AUSTRALIAN Wildlife

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Celebrating a new century of wildlife preservation in Australia

Journal of the Wildlife Preservation Society of Australia Limited
(Founded 1909)

Threatened Wildlife Photographic Competition

Hairy correa (*Correa aemula*). Image: John Muchan - 2020 entrant.

Nowa Nowa grevillea (*Grevillea celata*). Image: Stanislaw Wawrzyczek - 2019 entrant.

Long-flowered nancy (*Wurmbea Tubulosa*). Image: Jennifer Smith - 2018 entrant.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

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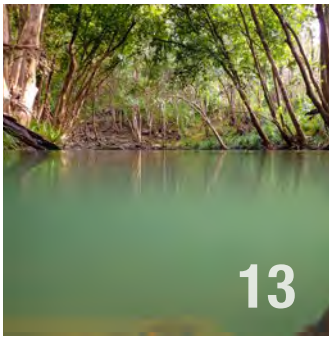

Regulars

Megan Fabian
Editor, Australian Wildlife

ON THE COVER:

Front Cover:
Silver princess (*Eucalyptus caesia*) is endemic to the south-west of Western Australia. Eucalyptus caesia subspecies magna grows to a height of fifteen metres with silvery drooping branches and larger blue-grey/mid-green leaves, buds, and fruit. Its large stunning flowers appear in autumn and winter and vary from pink to red, although white-flowered plants have been reported. These flowers attract nectar-feeding birds, making them an excellent choice for your garden. Image: Megan Fabian.

Back Cover:
Above Left: Grevillea loopy lou (*Grevillea hybrid*) is a small, fast-growing shrub with large flowers that change from yellow, pink, and red. Like most grevilleas, loopy lou is a bird attracting species and ideal for screening and hedging. Image: Megan Fabian.

Above Right: Caley's grevillea (*Grevillea caleyi*) is a shrub endemic to Australia and grows only in the northern suburbs of Sydney. Caley's grevillea is critically endangered and under threat from habitat loss, invasion of weeds, and rubbish dumping. Image: Dr Tony Auld.

Bottom Left: Pink pokers (*Grevillea petrophiloides*) is a tall, erect shrub native to Western Australia that produces bright pink flowers that grow eight centimetres long during winter and spring. The shrub attracts insects and nectar-eating birds such as hummingbirds. Image: Megan Fabian.

Bottom Right: The coloured spider-orchid (*Caladenia colorata*), endemic to South Australia and Victoria, is a ground orchid with a single hairy leaf and creamy-green flower with blood-red or purple-brown markings. Commonly found growing in sand or sandy soils, the flowering period of the orchid extends through August and September. The coloured spider-orchid is listed as Endangered and is under threat from various grazing animals, invasive weeds, and illegal collection of plants. Image: Noushka Reiter.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

Australian Wildlife

is the official journal of the Australian Wildlife Society (Wildlife Preservation Society of Australia Limited).

Founded in 1909, the Society is dedicated to the conservation of our unique Australian wildlife in all its forms.

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Directors

Member Notice

The Australian Wildlife Society (Wildlife Preservation Society of Australia Limited) is managed and controlled by an elected board of ten volunteer directors. The Society is a tax-deductible gift recipient and registered with the Australian Charities and Not-for-profit Commission. Its public fund is listed on the Register of Environmental Organisations under item 6.1.1 of subsection 30-55(1) of the Income Tax Assessment Act 1997.

Any member who might like to consider serving as a director of the Society is invited to contact the national office for more details. The most important qualification to serving as a director is 'a commitment to and love of Australian wildlife'.

The Society holds regular monthly meetings on the first Wednesday of each month in Sydney.

The Editor would like to feature a member's profile in the fortnightly email newsletter and occasionally in our quarterly magazine. Members are invited to consider submitting a short article with a photograph for possible publication.

Our Mission

The Australian Wildlife Society (Wildlife Preservation Society of Australia Limited) is a national not-for-profit wildlife conservation organisation, formed in 1909, and is committed to the preservation of Australia's precious flora and fauna. We act as a watchdog and provide advice to government agencies and institutions regarding environmental and conservation issues concerning all aspects of wildlife preservation.

Our mission is to conserve Australia's fauna and flora through education and involvement of the community. We are dedicated to the conservation of our unique Australian wildlife in all its forms through national environmental education, advocacy, public awareness, community involvement, and hands-on conservation work.

Our Society has always known that a conservation battle is never really won until the victory is enshrined in legislation. We have always attempted to convince politicians of the necessity to include the preservation of Australia's precious wildlife and its vital habitat in all their planning, environmental issues, and discussions.

From the President's desk

Doctor Julie Old - President

Well, winter is here already. The leaves have fallen from the deciduous trees, and jumpers have been found at the bottom of the draw. It is an ideal time to curl up under a blanket and read the Winter 2021 edition of Australian Wildlife!

Our alpine areas are spectacular and are indeed winter wonderlands, characterised by scattered boulders and abundant flora. I was lucky enough to enjoy some time trekking in the Snowy Mountains a few years ago. Whilst the higher areas are devoid of trees, including snow gums (*Eucalyptus pauciflora*), there are small shrubs, grasses, and sedges, as well as wildflowers. Along the paths and specially designed boardwalks, creeks and streams can be observed, and small waterfalls can be seen cascading over the rocks, sometimes frogs can be heard. However, it is unlikely that you will catch a glimpse of the endangered corroboree frog (*Pseudophryne pengilleyi*) or alpine tree frog (*Littoria verreauxii alpine*). Even the broad-tooth mouse (*Mastacomys fuscus*), Australia's only truly native alpine murid, might be seen or heard running through the sedges under the boardwalks.

Somewhere amongst the boulders, critically endangered mountain pygmy-possums (*Burramys parvus*), the 2020 Australian Wildlife Society species of the year, are hibernating now. The Society is playing a vital role in the preservation of this species by funding the establishment of a breeding facility to help save it from climate change and possible extinction. With construction now underway and expected to be completed by the end of spring, the breeding facility at Secret Creek Sanctuary aims to produce a large, healthy population of mountain pygmy-possums. Scientists and conservationists involved in the project plan to release the captive-bred pygmy-possums into the wild after acclimatising them to the local conditions, foods, and other species they will encounter in their new homes.

Sadly, other areas of our unique alpine habitats have become badly degraded by introduced species, particularly the feral horse, and they are no longer the pristine areas they should be. Feral horses trample and consume native shrubs, grasses, and sedges, which in these areas are incredibly slow-growing, and hence can take years to regrow and revegetate if damaged. Feral horses also foul pristine waterways and quickly degrade areas close to remote waterholes and natural springs, which during a drought become refuges critical to the survival of many native animals and plants. These areas are the only areas where some of our unique and precious native species can survive, such as those I have already mentioned as well as skinks, other frog species, the stocky galaxis (*Galaxias tantangara*), two species of unique crayfish, and several plant species. Without these refuges, these native plants and animals may become locally extinct.

In 2020, the Society supported Reclaim Kosci and assisted them in taking politicians and media representatives to Kosciusko National Park to help raise awareness about the impacts of feral horses on threatened wildlife and ecosystems. This year, we are continuing to support the growth and success of the Reclaim Kosci campaign. Funds provided will assist Reclaim Kosci to continue to raise awareness about the impacts of feral horses on threatened native wildlife in Kosciusko National Park. With the support of the Society, we hope that together we can ultimately preserve our unique flora and fauna in alpine areas by reducing the threats posed by feral horses.

The importance of preserving unique Australian alpine habitats for these native plants and animals is one reason the Australian Wildlife Society and its members are passionate about removing feral horses from Kosciusko National Park. If you want to support the Society's wildlife conservation efforts, you can become a member, a 'Friend of the Australian Wildlife Society', or donate to the Society.

Sunrise at Kosciuszko National Park. Image: Silvia Li (https://commons.wikimedia.org/wiki/File:Mt_Kosciuszko_sunrise.jpg)

Australian Wildlife Week: Connecting with Nature

Megan Fabian

Australian Wildlife Week is commemorated across the country during the first week of October to encourage a positive relationship between humanity and nature.

Unfortunately, Australia's wildlife has suffered significant declines since European colonisation, mainly through direct anthropogenic impacts. Land clearing, invasive species, and climate change are substantial threats to wildlife ecosystems and are key contributing factors to the loss of Australia's threatened species.

The Society has established many projects over time help to safeguard Australia's wildlife. The New South Wales Platypus Alliance advocated for a complete ban on opera house nets across the state to help protect platypus and other wildlife from the risk of entanglement and death. #SnipRingsforWildlife aims to raise awareness and encourage individuals to protect Australia's wildlife by cutting through plastic rings, rubber bands, hair ties, the loops of face masks, and dome-shaped plastic lids before disposing of them.

The President of the Australian Wildlife Society, Doctor Julie Old, said "the Society founded Australian Wildlife Week in 2019. We hope to raise awareness of wildlife conservation issues across Australia and inspire all Australians to explore and develop a deeper understanding of these issues, gain the necessary skills to make informed decisions, and implement wildlife conservation action where possible."

This year, to celebrate Australian Wildlife Week, we are hosting an online webinar. The webinar will showcase wildlife research and conservation projects across Australia. We will be joined by five keynote speakers, who will provide an overview of their projects. We will also be joined by six of the Society's University Research Grant winners, who will summarise their research and the importance of protecting Australian wildlife ecosystems.

Please keep an eye on our website, social media platforms, and newsletter for the most recent updates regarding the launch of the 2021 Australian Wildlife Week online webinar. The online webinar will take place during the first week of October. We hope you will join us, learn something new, and be inspired to take action to protect Australia's wildlife before it is too late. Please find below a draft program.

Speaker	Topic	Duration
President	Welcome, Acknowledgement of Country, Housekeeping	10min
Student Talk	University Research Grant Winner	5min
Keynote Speaker	New South Wales	15min
Student Talk	University Research Grant Winner	5min
Keynote Speaker	Western Australia	15min
Student Talk	University Research Grant Winner	5min
Keynote Speaker	Queensland	15min
Student Talk	University Research Grant Winner	5min
Keynote Speaker	Victoria	15min
Student Talk	University Research Grant Winner	5min
Keynote Speaker	Tasmania	15min
Student Talk	University Research Grant Winner	5min
President	Conclusion	10min

#SnipRingsforWildlife Receives a Leg Up

Megan Fabian

In 2020, the Society launched a new campaign called #SnipRingsforWildlife. The campaign aims to raise awareness and encourage individuals to protect Australia's wildlife by snipping through plastic rings, rubber bands, hair ties, the loops of facemasks, and dome-shaped plastic lids, in their entirety, before disposing of them.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

SNIP RINGS FOR WILDLIFE

Each year, thousands of birds and semi-aquatic wildlife such as platypus, turtles, and water dragons are strangled, obtain significant injuries, and often die horrific deaths from ring-shaped items. Native wildlife becomes entangled in these items that wrap around their beak or muzzle, preventing them from eating. These items can also tangle up their feet, wings, or fins, limiting their movement. Young animals can become entrapped in these items, and as they grow, these items cut into their flesh, sometimes amputating limbs or killing the animal. Other animals mistake these items for food and ingest them.

Despite contacting numerous manufacturers, informing them of the danger that ring-shaped items pose to native wildlife, and encouraging them to improve their products, the issue persists. We acknowledge and commend the companies that have already taken action to make a positive change and improve their products for Australia's wildlife. However, most companies are not taking action. Jars, bottles, and tetra packs with plastic lids now come with a recycled plastic ring that snaps apart from the lid upon opening or a peel-off seal under the cap.

Meeting with Mark Coure MP. L to R: Wayne Greenwood, Ken Mason, Mark Coure MP, and Patrick Medway AM.

Mark Coure MP is presented with a history book by Director Wayne Greenwood of the Society's wildlife conservation work since 1909.

The Society created a #SnipRingsforWildlife ePetition on change.org, which currently has just under 2,000 supporters, but we would now like to take the change.org ePetition to the next level – a Parliamentary ePetition. A Parliamentary ePetition of more than 20,000 signatures has a 'take note debate' in the Legislative Assembly.

On Wednesday 19 May 2021, the Society met with Mark Coure MP, the Member for Oatley, New South Wales. The Society's Chief Executive Officer, Patrick Medway AM, provided Mark with a brief overview of the Society's wildlife conservation projects and business operations. Mark expressed a great interest in our wildlife conservation projects across New South Wales. The Society asked for Mark's support to present the #SnipRingsforWildlife ePetition in Parliament on behalf of the Society. Mark has an ongoing commitment to reducing waste and understood the

This Australian water dragon (*Intellagama lesueurii*) got his head stuck through the plastic ring of a discarded bottle and would have slowly starved to death if it had not been rescued. Image: WIRES Northern Rivers.

deadly impact that ring-shaped items have on native wildlife. Mark agreed to present the ePetition in Parliament to help protect wildlife from the risk of entanglement and dying horrific deaths from ring-shaped items. As the meeting concluded, Directors Wayne Greenwood and Ken Mason presented Mark with a history book of the wildlife conservation work of the Society since its inception in 1909.

A new online ePetition has been launched calling on the New South Wales Parliament to urgently take action to prevent native wildlife from becoming entangled in ring-shaped items and dying preventable deaths. We need as many New South Wales residents as possible to sign the ePetition that asks the New South Wales Legislative Assembly to:

1. Implement a ban on ring-shaped items to protect native wildlife from the risk of entanglement and death,

2. Encourage companies to change their products to a more wildlife-friendly option (e.g., from plastic rings to a peel-off seal under the cap), and

3. Encourage the community to snip through ring-shaped items before disposing of them.

If we can reach 20,000 signatures by the end of September it will trigger a debate in the New South Wales Legislative Assembly, and politicians will be forced to openly declare whether they will or will not protect native wildlife from the risk of entanglement from ring-shaped items.

Please keep an eye on our website, social media platforms, and newsletter for the most recent updates in relation to the launch of the #SnipRingsforWildlife ePetition. The Society also encourages everyone to get behind #SnipRingsforWildlife to help raise awareness, inspire conservation action, and protect native wildlife from the risk of entanglement and death.

It is important to remind ourselves that we can act, both as individuals and collectively, to create real change and protect our precious wildlife for future generations.

This platypus (*Ornithorhynchus anatinus*) was bound and killed by injuries from a rubber band. The band was tangled tight around the animal's neck and cutting into its flesh under its left flipper. Image: Wildlife Rockhampton.

Patrick Medway AM, Ken Mason, and Wayne Greenwood stand in front of the Australian Wildlife Society banner at the National Office in Hurstville, New South Wales.

Banksias

Bushfire Survivors

Doctor Kevin Mills

The Australian flora we see today has largely evolved in a fire-prone environment over millions of years, during the drying of the continent, as it moved ever so slowly north by the mechanism we call continental drift. With this drying out, fire became a driving force in the Australian environment, just as important as soil and climate. Any species that could not adapt to an increasingly intense fire environment either did not survive the drying continent or retreated to the wettest, less fire-prone regions in the case of rainforest species.

Banksia is a genus in the primarily southern hemisphere family Proteaceae, an example of a Gondwanan family; close relatives occur in South Africa. Fossil evidence indicates that *Banksia*-like plants have been around for at least fifty million years. The genus *Banksia* was named by Carl Linnaeus the Younger in 1782, twelve years after Sir Joseph Banks collected the first specimens of a *Banksia* at Botany Bay (now Kamay National Park), in 1770 during James Cook's *Endeavour* voyage. Since the inclusion of the genus *Dryandra* into the genus *Banksia*, there are 173 species of *Banksia*, all but one being endemic to the Australian continent (including Tasmania). The south-west of Western Australia contains the most species. It is an excellent example of a plant group that has evolved to survive in a highly fire-prone environment.

Banksias' adaptations to survive regular bushfires are not unique to this genus and are shared by many other species in the same family and many other families. However, not all *Banksias* have produced the same strategies. The species can be divided into two groups; obligate seeders are killed by fire and rely totally on seeds for the next generation, while resprouters can produce shoots from a trunk or a lignotuber, a large underground woody swelling. The Sydney region is well endowed with *Banksias*, with thirteen species found in the Sydney Basin; these species display several different adaptations to fire.

Old man banksia (*Banksia serrata*) exhibits several strategies to survive fire: a thick bark that protects the trunk of the tree, the ability to produce epicormic shoots along the trunk after the fire, protection of its seeds in a woody cone that open post-fire to release the seeds, and rapid seed germination after the fire. On the other hand, coast banksia (*Banksia integrifolia*) is usually killed by fire, releases seed when ripe irrespective of fire, and relies on soil-stored seed for the next generation. This species grows on the coast and is less likely to be frequently burnt than the *Banksias* growing on the sandstone country. Other shrubby species produce a lignotuber that can produce sucker shoots quickly after losing all their aerial stems. Species that produce lignotubers include swamp banksia (*Bankia paludosa*) and hairpin banksia (*Banksia spinulosa*).

The strategies that each *Banksia* species has developed are successful; otherwise, they would not exist. Single-strategy species such as *Banksia integrifolia* and heath-leaved banksia (*Banksia ericifolia*), which rely entirely on seed and are killed by fire, risk not continuing on a site. If the fires are too

Above Left: Old man banksia (*Banksia serrata*) inflorescence.

Above Middle: The cone of a coast banksia (*Banksia integrifolia*) after releasing its seeds.

Above Right: Inflorescences of *Banksia ericifolia.*

infrequent, the old plants may die, and the seed held in the cones may become unviable. If fires are too frequent, the seed would be exhausted, and no plants would reach seed-producing age.

The *Banksias* of the Sydney Basin have also evolved to grow in sandy, nutrient-deficient soils derived from the sandstones that dominate the region. Like many Australian plants growing in poor soils, *Banksias* form relationships with the mycorrhizas (root systems) of fungi to extract soil nutrients. *Banksias* are also very important in the ecology of the heaths and woodlands that many of them inhabit and sometimes dominate. Flowering in the cooler months of the year, when most other plants are not, means that many animals rely on the nectar from their flowers, often produced in abundance. The honeyeaters are particularly active around flowering *Banksias*, while at night, small mammals visit the flowers such as the eastern pygmy possum (*Cercartetus nanus*).

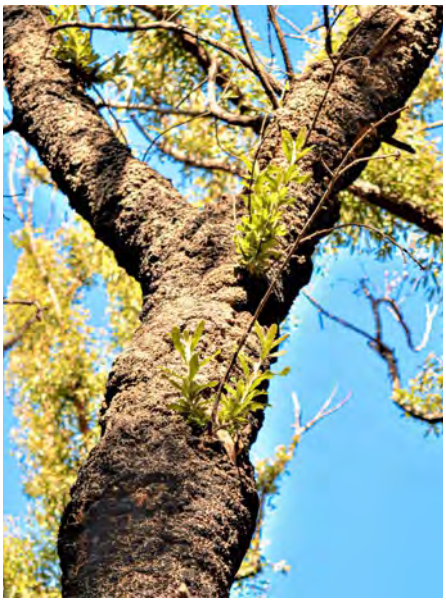
Two species are listed as Critically Endangered in New South Wales, *Banksia conferta* and *Banksia vincentia*. The former only occurs in a small area of the north coast, while the latter is only known in the wild from a handful of plants near Jervis Bay. While the other species of *Banksia* in New South Wales are currently secure, future threats to some of the more restricted species may well emerge. The long-term prognosis for *Banksias* in the Sydney Basin, considering climate change, is open to speculation. Under a regime

Dead plants of heath-leaved banskia (*Banksia ericifolia*), above post-fire seedlings.

Post-fire seedling of an old man banksia (*Banksia serrata*).

Post-fire seedlings of (*Banksia ericifolia*).

The cone of a coast banksia (*Banksia integrifolia*) after releasing its seeds.



Epicormic shoots on an old man banksia (*Banksia serrata*).

Thick bark of an old man banksia (*Banksia serrata*).

Sucker shoots from a lignotuber and empty cone of swamp banksia (*Banksia paludosa*).

Sucker shoots from lignotuber of hairpin banksia (*Banksia spinulosa*).

of frequent fires, obligate seeders may eventually disappear from a site due to a lack of time to produce enough seed to ensure the next generation.

The genus has been brought into cultivation for their showy flower spikes. The large showy inflorescences of the *Banksias* make them some of the most impressive Australian plants. Nothing impresses more than a tree or large shrub covered in flowering *Banksia* spikes. Native plant nurseries in your area probably have *Banksias* in stock, including various cultivars that have been developed. So why not try a *Banksia* or two in your garden? But make sure to check your soil first as most grow in poor soils and these species are not likely to do well in heavy soils.

DOCTOR KEVIN MILLS is a botanist and ecologist who, with his partner, ran an environmental consultancy for thirty years before retiring in 2019. He has studied the rainforests and the flora of the south coast of New South Wales for many years. Kevin is currently working on various botanical projects, including studies of all offshore islands, a field study of the ferns, and various rare plant surveys.

Changes to River Flows
Are Having a 'Damming' Impact on Platypuses

Doctor Tahneal Hawke, Doctor Gilad Bino, and Professor Richard Kingsford

The semi-aquatic platypus (*Ornithorhynchus anatinus*) is a much-loved Australian iconic mammal, dependent on freshwater rivers and streams along the continent's east for foraging, breeding, and nesting. The conservation status of the platypus is of concern, with evidence of declines across its range but with critical gaps in baseline data which would allow accurate assessment of numbers and trends. In South Australia, the platypus is listed as Endangered, given it is all but gone from the mainland and exists as a small, introduced population on Kangaroo Island. In 2016, the platypus was listed as Near Threatened by the International Union for Conservation of Nature Red List of Threatened Species. However, in early 2021, the platypus was formally listed as Vulnerable under the threatened species status in Victoria, given mounting evidence of declines and an uncertain future. Declines are primarily attributable to land clearing, particularly of riparian vegetation, erosion of earthen banks, increased sedimentation, as well as crayfish netting, pollution, disease, and predation by invasive species.

The distribution of the platypus also overlaps extensively with Australia's most regulated rivers, where we have built dams. Although dams are assumed to be detrimental to platypus populations, little was known about how river regulation and alteration to flows impact their abundances and movements. Dams pose formidable barriers which can limit the movements of platypuses and affect genetic relationships. Dams and river regulation of flows can also alter the composition and extent of riparian vegetation, leading to stream bank erosion and impacting habitat for platypuses by reducing available areas for burrows in riverbanks. Increased sediment load and deposition can also produce 'sand slugs', filling pools in rivers, destroying critical foraging habitats, and undermining critical refugia for platypuses during droughts. Abstraction of water and resultant reductions in flow volumes also increases the drying of rivers, while shifts in the seasonality of flows can impact platypus breeding and the availability of their macroinvertebrate prey.

To understand the impacts of dams and river regulation on platypuses, researchers from the Platypus Conservation Initiative at the Centre for Ecosystem Science, University of New South Wales, undertook surveys over three years, spanning across three regions in New South Wales and Victoria – the Upper Murray Rivers, Snowy Rivers, and Border Rivers. In each region, platypuses were surveyed above and below large dams and in adjacent unregulated rivers, comparing captures, demographics, abundances, and densities. Recent research published in the scientific journal *Aquatic Conservation* summarises the findings that large dams can significantly impact the downstream

Above: Key platypus (*Ornithorhynchus anatinus*) habitat.

An adult female platypus (*Ornithorhynchus anatinus*) captured on the Snowy River.

A platypus (*Ornithorhynchus anatinus*) ready for release after processing.

abundances of platypuses. Platypuses in the Mitta Mitta River in the Upper Murray Rivers region were significantly impacted by the alteration of flows from the Dartmouth Dam. Capture rates downstream of the dam were substantially lower when compared with captures upstream and on the adjacent unregulated Ovens River. Additionally, downstream of the dam, the sex ratio was biased towards males, with no female platypuses captured.

The low abundances and biased demographics in the Mitta Mitta River downstream of Dartmouth Dam likely reflect the considerable alteration of flows by the dam. Flows in the Mitta Mitta River downstream of the dam have increased over the summer months to meet downstream irrigation demands. The increase has resulted in long periods of constant high flows during water transfers, with periods of low flows when the dam water is stored. The high flows over the summer months coincide with the season when platypus eggs and puggles are inside burrows (November-March), potentially resulting in increased juvenile mortality by drowning or premature displacement from burrows. These changes to flow regimes can also alter the composition of macroinvertebrates, the exclusive prey of platypuses. Macroinvertebrate diversity and abundances have declined, and composition has changed on the Mitta Mitta River downstream of Dartmouth Dam, likely contributing to the impacts on the abundances and demographics of this platypus population.

While the dam significantly impacted platypus populations in the Mitta Mitta River in the Upper Murray Rivers regions, this was not the case in the Snowy or Border Rivers regions, where the extent of river regulation was less severe. In the Snowy Rivers region, similar capture rates upstream and downstream of the Jindabyne Dam, on the Thredbo and Snowy Rivers, probably reflect the restoration of the river and increased flows on the Snowy River for over a decade, implemented to mimic the natural flow regime. These flows have significantly improved riverbanks, channel depth, and the overall health of the river. Additionally, temperature control works have likely also improved conditions for macroinvertebrates and platypuses. Similarly, in the Border Rivers region, there were no differences in capture rates upstream or downstream of the Pindari Dam on the Severn River, compared to the unregulated Tenterfield Creek. Dam operations on the Severn River have

not reversed the seasonality of flows as they have on the Mitta Mitta River, and temperature differentials were also relatively low.

The research from the Platypus Conservation Initiative suggests that improving the flow regimes on regulated rivers can improve conditions for platypuses downstream of dams. On the Snowy River, environmental flows have improved the downstream river health, suggesting that such releases are essential. The Platypus Conservation Initiative has also tracked the movements of fifteen platypuses on the Snowy River during a large environmental flow release to determine if there was any impact of these flows on the platypuses movement. Research published in the scientific journal *Freshwater Biology* concludes that the environmental flow release did not affect platypuses movement, home range, or the number of detections. Foraging duration did increase after the flow, possibly associated with increased prey availability. However, juvenile numbers on the Snowy River were low compared to other rivers in the area. In addition, the timing of the first emergence of juveniles from their burrows may suggest that the timing of large spring environmental flows may be detrimental for early breeding attempts by platypuses, possibly inundating nests.

The research has shown that some large dams and associated river regulation can detrimentally impact platypus populations, but improved management of flows can possibly mitigate these impacts and are critical to sustaining platypuses downstream of dams. Poorly timed flows on other rivers can impact platypus breeding success, which is particularly concerning for the many regulated Australian rivers that have shifted flowing regimes from spring to summer, such as on the Mitta Mitta River. Maintaining the timing and volume of flows are highly important for platypus breeding success and the survival of juveniles. However, there are likely synergistic impacts of isolation and fragmentation affecting the long-term viability of these platypus populations.

The future conservation of platypus populations depends on limiting the regulation of rivers across their range and improving the flow management from large dams, and managing the many other threats affecting them. If we get this right, platypus could be a flagship species for healthy rivers.

Setting a fyke net to capture platypuses.

A flushing flow from the Jindabyne Dam, Snowy River.

Connectivity of Common Dolphins

Across the Australasian Metapopulation

Andrea Barceló, Luciano Beheregaray, and Luciana Möller

Australia and New Zealand share a vast ocean where many marine species interact, from phytoplankton to top predators such as dolphins, seals, and sharks. The common dolphin (*Delphinus delphis*) is a magnificent charismatic species widely distributed and abundant in the region. Common dolphins can be found along the continental shelf of southern and eastern Australia. In New Zealand, they mainly concentrate around the north island. Although they can migrate thousands of kilometres in large groups of hundreds of individuals, in some populations, they associate in smaller groups of a few to dozen individuals and remain in relatively small areas.

Common dolphins are known to follow the distribution of their prey. Dolphins feed mainly upon schooling fish such as mackerel, sardines, and anchovies. However, these prey species are also targeted by fisheries in the Australasian region, which has led to entanglements and mortalities of common dolphins in several fisheries regions. Compared to other coastal dolphin species or even some shark species, we know little about how many dolphin populations there are, where they are located, how populations are connected, and how they are adapted to their environment.

A PhD research based at Flinders University, in collaboration with several Australian and New Zealand institutes (listed below), has recently assessed the population structure and connectivity between Australasian common dolphins. The partnership allowed the analyses of over five hundred dolphin samples, collected between 2000 and 2017, and for the first time, used thousands of deoxyribonucleic acid (DNA) markers to clarify the connectivity of the species between Australia and New Zealand. Furthermore, the researchers identified and generated information that can be used to obtain successful conservation and management outcomes.

The Power of Genomics to Elucidate Population Connectivity

Conservation genetics, or genomics when referring to genome-wide data, plays a significant role in characterising genetic diversity and informing the management of endangered species. The same principle can be applied to species or populations currently at-risk from human activities and rapid environmental changes.

After a monumental field effort to collect samples over most of the distribution of common dolphins

Above: A common dolphin (*Delphinus delphis*) in southern Australia. Image: Kirsten Bilgmann.

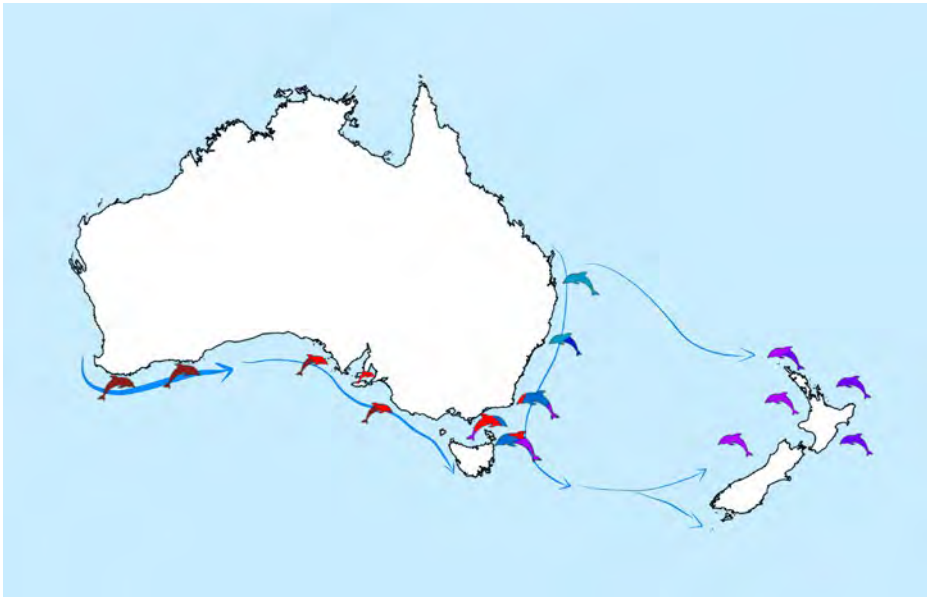
in Australasia, the study found that common dolphins are structured as a large, hierarchical metapopulation with various levels of connectivity between them. The metapopulation is subdivided into three main populations. The populations are represented by temperate eastern Australia and southern Australia, with low levels of connectivity between them, and New Zealand and Tasmania combined, the latter with moderate connectivity to the eastern Australian population.

Differences in levels of connectivity appear to be dependent on the scale of movement of different populations, which seem to be affected by different oceanographic processes occurring on the continental shelves of both the Pacific and Indian Oceans. For example, some common dolphins from southern Australia appear to seasonally move following the formation of upwellings and locally enhanced biological productivity, leading to wide-ranging populations and higher connectivity. In contrast, areas previously known to act as biogeographic boundaries, such as the 'Bassian Isthmus', separate many marine species between southern and eastern Australia and appear to reduce connectivity between common dolphins of the two ocean basins. Common dolphins from around Tasmania are particularly interesting, with individuals from eastern Tasmania exhibiting greater levels of connectivity to dolphins across the Tasman Sea in New Zealand, while others are more related to eastern Australian common dolphins.

Another interesting finding relates to common dolphins inhabiting the Gulf of St Vincent in South Australia. This subpopulation has low levels of connectivity to others outside the Gulf, suggesting that it may represent a resident population with potential gene adaptations to the environment it inhabits.

Management of Common Dolphin Populations

The common dolphin is currently an abundant species in Australia and New Zealand; thus, they are not generally considered a priority species for conservation. However, management of their populations is required given the species' protected status and by-catch levels in several fisheries. The distribution of the three main dolphin populations and their boundaries should be considered when managing dolphin and fisheries interactions. The need for continuing connectivity between demographically dependent subpopulations found within ocean



A simplified graphical representation of the study's findings shows that the metapopulation is subdivided into three main populations.

A common dolphin (*Delphinus delphis*) in the Gulf of St Vincent in Australia. Image: William Pyke.

Common dolphins (*Delphinus delphis*) in Australia are known to vary in colour between localities or populations. Image: Cetacean Behaviour, Ecological and Evolutionary Lab research team.

A pod of common dolphins (*Delphinus delphis*) in the Gulf of St Vincent in Australia. Image: William Pyke.

basins is vital. Given the findings, new collaborative efforts across state and international jurisdictions need to be made to ensure that management of the species in Australasia leads to the long-term persistence of its populations.

Conservation genomics is a developing field. The study provides an initial step towards understanding the adaptive resilience of local and regional populations of a small cetacean to naturally- and anthropogenically-driven environmental change. For more information on common dolphin genomics research, visit the Molecular and Ecology Research Lab website at www.molecularecology.flinders.edu.au/publications/

Collaborating institutions: the Cetacean Behaviour, Ecological and Evolutionary Lab (CEBEL) and the Molecular Ecology Lab from Flinders University, the Cetacean Ecology Research Group from Massey University, the National Institute of Water and Atmospheric Research of New Zealand, University of Auckland, Ministry of Primary Industries in New Zealand, Tasmanian Museum, and the Department of Primary Industries, Parks, Water and Environment of Tasmania.

An ariel view of a pod of common dolphins (*Delphinus delphis*) in Australia. Image: Cetacean Behaviour, Ecological and Evolutionary Lab research team.

Tackling Australian Wildlife Entanglement

Leonard Fitzpatrick

It is no secret that our native wildlife is battling a range of threats from human activities. One of the most consistent and distressing scenarios that wildlife rescuers and veterinarians face is entangled wildlife. The scale and diversity of terrestrial and aquatic wildlife maimed and killed through entanglement is of great concern. Flying-foxes, birds, lizards, snakes, macropods, turtles, platypus (*Ornithorhynchus anatinus*), and rakali (*Hydromys chrysogaster*), an Australian native rodent, are the species that fall victim to entanglement. The causes of wildlife entanglement are diverse and include barbed wire, fruit netting, fishing line and tackle, fishing nets, twine, face masks, plastic rings, and general rubbish. Although the causes of wildlife entanglement are directly linked to the choices we make, we also have the ability to make positive changes through our behaviour e.g., erecting wildlife-friendly fencing, snipping through plastic rings and the loops of face masks, and appropriately disposing of fishing line and netting.

Raising awareness of the threat of entanglement to native wildlife and the simple measures we can implement to help protect them is vital, including efforts implemented by local councils and other authorities. However, when wildlife groups or advocates approach local councils and other bodies to seek a change in regulations minimising the threat of wildlife entanglement, the availability of reliable and compelling data is often limited.

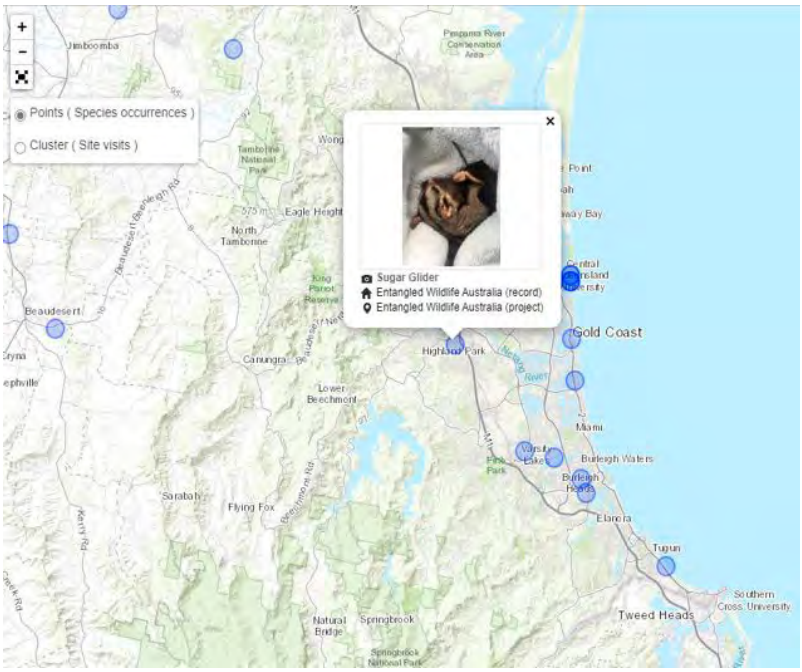
Volunteer wildlife groups and wildlife hospitals all have different methods and approaches to collecting and recording wildlife entanglement data. In July 2020, intending to help passionate wildlife advocates and groups, I collaborated with a team from the Atlas of Living Australia (hosted by the Commonwealth Scientific and Industrial Research Organisation) to launch an Australian-wide citizen science project – Entangled Wildlife Australia. Entangled Wildlife Australia is a database accessible via the Web, mobile device, or BioCollect application. Wildlife rescuers or the public can use these platforms to record sightings of entangled wildlife (living or deceased, rescued or escaped) in the Entangled Wildlife Australia database. Other information can also be uploaded, such as species, age group (if known), location, type of entanglement, and the option to include a photo. Users can view or download the data and the geographical distribution of different species at local and national levels, identifying wildlife entanglement hotspots.

The Entangled Wildlife Australia database has over 1,460 records. As more people become aware of Entangled Wildlife Australia and contribute much-needed data, I hope

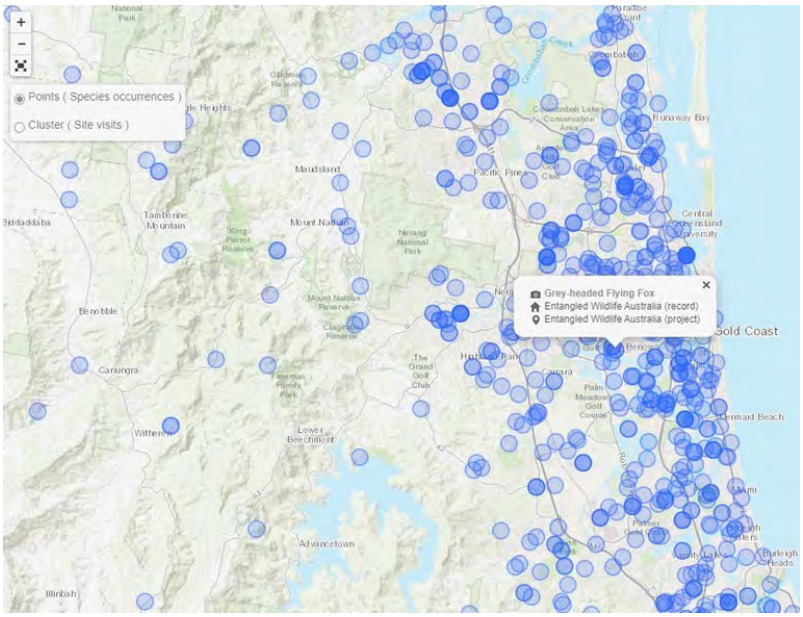
Above Left: A little red flying-fox (*Pteropus scapulatus*) found entangled on a barbed wire fence. Image: Michael Wilson, Bats Qld.

Above Right: A pelican (*Pelecanus conspicillatus*) found entangled in fishing line and a hook at Woody Point, Queensland. Image: Pelican and Seabird Rescue Inc.

Bottom Right: A bush stone-curlew (*Burhinus grallarius*) found entangled in a fishing line and a coat hanger at MacLeay Island, Queensland. Image: Pelican and Seabird Rescue Inc.



A screenshot from the Entangled Wildlife Australia website showing a geographic sample of sugar glider (*Petaurus breviceps*) entanglements in south-east Queensland.



A screenshot from the Entangled Wildlife Australia website showing a geographic sample of grey-headed flying-fox (*Pteropus poliocephalus*) entanglements in south-east Queensland.

Leonard Fitzpatrick, the founder of Entangled Wildlife Australia.

that the valuable body of information will support wildlife conservation efforts and bring about positive changes for native wildlife. I also hope the data helps to reduce the stress and demands on veterinarian staff, wildlife rescuers, and rehabilitators. Lastly, I hope the data will assist wildlife groups and other professionals in educating the community on the threat of wildlife entanglement and advocating for wildlife-friendly practices.

In 2017, I joined the Royal Society for the Prevention of Cruelty to Animals Queensland as a volunteer animal transport driver. I witnessed, first-hand, the direct and indirect impacts of human activities and how precious our native wildlife truly is. Within a short amount of time, I was inspired by the rescuers, veterinarian staff, and wildlife rehabilitators. Through them, I came to know about the following local wildlife rescue organisations: Wildcare, Bats Queensland, Bat Conservation and Rescue Queensland, and Reptile Rehabilitation Queensland. I also volunteered my time to these organisations to help where I could. The frequency and distressing outcomes of wildlife entanglements had a significant impact on me. Consequently, I vowed to be part of a solution to protect native wildlife. My inspiration behind developing Entangled Wildlife Australia was what I learnt from the Wildlife Friendly Fencing Project, the connections I made with people passionate about wildlife entanglements, and the diverse array of extraordinary native wildlife in Australia.

To Access Entangled Wildlife Australia

Please visit bit.ly/3q1EHPH, scan the QR code, or email entangledwildlifeaustralia@ihug.com.au

A platypus (*Ornithorhynchus anatinus*) found entangled in fishing line. Image: Denise Illing, Australian Platypus Conservancy.

Kangaroo Numbers May be Jeopardising Conservation Efforts

Charlotte Mills and Professor Mike Letnic

The conservation of plants and animals in Australia is a tricky business. Competition for land with agriculture, industry and urban sprawl, a climate punctuated by extreme droughts and floods, and a host of feral animals waiting to eat at the smorgasbords provided by reintroduction programs are all challenges faced by governments, non-governmental organisations, and other land managers seeking to protect Australian flora and fauna. Kangaroos, an iconic native species, might add to the long list of challenges faced by conservation managers and is not a suggestion provided lightly. However, that is precisely what has been witnessed in conservation reserves and National Parks in south-east Australia.

Kangaroos are widely recognised as pests on livestock grazing land because they compete with cattle and sheep for food and water. On conservation reserves, kangaroos are rarely managed and benefit from the lack of competition with livestock. Inadvertently, by creating good conditions for livestock grazing, other herbivores have benefitted. Across much of the country, we have suppressed dingo populations and increased the availability of water supplies to benefit livestock. These changes have also led to an increase in the numbers of kangaroos. Kangaroos impact on the land has been dismissed as a natural process, regardless of their abundance.

During the peak of the drought in 2018, four conservation reserves in semi-arid Australia were visited by researchers at the University of New South Wales, including Yathong Nature Reserve in the central-west region of New South Wales. The conservation reserves, where kangaroo management has been contentious, have successful population control programs for rabbits and goats. The researchers wanted to compare the effects of kangaroos and rabbits on the soil and vegetation across these four conservation reserves, using existing experimental fences. The fences were built by local land managers at each conservation reserve and are evidence that there are long-standing concerns about the numbers of herbivores and their potential impact on vegetation in conservation reserves. By comparing fenced areas, which kept out either rabbits, kangaroos, or both, to the broader landscape where all herbivores were free to graze, the researchers were able to identify which species were impacting the landscape. Furthermore, the researchers could determine whether grazing on the conservation reserves was a problem for the vegetation and soil.

Above: A red kangaroo (*Macropus rufus*).

Researchers from the University of New South Wales surveying the landscape inside one of the fenced exclosures at Yathong Nature Reserve.

Kangaroos were by far the most numerous herbivores on the reserves. At one of the reserves, 145 kangaroos per square kilometre were recorded – an unsustainable density. The researchers found that areas grazed by overabundant kangaroos had fewer plant species, and the soils were compacted and depleted in nutrients. Compacted soil means that less water can be absorbed when it rains, which leads to runoff and erosion, and eventually less water availability for plant growth. In addition, rabbits, considered the most destructive herbivore in the semi-arid zone, reduced the number of shrub species and contributed to the loss of soil nutrients.

The study took place in 2018 when much of the country was in drought. Drought, although a reality of Australian life, is challenging for plants and animals. When coupled with overgrazing, drought leaves little suitable habitat for other species. The impacts of kangaroos in these conservation reserves during the drought was confronting. Almost all available vegetation in the reserves was found inside the experimental fences, away from the reach of kangaroos. Overall, the study illustrated that too many kangaroos could compromise the conservation objectives of reserves in the semi-arid zone in Australia.

When land is set aside for biodiversity conservation, the primary goal is to provide refuge for all native species. However, too many kangaroos in an area could compromise this primary goal and result in extensive consequences for other plants and wildlife. For example, the plains-wanderer (*Pedionomus torquatus*) is a critically endangered ground-nesting bird that resides on some of the conservation reserves in the study. There are less than 1,000 plains-wanderers left in the wild, and they are the sole living representatives of their evolutionary lineage. The main threats to plains-wanderer survival are predation by foxes and the overgrazing of their grassland habitat. Unfortunately, kangaroos are directly contributing to the latter. Other research shows that overabundant kangaroos living without predators also increase the amount of carrion present. Carrion attracts scavengers such as foxes and ravens – predators of the nests of ground-nesting species like the plains-wanderer.

Soil surveys in herbivore grazing areas at Yathong Nature Reserve. The absence of vegetation cover was typical of areas where kangaroos and rabbits were grazing.

The consequences of grazing by overabundant herbivores are not limited to species like plains-wanderers. Other birds, reptiles like legless lizards, mammals such as the stripe-faced dunnart (*Sminthopsis macroura*), insects like butterflies, termites, and grasshoppers, and grasses, shrubs, and herbs that are eaten by herbivores are all threatened when conservation reserves are compromised. Unfortunately, the threat that kangaroos pose to the survival of other species is a direct result of human activity such as land clearing and habitat degradation. There is an obligation to manage the threat of kangaroos if we want to use conservation reserves to their full potential.

Consequently, there are difficult conversations to be had about the densities of kangaroos in conservation reserves. Kangaroos hold a special place in the heart of many Australians, which can make discussions of kangaroo population control such as culling, fencing, or other less conventional methods such as sterilisation particularly challenging. The most effective and humane solutions can be discovered and implemented through collaborations with key stakeholders, including governments, researchers, Traditional Custodians of the land, non-governmental organisations, and pastoralists. However, these solutions will differ depending on contexts, resources, and management objectives. Nevertheless, we can ensure that all species in conservation reserves thrive alongside large herbivores by using a landscape-level approach.

For more information about the study, please see the article at: doi.org/10.1016/j.gecco.2020.e01384

A New Way to Follow how Australia's Threatened Species are Faring

Doctor Ayesha Tulloch, Conservation Scientist, University of Sydney and
Doctor Micha Jackson, Ecologist, University of Adelaide

Most of us have watched nightly news readers describe how Australia's economic health is trending, using measures like the Australian Securities Exchange and unemployment rates. It is no less important to track how Australia's native species are doing, as it is increasingly evident that healthy biodiversity is key to well-functioning natural ecosystems and people's health and livelihoods. Yet, there has never been a simple way for the public to consider how large groups of Australia's animals and plants are faring over time.

To determine how Australia's animals and plants are faring over time, a dedicated team of researchers from the Threatened Species Recovery Hub worked with more than forty partners from all of Australia's state and territory governments, major non-government, and not-for-profit conservation organisations such as BirdLife Australia, Australian Wildlife Conservancy, Bush Heritage Australia, and individual community members to develop the Australian Threatened Species Index. To build the index, the team spent five years collecting and combining data from hundreds of threatened species monitoring programs and created a database representing thousands of sites and species all around the country. The data was fed into models that produced trend lines, showing how populations of threatened birds, mammals, and plants have changed over time. The next step was to ensure that anyone could access the data and visualise trends in different parts of Australia for different groups of threatened species. Consequently, a Threatened Species Index website, tsx.org.au, was created for anyone to use and review how threatened species in their region are going.

The information that was discovered was worrying! On average, populations of threatened species in Australia declined to less than half of their abundance twenty years ago. Of the mammals, birds, and plants in the Threatened Species Index database, threatened plants had seen the worst declines, with populations decreasing by more than seventy percent on average in the last twenty years. In other words, seven out of every ten threatened plants have disappeared in just two decades.

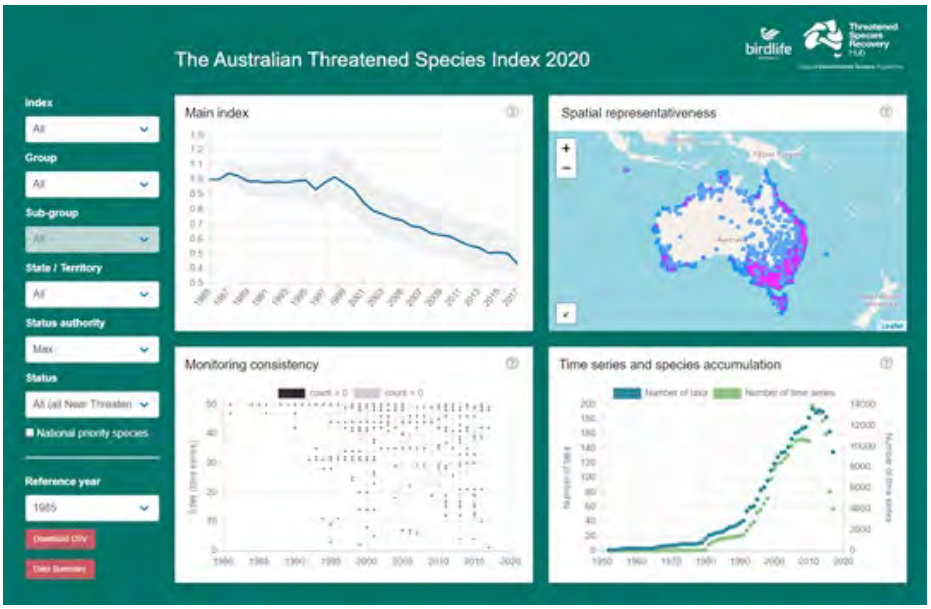
Building New Populations of Challenging Beauties

Some of the longest-spanning plant monitoring datasets identified are orchids, representing more than a quarter of all Australian Threatened Plant Index species. This charismatic and diverse family has over 26,000 species worldwide. Australia alone has more than 1,800 orchids. They represent about six percent of all plant species in the country but, alarmingly, consist of seventeen percent of all plants listed as threatened – more than any other plant family. The index shows that more than six out of every ten individual orchids have disappeared since 2000.

Orchids face many threats, including land clearing, changed fire regimes, competition from weeds, and climate change. They also face unique challenges due to their dependence on specific pollinators and fungi, which themselves can be under threat. For example, the endangered coloured spider-orchid (*Caladenia colorata*) is pollinated by only a single thynnine wasp or flower wasp species, to which the orchid provides a small amount of nectar reward. The orchid also relies on only one species of symbiotic mycorrhizal fungi to germinate in the wild. If these essential interactions with other species in the ecosystem are disrupted, orchid populations could decline to extinction.

Above Left: The endangered Tasmanian devil (*Sarcophilus harrisii*) has been declining due to the deadly devil facial tumour disease that was first spotted in 1996. Image: Micha Jackson.

Above Right: The critically endangered Brindabella midge orchid (*Corunastylis ectopa*). Image: Tom North, Australian National Botanic Gardens.



The Australian Threatened Species Index in 2020, showing how populations of threatened mammals, birds, and plants have decreased in abundance by fifty-five percent on average since 1985. Image: tsx.org.au

Volunteer birdwatchers played a vital role in collecting the information in the Threatened Species Index. Image: Idelies Govett.

The remaining eleven populations of the coloured spider-orchid mostly occur on privately-owned farms. There, vegetation clearing and grazing by cattle and rabbits continue to threaten its survival. Yet, even for such a challenging species, recovery is possible. Scientists from the Royal Botanic Gardens Victoria identified sites in western Victoria where the coloured spider-orchid could be re-introduced – by searching for places where the orchid's wasp pollinator was present. They propagated new orchids in a laboratory, using the orchid's symbiotic fungus, and translocated 883 propagated plants onto a private Trust for Nature covenanted property between 2013 and 2019. Each planted orchid was tagged for monitoring, protected with a cage, and had ongoing weed removal. These populations have started to flower and recruit and are now self-sustaining, increasing the total number of known coloured spider-orchids in the wild from 1,000 to 2,286 plants – a fantastic achievement in such a short time.

Management Does Pay Off

By comparing trends across different species groups, important discoveries were made about whether conservation actions were working or not. Six out of every ten plants have disappeared in sites where weeds and introduced herbivores like rabbits and cattle have been managed. However, it worsens to eight out of every ten plants having disappeared in areas where no conservation actions have occurred. Therefore, the result suggests that conservation actions have reduced the rate of decline at management sites. Unfortunately, efforts have not yet

Translocation is an essential tool used to assist in the conservation of many plants. Western Australian Department of Biodiversity, Conservation and Attractions Threatened Flora Officers collect cactus dryandra (*Banksia anatona*) seeds to propagate plants for a threatened species translocation program. After translocation, plants are protected with guards and monitored to track their survival – the information is fed into the Threatened Species Index. Images: Rebecca Dillon and Leonie Monks.

been enough to halt or reverse declines overall; not all plants receive the level of care of the coloured spider-orchid.

The benefit of management is more evident for threatened mammals. Mammal populations at many sites with targeted conservation actions, such as poison baiting of introduced foxes and feral cats, or ecological fire management, have increased over the last twenty years. However, mammal populations have declined at sites with no conservation actions, showing a sixty percent decline on average. Yet, remarkably, between 2000 and 2016, populations of fifteen threatened mammals at feral predator-free sites increased five-fold. These results highlighted the effectiveness of Australia's safe havens network of predator-free islands and fenced conservation areas, where threatened mammals such as the bilby (*Macrotis lagotis*) and numbat (*Myrmecobius fasciatus*) are protected from introduced predators.

How Can You Help?

The Threatened Species Index currently includes data from anywhere in Australia on threatened birds, mammals, and plants. Almost ten times more monitoring data is available for threatened birds than mammals and plants, primarily due to the fantastic efforts of community birdwatchers coordinated by groups like Birdlife Australia. However, birds make up only four percent of Australia's threatened species, and plants make up seventy-seven percent – 1,342 of Australia's 1,800 listed species.

Many of Australia's threatened species are impacted by human disturbance, historically by poaching and collection activities. Consequently, it is vitally important to ensure that the monitoring of threatened species does not further endanger them by disturbing their habitat or enabling wildlife collectors to access sensitive and protected wildlife populations. Therefore, protocols guide how the location of threatened species can be shared. The Threatened Species Index presents information to the public on trends at a regional scale, protecting the individual monitoring sites of threatened species – some of which might still be vulnerable to collection activities and the illegal wildlife trade, despite heavy fines.

There are, however, many threatened species populations that are known to local conservation groups and councils. Many of which are found in and around urban areas. If you are keen to get involved in monitoring threatened plant species, which are most in need

Macquarie University PhD student Tom Pyne is undertaking a flora survey in Ku-ring-gai Chase National Park, New South Wales. Image: Rachael Gallagher.

The nationally threatened golden-shouldered parrot (*Psephotus chrysopterygius*), or Alwal in Olkola language, is a significant cultural species for Indigenous peoples in Far North Queensland. Image: Micha Jackson.

Australian Department of Biodiversity, Conservation and Attractions Threatened Flora Officer, Leonie Monk, surveying Foote's grevillea (*Grevillea calliantha*). Image: Rebecca Dillon.

Left: the endangered pink-lipped spider orchid (*Caladenia behrii*). Image: Bob Bates.
Above Right: the coloured spider orchid (*Caladenia colorata*). Image: Noushka Reiter, Royal Botanic Gardens Victoria.
Bottom Right: the vulnerable leafy greenhood (*Pterostylis cucullate*). Image: Bob Bates.

of additional monitoring effort, it involves just a few simple steps. With the help of your local council or state or national native plants society (e.g., anpsa.org.au), locate a patch that contains a threatened plant species, and count the number of individual plants in a well-defined area. Revisit your patch once or twice a year and use the same searching method and the same amount of effort each visit. Take great care not to disturb the plant or its habitat when looking for it. Then tally up your numbers and contribute your data to the Threatened Species Index using the online submission template. It is important to monitor species at the same place using the same approach over many years, even if that does not sound like too much fun. However, without this rigour, we cannot accurately assess how species are doing over time.

Moving Forward to Save Australia's Threatened Species

Australia's plants and animals are unique – many are found nowhere else in the world. Many threatened species, particularly plants, lack data on their trends and have limited to no conservation funding and no recovery plans to guide how funding might be spent if funds became available in the future. Australia needs a radical overhaul of how much funding is allocated to conserving our unique natural heritage. Without such change, it is likely that many threatened animal and plant populations will continue to decline at an alarming rate. Extinctions are irreversible and have flow-on effects on the ecosystem around them – the loss of native species impacts humans and future generations. We lose essential services that those species provide, like pollination, and lose one more part of the ecosystem that can no longer bring us joy and enrich our world.

The last few years have been tough for native species. The 2019-2020 bushfires pushed more than a hundred of Australia's threatened species, like the Kangaroo Island dunnart (*Sminthopsis aitkeni*), closer to extinction. The coronavirus pandemic has had global consequences on economies and environmental spending. Despite these challenges, there is a reason for hope. Insights from the Threatened Species Index shows that it can pay off where dedicated conservation management is being implemented. The Threatened Species Index aims to help build public knowledge and awareness of the plight of threatened species, inform what species require urgent recovery action, engage individuals, groups, and governments in conservation action, and motivate collective action to stop further declines of native species before it is too late.

The development of the Threatened Species Index was supported by the Threatened Species Recovery Hub of the Australian Government's National Environmental Science Program and BirdLife Australia. It is the first of its kind in Australia, providing an evidence-based national-level understanding of threatened species trends.

Ground Parrots

The Society's Wildlife of the Year

Doctor Julie Old

This year, the Australian Wildlife Society's animal of the year consists of three species, all in the Genus *Pezoporus* and otherwise known as Australia's ground parrots. The three species of ground parrots include the western ground parrot (*Pezoporus flaviventris*), the eastern ground parrot (*Pezoporus wallicus*) and the night parrot (*Pezoporus occidentalis*).

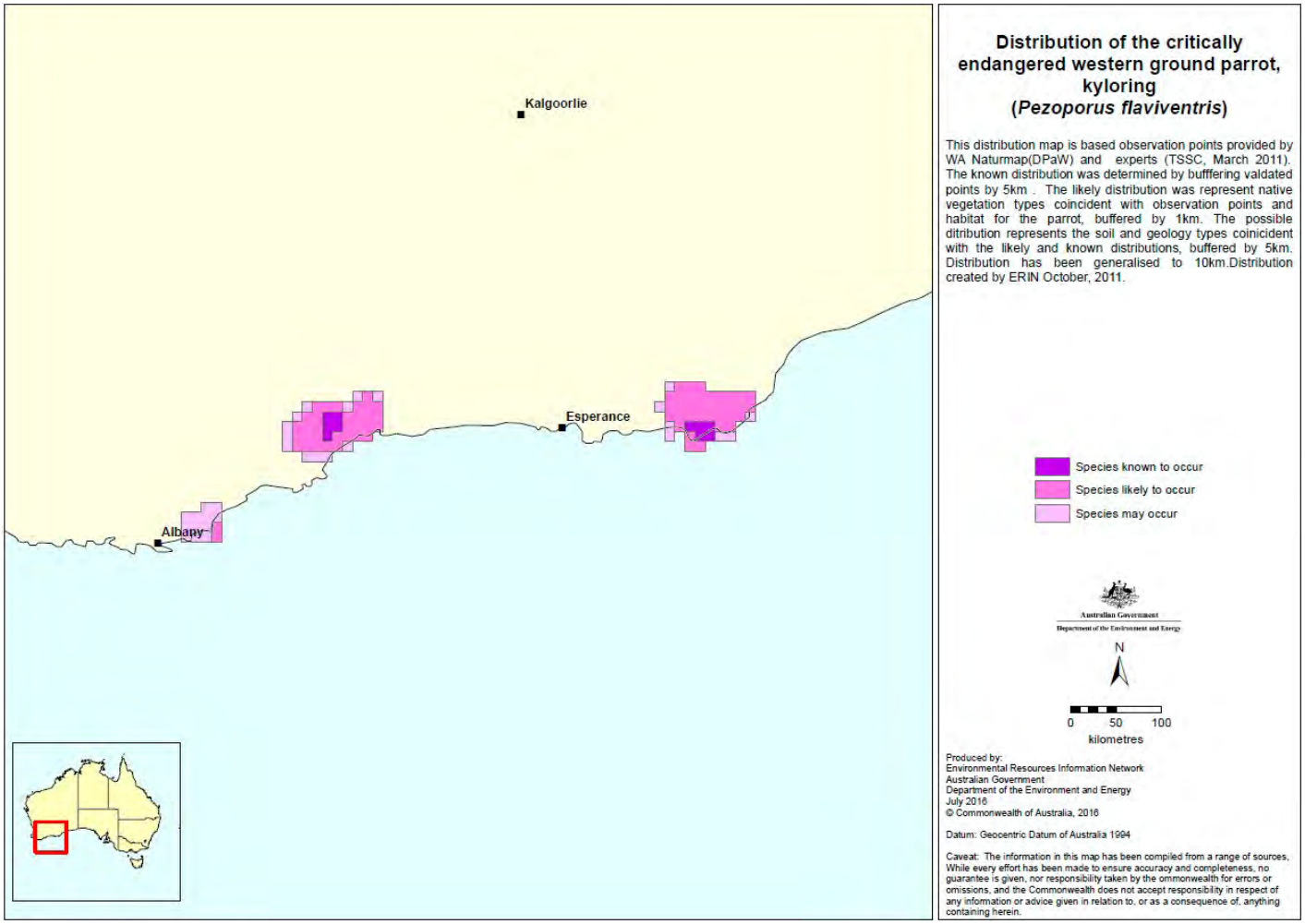
The Society recently supported Friends of the Western Ground Parrot's western ground parrot recovery efforts in Western Australia. In partnership with the Department of Biodiversity, Conservation and Attractions, Friends of the Western Ground Parrot installed twenty-five predator camera traps into potential western ground parrot translocation sites for predator detection and management purposes. The camera traps are required to undertake predator surveillance (feral cats and foxes) to guide necessary management actions to conserve the western ground parrot. Four feral cats and one fox have already been detected, and subsequently, the Department of Biodiversity, Conservation and Attractions implemented appropriate predator control.

Western ground parrots were first photographed in 2004. Whilst they are yet to be formally assessed by the International Union for the Conservation of Nature, given the low numbers of individuals, around 150, and the main threats to the species, they are likely to be listed as Critically Endangered. The main reason for their critically endangered status is significant declines in distribution and population size due to habitat clearing for agriculture.

Western and eastern ground parrots are similar in appearance, and therefore it was not until 2010 that genetic studies confirmed they were two separate species. Western ground parrots differ slightly from the eastern ground parrot in their appearance due to yellow on the underside of their tail and belly. Their tail also has black bars, whereas the eastern ground parrot is bright green on the belly and underside of the tail. Both parrots are otherwise green with black flecks and have a red band of colour just above the beak.

Previously, western ground parrots were distributed along the coast of south-west Western Australia, from Israelite Bay to Geraldton. Now they are limited to two main areas on the southern coast of Western Australia, with the largest population being in Cape Arid National Park. They have also been recorded in the Fitzgerald National Park, Nuytsland Nature Reserve, and Waychinnicup-Manypeaks.

Above: The western ground parrot (*Pezoporus flaviventris*) is listed as Critically Endangered and is under threat from historical habitat clearing for agriculture, frequent and extensive fires, predation by feral cats and foxes, and climate change. Image: Brent Barrett, Department of Biodiversity, Conservation and Attractions.



Distribution of the critically endangered western ground parrot (*Pezoporus flaviventris*). Image: Department of the Environment and Energy July 2016, Distribution of the critically endangered western ground parrot, kyloring (*Pezoporus flaviventris*), viewed 25 July 2021, bit.ly/WGPdistribution

Western ground parrots prefer low heathland habitats with a large number of sedges, specifically those that have not been burnt for more than four decades. However, they have also been observed in areas that are regenerating after several years post-fire, as long as there is long-established unburnt vegetation adjacent to it. Fire is, therefore, one of the biggest threats to the species, which is only expected to increase as a result of climate change. Introduced feral cats and European foxes (*Vulpes vulpes*) also pose significant threats given the birds ground-dwelling habits. Dieback, as a result of *Phytophthora cinnamomi,* is also impacting some vital food plants.

Western ground parrots mostly eat seeds, flowers, fruits, and leaves from a variety of plant species. Seeds are consumed from the sedge *Mesomelaena stygia* subsp. *stygia*, whilst flowers are eaten from grevilleas, beaufortias, and dryandras.

Precise numbers of western ground parrots are difficult to determine because they are elusive, rarely fly during the day, and are often only observed singularly or in pairs. Furthermore, their colouring allows them to be perfectly camouflaged in low vegetation. However, they can be heard calling at dusk and dawn, using a call described as an old-fashioned boiling kettle.

A captive breeding program was established at Perth Zoo in July 2014 with the hope of one day breeding them in captivity and releasing them back into the wild. At present, the zoo supports the conservation of the species by observing their behaviour and developing better husbandry protocols to aid breeding. They nest on the ground in a shallow scrape in the wild and lay up to five eggs, usually three to four. The young have been recorded from September to November at Cape Arid National Park.

In contrast, the eastern ground parrot resides in heathlands, sedgelands, and areas of button grass plains, with dense areas of low bushes and reed beds. Like the western ground parrot, it is also found in fragmented populations but is secure, with an estimated 4,000 breeding individuals remaining. Its range includes Tasmania and some of the offshore islands in the Bass Strait and extends along the coast of Victoria, New South Wales, and southern Queensland. It is listed as Vulnerable in Victoria, New South Wales, and Queensland, Endangered in South Australia, and secure in Tasmania and nationally. Threats to its status include habitat modification, and as with the western ground parrot, introduced predators and fire. The breeding period for the eastern ground parrot is from September to January.

By far the most elusive of the Australian ground parrot species, and perhaps the most elusive of birds worldwide, is the night parrot. It was first described by John Gould, the famous ornithologist in 1861, and was believed to be extinct due to a lack of confirmed observations between 1912 and 1979. Very rare sightings have been recorded since, including a sighting of a flock in far north South Australia and a roadkilled individual in 1990 in a remote area of Queensland. Hence, the International Union for the Conservation of Nature currently lists the night parrot as Endangered, suggesting there might be between 50-250 or more individuals remaining. Nationally, the night parrot is listed

as Endangered. It is also listed as Endangered in Queensland and South Australia and Critically Endangered in the Northern Territory and Western Australia.

Sightings or recordings of the night parrot have been attributed to Astrebla and Diamantina grasslands in southwestern Queensland (2006), the Fortescue Marshes in the Pilbara and Kimberley regions of Western Australia, as well as Kalamurina Station near Lake Eyre in South Australia, and areas in the Northern Territory. However, controversially, some photographs and sightings of the night parrot have since been retracted.

Ornithologists, however, captured and tagged a live night parrot in southwestern Queensland in 2015, the exact location of which has remained a secret to aid its conservation. Fledglings have also since been photographed in 2016 and 2018 in Pullen Pullen Reserve in southwestern Queensland.

While some aspects of its appearance are similar to both the western and eastern ground parrots, the tail of the night parrot is significantly shorter. It also differs in its distribution and habitat, preferring the arid interior spinifex grasslands. However, it may also occur in chenopod and mallee shrublands, as well as eucalypt woodlands. It is believed to eat herbs and seeds from Triodia grasses, but further research is required to gain a better understanding of the species.

Predator camera trap. Image: Helena Stokes, BirdLife Australia.

A recent study by Vera Weisbecker and colleagues at Flinders University examined the skull of a specimen found dead on a barbed wire fence using computed tomography or CT scans. Interestingly, the scans suggested that the visual system of the night parrot was more similar to diurnal parrots than other nocturnal birds, and it is likely that at night their visual resolution is poor. Weisbecker and colleagues made these conclusions based on the night parrot having smaller eyes than other nocturnal birds and smaller optic nerves and optic lobes in the brain, both essential for visual processing. Limitations with night vision may mean the nocturnal parrot would have difficulty avoiding obstacles such as the barbed wire fencing that led to the death of the individual night parrot examined in the study and predators such as introduced foxes and feral cats.

So, it is without a doubt that Australia's ground parrot species are unique. The Society is proud to highlight these species in 2021 as our species of the year and hope that these species will be conserved for future generations with our members' ongoing support.

A feral cat in potential western ground parrot habitat. Image: Department of Biodiversity, Conservation and Attractions.

Australian Wildlife Society

NATIONAL COLOURING-IN COMPETITION

The Australian Wildlife Society colouring-in competition is designed to inspire the younger generation to learn about Australia's native wildlife via visual art and creativity. We hope that the experience provides participants with the opportunity to explore and develop a deeper understanding of environmental and wildlife-related issues.

There will be one first, second and third place winner in each state and territory of Australia. The first place finalist in each state and territory will go into a draw to have their artwork published in the Society's magazine *Australian Wildlife*. All first place winners will receive an annual family membership, valued at $70, and a certificate of congratulations. Their artwork will be published in the Society's e-newsletter and social media platforms. Second and third place winners will receive a certificate of congratulations and their artwork will be published in the e-newsletter and social media platforms.

TERMS AND CONDITIONS

When you submit your entry, please include the following information:

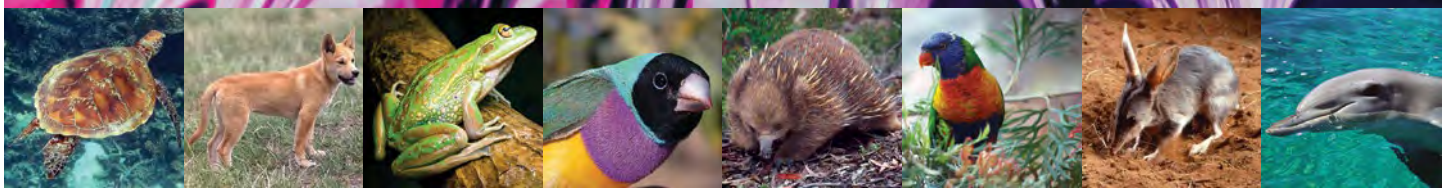
- Your name and age
- Your state of residence
- Telephone number and/or email address (this is how we will notify the winners)
- Parent/guardian's signature as consent for entry into the competition

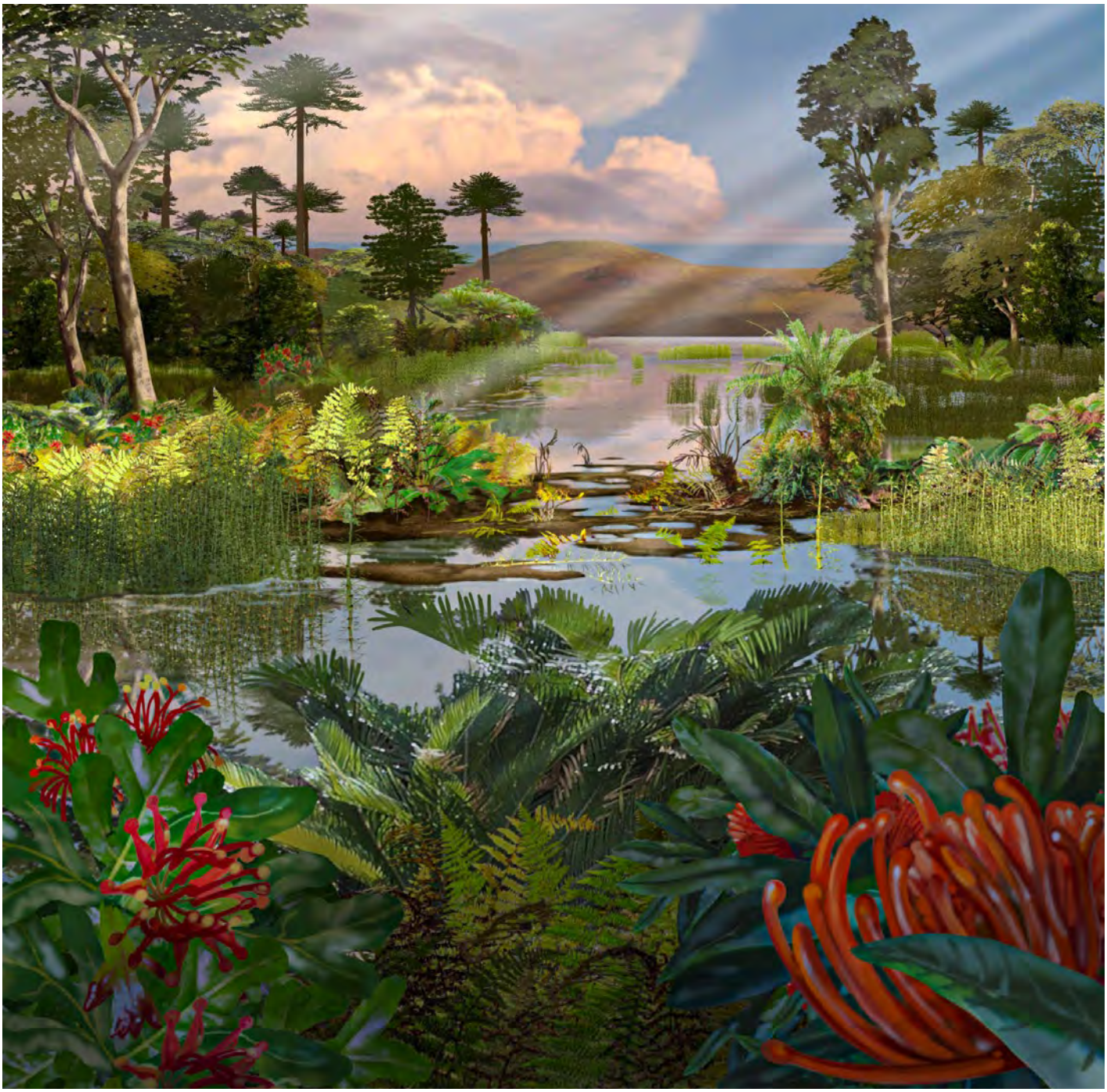
SUBMITTING YOUR ENTRY

- Entries are limited to one (1) entry per person
- To submit your entry, please take a photo or scan the completed artwork and email a copy to info@aws.org.au
- Please name your file according to the format: Name, Age, State (For example: Mark5yoNSW)

CLOSING DATE FOR ENTRIES: 30th NOVEMBER

PARTICIPANTS WILL BE NOTIFIED BY EMAIL/PHONE IN MID-DECEMBER





Prehistoric Insects

Doctor Eliza Middleton

The prehistoric era is full of giant dinosaurs and impressive fossils. Usually, we can name some of those dinosaurs, but do you know whether insects were around? Did insects evolve before or after dinosaurs? Were they running around at the same time? I picture a *Tyrannosaurus rex* with an annoying bite from a prehistoric mosquito that it cannot quite scratch. Insects are also important pollinators. During the reign of the dinosaurs, what was the relationship between pollinators and flowering plants, the angiosperms? In a classic chicken or the egg scenario, which came first, the bee or the flower?

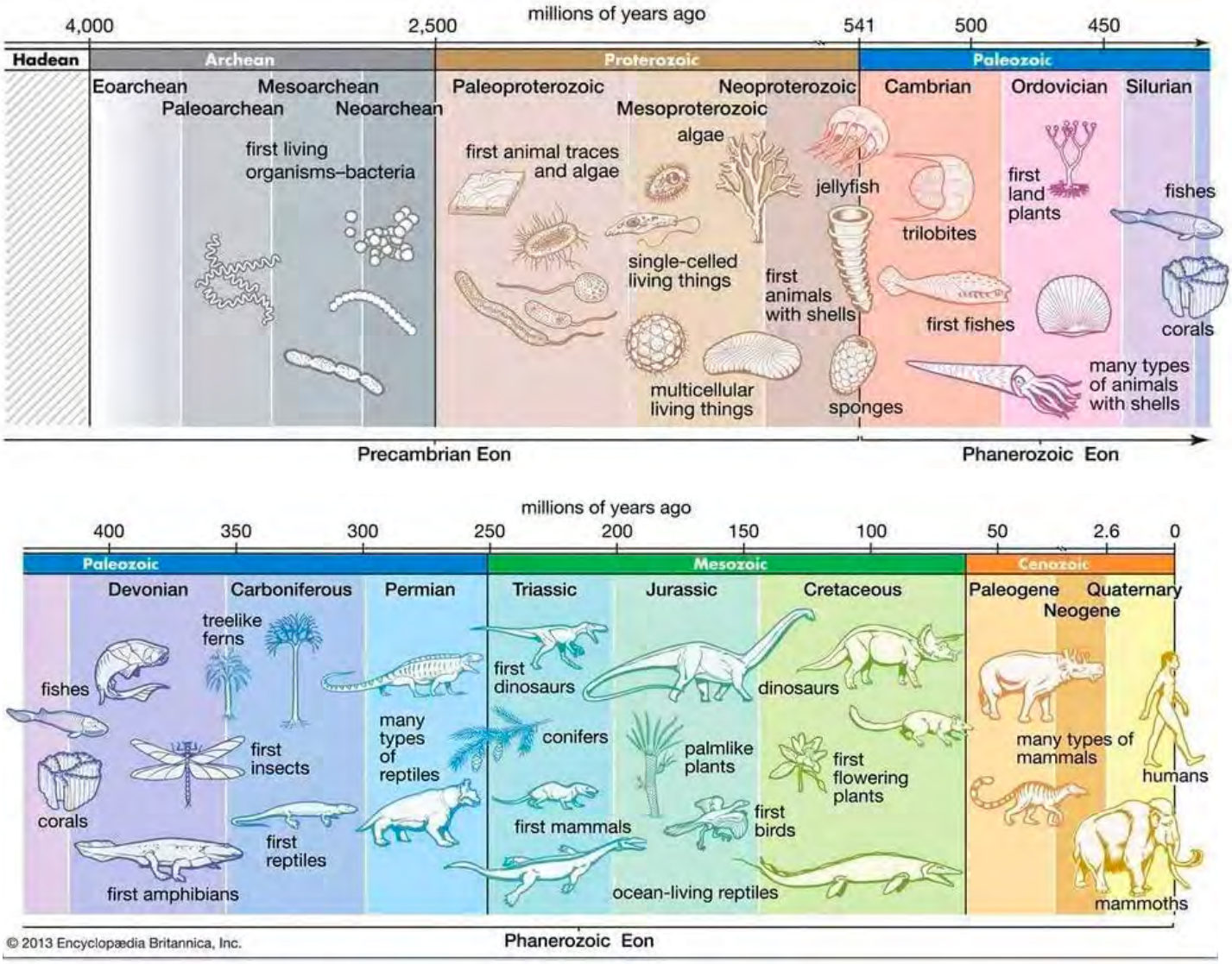
The Beginning of Insects

Insects inhabited the Earth before the time of the dinosaurs. The earliest identifiable insect in the fossil record came from the Devonian period – 407 to 396 million years ago. Dinosaurs did not appear until around 243 million years ago during the Triassic period. Insects during the time of the dinosaurs looked very like what we have today. They have also played an important part in the food chain throughout.

The earliest recorded insect is *Rhyniognatha hirsti*. A partial head and preserved mouthparts were found in a fossil from around 400 million years ago in the Early Devonian period. Its age and exactly what kind of insect it may be is still debated. It may have been a flying insect like a mayfly, or others have interpreted it as a millipede or centipede.

Prehistoric insects were a bit different to modern insects. Prehistoric insects were generally much larger. The *Meganeura* genus, related to modern-day dragonflies, had 'dragonflies' with a wingspan over

Above: An image of what Australia may have looked like during the Late Cretaceous period. Image: Karen Carr, Australian Museum.



Geologic time scale and Precambrian time through the Cenozoic era. Over hundreds of millions of years, life spread through the seas and over Earth's surface. The first life forms were small and simple. Later forms were more complicated and more varied. Image: courtesy of Encyclopedia Britannica, Inc., copyright 2017; used with permission (Geologic Time) and courtesy of Encyclopedia Britannica, Inc., copyright 2016; used with permission (Precambrian).

half a metre, around the size of a seagull. Our largest modern dragonflies are around nineteen centimetres, and the longest stick insects reach around fifty centimetres in length.

Higher levels of oxygen in the past contributed to the increased size of the insects. Current levels of oxygen are ten percent lower than in prehistoric times, part of the reason we do not see insects as large today. We may have also lost large insects when dinosaurs evolved into birds. They took to the air, now able to predate on and compete with larger insects.

Which Came First, The Bee or the Flower?

Flowers need bees for pollination, but bees need flowers for sustenance. These two branches of the tree of life have evolved to rely upon each other so tightly that you cannot have one without the other. So, which came first: bees or flowers?

Plants first colonised the land about 450 million years ago during the Ordovician period. The Ordovician period was a time when invertebrates dominated the seas, in the forms of molluscs and arthropods, and when fish started to evolve and diversify rapidly. During this time, animal life had not made it to the land, but we see the beginnings of plants. Plants similar in appearance to modern-day liverworts and mosses began colonising the land. In this instance, the plants came first, but what about flowering plants? Well, for the next 300 million years, there was not a single flower. Instead, as plants evolved, we see plants similar to ferns, conifers, ginkgos, and cycads. Insects began evolving from as far back as 400 million years ago, but there were no bees.

During the early Cretaceous period – 125 million years ago, the height of the reign of the dinosaurs, flowers appeared suddenly in the fossil record. Not only did they appear suddenly, but they were also in great diversity. This diversity posed a problem for the theory of gradual evolution that Charles Darwin called "an abominable mystery." These flowering plants, called angiosperms, quickly spread during the Cretaceous period. Today, angiosperms account for ninety percent of all plant species, including most food crops. In fact, nine out of every ten plants on Earth is a flowering plant.

Why did Flowering Plants Evolve?

Despite being stuck in one place, plants have evolved different strategies for exchanging sex cells with far off partners. Non-flowering plants like conifers rely on the wind to deliver their pollen (the plant equivalent of sperm), which is not efficient or reliable. Almost one hundred percent of pollen goes to waste, never finding a female plant to reproduce with.

The flowering plants were able to take advantage of a third party to spread their pollen, insects. It turns out that nectar is a side product. Initially, insects visited flowers for the highly nutritious pollen. You can still see that today. Magnolia trees are one of the oldest flowering plants still in existence. They have no nectar, and instead, beetles and bees will visit these flowers for the pollen. Magnolias developed these flowers before the bees evolved.

The earliest pollinators would hop from flower to flower eating pollen. As the pollinators moved about, they accidentally dropped pollen onto other flowers, and that is how they became the first pollinators, sex facilitators for plants – a beneficial and productive mutualistic relationship. Insects ate highly nutritious pollen, and flowering plants increased their reproductive success. Flowering plants pollinated by insects had an advantage over plants relying on the wind, allowing flowering plants to explode and diversify across the world. Insects now had a delicious reason to visit flowers, and flowers had a good reason to attract insects. An arms race began. Plants competed to have the most attractive flowers for pollinators to find and visit, which led to a diversity of colours, shapes, smells, and eventually nectar to sweeten the deal.

So, What About the Bees?

Bees appear after the flowering plants have made an entrance. Honeybees are the most famous flower farmers. Many modern species of bees live alone, giving us a hint of their origin. By studying DNA and anatomy, we know that bees evolved from solitary carnivorous wasps – *Sphecidae*. These wasps would stock their nests with insect corpses or the paralysed bodies of their prey. If that insect had recently visited a flower, its corpse might be dusted with a little bit of pollen. Over time, some wasps replaced their dead insect diet with more and more protein-rich pollen. Bees are essentially wasps turned vegetarian.

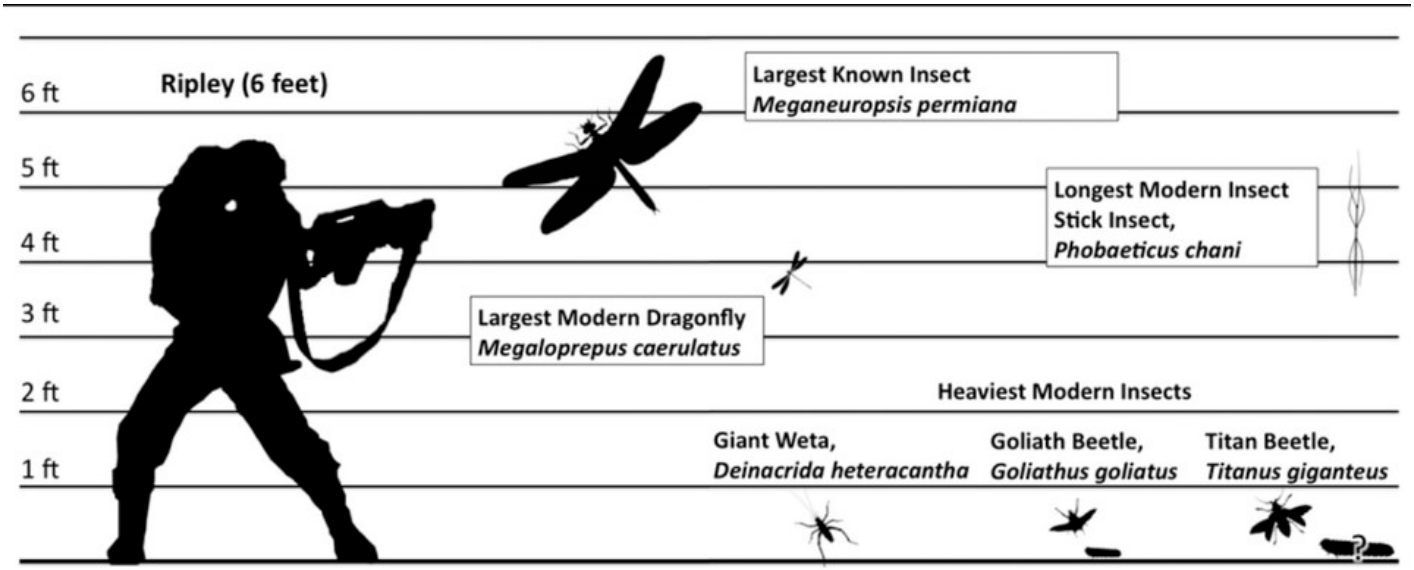
The fossil record of insects is patchy and incomplete. Despite this, researchers have been able to piece together a lot of information and continue to make discoveries. The oldest known bee trapped in amber is about eighty million years old. This bee was a type of social bee that lived in large colonies like modern honeybees and suggested that the earliest solitary bees evolved long before this. When we look at DNA and the divergence of evolutionary lineages between bees and wasps, the first bees appeared about 130 million years ago and was likely shortly after the first flowers appeared.

Plants were making flowers, and insects were pollinating them long before bees arose. Yet, the special adaptations of the bees allowed flowering plants to dominate the world like they do today. After the meteor impact sixty-five million years ago that killed most dinosaurs, bees allowed flowering plants to recover. The fruits that those plants produced then let mammals fill the roles once occupied by dinosaurs.

To Recap

Insects evolved not long after non-flowering plants made the transition from water to land. After about 300 million years, flowering plants then burst onto the scene. Shortly after that, insects started to specialise as pollinators, heralding the emergence of bees. Prehistoric insects were much larger than today. They existed before and well after the last of our non-avian dinosaurs went extinct. Without the continued presence of our avian dinosaurs (i.e., birds), we could have enormous insects flying around today. I am not sure which I would prefer more: I love the laugh of a kookaburra, but a dragonfly the size of a seagull sounds like a sight to be seen!

Doctor Eliza Middleton is a postdoctoral researcher and lab manager at the University of Sydney. She examines the resilience in biological systems, championing social insects, such as ants and bees, as great study tools for resilient systems and working on slime and snails to gain a greater appreciation for the development of resilience. Eliza is also a regular guest on 702 ABC Sydney Radio with Richard Glover for Self-Improvement Wednesday.



The griffenfly (*Meganeuropsis permiana*) compared to the largest living insects and a six-foot-tall human. Image: Michael Bok, Lund University, Sweden.

2021 University Research Grant Winners

The Australian Wildlife Society's University Research Grants are scholarships offered to honours or postgraduate students at Australian universities. Each year, ten grants of $1,500 are awarded. Grants are available for research projects of direct relevance to the conservation of Australian wildlife (flora or fauna). Grants may be used to purchase equipment and consumables, travel expenses related to field research, or attendance at conferences at which you are presenting your work.

The Australian Wildlife Society is delighted to announce the winners of the ten grants of $1,500 each to honours or postgraduate students conducting research that will contribute to the conservation of Australian wildlife. **The winners for 2021 are:**

GRACIE LIU
School of Biological, Earth and Environmental Sciences, University of New South Wales

Project Title:
How can we improve frog conservation in fragmented landscapes? Closing the gap with a novel genetic approach

GRANT LINLEY
Institute for Land, Water and Society, Charles Sturt University

Project Title:
The influence of landscape-scale fire refuges and pyrodiversity on mammal communities following an unprecedented megafire

KYLE BREWER
Clinical and Health Sciences, University of South Australia

Project Title:
pH-Responsive 1080 implants for the mitigation of the cat-astrophic predation of native animal populations

BETHANY NORDSTROM
School of Biological Sciences, University of Western Australia

Project Title:
Assisted colonisation of the western swamp turtle

BIANCA KEYS AND KARLI MYLIUS
Institute of Marine and Antarctic Studies, University of Tasmania

Project Title:
Assessing microplastic exposure through non-invasive examination of guano in resident Tasmanian shorebirds

ERICA DURANTE
Future Industries Institute, University of South Australia

Project Title:
Investigating the age and growth of an endemic octopus species

GOD'SPOWER OKOH
Veterinary and Biomedical Sciences, James Cook University

Project Title:
Investigating herpesvirus infections in Australian wildlife

PATRICK FINNERTY
School of Life and Environmental Sciences, University of Sydney

Project Title:
Strategically exploiting plant odours to manipulate mammalian herbivore foraging behaviours as a conservational tool

SHAE JONES
School of Earth, Atmospheric and Life Sciences, University of Wollongong

Project Title:
Do arbuscular mycorrhizal fungi help grasses in heat waves?

JENNA DRAPER
School of Biological Sciences, University of Adelaide

Project Title:
Conservation utility of *Pimelea microcephala* subsp. *microcephala* to arid zone frugivores and pollinators

2020 Australian Wildlife Society

University of Western Sydney Wildlife Ecology Research Scholarship

Koalas Going with the Flow

Ivan Kotzur

Ivan is our 2020 Australian Wildlife Society Western Sydney University Wildlife Ecology Research Scholarship Recipient

The 2019 drought, and the hot smokey summer that followed, threatened many koala (*Phascolarctos cinereus*) populations with overheating and dehydration. We have seen pictures of koalas approaching cyclists for a drink of water from their water bottles, and Kulin people tell of the koala taking control of the water in the country when it is mismanaged. During the drought, some koalas were forced to leave their dry *Eucalyptus* trees to hydrate and cool themselves down by means other than sweating. Suppose you braved the forest during the drought; a unique behaviour in the journey of koala thermoregulation may have been witnessed. Suppose you did manage to spot the solitary animal without the help of Global Positioning System tracking. In that case, the koala may have been observed spreading its limbs and belly across a large cool branch close to the ground, allowing heat to be drawn away into the bark. 'Tree-hugging' is a behaviour used during high air temperatures, above approximately 30°C, along with increased panting and shade seeking to lower the body temperature.

In many koala populations, clearing habitat for agriculture, development, and forestry limits the number of 'habitat trees' available for koalas to cool during high temperatures. Generally, fewer trees persist, and the resulting communities have warmer and drier local climates than densely treed communities. Across koala habitats, climate warming and drying is occurring mainly due to climate polluting industries. As a result, New South Wales and Queensland ecosystems will experience more frequent and intense periods of heat stress, and koalas must rely on 'tree-hugging' to deal with the physiological pressure. Researchers from Western Sydney University established a project to identify and improve the understanding of the capacity of tree-koala heat transfer, which can reduce heat stress at critical times.

We already know from Natalie Briscoe and others that the temperature difference between the bark of a tree and the surrounding air can be up to 9°C – at the base of a 'habitat tree' during hot weather. The temperature difference is significant compared to the temperature of a koala (35.5°C to 36.5°C); however, we do not know how the temperature difference changes as the trees adjust to extreme and variable weather conditions. Some *Eucalyptus* trees can move up to thirty-eight litres of water or more per day in the sap flow under the bark of a tree – the water transfers from the roots out of the soil, which is cooler than the air temperature. Sap flow creates a drop for external heat sources in the bark of 'habitat trees' by transferring heat further up the tree and drawing the cool water from the soil below. Koalas feel the transfer of cooler temperature when 'tree-hugging', and you may too after hiking on a warm day. There is no better place to cool down than at the base of a big smooth-barked gum tree (*Angophora costata*).

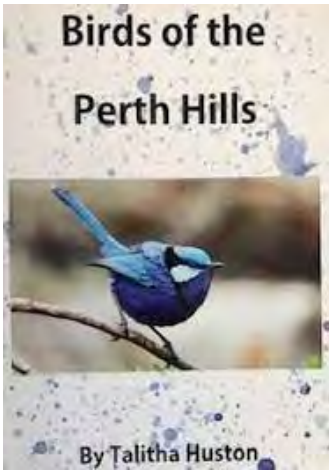
Koalas will retreat from their preferred feed tree to take up a cooling position in a characteristic and cooler 'habitat

Marble, the koala, losing some heat through the bark of a habitat tree'. Image: Matthew Stanton.

tree'. However, good cooling options are limited by the tree availability in the koala's home range. The selection of an ideal cooling position can be decreased by mismanaging koala habitat, where only a small list of specific feed trees is being preserved. Additionally, bark heat conductance is most likely controlled by the rate of sap flow and water transpired from the tree's canopy after it passes through the branches of the tree. Consequently, there may be times of drought and heat where the low sap flow rate does not allow much cooling by 'tree-hugging' when the koala needs it most.

The capacity of habitats to protect koalas from stress during seasonal or extreme changes is essential, particularly due to the threat of climate change. However, the koala in average conditions may overlook critical periods where characteristic 'habitat trees' no longer buffer heat effects on a koala's physiological tolerance. By applying energy through a heat transfer sensor bound to the bark of a 'habitat tree', researchers from Western Sydney University will measure the conductance of the tree bark for its magnitude and changes with temperature, humidity, and tree water availability. So far, the researchers have tracked koalas at a site near Sydney, including the exact trees used. The project will also measure the heat fluctuation in trees in different weather and seasons to see if conductance magnitude makes 'tree-hugging' a cool way to go.

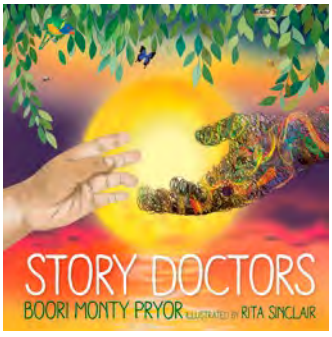
Book Reviews



Birds of the Perth Hills - *Talitha Huston*

After taking over 1,000 photos on her family camera, seventeen-year-old author, and photographer Talitha Huston, has published a book on the *Birds of the Perth Hills* in Western Australia. Primarily dominated by Marri and Jarrah forests, Talitha emphasises the beauty of Western Australia's precious birdlife and environmental surroundings. The book is an identification and information guide of the local birdlife and includes photography tips, a conservation rating for each bird, and the Noongar names of each species. From the red-capped parrot (*Purpureicephalus spurius*), which is endemic to the southwest of Western Australia, to the Carnaby's black cockatoo (*Calyptorhynchus latirostris*), an endangered species due to habitat loss and competition with other hollow-nesting species, there is sure to be a bird that will become your ultimate favourite. Furthermore, ten percent of the proceeds go to Kanyana Wildlife Rehabilitation Centre (the Australian Wildlife Society's 2018 Community Conservation Award winner).

Publisher: Self-published | RRP: $22.00



Story Doctors - *Boori Monty Pryor and Rita Sinclair*

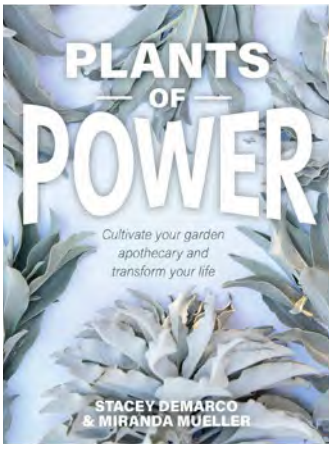
"We as a nation have been unwell for a very long time now…" are the words of legendary and much-loved First Nations storyteller Boori Monty Pryor. Boori offers a rich account of Australia's true history, drawing on his gentle instinct to teach and heal through 'Eco Echoes' - words of medicine. First Nations people were shaped from and by the earth, and if we listen to Boori's words - we all belong. *Story Doctors* is beautifully illustrated, by Rita Sinclair, from wombat footprints to gecko cave paintings and green shoots so small to trees so tall. *Story Doctors* is inspiring and encourages 'Healing Country' through 'Eco Echoes'.

Publisher: Allen & Unwin | RRP: $24.99

Nestling Cockatoos: The story of Squeak and Squawk - *Angela Robertson-Buchanan*

Angela Robertson-Buchanan writes wildlife rescue books for children from her unique perspective as a wildlife carer. Her books provide an insight into the care and rehabilitation of our native wildlife, and she hopes to inspire the next generation of wildlife warriors. *Nestling Cockatoos: The story of Squeak and Squawk* is a beautiful story of two sulphur-crested cockatoos (*Cacatua galerita*) who were rescued when their tree-hollow home was cut down. They were only two weeks old. The book describes Squeak and Squawk's rehabilitation to the point of release back into the wild. With cockatoo facts listed at the end of the book, there is plenty to learn about these beautiful animals.

Publisher: Wild Dog Books | RRP: $24.99

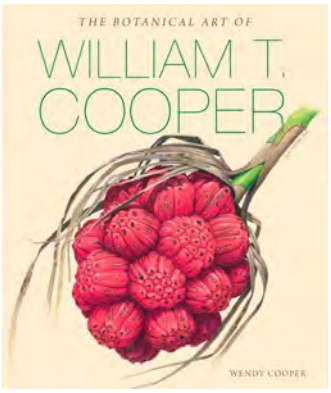


Plants of Power - *Stacey Demarco and Miranda Mueller*

In times of ongoing uncertainty, people are looking for ways to reclaim their relationship with nature. *Plants of Power* shows how to do just that. Authors Stacey Demarco and Miranda Mueller provide a modern guide to sixty-six foundational plants you can grow in your garden - no matter how much space you have. They show how to reconnect with the natural world and tap into the power of plants, whether for mood, healing, love, or other aspects of our lives. Readers will learn the history of these plants, understand how to grow them, the medicinal benefits, nutritious recipes, and that planting by seasons increases growing success. *Plants of Power* is a fun and practical guide to understanding our powerful plant allies.

Publisher: Rockpool Publishing | RRP: $39.99

Book Reviews



The Botanical Art of William T. Cooper - *Wendy Cooper*

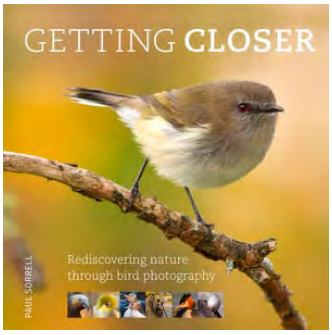
William Cooper was one of the world's most esteemed bird painters. In his paintings, birds nibble at plump red berries, rest on branches covered with lichen, and clutch forest fruits in their talons. These botanical details, the backdrops to his bird portraits, celebrate Australia's flora and are the subject of a new lavishly illustrated book written by his botanist wife, Wendy Cooper. In *The Botanical Art of William T. Cooper*, William's sketches and studies and paintings of plants provide a unique insight into his artistic process. Wendy's notes about where a specimen was collected or what attracted William to a fruit of a flower complement her husband's art. Be taken on a journey from rainforest to dry country, from swamps and beach forest to the jungles of north Australia.

Publisher: NLA Publishing | RRP: $65.00

Flames of Extinction: The Race to Save Australia's Threatened Wildlife - *John Pickrell*

In *Flames of Extinction,* award-winning science writer, John Pickrell, investigates the effects of the 2019–2020 bushfires on Australia's wildlife and ecosystems. Journeying across the firegrounds, John explores the stories of wildlife that escaped the flames, the wildlife rescuers who rescued them, and the conservationists, land managers, Aboriginal rangers, ecologists, and firefighters on the front line of the climate catastrophe. John also reveals the radical new conservation methods being trialled to save as many wildlife species as possible from the very precipice of extinction. Although many stories are brought to light, the Society's very own Rehabilitation Award Winner for 2019 and recipient of one of our Wildlife Affected by Fire' grants is featured in *Flames of Extinction.* John Creighton, the founder of Wombat Care Bundanoon, is recognised for the marvellous work he implemented during the 2019-2020 bushfires to protect the bare-nosed wombat in the Southern Highlands, New South Wales. Furthermore, one of the Society's New South Wales Platypus and Turtle Alliance members, the University of New South Wales's Centre for Ecosystem Science, is also featured for their tremendous work on surveying the health and numbers of platypus in both burned and unburned creeks in the Manning and Hastings River Catchments.
An emotional yet inspiring book that brings to light the devastation and large-scale impact of Australia's bushfires on Australia's wildlife and ecosystems, which encourages wildlife conservation action before it is too late.

Publisher: NewSouth Publishing | RRP: $29.99



Getting Closer - *Paul Sorrell*

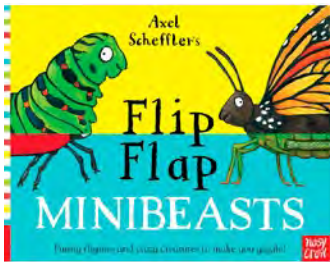
With *Getting Closer* to guide you, and a camera in hand, learn how to connect with nature using a photographer's eye. *Getting Closer* is an illustrated discussion of photography to achieve greater intimacy with the natural world. With a focus on birds, the book is directed primarily at photographers, birders, and people interested in the outdoors. Enjoy an array of birdlife, from a silvereye (*Zosterops lateralis*) cleverly balancing on a branch while feasting on autumn berries to a white-fronted tern (*Sterna striata*) feeding its chick along the edge of a waterway. The author offers hands-on techniques that will enable readers to connect deeply with their environment and become proficient wildlife photographers.

Publisher: Exisle Publishing | RRP: $39.99

Spirit of the Garden - *Trisha Dixon*

Featuring a series of written reflections, *Spirit of the Garden* explores the value in gardens and landscapes and the different approaches to garden design, framed in the context of a harsh and changing climate that we need to embrace. The author welcomes a shift towards landscape design to show an intimate engagement with the spirit of place, acknowledging the Aboriginal history and mythology embedded in the land. Full-colour photographs showcase everything from a eucalypt reflected in a still pool to mossy outcrops in an escarpment garden on Sydney's Northern Beaches. The message of *Spirit of the Garden* is the need to understand and respect the environment in our garden making.

Publisher: NLA Publishing | RRP: $65.00



Flip Flap Minibeasts - *Axel Scheffler*

What do you get if you cross a ladybird with a grasshopper? It is a ladybopper, of course! And how about a millipede with a stag beetle? Why, that is a millipeetle! With over 121 possible creations, silly names, and strange noises to make you giggle, this new Flip Flap book is perfect for pre-schoolers and ideal for creepy-crawly fans. With a hilarious rhyming text and brilliant illustrations from Axel Scheffler, flip the pages to create some seriously silly mixed-up minibeasts.

Publisher: Allen & Unwin | RRP: $15.99

Membership Form

Membership

Become a member of the Australian Wildlife Society

Simply fill out this form.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

Name:.....

Address: .....

City/Suburb:.....Postcode:.....

Telephone:.....Fax: .....

.....Email:.....

Membership category (please tick)

- ☐ Student (conditions apply): $0
- ☐ Individual (hardcopy magazine): $55
- ☐ Family (hardcopy magazine): $70
- ☐ Concession (pensioner/student/child): $50
- ☐ E-mag (emailed as PDF, no hardcopy will be sent): $30
- ☐ Associate (library, school, conservation groups): $85
- ☐ Corporate: $125
- ☐ Life: $2,000

(Includes postage within Australia. Add $40 for overseas postage)

Three year membership (please tick)

- ☐ Individual (hardcopy magazine): $150
- ☐ Family (hardcopy magazine): $190
- ☐ Concession (pensioner/student/child): $135
- ☐ E-mag (emailed as PDF, no hardcopy will be sent): $81
- ☐ Associate (library, school, conservation groups): $230
- ☐ Corporate: $340

(Includes postage within Australia. Add $60 for overseas postage)

Payment details (please tick)

☐ Direct Debit ☐ Cheque ☐ Money Order ☐ Mastercard ☐ Visa Card Security Code (CSC) __ __ __ __

Card Number:

Name on Card:.....Expiry:.....

Signature:.....

Amount $.....

Donation $.....

Total $.....

Mail to the: **Australian Wildlife Society**
29B/17 Macmahon St, HURSTVILLE NSW 2220
Email: accounts@aws.org.au
Website: www.aws.org.au

Direct debit: **BSB:** 062 235
Account No: 1069 6157
Account Name: Wildlife Preservation Society of Australia trading as the Australian Wildlife Society

Membership Hotline: Mob: 0424 287 297

Note: All cheques to be made out to the Australian Wildlife Society

Membership Benefits

Magazine: Receive the quarterly issue of Australian Wildlife via email or post to keep up-to-date with the collective work promoted nationally.

E-Newsletter: Receive the monthly e-newsletter. Keep up-to-date with news from our members and on the work of the Society.

AWS Portal: Access the Members' Resource Centre - your destination for resources and materials on various wildlife-related topics.

Social Media: Contribute to our social media platforms: Instagram, Twitter, Facebook, LinkedIn, YouTube, and Website.

Right to Vote: You have the right to vote on important matters at Society general meetings (financial members only).

Other Benefits: Awards, Scholarships, Grants, and the opportunity to network with like-minded people.

LEAVE A BEQUEST IN YOUR WILL

If you would like to find out how to leave a bequest to the Society or how your bequest can make an impact, please download our bequest information pack.

Graphic Designer and Wildlife Photographer

Michael Ritchie is a graphic designer and avid photographer living on the Central Coast of New South Wales. Michael has an appreciation for Australia's unique wildlife and has recently started focusing his attention on wildlife photography. Michael has assisted the Society with the layout of the Australian Wildlife magazine for more than ten years. He has also helped the Society design and produce other marketing materials such as business cards, membership forms, and brochures. Michael became a member of the Society in 2020 and is a long-term admirer of the Society's objectives in the continued preservation of Australia's unique fauna and flora.

Above Left: Australian pelican (*Pelecanus conspicillatus*) **Above Right:** Green catbird (*Ailuroedus crassirostris*)
Middle Left: Eastern water dragon (*Intellagama lesueurii lesueurii*) **Middle Right:** Brown falcon (*Falco berigora*)
Bottom Left: Red kangaroo (*Osphranter rufus*) **Bottom Right:** Emu (*Dromaius novaehollandiae*)