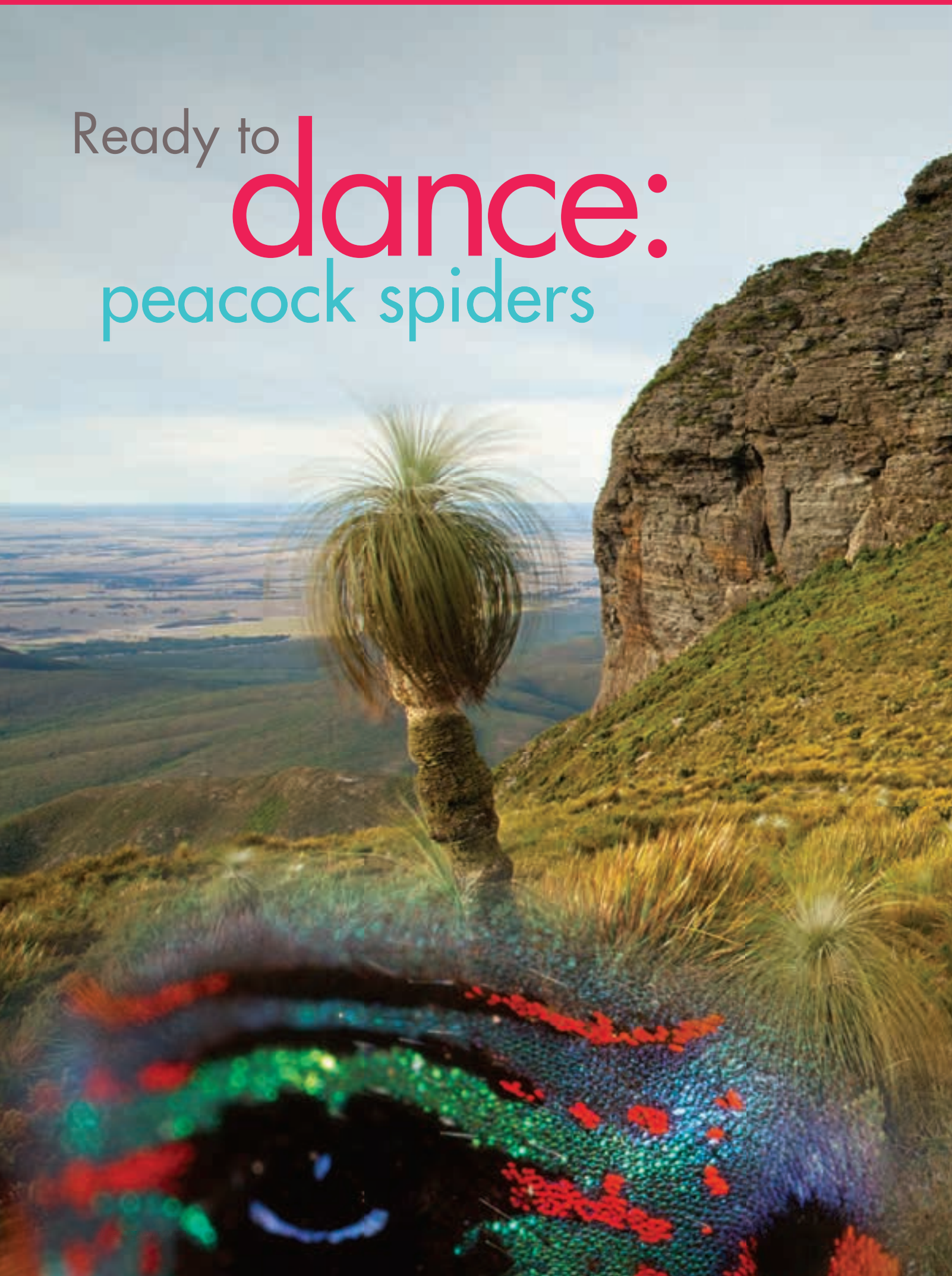
Kevin says school programs and groups such as the Naturalists' Club and the Gould League, which engages 7,000 students each year, and education and community-based programs run by DEC serve an important role in achieving this. He also agrees with concerns held by Australian Chief Scientist Ian Chubb that not enough people are studying science at school and university, which is jeapordising the nation's supply of researchers and investigators. However, Kevin acknowledges that the science community must also make itself available to avenues, such as the mainstream media, if it wants to be heard and impact young people. To this end, Kevin has authored, edited and contributed to several books, including *Broome and Beyond, Under a Regent Moon, A history of the Kimberley, Rock Art of the Kimberley* and *A botanical journey: The story of the Western Australian Herbarium*.

Onwards and upwards

In 2008 Kevin was appointed an Adjunct Professor with the Institute for Regional Development at UWA where he has the opportunity to work with and inspire undergraduate and postgraduate students. He continues to work with DEC's Flora Conservation and Herbarium Program and the WA Museum as a Honorary Research Associate. Kevin is currently involved in a collaborative research project in the USA studying the anatomy of native fern species with Professor Ed Schneider at the University of Minnesota and Dr Sherwin Carlquist at the Santa Barbara Botanic Gardens. His commitment to sharing his enthusiasm for the natural world with the community at large is unwavering, as is his willingness to share a tale or two about his journey along the way.

Rhianna King is a Department of Environment and Conservation editor and features writer who has contributed many *LANDSCOPE* articles and to numerous departmental publications.

Ready to dance: peacock spiders





Found throughout the southern Australian bush, peacock spiders are tiny but magnificent. The brilliant colours of the males and the species' fascinating antics delight those who observe them. But they can be easily missed unless you know what to look for.

by Jürgen Otto

If you take a walk anywhere in the southern Australian bush between September and December, carefully watching the ground or low vegetation, you could come across one of the most intriguing spectacles nature has to offer: peacock spider courtship. With nine described species found in Australia, this ritual probably happens thousands of times each day. But, as peacock spiders are small (four to six millimetres long), it happens on a scale that most of us aren't attuned to. And this has ensured that the peacock spiders' fantastic show has largely remained their secret, until recently at least.



While female peacock spiders are primarily brown, blending perfectly into the environment, the males are the exact opposite. Brightly coloured, they stand out. Their array of colours is dazzling, including blue, yellow, red, green, purple or orange hues. And if that wasn't enough, most species sport fields of iridescent hairs on the abdomen. A closer look reveals that these hairs are not uniform, and the various colours, it seems, are associated with differently shaped hairs; some colours are produced by pigments, while others are the result of refracted light.

In most invertebrate groups, such as beetles and butterflies, it is the tropical regions that have the most colourful representatives. But not so in peacock spiders. As brilliantly coloured as they may be, peacock spiders are at home in the southern parts of Australia: Tasmania, southern Western Australia, Victoria, New South Wales, and south-eastern Queensland. Only a single species is known from the tropics and it occurs predominantly in the southern range of this climate. But their colourful appearance is not the only thing that makes peacock spiders special; there is a lot more to them than first meets the eye.

Male seeking female

Like all jumping spiders, 'peacocks' have two large front eyes and well-developed vision. Males spend much of their day looking for a partner and nothing in their immediate surroundings escapes their attention. Chemical signals also seem to play a role, and males can often be seen getting visibly excited without a female in sight. When that happens the male raises one or two legs and begins to move them up and down, as if to advertise its presence. One species even has an area of iridescent scales on the legs that reflects the sunlight, like a mirror, and produces a flash of blue light every time the legs



Previous page
Main Ellen Peak in Stirling Range National Park is home to 'Darlington's peacock spider.'
Photo – Damon Annison
Inset 'Darlington's peacock spider' is thought to be the largest in the *Maratus* genus.

Above 'Linnaeus" peacock spider starting its courtship dance.

Left Peacock spiders have two large front eyes and well-developed vision.
Photos – Jürgen Otto



Above Male peacock spiders such as this *Maratus volans* from eastern Australia extend a colourful fan and third pair of legs during courtship.
Photo – Jürgen Otto

move. In addition, most species are able to produce sounds by vibrating their abdomen, and presumably the females are able to feel these from some distance. But all this is only a prelude to something much more impressive.

Courtship dance

Male peacock spiders have a pair of wing-like extensions or 'flaps' on their abdomen, that most times are folded away and out of sight. When a female is in close range, the male raises its abdomen and expands these flaps in a spectacular display of colour and movement. Only then does the true beauty of these spiders become apparent, as patterns resembling grotesque faces complete with eyes and lips, bright circles, or a caricature of an entire spider, are revealed.

After the flaps are unfolded, the spiders move from side to side, raising and waving a pair of legs to further enhance their display. Some species have white tips on these legs, adding to the impressive spectacle. It is hard to say whether this show is more impressive to the female peacock spider or the human observer. But seeing one of these tiny males performing its energetic and colourful act seems to defy human logic and experience, as spiders are not an animal we associate with beauty and complex behaviour.

Romance

Once the male has performed its dance, the female's reaction will determine what happens next. In some species, already-pregnant females clearly dislike advances by males. They signal their displeasure by raising and waving their abdomens, and, on occasion, simply attack and make a meal of the male, welcome nourishment for the female's developing eggs. In other species, the females are more tolerant and let the males try until they finally give up.

If the male has found a female willing to mate, it approaches slowly from the front. Then gently, almost hesitantly, the male lowers its front legs onto the area behind the female's eyes, known as the cephalothorax. Usually, the female reacts with a little twitch. While this is a scene that humans may interpret as brimming with affection, it may just be a ritual leading to the next stage. To gain access to the female's genital opening the male climbs on top. Then, in what appears more like a painful contortionist's act, the male twists the female's abdomen by 180 degrees, before it is able to discharge the sperm contents of its pedipalps into the female's genital opening. The female is surprisingly accepting of all this. Sometimes it will move underneath a twig or leaf, which seems to make it easier for the male to rotate its abdomen. Once insemination is complete the male jumps away quickly, clearly wanting to avoid paying with its life for its amorous adventure.







Left Before mating, male peacock spiders retract their colourful fan to get close to the female.

Centre left A mating pair of peacock spiders.

Below left The common peacock spider can be found in Perth.
Photos – Jürgen Otto

Aftermath

By mid-summer most males die, having tried for months to impress females with their display. The ones that survive look a little worn—many of the colourful scales have fallen off and, in the latest stages of life, not even the sight of a female gets them excited. The females seem to hang in there a bit longer and a few weeks after insemination (the exact times aren't known) they produce a small clutch of eggs.

In autumn, when all adults have completely disappeared, some juveniles can already be seen hopping around and feasting on small insects. However, the immature males look nothing like the colourful adults. In fact, in some species they resemble adult females. Only when they go through their final moult, around September, do they assume the colourful costume.

Species of the west

Of the nine named species that are commonly considered 'peacock spiders', five can be found in WA. The common peacock spider (*Maratus pavonis*) is widespread and may even be encountered in Perth gardens. The male has a bright red 'ring' on the abdomen, resembling a target sign, and when it is close to a female its whole body vigorously shakes, as two of its legs hit the substrate. Its name *pavonis* is derived from *pavo*, which is Latin for peacock, a name that is now applied to all similar species that raise their abdomen during courtship.

The banksia peacock spider (*M. mungaich*) inhabits banksia, marri and jarrah mixed forests of south-western Australia. It is a beautiful little spider, predominantly iridescent blue with a dark central patch and some red



Above The summit of Bluff Knoll in Stirling Range National Park is just one place in the south-west where peacock spiders can be found.
Photo – Damon Annison



Right 'Darlington's peacock spider' has yet to be formally named. It can be found on some peaks in the Stirling Range.
Photo – Jürgen Otto

transverse bands on the abdomen. It has one of the largest pairs of flaps in relation to body size.

In drier areas you may encounter a more drab-looking species, the bat-like peacock spider (*M. vespertilio*). While its colouration can't match that of the others, it is unique in the males' ritual fighting. With their flaps expanded and legs stretched out, they take turns in gently hitting each other until one gives up or a little brawl resolves the matter.

Linnaeus' peacock spider (*M. linnaei*) is known only from Two Peoples Bay near Albany. Despite its very small flaps that do not extend, its courtship is fascinating to watch. As the male steps sideways, it moves backwards with each step and wiggles its abdomen between two hind legs held up like goal posts. The female follows the male's moves as if in a trance or being pulled along by invisible strings.

The coastal peacock spider (*Saitis speciosus*) can be found among sea spinach (*Tetragonia decumbens*) plants on beaches around Perth. In this species, the flaps have been replaced by a beautiful downy fringe, but the courtship dance is similar to that of other peacock spiders. It too is brightly coloured: iridescent blue with black and red markings.

A Western Australian species that has been photographed but not yet named may be the largest species in the genus *Maratus*. It is known as 'Darlington's peacock spider' in honour of American naturalist Dr Philip Jackson Darlington Jr who was the first to collect it. This species has been found near the summits of Bluff Knoll and Ellen Peak in the eastern part of the Stirling Range. Two large eye spot markings and a bright-red transverse band make the expanded abdomen of the male appear like a clown's face. During courtship this 'face' is flicked from side to side while the extended third pair of legs remains static until rearranged in quick, erratic and unpredictable bursts of activity.



Peacock spider identification

Many spiders can only be recognised by the shape of their reproductive organs. In contrast, the peacock spiders' colourations are so specific that nothing more is required to identify them than good eyes or photographs. Better still, there are many new species to discover, even close to Australia's big cities. The most recently described species, Harris' peacock spider (*Maratus harrisi*), was found as a result of an amateur photographer posting a picture of the spider on the internet, hoping that someone could identify it. It now bears his name, and several other species also known from amateur photographs are now waiting to be scientifically described.

Australia is a large country and, with very few spider experts looking for peacock spiders, it seems photography enthusiasts can play an important role in the discovery and documentation of new species. So, if you are a keen photographer, keep an eye open this spring—you may be the next to discover a new species. But respect their environment and consider that the animals you are looking for may be under your boot.

A 'flying spider' that can't fly

The first peacock spider was collected by lawyer and spider enthusiast HHB Bradley in Sydney during the late 19th century. Bradley gave three specimens to British arachnologist Octavius Pickard-Cambridge and told him that "he has observed the spiders elevating and depressing these flaps and to use them as wings or supporters to sustain the length of their leaps". Pickard-Cambridge never saw this spider alive but he did not doubt the story. So he gave it the species name *volans*, which is the Latin word for flying.

The story of the 'flying spider' was so convincing that it became accepted by arachnologists around the world. This continued even after RA Dunn reported in the April 1957 edition of *Walkabout* magazine that males of the related species *M. pavonis* use their flaps in courtship display, not for flying. It seems nobody took note of Dunn's fabulously entertaining description of the beautiful spider he discovered accidentally while clipping the grass, which his family named 'Hector'. The first claims that *Maratus* species can't fly were published only recently, in 2007. But it was not until the following year that the courtship display of *M. volans* was eventually observed and photographed for the first time.

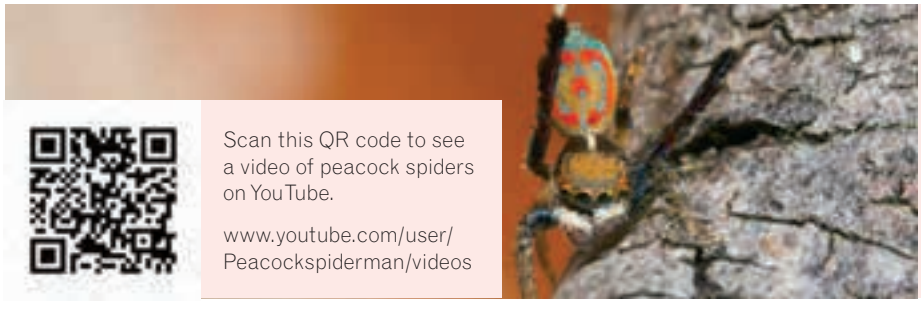
Rising to fame

The first photographs of *M. volans'* courtship display, published in 2008, were something of a sensation. At the time virtually nobody had seen or even heard of such colourful spiders or their amazing courtship display. Owing to their brilliant colours, they quickly earned a reputation as excellent photographic subjects. Some even consider them the 'holy grail' of macro photography. Peacock spiders now feature on book and magazine covers and photography sharing sites, and videos showing them in action not only attract a considerable audience on YouTube but have also been broadcast on national and overseas television shows.

People who admit to an intense fear of spiders comment on peacock spiders being surprisingly 'cute', and there are also those who paint them, make glass models or produce quilts around peacock spider motives. There are even some who have them tattooed on their bodies. Recently the spiders inspired United States artists to perform a dance based on their moves. Will peacock spiders eventually rival the koala or kangaroo as symbol of the Australian fauna, and will visitors travel to Australia to see them? Time will tell.

Above Peacock spiders are a tiny four to six millimetres long but their prominent markings easily identify species.

Below The Tasmanian common peacock spider has a smaller abdominal fan and more blue on its legs than the Western Australian species.
Photos – Jürgen Otto



Scan this QR code to see a video of peacock spiders on YouTube.

www.youtube.com/user/Peacockspiderman/videos

Jürgen Otto lives in Sydney and spends much of his spare time photographing and studying peacock spiders.

He can be contacted by email (jurgenotto@optusnet.com.au) and encourages those who see peacock spiders to get in touch.

bookmarks by Rhianna King

On a Wing and a Prayer: The story of a Carnaby's cockatoo family

Author: Leighton de Barros
Publisher: Department of Environment and Conservation
www.dec.wa.gov.au
90 pages, soft cover, colour photographs throughout
ISBN: 948 19 2170 318 8
RRP: $24.95

This endearing book is based on the *On a Wing and a Prayer* documentary made by esteemed wildlife filmmaker Leighton de Barros. Its easy-to-read text and superb photographs guide readers through the trials and tribulations of a family of Carnaby's cockatoos—one of Western Australia's most well-known and loved bird species. It shares intriguing details of their lives, such as how they select nests, their courtship practices and the celebrated arrival of their chicks. However, these stories don't always have the happy endings we hope for.

Carnaby's cockatoos face various threats such as hypothermia, starvation, predation and poaching, and their population has declined significantly since European settlement. But one thing is in their favour: this book and the accompanying documentary are sure to raise awareness of, and build affection for, this special bird.

Cape Arid

Authors: Philippa and Alex Nikulinsky
Publisher: Fremantle Press
www.fremantlepress.com.au
64 pages, hard cover
ISBN: 978 19 2208 900 7
RRP: $65

Well known throughout Western Australia and further abroad for her beautiful paintings, covers of *LANDSCOPE* and work with Australian Fine China, Philippa is a household name for lovers of nature. Perhaps less well known is her husband Alex's skill for art. But a new title, *Cape Arid*, is a magnificent collaboration. Alex's monochrome paintings perfectly set the context for Philippa's trademark attention to even the most microscopic detail, and the seamless continuity throughout the book is testament to the way they work as a pair. The introduction, where Philippa describes their time together in the bush, confirms this is a unique partnership.

Cape Arid, a large-format landscape book, was developed from 11 trips to Cape Arid where the pair spent months drawing and painting the area's flora and fauna. The pages of the book are dotted with diary notes that share tidbits of their experiences, including the extreme conditions in which the pair worked and the various challenges they faced.

This is a truly stunning book and one that would make a treasured gift or addition to any bookshelf.



Kimberley History: People, Exploration and Development

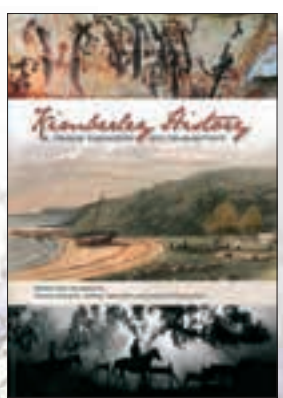
Edited and complied by: Cathie Clement, Jeffrey Gresham and Hamish McGlashan
Publisher: Kimberley Society
www.kimberleysociety.org
228 pages, soft cover, full colour
ISBN: 978 09 5871 302 3
RRP: $49.95

The rugged Kimberley has held significance to Aboriginal people for at least 55,000 years and, more recently, has captivated the hearts of European settlers who have tried to tame it for agriculture and industry or have travelled to it to appreciate its beauty.

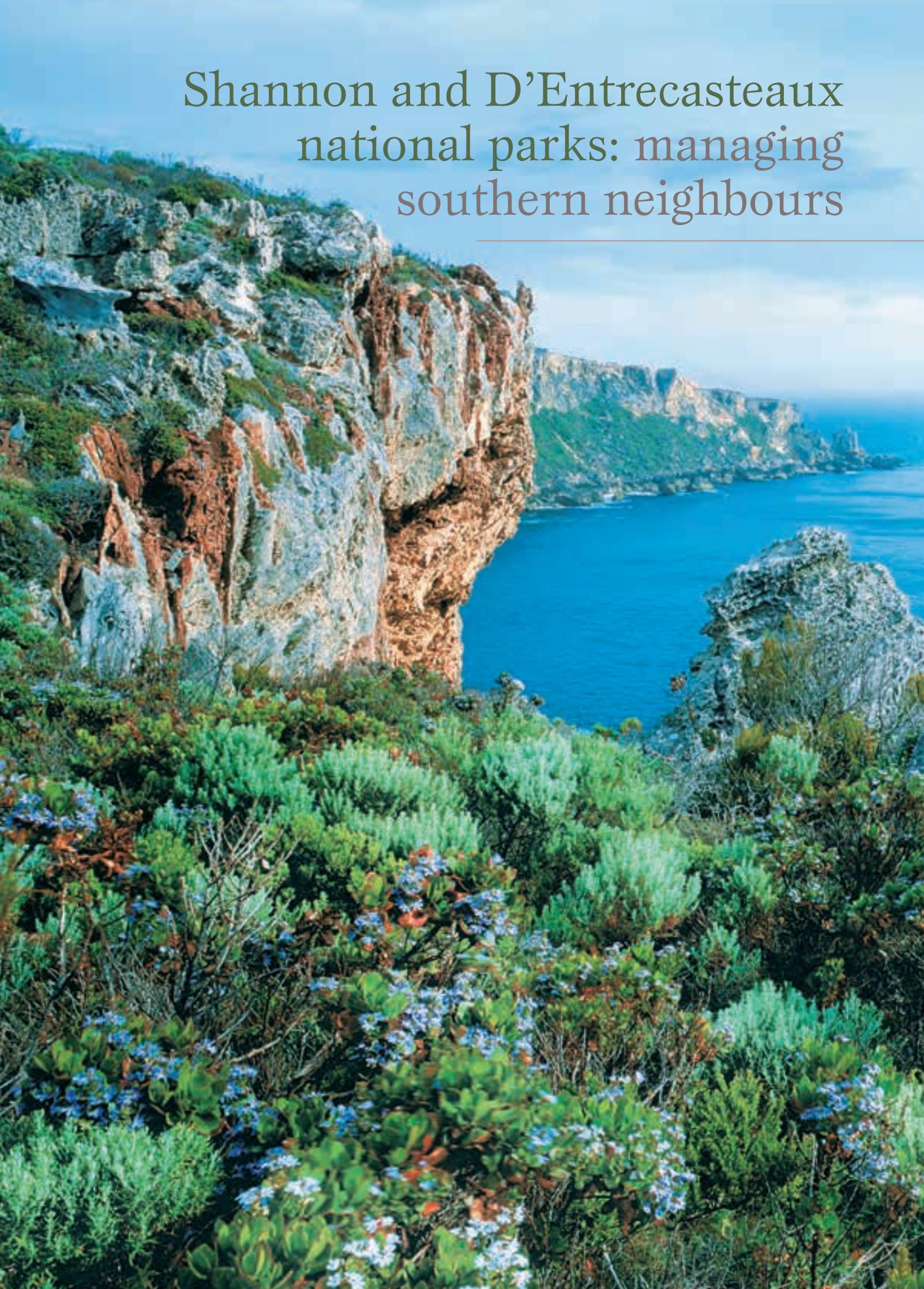
This book is a fascinating compendium of historical and contemporary papers that tell the story of the area—some are published speeches, others are excerpts from books. They are illustrated by maps and drawings as well as photos that depict this stunning area.





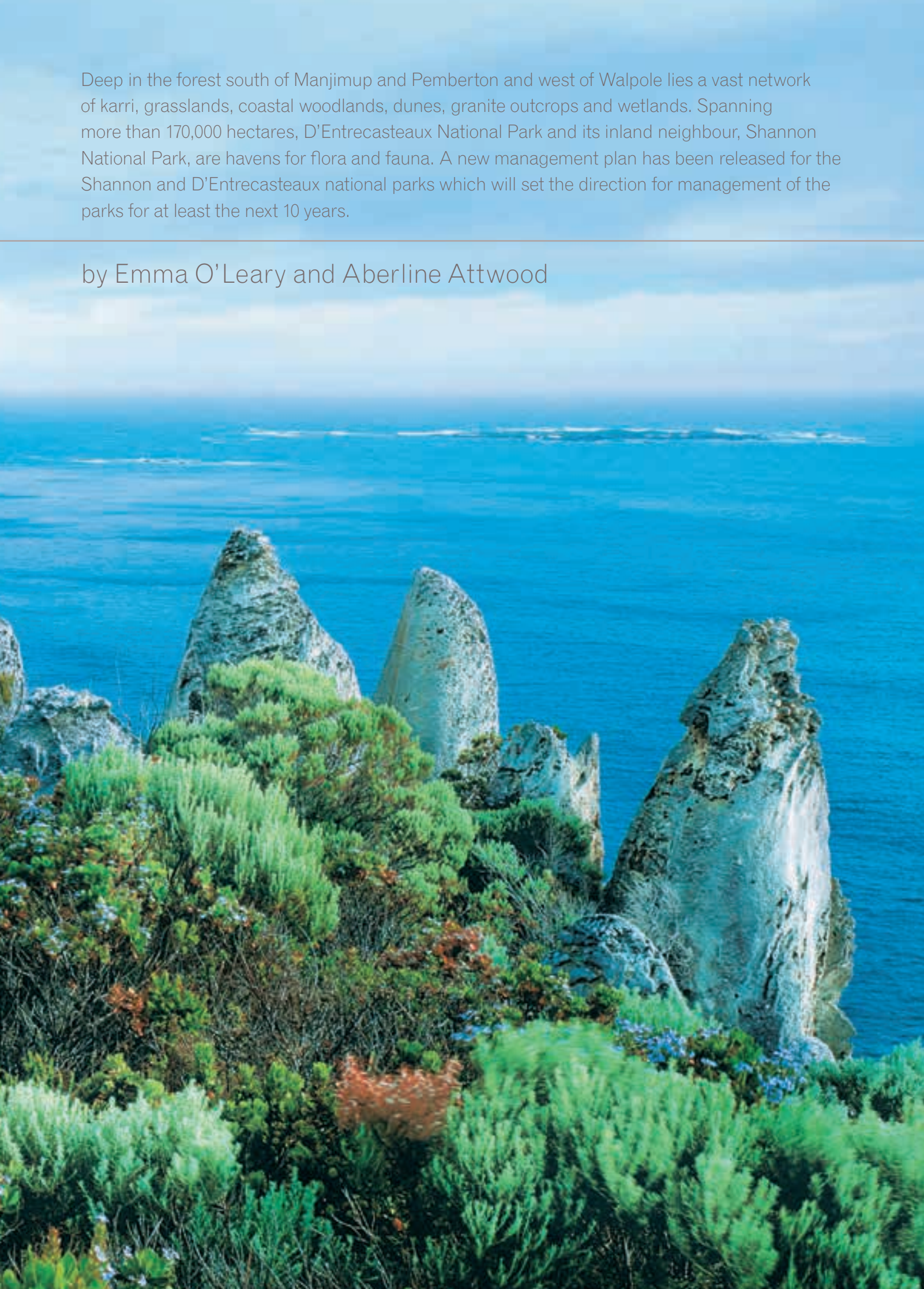


Shannon and D'Entrecasteaux national parks: managing southern neighbours



Deep in the forest south of Manjimup and Pemberton and west of Walpole lies a vast network of karri, grasslands, coastal woodlands, dunes, granite outcrops and wetlands. Spanning more than 170,000 hectares, D'Entrecasteaux National Park and its inland neighbour, Shannon National Park, are havens for flora and fauna. A new management plan has been released for the Shannon and D'Entrecasteaux national parks which will set the direction for management of the parks for at least the next 10 years.

by Emma O'Leary and Aberline Attwood



In 1791, French Admiral Bruny D'Entrecasteaux set out on the 18th century's largest scientific expedition sent to explore Australia. D'Entrecasteaux's party consisted of two research ships, the *La Recherche* and *L'Esperance*, and 16 scientists from the French Society of Natural History. They began their survey of the southern coast between Silver Mount and the Donnelly River on 5 December 1792. It was during this voyage that the Admiral first sighted and named rugged limestone cliffs that tower above the southern ocean 'Point D'Entrecasteaux'. While Bruny D'Entrecasteaux and his party were largely unimpressed with the land they sighted from their ships, today those cliffs form a grand entrance to the spectacular D'Entrecasteaux National Park.

A wilderness experience

The cliffs and dunes first sighted by Bruny D'Entrecasteaux more than two centuries ago tower over the ocean as an imposing reception to passing boats. These dunes give way to coastal heathlands and a series of inland lakes and swamps, and beyond that is an array of wetland, woodland and forest ecosystems. When the national parks were created, the key aim was to maintain a large area free from human development, which provided wilderness and solitude for visitors, magnificent coastal scenery, varied natural features and diverse vegetation types.

Today, the parks' spectacular and natural beauty draws more than 150,000 visits by locals and tourists each year. Four-wheel driving, camping, fishing, boating and bushwalking, especially along the Bibbulmun Track, are popular pastimes. Many places of interest can be reached only by boat. Because the parks offer places that are difficult to reach, they provide visitors with a true wilderness experience.



Previous page
Towards Point D'Entrecasteaux, named by French Admiral Bruny D'Entrecasteaux.
Photo – David Bettini

Left Granite outcrop in Shannon National Park.

Below Lake Yeagarup in D'Entrecasteaux National Park.
Photos – Alex Bond

Columns, cliffs and dunes

The basalt columns of Black Point are one of the park's most stunning landforms. This feature originated from a volcanic lava flow some 135 million years ago. In the process of lava cracking and shrinking, columns were formed perpendicular to the surface, creating a series of hexagonal columns that are now slowly being eroded by the sea. D'Entrecasteaux National Park is also famous for its dunes. The coastal belt consists of aeolian (wind blown) dunes which, in places, form large areas of drifting sand up to 4,000 hectares in size. The inland dunes are becoming more stable and vegetated and regular in form. In other places, the dunes have lithified, creating massive, consolidated ridges, such as





Right The spectacular columns of Black Point in D'Entrecasteaux National Park. *Photo – Jiri Lochman*



those south of Broke Inlet and within the Yeagarup and Callcup areas. The natural sand formations at Yeagarup form one of the largest dune systems in the world.

Limestone cliffs occur intermittently along the entire length of D'Entrecasteaux National Park, and range in height from 40 metres in the western section near Black Point to 150 metres in the eastern section between West Cliff Point and Cliffy Head.

Wetlands

The Warren, Donnelly and Shannon rivers are among the many rivers and major streams that drain through D'Entrecasteaux National Park and empty into its coastal waters.

High sand dunes and limestone cliffs on the coast give way to coastal heathlands and a series of lakes and swamps further inland. These include lakes Yeagarup and Jasper—the largest freshwater lake in the southern half of Western Australia. Vast areas of wetlands behind the coastal dunes are known as The Blackwater.

The national parks of D'Entrecasteaux and Shannon surround Broke Inlet, one of WA's largest inlets. This large, shallow estuary is linked to the ocean by a narrow channel that passes through sand dunes. Sandy beaches along its shores are interspersed with low, rocky headlands of gneiss. The gneissic basement projects above water level in many places to form several small islands.

Wildlife wonders

There are 12 threatened fauna species known to live in the parks, including the quokka (*Setonix brachyurus*), woylie (*Bettongia penicillata*) and chuditch (*Dasyurus geoffroii*). Forest red-tailed cockatoos (*Calyptorhynchus banksii naso*), Baudin's cockatoos (*C. baudinii*), Carnaby's cockatoos (*C. latirostris*), Australasian bitterns (*Botaurus poiciloptilus*), fairy terns (*Sterna nereis*)





Above The Donnelly River, which runs through D'Entrecasteaux National Park.
Photo – Alex Bond

Left Lake Jasper, the largest freshwater lake in the southern half of WA.
Photo – Jiri Lochman

and malleefowl (*Leipoa ocellata*) also occur in the area. The malleefowl inhabit jarrah forests and the area between karri forests and coastal heath. Sightings have occurred at Yeagarup dunes in D'Entrecasteaux National Park and Curtin forest block in Shannon National Park. The occasional visit from an albatross has also been recorded, including the shy albatross (*Diomedea cauta*), and the specially protected New Zealand fur seal (*Arctocephalus forsteri*) is also known to haul out at Black Point in D'Entrecasteaux National Park. It is also likely that the threatened western ringtail possum (*Pseudocheirus occidentalis*) occurs within the parks, as there have been sightings in adjacent forest areas.

The first inhabitants

From long before Bruny D'Entrecasteaux sighted the coastlines that mark the beginning of the national parks, Indigenous people lived in the area. Aboriginal people are thought to have occupied the south-west for almost 50,000 years, though the oldest archaeological evidence in D'Entrecasteaux National Park is dated at 6,000 years. Because D'Entrecasteaux National Park was fertile, with plenty of food and water, it would have been an ideal place to live. Now, people can visit sites and landscapes that continue to hold spiritual, mythological, ceremonial and cultural significance to Nyoongar people.

Of particular archeological and cultural significance is Lake Jasper. In 1989 archaeologists and divers from the WA Museum identified a number of Aboriginal sites on the bed of the lake. The artefacts indicate the presence of a number of major camp sites, quarry and chipping sites estimated to be several thousand years old, when the lake bed was part of the forest. Some of these ancient sites occur close to the edge of the lake, where they are susceptible to disturbance and changing water levels. Under the new management plan, Lake Jasper is now better protected because new rules have been introduced to prevent powerboats from using the lake.



Right Mandalay Beach in D'Entrecasteaux National Park.
Photo – Damon Annison



Below right Australasian bitterns are known to occur in both parks.
Photo – Hans and Judy Beste/Lochman Transparencies

By working together with Aboriginal people to care for the land, there will be benefits for the preservation of heritage and environment as well as for cross-cultural awareness. A memorandum of understanding is in place between the Department of Environment and Conservation (DEC) and the South-West Aboriginal Land and Sea Council, which sets out guidelines under which access and cooperative management agreements may be established.

Fire in the bush

Before European settlement, Aboriginal people applied fire to the landscape for many purposes. It was used to make access through thick and prickly vegetation easier, to encourage new vegetation growth, to attract game for hunting, to stimulate the development of useful food plants, for cooking, warmth and signalling, and for spiritual reasons. This constant use of fire resulted in a fine-grained, fire-induced mosaic of vegetation and fuel ages across the landscape. This meant large intense wildfires were uncommon. Today, DEC's objective is to provide a spatial and temporal diversity of burnt and unburnt areas. This is achieved by varying the season of burn, and frequency and intensity of fire, based on vital attributes and life histories of fire-sensitive species and vegetation communities.

There have been several large bushfires in D'Entrecasteaux National Park in the past few years. Each year, one or two per cent of DEC-managed bushfires are the result of escapes from prescribed burns, including in November 2011, when nearly 30,000 hectares were burnt in the northern part of the park. In February 2012, lightning caused a bushfire that burnt through more than 30,000 hectares in the south-western part of the park. Both these fires ran into areas that had been prescribed burnt in previous years. Without this prescribed burning, these bushfires could have been much worse and may have reached towns and communities. The management plan aims to maintain conservation values while protecting people, property, heritage and recreation assets in and near the parks.

A pastoral and timber heritage

In the 1850s, farmers began settling in and around Pemberton and Manjimup. Settlers in the area found that the land on the coast provided much-needed summer grazing for their stock and many families began droving their cattle to the coast each summer. These farmers took out leases and purchased land along the coast from the 1880s in what is now D'Entrecasteaux National Park, with grazing continuing in some areas until the 1980s. One grazing lease still remains in the area (Quannup) although this is not currently stocked. Other grazing leases have progressively been bought and incorporated into the parks.

Timber milling also plays an important role in the area's history. This was well underway in the south-west by the 1920s, but the Shannon area was largely untouched until the 1940s, when a shortage of timber after World War Two prompted the state government to establish a timber

mill there. Timber cutting began in the Shannon basin in the mid-1940s and the town and timber mill were established in the late 1940s. Most of the timber went to the Shannon Mill, which operated until 1970. A town was built around the mill. When the mill closed the houses from the old town site were sold and taken away.

Only traces of the mill town and former forestry settlement can now be seen, such as the fruit trees still growing in cleared areas of the Shannon camping ground and the grassed areas of the former golf course and oval. There are also the remains of old buildings and railway lines along the Shannon Dam walk trail. Some of the old logging tramways and roads are now used for walk trails and scenic drives.

Holiday huts

From the days of the early cattlemen in the 1880s, the parks were used for recreation, particularly fishing on the coast and in the inlets. Huts were built as a base for recreation in the surrounding areas from the 1920s, and continued to be built in the parks until the early 1980s, mostly as weekenders and fishing shacks. There are 63 huts located in the parks, including 43 along the lower reaches of the Donnelly River, 18 scattered throughout D'Entrecasteaux National Park and two huts within Quannup Pastoral Lease. Some of these huts have high heritage value and are being retained and managed by DEC for cultural heritage purposes. Others have been moved, removed or replaced for safety and environmental reasons. Most of the huts are privately occupied and, under the new management plan, DEC is working with the Lower Donnelly River Conservation Association and other hut occupiers to retain huts for use by the public and members of the association, on the condition that the huts meet environmental, safety, health and building standards.

Demand has risen for new types of accommodation other than the huts, with opportunities to further develop built accommodation at Shannon town site. The new management plan has also identified that existing camping areas are in need of an upgrade to meet demand for the growing number of people wanting to stay in the park overnight.

Below Great Forest Trees Drive guides visitors for 48 kilometres through Shannon National Park and is supported by information stops and its own radio broadcasts.
Photo – Marie Lochman

Driving the parks

The past decade has seen a big increase in visitation to the parks, putting more pressure on conservation values. What once was irregular and mainly seasonal four-wheel-drive access by locals has increased to year-round use by many sectors of the community, with hundreds of four-wheel-drive vehicles in the park during peak periods. Much of the coastline in D'Entrecasteaux National Park is sensitive to erosion, and many of the vehicle tracks in the park traverse sensitive landforms that can be easily eroded. Vehicle use on beaches can damage hooded plover (*Thinornis rubricollis*) and fairy tern nests during the breeding season. Additionally,



Right Sand dunes of Yeagarup.
Photo – Damon Annison

Below right Fairy terns nest on beaches in D'Entrecasteaux National Park.
Photo – Bill Belson/Lochman Transparencies

Below Shannon Dam in Shannon National Park.
Photo – Marie Lochman



dieback, caused by the plant pathogen *Phytophthora cinnamomi*, is present in the park, with vehicles being a major factor in its spread. Continuing to educate users on the appropriate techniques for four-wheel driving in the parks, such as reducing tyre pressure when driving on sandy tracks, could aid in reducing impacts of the activity. However, in some cases access may need to be managed by track reinforcement, realignment, closure or use of a permit system.

In contrast, Shannon National Park has few four-wheel-drive tracks open for public use. Managing four-wheel-drive access within Shannon National Park is much easier as the density of the surrounding forest generally prevents vehicles from leaving public roads and tracks.

There are many ways to explore D'Entrecasteaux and Shannon national parks. Whether it be by driving, walking the Bibbulmun Track, or boating along the tranquil and meandering Donnelly River, the parks provide the perfect place to step back and take in WA's stunning south coast region in all its different forms.





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 by Rhianna King and Samille Mitchell



Two Peoples Bay Nature Reserve

Two Peoples Bay Nature Reserve, on Western Australia's south coast, provides a haven for 12 threatened fauna species as well as a range of other land and sea-dwelling animals, and a wealth of native flora.

Above Little Beach, at the north-eastern side of Two Peoples Bay Nature Reserve.
Photo – David Bettini

Opposite page
Above right Noisy scrub-bird, one of the reserve's special residents.

Above far right Fairy Rocks, at the southern end of Two Peoples Bay Nature Reserve.
Photos – Jiri Lochman

Right Cape Vancouver.
Photo – Bill Belson/Lochman Transparencies

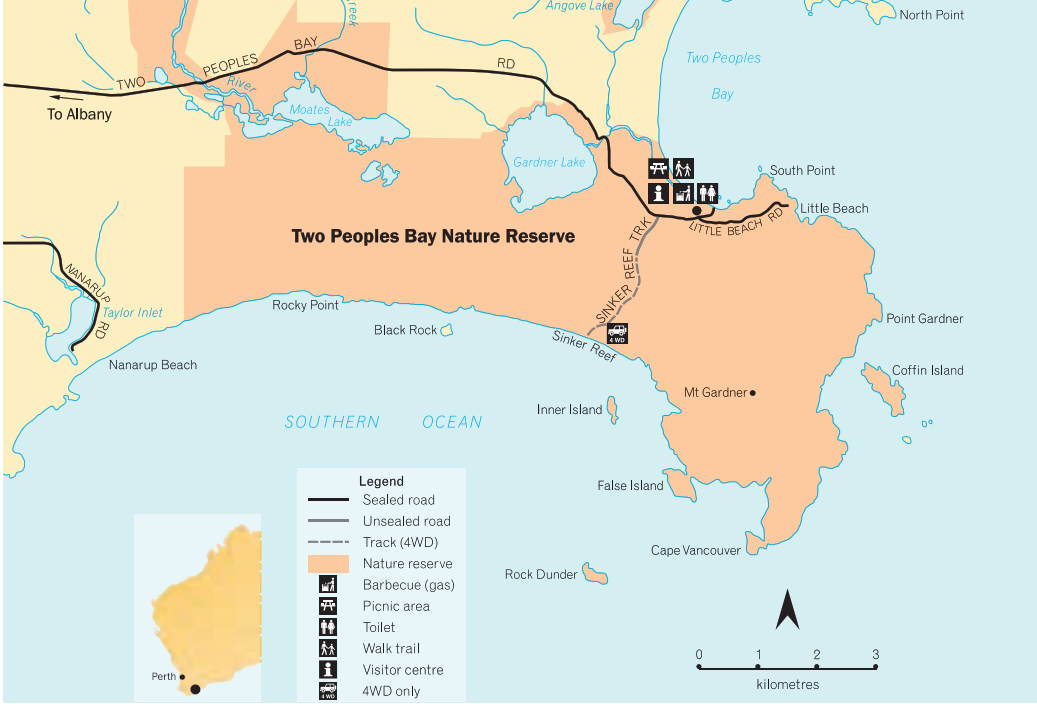
Two Peoples Bay Nature Reserve lies between the granites of Mount Gardner and Mount Manypeaks. The high, rocky hills around Mount Gardner form a headland on the south side of the bay, protecting it from the heavy Southern Ocean swells. The area has unspoilt scenery and was gazetted to protect a special colony of noisy scrub-birds (*Atrichornis clamosus*) which were presumed extinct until 1961 when they were rediscovered in the area. Another exciting rediscovery was made in 1994 when Elizabeth Sinclair and Adrian Wayne set traps for quokkas (*Setonix brachyurus*) and caught a Gilbert's potoroo (*Potorous gilbertii*) (see 'Lost and Found', *LANDSCOPE*, Autumn 1995).

There are currently fewer than 100 known Gilbert's potoroos in two wild populations—one on the slopes on Mount Gardner and the other on nearby Bald Island. The Bald Island population was established as part of the Department of Environment and Conservation's (DEC's) translocation program to protect the species against being wiped out from a single catastrophic event such as a bushfire. DEC has also fenced off a 380-hectare enclosure for potoroos near Mount Manypeaks, outside the reserve, to exclude foxes and feral cats.

Other natural residents

As well as the noisy scrub-bird, Two Peoples Bay Nature Reserve is home to nearly 190 other bird species. Seabirds include great-winged petrels (*Pterodroma macroptera*), fleshfooted shearwaters (*Puffinus carneipes*) and little penguins (*Eudyptula minor*) that breed on Coffin Island. Others include the trans-equatorial waders and some nomadic species of honeyeaters, lorikeets and paradalotes, which appear in response to seasonal blossom. Most, however, are residents that breed within the reserve. The threatened Australasian bittern (*Botaurus poiciloptilus*), the western heathy subspecies of the western whipbird (*Psophodes nigrogularis*)











and the western bristlebird (*Dasyornis longirostris*) also occur in the reserve, further increasing its importance for bird conservation.

Mammal life is also abundant, with 28 species recorded in the reserve. The animals that occur there are typical of the wetter areas of the south coast with many species at or near the eastern limit of their range. In addition to the Gilbert's potoroo, the reserve is home to the quokka, honey possum (*Tarsipes rostratus*), quenda (*Isoodon obesulus*) and western ringtail possum (*Pseudocheirus occidentalis*). DEC's Western Shield fox baiting is playing a vital role in protecting these species.

Sea life is also prolific, with marine mammals such as the common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*) and bottlenose dolphin (*Tursiops aduncus*) all occurring in the nearby waters. Southern right whales (*Eubalaena australis*) are regular visitors and are renowned for the tendency of females to remain close to shore with their calves during calving season. Regularly seen are New Zealand fur seals (*Arctocephalus forsteri*) and Australian sea lions (*Neophoca cinerea*), which often haul out on Coffin Island. Humpback whales (*Megaptera novaeangliae*) are frequent visitors.

The variety of landforms and soils found on the reserve supports a diversity of vegetation. At least 33 plant communities have been identified, including 622 vascular plant species. In addition, 441 species of fungi have been recorded. Gilbert's potoroos are heavily reliant on underground fungi for food and produce prolific diggings in their hunt for truffles.

Exploring the park

There is a visitor centre in the park, complete with interpretive material on the park and its flora and fauna, particularly Gilbert's potoroo and the noisy scrub-bird. Toilets are available at the centre, and a picnic area and gas barbecues are nearby.

Walk trails leave from the visitor centre, including one via a coastal lookout to Little Beach. Those with four-wheel-drive vehicles can set out on Sinker Reef Track to Sinker Reef Beach.

park facts

Where is it? 35 kilometres east of Albany.

Total area: 4,745 hectares.

What to do: Sightseeing, nature study, swimming, bushwalking, fishing.

Facilities: Toilets, visitor centre, gas barbecues, picnic area. There is no drinking water available in the reserve.

Nearest DEC office: South Coast Regional Office, 120 Albany Highway, Albany, phone (08) 9842 4500.





The spectacular wildflowers of the Great Western Woodlands

The Great Western Woodlands abound with biodiversity values, particularly floral richness. Andrew Brown takes a journey which explores the area's spectacular eremophilas, orchids, native lilies and other wildflowers.

by Andrew Brown

The Great Western Woodlands is internationally significant for its rich biological diversity. It is the largest remaining area of intact Mediterranean-climate woodland left on Earth and covers almost 16 million hectares. The continuous band of native vegetation stretches from the edge of the Western Australian Wheatbelt to Kalgoorlie-Boulder in the north, to the inland deserts to the north-east and the Nullarbor Plain to the east.

The Great Western Woodlands area spans two climatic and botanical zones—the wetter south-west and the arid interzone—contributing to its floral richness, and supports at least 3,314 flowering plant species from 119 families.

While the area is unrivalled for its incredible diversity of eucalypts, perhaps less well known is that it contains many different *Eremophila* species and, despite the semi-arid climate, a number of orchid species thrive in its wetter habitats. Even less well known is that several species of native lily (*Wurmbea*) are found in the area, including one that is yet to be named. Take a drive around the Great Western Woodlands and you can discover these remarkable species for yourself.



Eremophilas

The Great Western Woodlands is a marvel for the form and colour diversity of its *Eremophila* species. Some 53 named and four unnamed species are known, with most being common and several found nowhere else in the world.

Eremophila, which is in the Scrophulariaceae family, comprises some 262 species collectively known as poverty bushes, emu bushes and native fuchias. All are endemic to Australia with the majority (229 species) found in Western Australia. In the Great Western Woodlands they predominantly inhabit woodland areas where, in some places, they form the dominant understorey. They are at their best in October and early November and in some favourable habitats it isn't unusual to see as many as eight or more species flowering together.

Previous page
Main Narrow-leaved emu bush abounds in the Great Western Woodlands.

Below left Wrinkled-leaved eremophila.

Below right Small-leaved spotted emu bush.

Bottom right Blue-flowered eremophila.
Photos – Andrew Brown

A wide range of eremophila species may be seen over a one- or two-day drive between Coolgardie and Hyden. Three areas along this route are described below but eremophilas can be found in most parts of the Great Western Woodlands.

Start by driving down the Coolgardie-Victoria Rocks Road. In this area some 20 species may be seen in a 25-kilometre range. One of the most obvious is narrow-leaved emu bush (*Eremophila alternifolia*). In October and early November the two- to four-metre-high shrubs are covered in large red or pink fuchsia-like flowers. Lower growing but equally attractive is small-leaved spotted emu bush (*E. maculata*



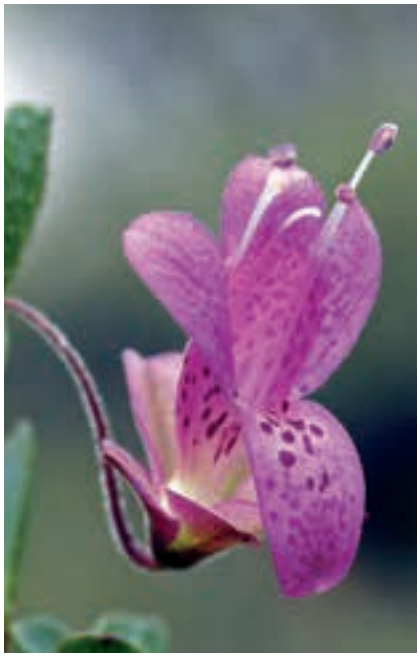












Top left Small-leaved spotted emu bush.

Top right Kalgoorlie eremophila.

Above left Kopi poverty bush.

Above right Purple eremophila.
Photos – Andrew Brown

subsp. *brevifolia*). The 30-centimetre to one-metre-high plants are found scattered in seasonally moist areas, with each plant having slightly different coloured flowers, ranging from red, pink and orange to yellow. This species flowers throughout the year in response to rainfall. Although most *Eremophila* species have flowers that are varying shades of red or blue, there are a few white-flowered species. One of these, white-flowered eremophila (*E. interstans*), has two subspecies which both grow in this area but flower several months apart—the subspecies *interstans* in September and early October and the subspecies *virgata* in November and December.

The geographically restricted veronica-like eremophila (*E. veronica*) is also found along this road. Growing to just eight centimetres high and 60 centimetres wide, it forms low thickets in open eucalypt woodland. Its flowers, which appear in October and November, have an unusually short corolla with spreading lobes. Another low-growing species that occurs here is blue-flowered eremophila (*E. caerulea* subsp. *caerulea*). It produces very attractive blue or violet flowers in October.

Turn back to Coolgardie and then travel south down the Goldfields Highway towards Norseman. Even when travelling at 110 kilometres per hour you cannot help seeing the attractive blue flowers of violet-flowered eremophila (*E. ionantha*) which often grows in thickets and is at its best in October. Stop to look around and you will be astounded by the number of *Eremophila* species that you will find. These may include wrinkled-leaved eremophila (*E. caperata*), common emu bush (*E. glabra* subsp. *glabra*) and narrow-leaved pixie bush (*E. oldfieldii* subsp. *angustifolia*). One of my favorites is smooth calyx eremophila (*E. psilocalyx*) which grows to three metres high and has numerous white, pink, blue or pale purple flowers in September and October. An undescribed species which grows on the tops and upper slopes of low rocky hills and flowers at the same time of year is Kalgoorlie eremophila (*E.* sp. 'Kalgoorlie'). It was first discovered in 1996 and has since been found in scattered localities between Norseman and Mount Jackson. Plants grow to three metres high and have pinkish-mauve tubular flowers with yellow throats.

Travelling further south, turn west onto the Hyden-Norseman Road and cross Lake Cowan. Growing on sandy rises above the lake bed is one of WA's most attractive tree *Eremophilas*, kopi poverty bush (*E. miniata*). The species grows to five metres high and in October is covered in large pink, orange or yellow flowers. On the other side of the lake system you will begin seeing many other *Eremophila* species. At the lookout on the western side of the lake you will find the attractive purple or pink, prominently spotted flowers of purple eremophila (*E. purpurascens*) which grows to 1.5 metres high and has unusual warty leaves. Nearby is willowy eremophila (*E. saligna*), a narrow shrub to four







Above left The Great Western Woodlands is well known for its eucalypts.
Photo – Marie Lochman

Top Pink candy orchid.

Above Sugar orchid.
Photos – Andrew Brown

metres high, which produces unusual tubular creamy-white flowers in groups of two or three in October and November. A little further west you will spot the low growing club-leaved eremophila (*E. clavata*), one of the most common inhabitants of tall woodland areas. In good seasons, in October and November, the plants are covered in purple or mauve flowers. Wrinkled-branched eremophila (*E. rugosa*) and broom bush (*E. scoparia*) also grow along this road.

Orchids

Orchids comprise some 28 genera and 394 species in WA, with most species endemic. All orchids of the Great Western Woodlands are summer dormant, resprouting from an underground fleshy tuber in autumn. Most flower in August and September, although a few species continue into October and early November.

Some 13 genera and 56 species have been recorded from the Great Western Woodlands, a remarkable number given how little rainfall occurs over much of its area. Although a few of these orchids have adapted to woodland and shrubland habitats they are predominantly found in association with granite outcrops and other rocky areas. In these places water collects following intermittent, rare rainfall and the soil stays moist longer than in the surrounding woodlands.

Orchids can sometimes be common, with several species growing in colonies that may number hundreds of flowering plants. One of these is the hairy snail orchid (*Pterostylis* sp. 'hairy') which is common on granite outcrops. Almost as common is granite donkey orchid (*Diuris* sp. 'granite') which forms dense colonies up to two metres across. Its bright yellow flowers are easily distinguished against the grey-coloured granite and green native vegetation among which it grows. Both species are at their best in August.

A good range of orchids can be seen during a one- or two-day drive, starting at Coolgardie and finishing at Lake King. Make your first stop Victoria Rocks south of Coolgardie, where in August and September you will find the lovely green and yellow-flowered clown orchid (*Caladenia roei*). The species often grows in clumps of up to five or more flowering plants and is sometimes quite common. Also



Above Peak Charles National Park provides an opportunity to see more than 30 species of orchid.
Photo – Jiri Lochman

Right Sigmoid spider orchid.
Photo – Andrew Brown



flowering at this time is the yellow-flowered vanilla orchid (*Thelymitra antennifera*) which forms colonies in moist soil pockets and the blue-flowered plain sun orchid (*T. petrophila*) which grows as scattered individuals all over the rock. Occasionally these two species hybridise to form attractive orange or red-flowered offspring.

Another good area to search for orchids is McPherson Rock on the Goldfields Highway south of Norseman. Growing in the shallow soil pockets is a range of orchid species, one of the most common being the previously mentioned granite donkey orchid, which is at its best in August. Several spider orchids are also found here and include the western wispy spider orchid (*C. microchila*) and sigmoid spider orchid (*C. sigmoidea*). Both flower in late August and early September. Also flowering at this time is the diminutive little laughing leek orchid (*Prasophyllum gracile*), while in late October you may find the unusual elbow orchid (*Spiculaea ciliata*).

One of my favorite areas to see orchids is Peak Charles National Park. More than 30 species are found there, most growing in shallow soil pockets on the lower slopes of the rock and in deeper soils around its base. The pink candy orchid (*C. hirta* subsp. *rosea*) is common, as is the dwarf zebra orchid (*C. pachychila*), both flowering in August and September. In seasons of good rainfall the rare, currently undescribed granite mantis orchid (*C. attingens* subsp. 'granite') can be found just a short walk from the parking area. The species is known from just three other granite outcrops.

More common is the sugar orchid (*Ericksonella saccharata*). Its small white flowers are often abundant in late August and September. Many *Pterostylis* species are found here and include the shy greenhood (*P. allantoidea*) which grows in small colonies and the midget greenhood (*P. mutica*) which is scattered in a range of habitats. Both species flower in September. Several members of the *P. rufa* complex are also found here and include the spoon-lipped rufous greenhood (*P. spathulata*) and the rufous greenhood (*P. roensis*). The rufous greenhoods flower later than most other orchids, reaching their peak in October.

Native lilies

Often called early nancies or native lilies, *Wurmbea* species are members of the Colchicaceae family which also includes the common Western Australian genus *Burchardia*. Some 52 species of *Wurmbea* are found in WA, most of which are endemic to the state. The majority are unnamed, having been discovered only recently.

All *Wurmbea* species have an underground corm which is dormant over summer. Plants resprout following autumn rainfall, with most species flowering in winter.



Above Wurmbea sp. 'Dundas'.

Right Granite nancy.
Photos – Andrew Brown

'*Wurmbea* species often inhabit the same areas as orchids and it is not unusual to come across them when searching for orchids. The most common species in the Great Western Woodlands is eight nancy (*W. tenella*). Its small white and purple or pink-mauve flowers can be seen in moist situations in many habitats but are most abundant in soil pockets on granite outcrops. Look on any outcrop in the Great Western Woodlands between late July and early August and you will almost certainly find it.

Another species to look out for is granite nancy (*W. graniticola*), which is only found on granite outcrops. This species, which has gracefully up-curved petals, is abundant in seepage areas on the slopes of Disappointment Rock and around its base in mid August. The form found here has colourful pink-mauve and white flowers rather than the all-white flowers found elsewhere.

In 2004, while walking over a granite outcrop south-west of Norseman, I was surprised to find the small, but attractive, pure white flowers of what appeared to be an undescribed species of *Wurmbea*. Following further surveys in 2009 the taxon, now known as *Wurmbea* sp. 'Dundas', was found to be common on other granite outcrops in the same general area and was confirmed as being new. A good place to see it is on McPherson Rock, where it flowers in abundance in early August.

There are several other native lilies found in the Great Western Woodlands and these include the dainty nancy (*W. cernua*) and the southern nancy (*W. sinora*).

This is just a glimpse of three groups of plants that are dear to my heart. However, there are many more wildflowers in the Great Western Woodlands and there is nearly always something in flower, regardless of when you visit. If the opportunity arises, take the time to explore some of the places highlighted, or stop at random in the Great Western Woodlands and you will be astounded at the range and diversity of its native flora.



Andrew Brown is a botanist in the Department of Environment and Conservation's (DEC's) Species and Communities Branch and a research associate at the Western Australian Herbarium. He is principally involved in helping coordinate DEC's conservation and management of WA's threatened flora. He is the author of several books on WA orchids and co-author of *A Field Guide to the Eremophilas of Western Australia* and *Western Australia's Threatened flora*. Together with Stephen Hopper, Director of the Royal Botanic Gardens, Kew, Andrew has named more than 120 new orchid taxa for WA. He can be contacted on (08) 9334 0122 or by email (andrew.brown@dec.wa.gov.au).

Refuge in refuse



Human impact on our oceans is enormous. Although many measures are being taken to lessen the amount and effects of our pollution, the burden on our marine ecosystems is ever increasing.

Yet in this sea of debris, a number of plants and animals have found methods to use our rubbish and even to thrive in it.

by Ann Storrie

Floating islands of debris now cover massive areas of our oceans. Fishing lines and nets may float for years until they finally wind around coral reefs or wash up on the shore. During their journey, they entangle thousands of animals including fish, whales, dolphins, turtles and seabirds. Plastics that take hundreds of years to decompose leach toxic chemicals into the water. Tiny balls of plastic resin are mistakenly thought to be fish eggs. These and their fragmented particles are consumed by everything from the smallest crustaceans to marine mammals. Turtles and fish mistake plastic bags for jellyfish and whales mistake them for squid. Seabirds feed all kinds of plastic to their chicks and even adults consume it while feeding on natural foods. After the tsunami that affected Japan in 2011, hundreds of kilometres of debris covered the surface of the Pacific Ocean. Parts of vehicles, fences, sheds and even entire houses floated and caused havoc, not only to marine life, but also in shipping lanes where they entangled propellers and blocked ships' paths. Floating marine debris is now more common than driftwood.



Previous page
Sabretooth blenny emerging from a bottle.
Photo – Shannon Conway

Left Floating refuse.

Below Plastic bags are often mistaken for food by sea animals and birds.
Photos – Ann Storrie

Surviving on the surface

Marine plants and animals have always colonised and used driftwood. Micro-organisms and marine worms bore into the wood, while encrusting invertebrates such as bryozoans and sponges attach and grow on its surface. Many of these animals have adapted to live in and on the floating waste. Pick up a piece of debris that has been afloat in the ocean for a few months and it will be covered in algae and marine animals. Many of these creatures are minute, others are very visible.

One group of crustaceans, the barnacles, has very successfully adapted to life in the intertidal zones, living on rocks and reefs on the shoreline, or cemented onto ships' hulls and floating debris. Several species of these strange creatures can attach themselves to almost any surface. They belong to the same phylum as crabs and shrimps, although as adults barnacles look more like molluscs with a hard shell and a valve at the top. It is in their larval stage that their resemblance to crustaceans is more obvious. Barnacle larvae are free-swimming and similar to the larvae of several other crustacean groups. After numerous moults, the larvae settle on a hard surface and their bodies and limbs change dramatically. Their jointed legs become feathery feeding tentacles known as 'cirri', their





Right Goose barnacles on a boat keel.
Photo – Ann Storrie



Below right False Tasmanian blenny on HMAS *Swan*.
Photo – Tammy Gibbs

external skeleton becomes a series of hard plates and their head disappears. To add to this queer transformation, cement glands near the head secrete one of the strongest adhesives known to man. In fact, during the 1960s, the National Institute of Dental Research in America investigated the properties of barnacle cement with the possibility of using it for filling teeth! It is almost impossible to pull a live barnacle from its attachment point. The barnacle feeds with its feathery cirri that protrude from a slit-like opening between the top plates. They scoop the water, straining plankton and transferring it into an upturned 'mouth'. If exposed to air, the top opening closes tightly, enabling the barnacles to survive for several hours out of the water, some even surviving in direct sunlight. The most common barnacles that live on driftwood and refuse are the stalked or goose-necked barnacles.

Bivalve molluscs such as clams, oysters and mussels are also found on floating debris. Their shells (often referred to as valves) are joined by a flexible ligament and are hinged. They usually have interlocking teeth and pits that provide very efficient closure of the shell, enabling them to survive prolonged periods out of the water. Some burrowing species have long siphons for the entry and exit of sea water, enabling them to live several centimetres inside a jetty pile or piece of driftwood.

Tiny tubeworms vie for space among the barnacles and molluscs. *Hydroides elegans* is not a particularly elegant worm and all that can be seen is a tiny, pale, limy tube. In fact, you would probably never see it at all if not for the fact that they live in groups of hundreds and look like lifeless droppings left by a larger marine creature. A closer inspection reveals masses of straight or twisted



Left Crinoids, sponges and algae occupy an old pipe.
Photo – Ann Storrie

tubes with a pair of long tentacles protruding from the end. These, plus several other species of tube worm, are common fouling organisms of boats. They can attach and grow on most metals, wood and even hard plastic. Their waving tentacles trap plankton, which is transferred to the animal's mouth and body that is encased in the tube and is never seen unless the tube is broken.

Many fish, crustaceans and other creatures live and drift in floating debris for shelter and protection from predators. The sargassum fish (*Histrio histrio*) now floats in the weed combined with rubbish. It is an odd-looking fish that is a member of the anglerfish family. Its pelvic and pectoral fins are modified into finger-like projections used for 'walking' and holding onto the weed. Its patterns and colours blend in beautifully with both the sargassum and the rubbish around it. As with other species of anglerfish, it has a lure, called an 'esca', protruding on an appendage above its mouth. Like bait on the end of a fishing rod, the esca is wriggled to attract small fish. As these come close to the bait, the sargassum fish ingests them in a split second simply by opening its enormous mouth and allowing the pressure difference to suck in water and fish.

Several other species of fish use marine refuse as hiding places, while crustaceans such as crabs and shrimps hitch rides on refuse, or float along under refuse for protection. Their larvae, together with myriads of other microscopic animals that make up zooplankton and plants that form the phytoplankton, are taken along with the debris in the major currents of the oceans. These plants and animals provide food for larger invertebrates such as jellyfish, comb jellies (ctenophores) and blue bottles, or Portuguese man-o-war (*Physalia utriculus*), which in turn are preyed upon by turtles and pelagic (open ocean) fish. Seabirds may be drawn to these floating islands to hunt and to rest on a solid surface in the middle of a long flight across the ocean. The whole floating rubbish dump ends up with an ecosystem of its own. However, if you add oil slick and chemical pollutants to the mix, the strange habitat may be very dangerous to those who try to reside there.

Bottles and beer cans for benthic dwellers

Benthic animals are marine creatures that live on the bottom of the ocean, in contrast to pelagic animals that spend their lives swimming in the open water. The bottom can be shallow, on sand, in seagrasses, on reefs, or at the very depths of massive crevasses and in caves. Unfortunately, wherever these animals live, there will now be human refuse.

Most marine debris eventually sinks to the bottom. It is amazing how such items as shopping trolleys, chairs, shovels, road signs, toilets, jumpers and sand shoes can end up at the bottom of the ocean, sometimes many kilometres from shore. Cans and bottles are often the most numerous items and, ironically, they provide shelter and homes for thousands of sea creatures. Small fish such as gobies and blennies usually favour bottles and cans that are dumped in the shallows. They also like old sawn-off pipes such as the railings of ships. The HMAS *Swan,* that was sunk as a dive wreck in Geographe Bay in the state's south-west, has a

Right Blue-ringed octopus commonly use cans for their homes.

Below A gloomy octopus (*Octopus tetricus*) in a pipe.
Photos – Ann Storrie



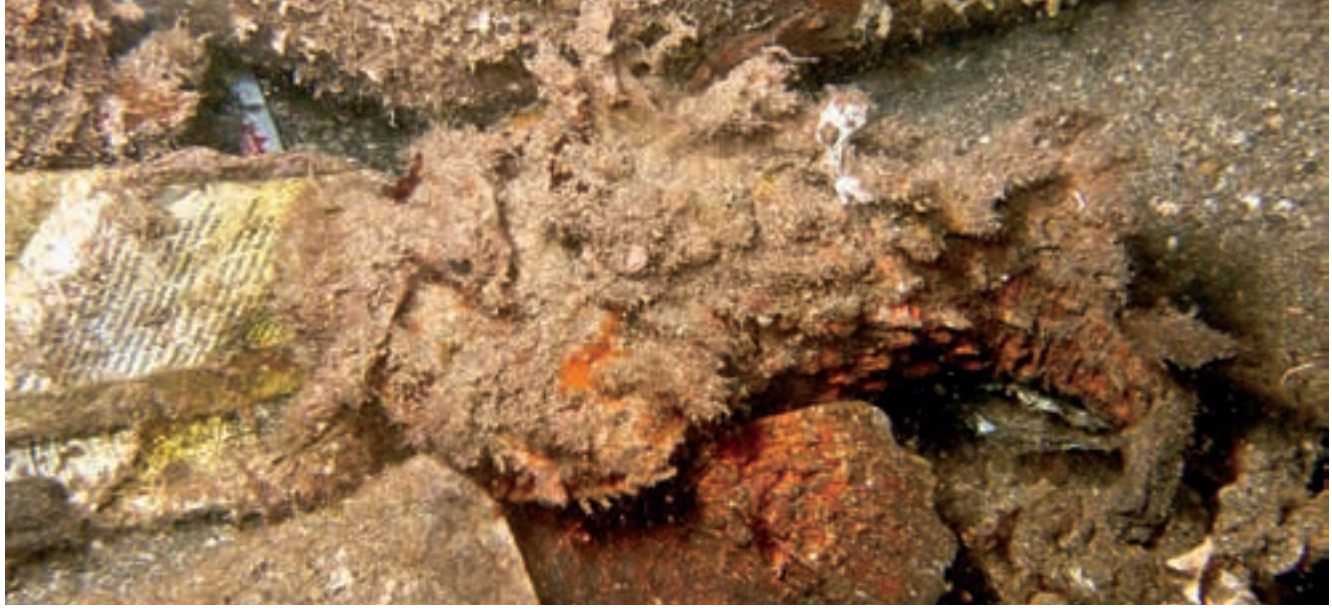
false Tasmanian blenny (*Parablennius postoculomaculatus*) poking out of nearly every piece of railing on the bridge and crows nest. The Busselton Jetty hosts many blennies in the old timbers and empty mussel shells close to the surface. These small fish with attitudes swim backwards into their home, their beady eyes and fluffy antennae protruding from the opening where they keep watch for prey, predators and mates. They perform kamikaze moves, darting out to ward off intruders or to catch prey. The female lays her eggs in and on the male's 'house', leaving the male to guard and aerate them by wafting water over the eggs with its fins.

So frequently does the species use refuse for homes that one almost wonders where a blue-ringed octopus (*Hapalochaena* spp.) would normally live without a can. Both Western Australia's northern and southern species of blue-ringed octopus are surprisingly common, but are not often seen because of their small size, amazing camouflage and secretive habit of hiding in and under rocks and refuse during the day. Their normal colour is brown with pale blue markings. The bright blue rings are only shown when the animal is threatened or disturbed. Female blue-ringed octopus do not use their refuse home for egg attachment as they usually carry their eggs under their arms for about six months. After the eggs hatch the female dies.

Most large octopus make their homes under rocks, reef or refuse. Their lair is often given away by the discarded shells of creatures the octopus has eaten. The shells pile up around the entrance and occasionally an octopus will pull a shell up against the opening or even over itself for camouflage if it is in the open. Octopus are inquisitive of any new piece of debris that might be put to good use. Items such as clothing, bags, shoes, toys and building materials are all possible homes, with old pipes and flower pots particularly in demand.

Pick up any piece of tin or wood from the bottom and there will be a scurry of small creatures racing to hide under the next piece of debris. Bristle worms, flat worms, peanut worms, pebble crabs, spider crabs, shrimps, snails and other molluscs live under the rubble during the day and emerge at night to feed. Echinoderms such as sea urchins, sea stars, sea cucumbers and, occasionally, yellow feather stars (crinoids) may also be hiding under the refuse. If the refuse is solid and relatively stable, you may find eggs attached to it. Brightly coloured coiled, gelatinous ribbons or rosettes consisting of thousands of





Above A stonefish camouflaged among refuse.
Photo – Ann Storrie

Below Jewel anemones on HMAS *Perth.*
Photo – Tammy Gibbs

eggs are laid by nudibranchs (sea slugs), while squid egg capsules are white and cylindrical. Each capsule contains several eggs. Cuttlefish lay individual, pale eggs in bunches.

Sedentary invertebrates such as sponges, bryozoans and ascidians (sea squirts) quickly grow on many of these hard objects. They form a thin layer over the surface and are known as encrusting invertebrates. All are filter feeders, drawing water into their cells and extracting nutrients. Sponges are renowned for filtering bacteria and organic particles from the water and releasing the 'purified' water back into the environment. A bryozoan colony is made up of many tiny animals called zooids. There are more than 5,000 species of bryozoans, yet most are mistaken for corals, sponges or algae due to their many different forms that range in appearance from lacy corals to fluffy tufts of algae. The encrusting forms are usually the first animals to grow on hard surfaces and will coat timber and metal very quickly. They play an important role in the ecology of the environment as many species of mollusc, crustacean and sea spider feed solely on bryozoans. Encrusting ascidians are also mistaken for other animals, especially sponges. Ascidians, however, have a rudimentary nervous system and distinct organs and respond to stimuli by closing their siphons. Sponges do not. Encrusting ascidians are composed of many animals that have their own inlet siphons, but sometimes share larger outlet siphons.

It is no wonder that we have created artificial reefs to attract this bevy of marine life. Ships such as the HMAS *Swan* and HMAS *Perth* (following being stripped of all wiring and loose fittings, having oil removed and being scrubbed spotless) have been sunk and have created a haven for thousands of invertebrates and fish that would normally not be found on the otherwise bare sand. Old tyres and dinghies have been sunk along dive trails to provide a vibrant community of marine life to interest divers. Jetties, oil rigs, shipping markers, in fact almost anything that we build in the ocean is colonised very quickly by all manner of marine life. Even mooring ropes provide anchorage for many animals, including the Western Australian sea horse (*Hippolampus subelongatus*) that is a favourite of divers in the Swan River. So next time, when on a clean-up day in the ocean, spare a thought for the animals that are living on the refuse. By all means pick up plastic, nets, fishing lines and other rubbish, but please check those bottles and cans for little blue rings before stuffing them into your goody bag.



Ann Storrie has written and contributed photographs to several Department of Environment and Conservation books and countless *LANDSCOPE* articles. She can be contacted by email (naturescapes.au@hotmail.com).



Outdoor university:

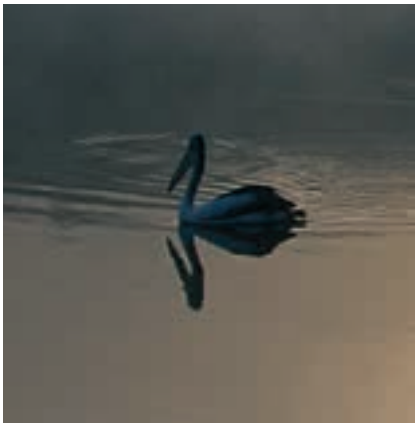
environmental education in the Walpole and Nornalup Inlets Marine Park

A successful collaboration between the Department of Environment and Conservation and Edith Cowan University is providing invaluable learning opportunities for students and contributing important data towards the management of one of Western Australia's precious marine parks.

by Alan Kendrick and Glenn Hyndes

Many people would be familiar with the diverse ecological and recreational values that make Western Australia's marine parks and reserves important areas for preserving biodiversity and providing great outdoors experiences for visitors. However, it's less well known that these marine reserves also have significant educational value. An example of this is taking place at the Walpole and Nornalup Inlets Marine Park on WA's south coast, a popular recreational destination that is justifiably famous for its scenery, wildlife and wilderness. It is one of south-western WA's most intact estuarine systems that has not been significantly degraded by catchment impacts or adjacent development, which makes it an ideal location for teaching about the environment. This value is further enhanced by the area's accessibility from Perth on sealed roads, its close proximity to local accommodation and town facilities, and the small size of the inlets that enable safe water-based work to occur in most weather conditions.





A long-standing collaboration

Glenn Hyndes and Paul Lavery from Edith Cowan University's (ECU's) School of Natural Sciences in Perth share a long ecological research association with the Walpole and Nornalup inlets. Since 2003, they have also collaborated with the Department of Environment and Conservation (DEC) to use the inlets as a living lecture theatre and laboratory where undergraduate students studying coastal and marine management can learn about estuarine ecology and how WA's marine parks and reserves are managed. Before the creation of the marine park in 2009, students collected data and compiled maps of benthic habitats and riparian vegetation that were used in the reserve planning process, and formed the basis for the published maps in the current marine park management plan which are still used by DEC.

Recently, this program has become a more structured collaboration, with DEC marine scientists and local operational staff assisting in student teaching, and the university staff and students working alongside them on research projects. Following university-based lectures and tutorials about marine reserve management and how to conduct marine biological surveys and monitoring, the students spend a week at Walpole where they undertake fieldwork, process the samples they collect in a temporary laboratory, and then analyse and interpret the results in relation to marine park management. On the final evening, students present their work to their colleagues and ECU and DEC staff before compiling the information into a report as part of their course assessment. For the ECU lecturers, the collaboration with DEC provides their students with an experience that translates university-



Previous page
Main Walpole and Nornalup Inlets Marine Park.

Above A pelican at dawn in the marine park.
Photos – Brett Dennis/Lochman Transparencies

Left ECU students sampling bivalves in the marine park.
Photo – Alan Kendrick



based lectures into 'real world' learning that ranges widely, from collecting field samples in sometimes cold, wet and windy conditions to identifying animal species, interpreting data and making presentations. The data collected by the students are then passed to DEC's Marine Science Program, adding to the knowledge gleaned during previous camps.

Gaining information on bivalve communities

Most recently, the ECU students have worked on DEC research examining benthic invertebrate communities in the marine park as part of a long-term program to increase ecological knowledge of the reserve and assist with monitoring its important natural features. As part of this project, the students have assisted DEC with surveys of the abundance and distribution of large bivalve molluscs across the marine park's extensive shallow sand flats. Conducted over a few years, the surveys have found that the sunset shell (*Soletellina biradiata*) is the most abundant and widespread of these species, while other bivalves, such *Wallucina assimilis*, occur mostly at particular locations within the marine park. Notably, the cockle *Katelysia scalarina* has consistently occurred in low numbers despite anecdotal evidence that this species was once very abundant in the inlets.

The Walpole and Nornalup Inlets Marine Park field camp always receives extremely positive feedback from the students, partly because they enjoy working outdoors in the natural environment, but also because they are aware that their work contributes directly to managing the marine park. Moreover, the collaboration between ECU and DEC is a great example of the benefits of education, research and management organisations working together to improve our knowledge and management of the marine environment, while also providing a realistic and meaningful educational experience.



Top ECU students sampling fish.
Photo – Glen Hyndes

Above Forest overlooking the inlet shrouded in mist.
Photos – Brett Dennis/Lochman Transparencies



Right ECU students with marine park ranger Justin Ettridge on DEC's vessel *Osprey*.
Photo – Glen Hyndes

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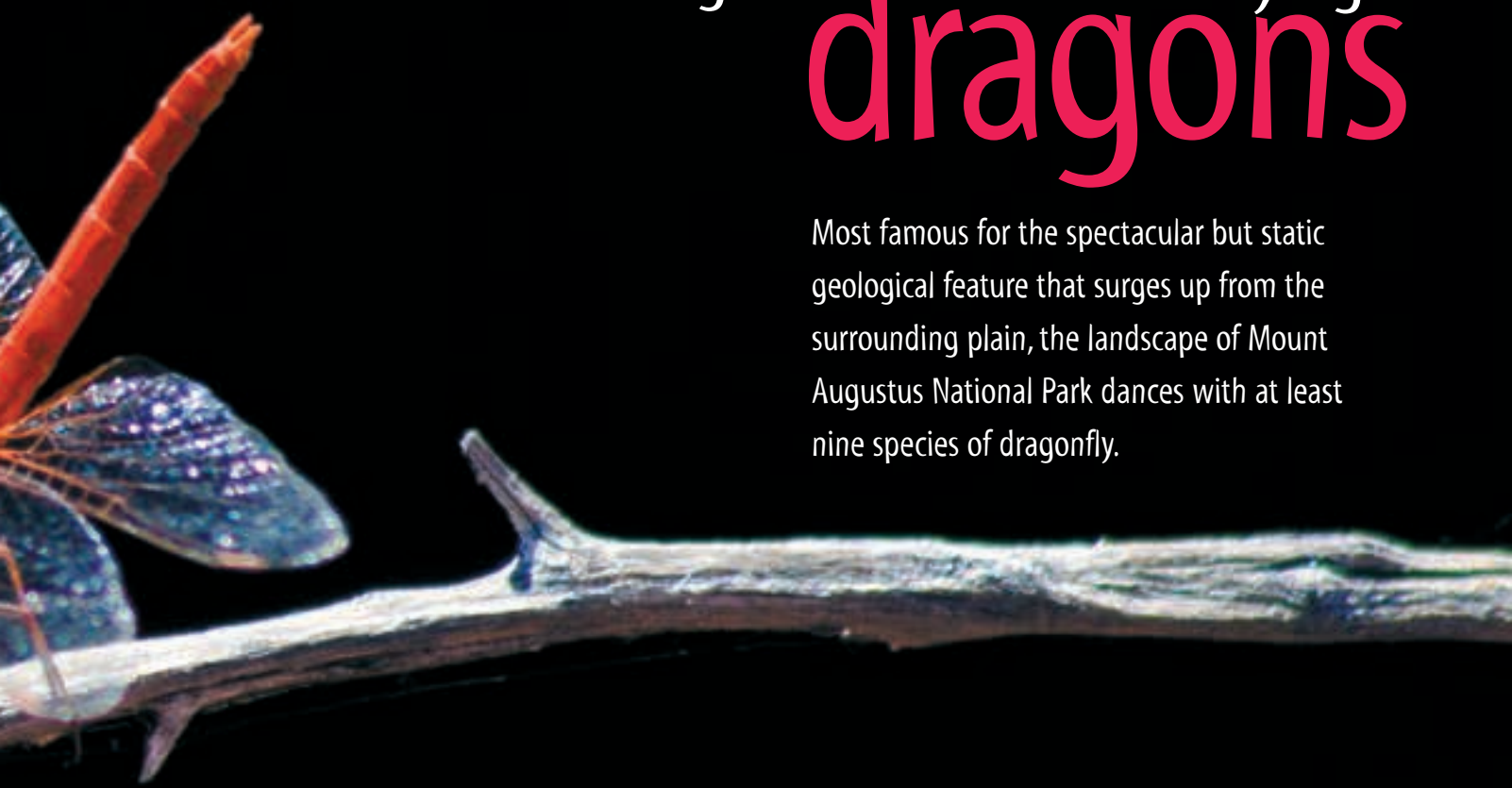
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Mount Augustus: home of the flying dragons



Most famous for the spectacular but static geological feature that surges up from the surrounding plain, the landscape of Mount Augustus National Park dances with at least nine species of dragonfly.

words and photos by Janine Guenther

About 430 kilometres north-east of Carnarvon, in the magnificent Gascoyne region, an extraordinary monadnock rises amid the colourful composition of red earth, green acacia scrubland and blue sky. To the traditional owners, the Wajarri, this mountain has been known as Burringurrah for countless generations. Since 31 May 1858, when the explorer Francis Thomas Gregory became the first European to sight the mountain, it has also been known as Mount Augustus. In 1989 this monumental monadnock and a small stretch of acacia scrubland surrounding it were declared a national park.

With its sparsely vegetated flanks made of orange-brown sandstone, its ancient rock art galleries and its lofty summit towering 715 metres above the surrounding plain, the mountain is, without doubt, an attraction in its own right. However, the rock is remarkable not only for its natural beauty and cultural treasures but also for being a haven for wildlife. Among the animals that can be encountered are many typical representatives of the semi-arid outback region, such as euros (*Macropus robustus*), echidnas (*Tachyglossus aculeatus*), dingos (*Canis lupus dingo*), Gould's goannas (*Varanus gouldii*), ring-tailed dragons (*Ctenophorus caudicinctus*) and more than 100 bird species. Perhaps surprisingly, the park is also home to some creatures that are not readily associated with a hot and arid environment—creatures so intriguing that they alone would be worth a trip to this remote national park: dragonflies.



Previous page
The vibrant colour of the scarlet percher makes it one of the most conspicuous dragonfly residents of Mount Augustus National Park.

Below left Edney Spring.

Designed by nature

Dragonflies belong to the order Odonata which also comprises the smaller, more slender-built damselflies. The word Odonata derives from the Greek word for tooth and refers to the teeth found on the mandibles of all members of this order.

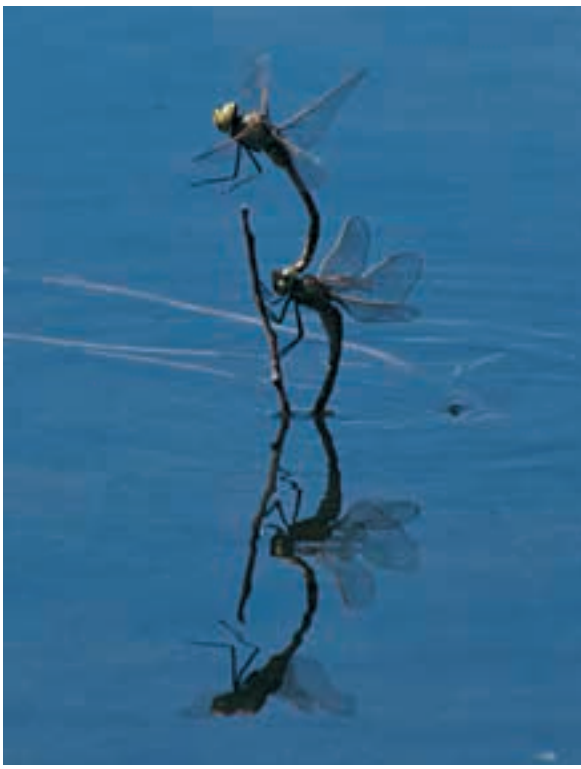
The body of a dragonfly is, like the body of all insects, divided into three main parts: the head, the thorax, to which legs and wings are attached, and the abdomen, which is made of 10 segments. The most striking physical feature of the dragonfly is the head which is almost completely covered by two large compound eyes. These eyes are composed of many closely packed facets, called ommatidia. Each ommatidium captures a tiny fragment of the overall picture and the higher the number of ommatidia, the more accurate the vision. In dragonflies, each eye consists of up to 28,000 ommatidia—a number unrivalled in the insect world—providing sharp 360-degree vision. In addition to these highly efficient eyes, all members of Odonata are characterised by three simple but extremely light-sensitive eyes positioned at the front of the head, called ocelli. Although only single-lensed, the ocelli serve an important function as they assist the animal to control its flight path by determining the position of the horizon.



No less remarkable than the two sets of eyes are the two pairs of large wings. The two pairs differ slightly in size and shape and are put into motion by powerful flight muscles which enable the dragonfly to fly long distances and even to migrate over hundreds of kilometres. In contrast to many other insects, dragonflies can not only move their wings in unison but are also able to beat them independently. This accounts for their remarkable aerial agility. They can switch into different 'flight modes' simply by altering wing movements and stroke angles.

The wings of most species are translucent, except for a delicate network of veins. A closer look at this seemingly uniform network reveals a few anomalies. The most obvious is a dark spot near each wing-tip known as a pterostigma. These marks are pigmented cells which are believed to reduce wing flutter during gliding by acting as counterweights. In some species, the leading vein, known as the costa, is also distinctively coloured and can therefore provide a valuable clue for identification. This is helpful as the





Above left Goolinee, also known as Cattle Pool, is one of two permanent waterholes in Mount Augustus National Park.

Above An Australian emperor pair during oviposition, or egg laying.

often-similar appearance of Australia's 324 described species of flying dragons—including 113 species of damselflies—can make identification a challenge.

Meet the locals

Although no biological survey has been conducted at Mount Augustus, the national park is known to support at least nine species of dragonfly. The star among these whizzing flashes of colour is the scarlet percher (*Diplacodes haematodes*). With a body length of 3.5 centimetres and a wingspan of only six centimetres, it is by no means the biggest species in the region, but, due to its bright red colour, is undoubtedly one of the most conspicuous. However, as is so often the case in the animal kingdom, only the males are strikingly coloured; the female is a rather pale yellowish-green. In other respects both sexes live up to their name as this species frequently perches on rocks, grasses and branches close to the ground and water. This behaviour is typical for all five Australian members of the genus *Diplacodes*, including the wandering percher (*D. bipunctata*) which is also a resident in the park. The wandering percher is smaller in size and not so brilliantly coloured. It also differs from its showy cousin by having black markings on the abdomen.

Another eye-catcher at Mount Augustus is the narrow-lobed glider (*Tramea stenoloba*). Whereas the majority of species have translucent wings, the wings of this dragonfly are partly coloured. Although the colouration is restricted to the base of the wing, the narrow-lobed glider clearly stands out from the other species. The males are orange-brown to red with equally coloured wing patches, and the females are of a yellowish colour with brown wing patches. With wingspans of up to 11 centimetres, the narrow-lobed glider is significantly bigger than the scarlet percher.

Being the only bluish-coloured dragonfly in the park, the blue skimmer (*Orthetrum caledonicum*) can also be easily identified. The intense colour is typical only for mature adults. Young males are much paler, while females change colour with age from yellow and black to bluish-grey. This common dragonfly can grow to a body length of 4.5 centimetres and is widespread throughout Australia. Of similar size is a rose-coloured relative which can also be frequently seen, the rosy skimmer (*O. migratum*).

Size is the most striking feature of the Australian emperor (*Hemianax papuensis*). It is the largest species in the park and one of the largest in Australia, reaching body lengths of up to seven centimetres and wingspans of 13 centimetres. The leading vein of the wings is a distinctive yellow colour and the abdomen is patterned with yellow and black. Similar patterns and colours characterise the three remaining species: the Pilbara tiger (*Ictinogomphus dobsoni*) and two representatives of the genus *Hemicordulia*, the Pilbara emerald (*H. koomina*) and the tau emerald (*H. tau*).

Water means life

Mount Augustus National Park incorporates two permanent waterholes which provide an ideal environment and breeding ground for dragonflies: the small freshwater spring Edney Spring, located in a picturesque gully at the foot of the mountain, and a large waterhole on the Lyons River called Goolinee, also known as Cattle Pool, about two kilometres north of the mountain. After heavy rain, which usually occurs during the summer months, several semi-permanent







Above Mount Augustus the famed mondanock of the national park.

Left A narrow-lobed glider.

Below left Blue skimmer.

waterholes create additional habitat for a thriving population of dragonflies.

Water plays an essential role in the life cycle of dragonflies. Not only are these magnificent insects dependent on water for reproduction but they also spend most of their lives submerged. The life of a dragonfly is divided into three stages: egg, larva (also known as nymph) and adult. The first two stages are aquatic and, depending on the species, can last up to several years. Eggs are laid into water, by either dropping them directly into it or inserting them into plant tissue. Once hatched, the nymphs become aggressive hunters that prey on aquatic invertebrates, small tadpoles and other larvae, particularly those of mosquitoes. Equipped with internal gills, the nymphs do not need to surface to breathe. Oxygen is absorbed from water pumped through the gills that are located at the end of the abdomen. The water is drawn in and expelled through the anus. This way of breathing has a positive side effect. Water squirted out through the anus can be used as a jet propulsion, enabling the nymph to move quickly forward without using its legs.



Right A pair of Australian emperor dragonflies during oviposition.

The growing nymphs moult frequently, in some species more than a dozen times. When fully developed and ready for its last moult, the nymph leaves the water, crawls up a stick or leaf and flicks its body until the back of the skin splits open. Very slowly the winged adult emerges. Body fluids are pumped into the thorax, legs, abdomen and, finally, into the wings, causing them to swell, expand and harden. It can take several hours before the wings are hard enough for flying. Only then can the dragonfly take off for its maiden flight.

Life as an adult

Once the dragonfly has shed its nymphal skin, it enters the last stage of its life which is comparably short—on average only a few months. At the beginning of their adult stage, all dragonflies are pale yellowish to green. Their body is soft as it can take up to two days before the exoskeleton, the external skeleton, is fully hardened. While hardening, their species-specific pigmentation develops.

It takes another few days or, in some species, up to several weeks to reach sexual maturity. To avoid encounters with aggressive, sexually mature males, immature dragonflies stay away from the water until they are ready to mate and face their rivals.

Like the nymphs, the adults are ferocious predators that feed mostly on other insects, including mosquitoes, flies, butterflies and wasps. Prey is caught and devoured in flight. Only larger prey is eaten while perching. Quite often, however, the skilful hunter becomes the hunted. During all their life stages, dragonflies are highly susceptible to predation. Eggs and nymphs are preyed on by fish, frogs and other predatory insects, while the adults have to be on the look out for birds such as Australian kestrels (*Falco cenchroides*) and rainbow bee-eaters (*Merops ornatus*). They also have to keep their compound eyes open for spider webs, especially for the strong webs made by golden orb spiders of the genus *Nephila* and those of long-jawed spiders of the genus *Tetragnatha* which are commonly built close to the water. Once entangled in a web, there is usually no escape—at least not for smaller dragonflies.

For those who survive until they reach maturity, it becomes time to return to the water. While the males of non-territorial species fly up and down the water bodies to 'hunt' for females, the males of most species select a territory and secure a suitable breeding ground where they wait for receptive females. It is within the borders of these territories that the most exciting air shows take place.

Acrobats of the air

Few insects are more captivating and more challenging to watch than dragonflies. They are not only extremely fast flyers, with some species reaching up to 60 kilometres per hour, but they are also among the most manoeuvrable insects in the world. Dragonflies are able to fly backwards, shift sidewards, move up and down like

Identifying dragonflies

It is not only colour and size that help to distinguish between the species but also their behaviour during oviposition. The keen observer will note at least four different behaviour patterns.

Scarlet perchers remain in tandem during the entire egg-laying process. Together they flit across the water's surface until they suddenly swoop down for a fraction of a second while the female dips the tip of its abdomen into the water and deposits the first batch of eggs. This procedure is repeated frequently and performed at such a high speed that one can hardly follow it with one's eyes—let alone with the camera.

Male and female of the narrow-lobed glider also stay together until oviposition is completed. However, they do not stay physically attached all the time. Just before the female is ready to lay eggs, the male opens its claspers and lets the female go. During egg-laying, the male hovers above the female to recapture it the moment the female has finished.

The Australian emperor differs from most other species in that the female does not lay the eggs directly into water. Instead, the eggs are inserted into plant tissue, which is cut open by the female's knife-like ovipositor, a structure at the end of its abdomen specifically designed to cut into plants and lay eggs. This ovipostion strategy is typical of all members of the family Aeshnidae which in Australia is represented by seven genera, comprising 13 species.

The male of the blue skimmer does not guard the egg-laying process but separates from the female after mating. The female can be watched flying close to the water's surface, dipping the tip of its abdomen repeatedly into the water.



Right Narrow-lobed glider.



Below right A blue skimmer pair mating in the wheel position.

helicopters, glide motionless, swoop down like kookaburras and hover like hummingbirds. Sudden changes of direction and speed in mid air are also mastered effortlessly. This makes it very pleasing—but also quite difficult—to watch these unpredictable and restless acrobats of the air. However, it is during the mating season that the acrobats show what they are really made of.

The male dragonfly not only possesses two sets of eyes and wings but also two sets of genitalia: a primary set near the tip of the abdomen to produce sperm, and a secondary set closer to the thorax that is used to insert the sperm into the female. Before a male can mate with a female, it must move the sperm produced in the primary set to the secondary set. This is achieved by curling the abdomen so that the two sets of genitalia touch.

Once this first acrobatic stunt has been accomplished—which either takes place in flight or while perching—the male literally swoops down on the next female entering its territory or, in non-territorial species, the next female in sight. The males of most species are anything but gentlemen and do not waste time and energy with extravagant courtship displays. Instead, they firmly grab the female at the back of the head with their claw-like abdominal appendages, called under claspers. Made of formidable spines and hooks, under the magnifying glass, claspers resemble medieval torture instruments and, indeed, can scratch or sometimes even punch holes into the head and eyes of the female.

Male and female stay hooked together in a tandem position for the rest of the mating process and, depending on the species, also during egg-laying. Contrary to popular belief they do not mate while flying in tandem. Copulation takes place in a wheel position while the receptive female bends its body until it touches the male's secondary set of genitalia, enabling the male to insert its penis. Interestingly, the penises of dragonflies are not only designed to introduce sperm but also to remove it—namely the sperm of predecessors. There is a high competition between males for females and it is not uncommon for males to try to capture newly fertilised females in order to remove the sperm of a rival. For this reason, the males of many species guard the females or even stay with them in tandem until all eggs are laid. The egg-laying process, known as oviposition, starts immediately after mating. With the first eggs laid into water, the life cycle starts again and a new generation of dragonflies grows up to continue to intrigue visitors to Mount Augustus National Park.

Janine Guenther has visited Australia many times from her home country Germany, accumulating more than five years' residence in Australia, much of which has been spent in outback Western Australia. She joined the Department of Environment and Conservation (DEC) campground host program and spent time in Mount Augustus National Park in 2008 and 2011. Janine can be contacted by email (j.guenther@verlag360grad.com).

The author would like to thank Jan Taylor from the Western Australian Insect Study Society Inc who helped with the identification of some species.

A new title in DEC's Discovering Book series Discovering Mount Augustus National Park*—also authored by Janine—details the history, geology, walk trails and common plants and animals of Mount Augustus National Park. This can be purchased using the order form in this magazine or at www.dec.wa.gov.au/shop.*



endangered

by Melinda Moir



Vesk's plant-louse

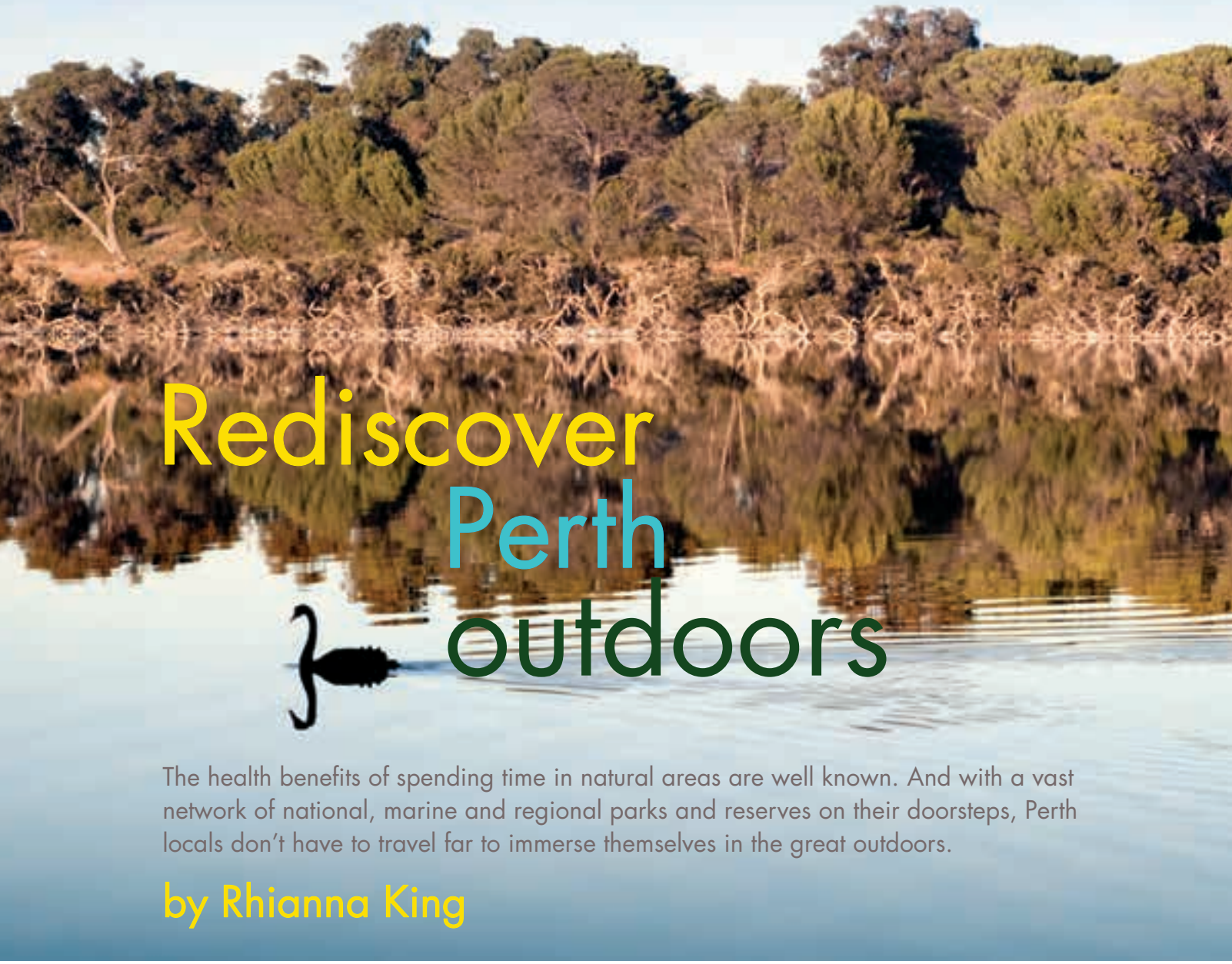
Vesk's plant-louse (*Acizzia veski*), described in 2009 by Gary Taylor and myself, is an attractive bright orange with distinctive chocolate-brown markings. The delicate and species-unique patterns present on the adult wings and body of plant-lice somewhat compensates for their unflattering name, which probably stems from the nymphs looking like lice to the untrained eye, and from their very small size; Vesk's plant-louse is relatively large at 3.5 millimetres.

All plant-lice are herbivorous, feeding on the sap of their plant hosts, which in the case of Vesk's plant-louse is only one population of a conservation-listed plant—*Acacia veronica* ('priority 3'). This small strappy-leaved tree (pictured in the centre of the photo above) is endemic to Stirling Range National Park, in the state's south-west. Despite there being a number of populations scattered throughout the national park, Vesk's plant-louse has been found on only one of these populations. This is surprising, as Vesk's plant-louse has wings and should be capable of flying to other *A. veronica* populations. However, these insects are small and may not be able to locate their host plant easily, especially given the diversity of plants in the Stirling Ranges, which is estimated at more than 1,500 species, and the gully habitats that *A. veronica* is usually found in.

The National Climate Change Adaptation Research Facility (NCCARF) is funding the translocation of some Vesk's plant-louse individuals to other *A. veronica* populations to safeguard the tiny insect from extinction, should anything happen to the one population on which it is currently found. Further research into the specific climatic conditions required by *A. veronica* should also help to determine what will happen to this plant and its dependent insects with predictions of future climate change.

Vesk's plant-louse's reliance on only one population of a conservation-listed plant has led to it being recorded as 'vulnerable' in the February 2012 threatened species list; one of the few insect species to be listed, and the first to be defined as threatened by the process of co-extinction. The conservation list contains few plant-dwelling insects. This is not because there are fewer rare bugs than other animals, but because Western Australia has such a diverse insect fauna that new species are still being uncovered, even in more heavily populated regions such as the south-west. In addition, there are very few taxonomists and ecologists Australia-wide who study tiny insects like plant-lice. Therefore it is no wonder that such a specialised feeder as Vesk's plant-louse has gone unrecorded until recently.

Photos by Melinda Moir



Rediscover Perth outdoors

The health benefits of spending time in natural areas are well known. And with a vast network of national, marine and regional parks and reserves on their doorsteps, Perth locals don't have to travel far to immerse themselves in the great outdoors.

by Rhianna King

It won't come as a surprise to many Perth locals that, even on an international stage, their city is regarded as one of the most liveable. In fact, in 2011, the Economist Intelligence Unit ranked Perth the world's eighth most liveable city. Naturally, a number of criteria is used to determine these rankings but one Perth definitely has stitched up is its availability of 'green space'. No doubt the beautiful weather that enables these areas to be enjoyed year round helps too.

Natural setting

Perth has beautiful outdoor environments to its north, south, east and west, and along the Swan and Canning rivers that run through its heart. And many of these areas, and the diverse ecosystems they include, are protected by a network of national, marine and regional parks and reserves. On a broad scale, these areas benefit the environment as a whole. They provide habitats for plants and animals and play a vital role in maintaining clean air and water. At the same time, they provide settings in which humans can relax, recharge and contemplate. The associated health benefits are well documented, but in some cases can be felt more than seen (see 'Healthy Parks, Healthy People', *LANDSCOPE*, Spring 2007). Perth's natural areas cater for a variety of activities such as hiking, swimming, abseiling, photography, cycling, surfing, snorkelling, rock climbing and camping, or just a walk or a picnic in the park. For many Perth locals these activities are interwoven with an active, outdoor lifestyle, which they enjoy throughout the year. For visitors these outdoor pursuits are a big drawcard.

Of course, these activities are relatively recent additions to the landscape; Nyoongar people have held a special bond with the land and its plants and animals for up to 50,000 years. They took cues from nature to guide their hunting and gathering. They recognised six weather seasons and these determined where they stayed and what they hunted. The Perth area also holds mythological significance to Aboriginal people who recognise the strong connection between the Swan and Canning rivers and the Waugal, or serpent.

City-siders

With its southern edge set against the Swan River and the western edge abutting Kings Park, 'Perthites' don't need to stray far from the central business district to immerse themselves in nature. At 4.06 square kilometres, Kings Park is the world's largest inner-city park. It has a variety of environments from large sections of native bush to beautifully manicured



Main Coogee, Beeliar Regional Park.
Photo – Sallyanne Cousans

Inset top Matilda Bay Reserve.
Photo – Peter Nicholas/DEC

Inset middle Snorkelling at Shoalwater Islands Marine Park.
Photo – Michael James/DEC

Inset above Wandoo National Park.
Photo – David Bettini

lawns, and from water features to children's playgrounds. There are a number of walking trails on which to explore the park at your own pace, or on a guided tour if you'd prefer. There are also a number of special events held in the park, such as concerts, theatrical performances and ballets, and the ever-popular Wildflower Festival held each spring.

Travelling north-west into suburbia a short way takes you to Herdsman Lake Regional Park, with its rich wetland ecosystems, native vegetation and abundant birdlife. Black swans (*Cygnus atratus*), Eurasian coots (*Fulica atra*) and Pacific black ducks (*Anas superciliosa*), and more than 100 other species, including a number of migratory birds that travel from Siberia and China, strut around the park. It is also home to a couple of notable reptile species, namely the western tiger snake (*Notechis scutatus*) and the long-neck or oblong turtle (*Chelodina oblonga*). This park is popular among birdwatchers and for its cycling and walking trails and picnic spots.

Closer to the coast, Bold Park is 437 hectares of tuart-banksia woodland and limestone heath which contains 300 native plant species. The area was once an important site to Aboriginal people who camped there and relied on plants and animals for food and medicine. These days, the park is popular for its 15 kilometres of walk trails, and for the views it offers of the coast and to the city with glimpses of the Swan River.

The Swan River offers an environment for marine life and a place for water sports and shore-based recreation. Three special areas of the Swan River are protected as part of Swan Estuary Marine Park to provide a haven for wildlife in an otherwise urban environment. In particular, the marine park provides protection for a number of locally and internationally significant shorebirds and marine plants and animals such as seagrasses, anemones, crabs and the beloved bottlenose dolphins (*Tursiops* sp.). While on dry land, barbecues and tables at Matilda Bay Reserve in Crawley make it a well-suited destination for picnics and gatherings.

The Canning River is a major tributary of the Swan River and its eastern end is protected by Canning River Regional Park, which straddles

the river and provides protection for the riverine ecosystems between the Shelley and Nicholson Road bridges. The regional park is an important habitat for a number of migratory birds including the greenshank (*Tringa nebularia*) and curlew (*Calidris ferruginea*), and the river waters provide a nursery for fish such as the Perth herring (*Nematalosa vlaminghi*), flatheads and yellow-eye mullet (*Aldrichetta forsteri*). There are a number of walk tracks to explore the park or you can launch a canoe from several spots along the river.

Heading for the hills

The hills that surround Perth's eastern range offer a number of opportunities to enjoy the great outdoors, and the network of regional parks means you don't need to travel far to enjoy spending time in nature. Beeliar, Jandakot and Wungong regional parks offer a range of eco-experiences on the edge of suburbia.



Left The quenda is one of the native species found in Beelu National Park.
Photo – Sallyanne Cousans

Below Golden View Lookout in Beelu National Park.
Photo – Rob D'Raine

In the north-eastern reaches, Avon Valley National Park offers several camping sites from where visitors can explore the park, which was infamous bushranger Moondyne Joe's hideout in the 1850s. In addition to its rich cultural heritage, the park teems with natural values and its undergrowth explodes into bloom in spring with a stunning wildflower display.

The fascinating history of Walyunga National Park dates back to more than 40,000 years ago. The area was one of the biggest camp sites near Perth and was used by local Nyoongar people to meet, share stories and rekindle family ties. Nowadays, picnic areas and walk trails provide the setting for family and community gatherings.

Another popular area for families is Wooroloo Regional Park, which includes Lake Leschenaultia—a recreation area managed by the Shire of Mundaring. Lake Leschenaultia has picnic and barbecue facilities, shelter, toilets, a café, beaches, grassy lawns and a camping area. Hiking and mountain bike trails surround the lake and canoes are available for hire. The area is particularly pretty in spring when its wildflowers come into bloom.

Another park that dazzles during wildflower season is Whiteman Park, when species such as the Guinea flower (*Hibbertia glomerosa*) and prickly Moses (*Acacia pulchella*) are in flower. But the park boasts more than wildflowers and contains seven frog species, 32 reptile species, 104 bird species and eight species of native mammal. It also houses the Birds of Prey Flying Display, operated by the Western Australian Birds of Prey Centre, and Caversham Wildlife Park, home to Australian animals including koalas (*Phascolarctos cinereus*), wallabies, possums, Tasmanian devils (*Sarcophilus harrisii*) and hairy-nosed wombats (*Lasiorhinus krefftii*). For a complete change of pace, visitors can visit the Tractor Museum, Motor Museum of WA and Revolutions Transport Heritage Centre.

One centre definitely worth a visit is the Perth Hills Centre. Located within Beelu National Park, it is open from 11am to 2pm during the week and by prior arrangement for group bookings on the weekend. It provides





Above The Avon River runs through Avon Valley National Park.
Photo – Dennis Sarson/Lochman Transparencies



Right Birds of Prey Flying Display at Whiteman Park.
Photo – Ann Storrie

information about the national and regional parks in the area and sells a range of publications, and refreshments. It is also home to the Department of Environment and Conservation's (DEC's) *Nearer to Nature* program and hosts *EcoEducation* activities. A number of trails are found in the park including the Bibbulmun Track, which starts in the adjoining Kalamunda National Park, and the Munda Biddi Trail. The Munda Biddi Trail also runs through Korung and Midgegooroo national parks to the south.

If riding is your thing, then visiting Greenmount National Park is a must. An internationally recognised mountain bike course is located in the park, which also provides rock climbing and abseiling opportunities. Rock climbing is also available in Gooseberry Hill National Park.

Wandoo National Park—named after the woodland that occurs there—has an animal-viewing hide which enables visitors to observe the birds and native mammals that occur there, including splendid fairy-wrens (*Malurus splendens*), western grey kangaroos (*Macropus fuliginosus*), brush wallabies (*M. irma*) and brushtail possums (*Trichosurus vulpecula*).

Another park where native wildlife abounds is Lesmurdie Falls National Park. The park is home to 150 species of bird, mammal and reptile as well as many thousands of invertebrates. These animals live among the forests and woodlands of jarrah, marri and wandoo. Of course, as its name suggests, Lesmurdie Falls National Park is famed for its waterfall, which cascades 50 metres over the face of the Darling Scarp. These falls can also be viewed from afar from a number of walk trails located within Mundy Regional Park, which surrounds the national park.

John Forrest National Park—Western Australia's oldest national park—is also popular for its waterfalls which have been attracting tourists since the 1930s. There is anecdotal evidence that the area was once used as a hunting place by Nyoongar people. Nowadays, visitors can drop into the tavern located in the park for a feed.

There are other parks in the Perth hills area which boast spectacular waterfalls. Serpentine National Park is renowned for the pretty flow of the Serpentine Falls, which tumble over 15 metres of sheer granite rock into the Serpentine River, while the spectacular Sixty Foot Falls is found within Banyowla Regional Park. Both these attractions can be explored by walk trails.

If you'd prefer to be on the water, then Lane Poole Reserve is popular for fishing, canoeing and white-water rafting. There are also a number of walk trails—ranging in length from two to 19 kilometres—and camping is available throughout the park.



Left Exploring the caves of Yanchep National Park.
Photo – DEC



Below left Three Step Track at Toms Crossing, in Lane Poole Reserve.
Photo – Travis Deane

Coastal living

Perth is renowned for sweeping stretches of white beach that attract hoards of visitors and locals each year. Beneath the ocean surface lies an abundance of marine species, which delight snorkellers and divers, while marine mammals such as dolphins, sea lions and whales never fail to delight those who observe them from the shore. There are numerous areas along and near the metropolitan coast, and several offshore, that provide people with recreation opportunities and protect the natural values.

Fifty-one kilometres north of Perth lies nearly 3,000 hectares of bushland steeped in rich Aboriginal and other Australian history, and natural wonders. Yanchep National Park is one of Perth's oldest tourism sites and continues to be popular for day trips and camping. Visitors flock to see the spectacular cave system and view the park's resident koalas. It is also rich in birdlife and native vegetation, with species such as tuart (*Eucalyptus gomphocephala*), jarrah (*E. marginata*), marri (*Corymbia calophylla*), grasstrees (*Xanthorrhoea preissii*) and kangaroo paws making up the landscape.

Back towards Perth, Yellagonga Regional Park protects some of the last remaining wetlands on the Swan Coastal Plain. The park stretches for about 13 kilometres and contains lakes Joondalup and Goollelal, and Walluburnu and Beenyup swamps. A network of walk trails guides visitors and provides glimpses into the habitats used by a variety of birds, including migratory waders that have travelled from as far afield as China and Japan.

South of Perth, Woodman Point Regional Park marks the northernmost part of Cockburn Sound and is popular for picnicking, swimming, diving, fishing, sailing, boating and walking. It also has parklands, playgrounds, jetties and caravan parks. The area has a rich history; the tip of Woodman Point was used as a disease quarantine station from 1829 and later housed returned servicemen. Then, in the 1950s, it was the gateway to Australia for thousands of immigrants before the site was used to store mining explosives. The buildings then came under the management of the Department of Sport and Recreation as a recreation camp. It became a regional park in 1997.

Further south, Rockingham Lakes Regional Park is a haven for plants and animals that are now uncommon in the metropolitan area due to urbanisation. It is also home to a threatened thrombolite community. A thrombolite community can also be found in Yalgorup National Park, located 50 kilometres south of Mandurah. Thrombolites are built by micro-organisms that resemble the earliest life forms on Earth and have helped scientists unravel the secrets of how life began on the planet. A walkway takes visitors to a vantage point to observe these fascinating structures without damaging them. The park's vegetation, which includes woodlands, heaths and herb fields as well as mixed eucalypt woodland of tuart, jarrah and marri, provides refuge for western grey kangaroos, brush wallabies, quenda (*Isoodon obesulus*), chuditch (*Dasyurus geoffroii*), brushtail possums and echidnas (*Tachyglossus aculeatus*).



Right The Basin on Rottnest Island is popular with visitors.
Photo – David Bettini

Below Limestone cliffs and sandy beaches are features of Cape Peron in Shoalwater Islands Marine Park.
Photo – Sallyanne Cousans

Offshore, there are numerous opportunities to observe an array of marine life, including in the waters surrounding WA's beloved Rottnest Island. The turquoise waters, hidden bays and fascinating Aboriginal and European heritage draw thousands of visitors each year who cycle, walk and snorkel their way around the island. The island's most famous resident—the quokka (*Setonix brachyurus*)—freely roams around the scrub and even the most heavily visited tourist areas. The island is also renowned for its sea and waterbirds and for its abundant temperate and tropical marine life, which dazzles snorkellers and divers.

Another island that draws thousands of visitors each year is Penguin Island, a conservation park located within Shoalwater Islands Marine Park. Penguin Island is accessible by ferry from Mersey Point and its Penguin Discovery Centre provides the opportunity to see little penguins (*Eudyptula minor*) up close. The islands in Shoalwater Islands Marine Park offer important seabird breeding sites, and Australian sea lions (*Neophoca cinerea*) can often be seen at Seal Island.

Sea lions are also known to haul out at Carnac Island Nature Reserve during the non-breeding season. Carnac Island is also known for its seabird populations and tiger snakes. Visitors to the island are restricted to a small section of the beach to ensure the sea lions are not disturbed.

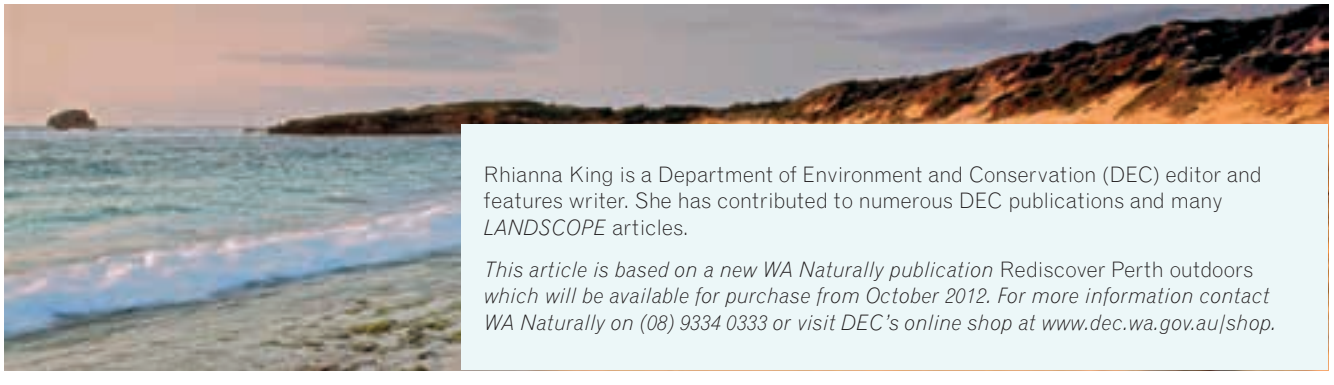
Nearby, Garden Island provides a lovely setting for a day trip. Access to the island, which also houses HMAS *Stirling*—Australia's largest Royal Australian Naval Base—is by private boat only. The surrounding waters support seagrass meadows and the island is home to the native tammar wallaby (*Macropus eugenii*) and a number of seabirds. Picnic and toilet facilities are available, and visitors can enjoy fishing, sailing, snorkelling, surfing and swimming.

These activities can also be enjoyed in Marmion Marine Park, offshore from Perth's northern suburbs. The spectacular marine life of this park includes a variety of fish species including western blue devils (*Paraplesiops meleagris*), old wives (*Enoplosus armatus*), banded sweep (*Scorpis georgianus*) and crested morwong (*Cheilodactylus vestitus*). Humpback whales (*Megaptera novaeangliae*) pass through the deeper waters of the park during their annual migration from June to November. Bottlenose dolphins and male Australian sea lions can also be seen.

Get out

There's no doubt Perthites are spoilt for choice when it comes to natural areas to explore and DEC runs a number of programs designed to deepen people's involvement in nature by taking a more hands-on role in learning about the wonders of the natural world. *Nearer to Nature* caters to groups of all ages, while a number of DEC programs are targeted at students. These provide fun and interactive activities in natural settings. The department also offers volunteering programs that range from scientific research to community education.

So, whether you are a Perth local or a visitor to the city, there is no shortage of areas to discover and ways to get involved.



Rhianna King is a Department of Environment and Conservation (DEC) editor and features writer. She has contributed to numerous DEC publications and many *LANDSCOPE* articles.

This article is based on a new WA Naturally publication Rediscover Perth outdoors *which will be available for purchase from October 2012. For more information contact WA Naturally on (08) 9334 0333 or visit DEC's online shop at www.dec.wa.gov.au/shop.*

urban antics

by John Hunter



Web of intrigue

Winter solstice 2012 ... according to the calendar, but the sun still had a degree or two to travel north before it peaked in its usual place through the forks of the tuart across the road ... two days maybe? The sun is my clock ... it is never wrong.

The morning was clear and sunny and so my shi tzu terrier was able to take me to the park and, while he went about his business, I frantically searched for my female friend who had been hanging about the shadows in resplendent silence for six months; rain, hail or heat. And there she was, curvaceous and quiet as usual, suspended in all her glory, her long slender and near-naked legs glistening brilliantly in the sun.

On moving closer, I could see into her large black eyes which reflected the soft light like limpid pools of ink. Not a movement. Not a quiver from the silken flanks of her distended abdomen or the wide brim of her cephalothorax. My breath nervously expelled into the crisp air and shrouded her entire body. I was obsessed with this superb acrobat in her enormous web of intrigue, but somehow I knew I was safe, though under close observation.

Nephila edulis is one of the largest and most common of the golden orb-weaving spiders found in our Perth suburban bush. While predominantly silver-grey on the body, the animal has brownish legs with tufted hairs on six legs and reddish bands at all leg joints. A strikingly sleek-looking beast, it can vary in size when mature, but is normally about 25 millimetres in body length and, including the legs, some 90 millimetres overall. Also found on webs are the minute male of the species, who is a mere six millimetres but an efficient suitor when courting his giant partner.

Perhaps one of the most attractive things about the orb-weaving spider is the web in which it lives. Generally a flat, angled net is constructed by first floating a non-sticky line of silk on the wind to another surface. Two other surfaces are then secured to form a 'Y' then a scaffold of many similar radii follows. A spiral of very sticky capture silk is finally added. The webs of *edulis* are usually about a metre wide and are most beautiful if viewed at a sharp angle to sunlight which highlights the golden silk produced by this spider.

Unlike some other species of her kind, *edulis* does not consume and replace her web each day, but lives suspended continuously, always facing downwards, her three-clawed toes waiting patiently for the tell-tale vibrations of an insect that has crashed into her net of death. At this point the spider springs to life, and before damage is done to the structure, a quick and fatal bite is administered and the prey wrapped in a shroud of silk.

Depending on the hunger of the spider the victim may be immediately sucked of its body juices or stored for later in a string of garbage and empty body husks on the web. This rubbish helps either to camouflage the waiting predator against enemies like birds or wasps, or simply to advertise the presence of the web to alleviate damage by prey that is too large.

The golden orb-web spider only lives for about one year after having been freed of its golden cocoon in early spring with its 200 brothers and sisters. As tiny instars, they point their tails to the sky and release fine gossamers of silk from their spinneretes. In a phenomenon called 'ballooning', the spiderlings are whisked skywards on gusts of wind, to be scattered over many kilometres. And so the cycle starts again.

DID YOU KNOW?

- Spider silk is a mixture of amino acids and carbohydrate components (glycoproteins) and when it hardens is about as strong as kevlar and, weight for weight, more than five times stronger than steel.
- Entomologists have estimated that the weight of insects consumed annually by spiders is perhaps greater than the total weight of the entire human population.
- A spider pumps its blood around its body through vessels and it returns through open channels. If its external skin is sufficiently damaged, it will bleed to death.



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