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)

2021

Colouring-in Competition

Six-year-old Faith
from South Australia

Thirteen-year-old Gabriella
from Victoria

Seven-year-old Zara
from Northern Territory

Eight-year-old Lara
from Australian Capital Territory

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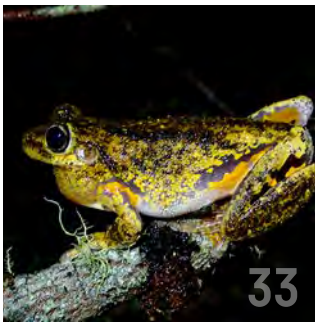

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Megan Fabian
Editor, Australian Wildlife

On the Cover:

Front Cover:
Ian was fortunate to encounter this female giant burrowing frog (*Heleioporus australiacus*) in Ku-ring-gai Chase National Park. The giant burrowing frog is listed as Vulnerable, and threats to this species include disturbance to its habitat, chytrid fungus, reduced water quality, and climate change. The frog is found in heath, woodland, and open dry sclerophyll forests and feeds on invertebrates such as beetles, cockroaches, ants, spiders, and centipedes. Image: Ian Cairney.

Back Cover:
The red-crowned toadlet (*Pseudophryne australis*), a species endemic to the Sydney Basin region, is listed as Vulnerable on the *International Union for Conservation of Nature Red List of Threatened Species*. It is under threat from the clearing of habitat, reduction in water quality, high-frequency fire, collection of bush rock, chytrid fungus, climate change, disturbance to its breeding habitat by recreational activities and forestry operations. Image: Ian Cairney.

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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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

The Board of the Australian Wildlife Society is proud to have chosen Australia's amphibians as the Australian Wildlife Society's wildlife of the year!

Welcome to the Summer 2022 Edition of Australian Wildlife

The Society has been busy over the last few months. We called on the Tasmanian government to remove the protected status of feral deer and reduce numbers to a manageable level, advocated for the protection of the blue gum high forest and Sydney turpentine-ironbark forest in West Pennant Hills, New South Wales, which provides habitat for the critically endangered powerful owl (*Ninox strenua*) and Dural land snail (*Pommerhelix duralensis*), commented on the Draft Kosciuszko National Park Wild Horse Heritage Management Plan and Warragamba Dam Raising Project, and called on the South Australian government to cease any attempt to bring the Pastoral Lands Bill 2020 to the South Australian Parliament to help preserve the South Australian outback and set it aside for biodiversity and wildlife conservation.

The Society continued to advocate for the protection of wildlife threatened by enclosed yabby traps and received a response from the Federal Environment Minister. The Minister supports a coordinated and nationally consistent approach to using alternate trapping methods to minimise impacts on native wildlife such as the platypus (*Ornithorhynchus anatinus*), rakali (*Hydromys chrysogaster*), and water dragon (*Intellagama lesueurii*).

We received a response to our #SnipRingsforWildlife petition, which acknowledged the importance of the campaign. The response focused on plastic waste reduction and stated that the Plastic Reduction and Circular Economy Bill 2021 might provide a framework to address ring-shaped items in the future. The response highlighted that the New South Wales Plastics Action Plan outlines a commitment to review other plastic items for a future phase-out, such as plastic cups and their lids (including dome-shaped lids), in three years to determine whether a phase-out is appropriate at that time. The response stated that the government recently released the New South Wales Waste and Sustainable Materials Strategy 2041. The strategy outlines the government's approach to transitioning to a circular economy over the next twenty years and introduces a new overall litter reduction of sixty percent by 2030 and a plastic litter reduction target of thirty percent by 2025. The strategy will invest $38 million over five years in litter prevention programs to help protect the natural environment, waterways, and wildlife.

In the spring edition of Australian Wildlife, I mentioned that I had been spending a great deal of time in the backyard, like many of you, and the importance of a backyard pond, or another water source, such as that established at the Australian Wildlife Society's National Office, to support our native wildlife, particularly during our hot Australian summers. I have striped marsh frogs (*Limnodynastes peronii*), and Peron's tree frogs (*Litoria peronii*) visit my backyard pond. Sometimes I even see the occasional eastern water skink (*Eulamprus quoyii*) or blue-tongued lizard (*Tiliqua scincoides*). Once, I had a white-faced heron (*Egretta novaehollandiae*) carefully selecting its next tadpole meal, something I was not ever expecting to see in my suburban backyard.

Although the striped marsh frog and Peron's tree frog species are relatively common in urban areas of Sydney, the green and golden bell frog (*Litoria aurea*) is listed nationally as Vulnerable and Endangered in New South Wales. In Sydney, they were discovered in 1992 during the development of the Homebush Bay site for the 2000 Olympic Games. Its discovery led to the construction of vehicle overpasses, frog underpasses, frog-proof fences and the removal of frogs and tadpoles from development areas. They are large frogs, and as their name suggests, they have gold or white stripes on either side of their usually pea-green body, with metallic brown or gold splotches. While the green and golden bell frog remains under threat from a range of factors, including water pollution, loss of habitat, and the invasive and highly fecundate eastern mosquitofish (*Gambusia holbrooki*), there have been some successes, including their ongoing occurrence in areas where captive-bred individuals have been released.

While many threats to the green and golden bell frog are not unique to the species, one of the greatest threats to amphibians worldwide is a disease called chytridiomycosis. Internationally, over 500 species have declined, and at least ninety species are thought to have been lost forever due to this disease. Likewise, in Australia, chytridiomycosis has led to the decline of many frog species and the extinction of at least six, including the unique gastric-brooding frog (*Rheobatrachus silus*). For this reason, the Board of the Australian Wildlife Society is proud to have chosen Australia's amphibians as the Australian Wildlife Society's wildlife of the year! Funds contributed by the Society have assisted Doctor Conrad Hoskins, from James Cook University, to monitor armoured mist frog (*Litoria lorica*) populations and implement a translocation program to protect this species for future generations. An article on the armoured mist frog research project will be featured in a future issue of Australian Wildlife. The Society has also contributed funds to Brittany Mitchelle's frog research project, featured on pages 32-33. We hope you enjoy this amphibian-packed edition of Australian Wildlife and help support our unique Australian amphibians. Donations are always welcome at aws.org.au/donate

2022

2022 Wildlife of The Year

Australia's Amphibians

Red-crowned toadlet (*Pseudophryne australis*). Image: Dr Jodi Rowley.

Which Frogs Are Best Equipped to Survive the Human World?

Australia's frog species are ranked based on how likely they are to persist in human-modified habitats - with some surprising results!

Gracie Liu

Frogs are a sign of a healthy ecosystem, but they are one of the most threatened groups of animals on earth. Humans have played a large part in global frog declines by clearing and modifying native vegetation for housing, agriculture, roads, and recreation. In Australia, cities and agriculture account for more than half of the country's land use. If we are to conserve our frog diversity, we must identify which frog species are likely to tolerate habitat modification and which are likely to be intolerant. This identification will allow conservation efforts to be directed towards the species that are most in need of our help.

Like us, frogs have preferences when it comes to where they live. While some species might be perfectly content living anywhere with water – in your backyard pond, down a drainpipe, or even in your toilet – others have more specific (arguably, more refined) tastes, showering under the misty waterfalls of the rainforest, or riding fast-flowing streams.

But as urban expansion continues and the natural landscape becomes increasingly modified, these frogs are at risk of losing their homes, and finding a new one that supports their survival is no easy feat. The nearest suitable habitat may be too far away to reach, and the journey can be treacherous. Anyone who has ever played Frogger, or its various modern reincarnations, would be able to tell you that, as a frog, braving a road is a gamble on life.

To understand which species could persist or even thrive in modified habitats and which ones were vanishing, researchers from the University of New South Wales and the Australian Museum created a 'modification tolerance index' to rank frog species from intolerant to tolerant. To create this index, the researchers gathered over 126,000 records of frogs submitted by people across Australia to FrogID, a citizen science project set up by the Australian Museum to help monitor, better understand, and conserve Australia's frog species. The researchers combined the data with a global measure of human habitat modification, which considers a broad range of human stressors, including built-up areas, roads, railways, agriculture, mining and energy production, and night-time lights.

The project examined eighty-seven frog species (those with one hundred or more FrogID records) – more than a third of Australia's frog species. Alarmingly, the researchers found that an overwhelming seventy percent of the frog species examined were intolerant of human-modified environments.

These findings, published in the journal *Global Change Biology* in 2021, are particularly concerning as more than forty of Australia's 245 frog species are already threatened with extinction.

The most intolerant species were habitat specialists (those with specific habitat requirements). The most intolerant species includes many frogs from the *Pseudophryne* genus, such as the red-crowned toadlet (*Pseudophryne australis*), which resides exclusively in the Sydney Basin's Hawkesbury sandstone regions, inhabiting open forests with temporary water bodies along drainage lines. Although their geographic range includes the more modified parts of Sydney, they are rarely found in people's backyards, preferring remnant forests instead.

Frog species that laid their eggs on land were also amongst the most intolerant. This category, again, includes all the frogs from the *Pseudophryne* genus, including the crawling toadlet (*Pseudophryne guentheri*), Bibron's toadlet (*Pseudophryne bibronii*) and red-backed toadlet (*Pseudophryne coriacea*). The resources they depend on (for example, moist leaf litter) are rarely present in human-modified habitats. The future of these frogs will therefore depend on our ability to preserve their natural habitats.

There is some good news, however, for species that call from vegetation. These frogs tended to be the most

Top: Crawling toadlet (*Pseudophryne guentheri*). Image: Stephen Mahony.

modification tolerant, which suggests that creating green spaces and 'frog-friendly' gardens with plenty of vegetation could help to improve frog diversity in modified areas, including our cities.

But when it comes to life in our cities, suburbia and farms, the standout and most tolerant species were the generalists. These species can use a diverse range of resources and tolerate various environmental conditions and habitats (including human-modified habitats). Unfortunately, these tolerant species were few and far between. Only three in ten frog species examined were tolerant of modified habitats, when considering the apparent elements of human modification. The index did not account for other direct and indirect human impacts such as our influence on the climate, introduced species, and water resource development. Factor those in, and the proportion of intolerant frogs are probably even higher.

Supporting the long-term persistence of frog populations requires greater consideration of the impacts of humans on the environment. We also need improved conservation measures. A good place to start would be to focus on habitat specialists and species identified as intolerant of human-modified habitats. Thankfully, with the help of thousands of citizen scientists distributed across the country, acquiring the information that scientists need to make informed conservation decisions is now easier than ever.

You can discover which frogs live near you and help count and better understand Australia's frogs by recording frog calls with the FrogID app (available on Android and iOS). For further information on FrogID, please visit www.frogid.net.au or follow FrogID on Facebook, Twitter, or Instagram @frogidaus.

Meet Australia's Least Tolerant Frogs

Out of the eighty-seven species we examined, the crawling toadlet (*Pseudophryne guentheri*) from south-west Western Australia was the most intolerant of human-modified habitats. The crawling toadlet is a small ground-dwelling species, no more than four centimetres in body length. While this species was the least tolerant of the frogs studied, some species did not have enough data to analyse. Most of these species were habitat specialists, secretive species, or species that live in very remote parts of Australia – species expected to be even more intolerant of habitat modification.

The second most intolerant species was the bleating froglet (*Crinia pseudinsignifera*), another small species, reaching three centimetres in body length, from south-west Western Australia. This species lives in temporary swamps in granite areas.

The ticking frog (*Geocrinia leai*), another Western Australian frog, was the third most intolerant species. This small frog, no more than three centimetres in length, can be found in the south-west of the state in Jarrah Forest. The males, the sex that makes advertisement calls, live up to their name, wooing females with a continuous ticking call. Females lay their eggs in a cluster on land under wet leaf litter, logs, and waterside vegetation.

Striped marsh frog (*Limnodynastes peronii*). Image: Jodi Rowley.

Bleating froglet (*Crinia pseudinsignifera*). Image: Stephen Mahony.

Ticking frog (*Geocrinia leai*). Image: Stephen Mahony.

Motorbike frog (*Litoria moorei*). Image: Jodi Rowley.

Gracie Liu is a FrogID validator at the Australian Museum and a PhD candidate at the University of New South Wales and the Australian Museum. Her research focuses on the effects of habitat modification on frogs.

Meet Australia's Most Tolerant Frogs

On the other hand, Australia's most tolerant frog turned out to be the striped marsh frog (*Limnodynastes peronii*). This species is likely familiar to the residents of Australia's east coast, from south of Cape York to northern Tasmania. Males have a distinctive call that sounds like a dripping tap, or a tennis ball being hit. In a chorus, they can sound like a mass of microwave popcorn. This species not only occupies human-modified habitats but may even prefer them to more pristine habitats.

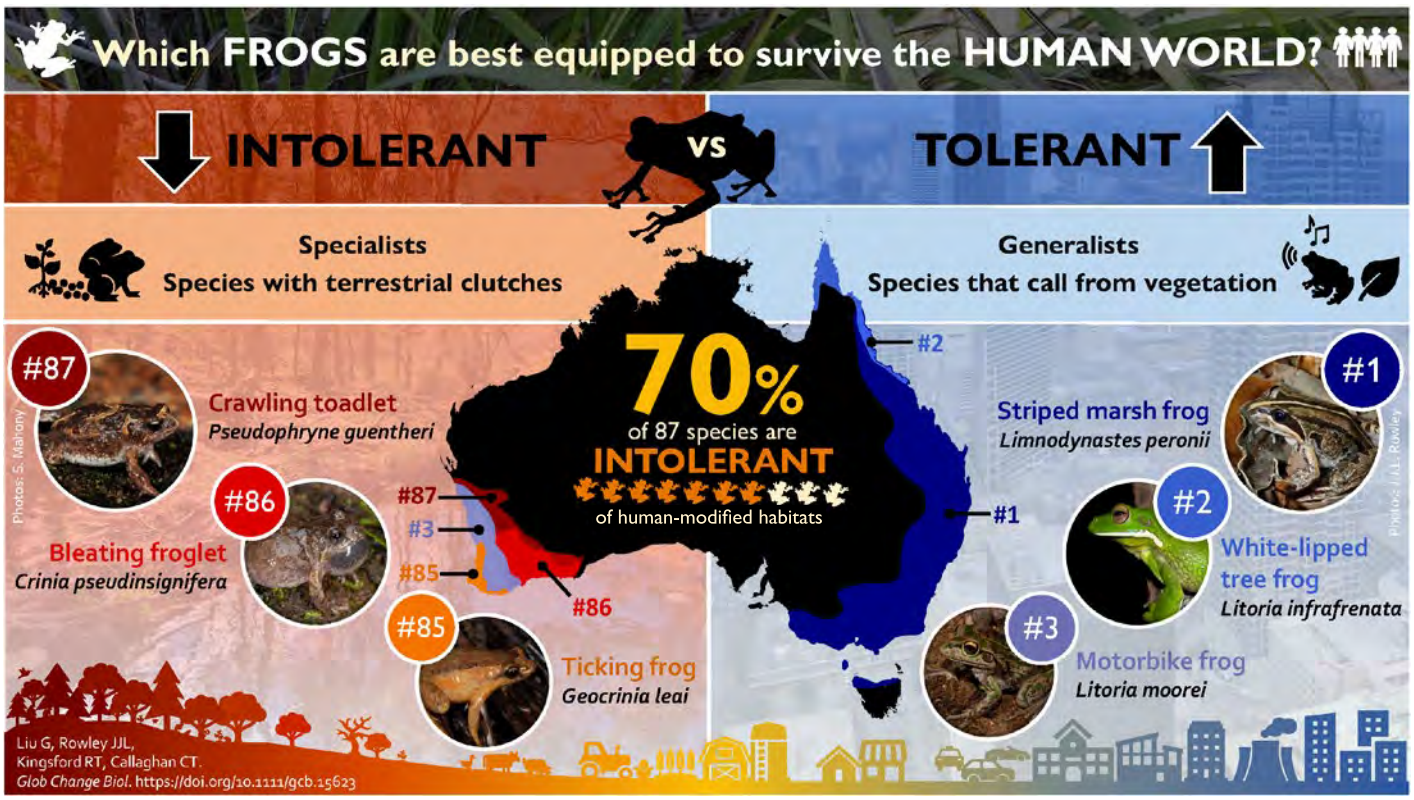
The second most tolerant species was the white-lipped tree frog (*Litoria infrafrenata*), a northern Queensland species and Australia's largest frog, reaching 13.5 centimetres in body length. This frog inhabits rainforest and Melaleuca swamps, but it is not unusual for them to appear on farms and in suburban gardens.

The third place for tolerance went to Western Australia's motorbike frog (*Litoria moorei*). It should come as no surprise that their advertisement call sounds like the rumble of a motorbike. If you had this species in your backyard, you would be forgiven for thinking that someone was doing burnouts outside your house.

For more information and to see the complete list of species, please visit the link in the Further Reading list below.

Further Reading

Liu, G., Rowley, J. J. L., Kingsford, R. T., & Callaghan, C. T. (2021). Species' traits drive amphibian tolerance to anthropogenic habitat modification. *Global Change Biology*, 27(13), 3120-3132. https://doi.org/10.1111/gcb.15623



Some of Australia's most and least tolerant frogs. Image: Gracie Liu.

Habitats of a Lifetime

Jo Fulwood

Researchers at James Cook University have used advanced underwater video sampling over three years in the Hinchinbrook region of north-east Queensland to uncover the specific characteristics and features of fish habitats important to specific species at different points in their life cycles. Using this information, the researchers have developed summary diagrams (or matrices) that highlight the value of critical ecological areas to the survival of particular tropical fish species in north-east Queensland.

The research is the starting point to understanding the many and varied habitats tropical fish require throughout their life cycles and the importance of maintaining the integrity of these habitats to ensure each species survives in the future. For instance, little had been known about how fish use deep-water estuary habitats.

The researchers knew that particular deep-water habitats harbour large numbers of juveniles of important food fish, such as golden snapper (*Lutjanus johnii*). Although anglers had observed this, it had not been scientifically verified. The research developed a way to record this critical information, to support planning and research decisions about the numerous habitats this species occupies throughout its lifetime.

Decision Tools

By summarising how specific species use and rely on different habitats, the matrices will allow experienced and non-experienced decision-makers to identify the most vital habitats to conserve, replace or remediate. Managers can also use the framework to make decisions about coastal and estuarine regions based on data, not guesswork or public perception.

Without the whole story, it is easy to make wrong decisions. Commercial fisheries in many parts of the world have collapsed due to a lack of understanding about the entire life cycle of a species and the interconnecting habitats that need protection to provide for every stage of its development. While there are still significant gaps in the research, researchers have now identified a framework that can allow anyone in a decision-making capacity to ascertain which habitats, large or small, are important for certain tropical fish species to thrive.

Significantly, the research could provide the information needed to protect key fisheries habitats without locking away productive fishing areas by unnecessary zoning. It could allow resource managers to make decisions more rapidly and with more certainty and help property developers allocate money for conservation more accurately and effectively. While the practical application of the framework

Top Left: Estuarine and coastal areas act as components of an interrelated nursery mosaic for many species. Under-protecting these habitats can have catastrophic effects on fish populations.

Top Right: Mangrove swamps are marine or estuarine wetlands found in subtropical or tropical areas. They are tidal forests found in the zone between high and low tide called the intertidal zone, in bays or estuaries.

is still some time away, ultimately, the tool will ensure research dollars and repair funding are appropriately targeted.

The research is also helping to map and classify coastal habitats, which, in turn, will be key contributors to improved management outcomes. The research is expected to help provide more accurate estimates of the extent and nature of habitat loss in the northern Queensland region.

Complex Developmental Stages

The research highlights that not all inshore tropical fish species use the same nursery areas. It highlights the danger of large-scale works – such as dredging in coastal areas – without a complete understanding of the fish life-history values in the area. The research has also underscored the importance of the nursery mosaic, meaning each species requires numerous different habitats at each different stage throughout its life, most of which are not interchangeable.

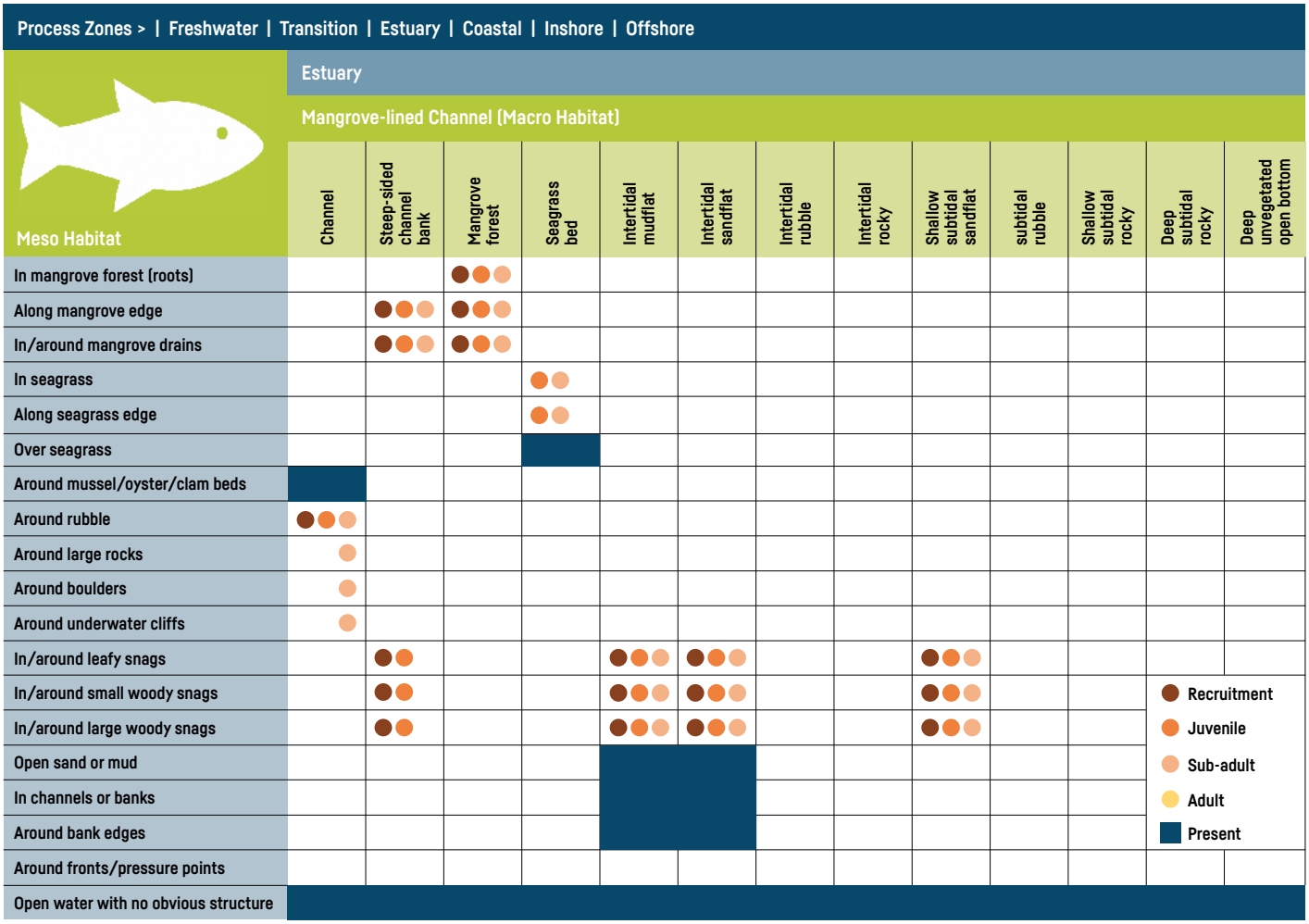
Estuarine and coastal areas act as components of an interrelated nursery mosaic for many species. Different nursery values are often contributed by many different macro-habitat components, such as rocks or woody debris, and underlines the importance of the whole interacting mosaic and the connections among its components.

The research also uncovered a clear distinction between early-juvenile and late-juvenile habitat-use patterns. In general, early juveniles often appeared to be concentrated in a single, specific habitat type, while late juveniles were more evenly spread between three or four habitats. A habitat, such as a mangrove habitat or an estuary, is a general term. We need to drill down and understand which specific parts of these larger areas are essential for these tropical fish species at certain stages of their lives.

Habitat Redefined

The research challenges the broad use of the term 'habitat', building its summary diagrams or matrices on four different zones. Process zones refer to the gradient of overlapping environments from freshwater to offshore that have particular sets of physical conditions and resources. Macro-habitats are large, homogenous units within the seascape, such as mangrove forests, seabeds, and sub-tidal channels, considered at a scale of tens to hundreds of metres. Meso-habitats are the functional components of a macro-habitat. For example, a mangrove forest could be divided into subdivisions based on horizontal spatial arrangements or vertical categories such as substrate, roots, trunks, and leaves. Finally, micro-habitats are classified as subdivisions of meso-habitats, providing a more detailed understanding of the requirements of each species of fish within each zone.

Under-protecting these habitats can have catastrophic effects on fish populations, but the reverse is also true when a blanket approach to ecological protection takes place, having a significant impact on many user groups. In southern Australia, loss of connection to key habitats has contributed to reductions in catches in the Coorong fishery at the mouth of the Murray River to well below fifty percent of historic levels. In some Queensland catchments, construction of barriers has seen marine fish excluded from eighty percent of coastal wetlands. The development of this framework will allow greater ability to direct resources to the most critical habitats.



Process zone × meso-habitat matrix for the Mangrove Jack (*Lutjanus argentimaculatus*). Image: Marcus Sheaves.

WATCH OUT! WILDLIFE ABOUT!

Megan Fabian, Doctor Hayley Stannard, and Doctor Julie Old

Roads affect native wildlife on a national scale. They directly impact wildlife through injury and death due to vehicle collision, fragment habitats, and restrict the movement of some wildlife, whilst supporting the movement of introduced predators. For these reasons, roads can significantly reduce wildlife populations, particularly at the local level.

According to the Australian Bureau of Statistics there were 19.8 million registered motor vehicles in Australia on 31 January 2020. Of these registered motor vehicles, the average vehicle is driven 13,000 kilometres per year. Furthermore, two in three Australians drive to work each day on the 900,000 kilometres of roads covering Australia's landscape. The network of Australia's roads become an issue when we need to share the landscape with other animals such as native wildlife, especially when these networks have proven time and time again to result in negative consequences.

The ecological consequences of road networks are immense, and countless native wildlife are injured and killed each year when they are struck by vehicles while trying to cross the road. Macropods and wombats are the two most common native species impacted by wildlife-vehicle collisions in Australia, with 7,992 kangaroo collision claims made in 2020 through the Australian Associated Motor Insurers (AAMI). Kangaroos made up a whopping eighty-three percent of all wildlife-vehicle collisions, followed by wallabies and wombats.

In 2019, Victoria was the state with the highest rate of wildlife-vehicle collision, with 3,673 AAMI wildlife-vehicle collision claims. This high number is 779 more than New South Wales, which had 2,894, and ranked second in Australia for wildlife-vehicle collision claims. In 2018, the National Roads and Motorists' Association (NRMA) reported kangaroos were the most commonly hit native wildlife species, followed by wombats, with regional townships having higher rates of wildlife-vehicle collisions.

Many wildlife-vehicle collisions involve threatened species, such as eastern quolls (*Dasyurus viverrinus*) and Tasmanian devils (*Sarcophilus harrisii*) in central Tasmania and koalas (*Phascolarctos cinereus*) in southeast Queensland. The Queensland Department of Environment and Heritage Protection (2012) found that about 300 koalas are killed on roads each year in southeast Queensland. Wildlife-vehicle collisions have reportedly caused a rapid decline in these species.

A similar picture has emerged for koalas in New South Wales. The koala population has declined by at least twenty-six percent over the last twenty years. Wildlife-vehicle collisions have played a key role in this decline – it is one of the most frequently reported causes of injury and death for koalas brought into care by wildlife rehabilitation groups. According to the New South Wales Office of Environment and Heritage (2019), an estimated 3,500 koalas were killed by vehicles on New South Wales roads between 1980 and 2018. However, this number is likely underestimated because many koalas injured or killed by vehicles are unlikely to be reported. The koala is listed as Vulnerable in New South Wales under New South Wales and Australian Government legislation.

Factors that Contribute to Wildlife-Vehicle Collision

Wildlife-vehicle collisions tend to be clustered at specific locations or sections of road called 'hotspots'. These are likely to occur where a road cuts through a habitat that serves as a corridor for wildlife movement. Other factors that contribute to wildlife-vehicle collision are:

1. Vehicle speed – How fast a vehicle is going plays a significant role in the collision. The likelihood of a collision increases with vehicle speeds over sixty kilometres per hour because drivers have less time to react,
2. Time of year – For some wildlife, including koalas, wildlife-vehicle collisions increase at certain times of the year. In New South Wales, wildlife-vehicle collisions mainly occur between July and November. This time of year is koala mating

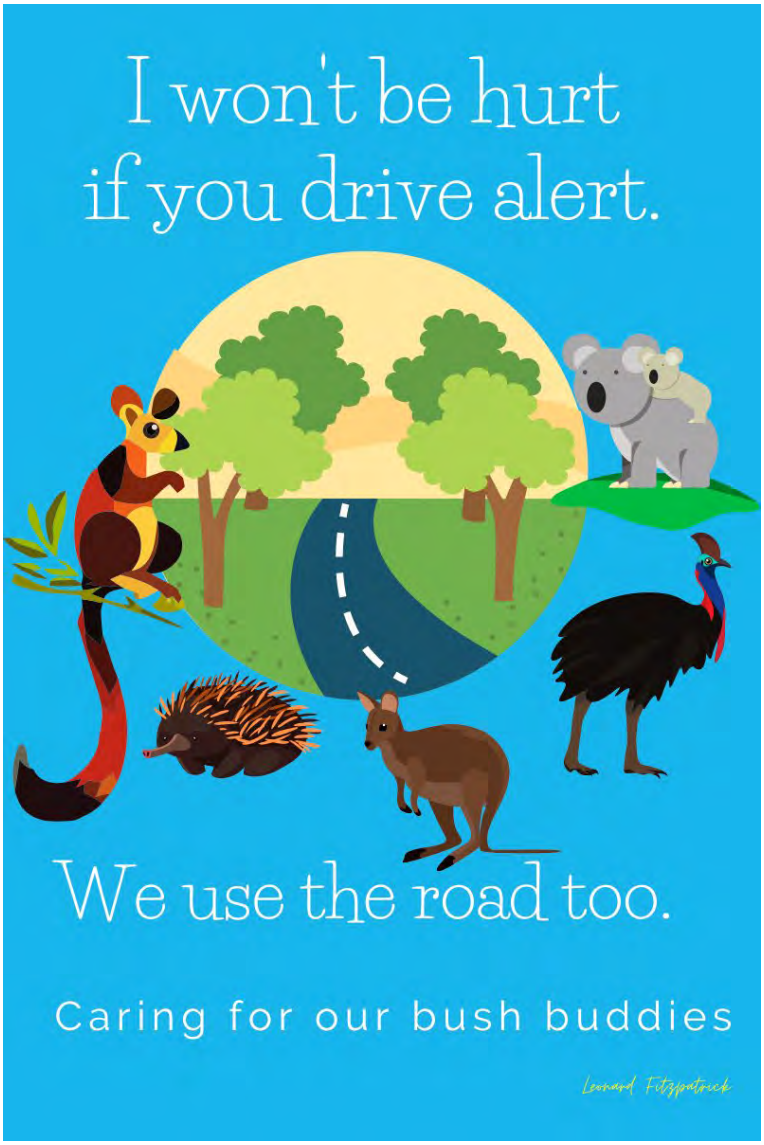
Top left: A 'wildlife ahead' sign warning motorists to stay alert due to wildlife being present in the area.

Top middle: 'Slow down for wildlife' – it is one of the most important things we can do.

Top right: Residents of New South Wales can phone WIRES on 13 000 WIRES if they come across a distressed native animal requiring assistance.

If you have struck an animal or seen an animal on the road that appears to have been hit, please contact your local wildlife rescue group

State	Wildlife Group	Contact
ACT	RSPCA ACT ACT Wildlife	(02) 6287 8100 0432 300 033
TAS	Wildcare TAS Bonorong Wildlife Rescue	1300 827 727 0447 264 625
VIC	Wildlife Victoria Help for Wildlife	(03) 8400 7300 0477 555 611
NSW	WIRES Sydney Metropolitan Wildlife Services Wildlife Rescue Inc	1300 094 737 (02) 9413 4300 1300 596 457
SA	RSPCA SA Fauna Rescue SA Native Animal Network of SA	1300 477 722 (08) 8289 0896 0411 102 763
NT	Wildcare NT Darwin Wildlife Sanctuary	0408 885 341 0473 992 581
WA	Wildcare WA Native Animal Rescue	(08) 9474 9055 (08) 9249 3434
QLD	RSPCA QLD Wildlife Rescue Queensland Queensland Parks and Wildlife Service	1300 264 625 0478 901 801 1300 130 372
National	Wildlife Rescue Inc is Australia-wide	1300 596 457



Make sure to stay alert when driving, particularly at dusk and dawn. Image: Leonard Fitzpatrick.

season when males are actively moving around the landscape in search of new territory and mates,

3. Time of day – Wildlife is most active in the early morning and evening and are therefore more likely to attempt to cross the road and be struck by vehicles at these times. Low-light conditions at dawn and dusk mean drivers may find it harder to see wildlife crossing the road,
4. Visibility when driving – Road contours and crests, fog, and roadside vegetation can obscure wildlife and increase the risk of wildlife-vehicle collision. Slashing, pruning, and maintaining roadside vegetation can improve driver visibility. Streetlights at wildlife-vehicle collision 'hotspots' can also help visibility by illuminating the road, and
5. Biology – The density of wildlife in habitat intersected by a road, behaviour towards vehicles and open spaces, and attractiveness of roadside vegetation can all impact an animal's risk of being hit by a vehicle.

Other factors that influence wildlife-vehicle collisions include location and water availability, road cuttings that funnel wildlife to cross at a particular part of a road, intersections of habitat corridors and road corridors, and weather conditions, including drought and flood or high rainfall.

Changing Driver Behaviour

Wildlife-vehicle collision is one of the most significant impacts of roads on wildlife. Understanding the impacts of roads on wildlife and the natural environment is of increasing importance. Conservation efforts to address wildlife-vehicle collisions show that potential collisions are manageable with proper planning and management.

To reduce wildlife-vehicle collision, vehicle drivers must:

1. Slow down. Studies demonstrate that lower vehicle speeds can reduce the incidence of wildlife-vehicle collision, reduce the severity of injuries to wildlife, and increase the likelihood of wildlife surviving the collision,
2. Be more vigilant when driving through known 'hotspot' areas and take note of roadside warning signs,
3. Be aware of rumble strips. Rumble strips are raised rubber strips that cause a vehicle to vibrate with a loud noise as the tyres roll over the strips, and
4. Take notice of speed limits.

Studying roadkill helps identify 'hotspots', gathers information to inform the development of mitigation strategies to be implemented, and supports the planning of safer roads for people and wildlife. Mitigation strategies to reduce roadkill include physical fencing and road signage, underpasses, overpasses, and clearing vegetation along roadsides. Investigations of various types of road mitigation focuses on wildlife-exclusion fencing and road crossing structures as the most effective option, although the high cost of these measures appears to limit their implementation.

In Australia, several studies have recently examined virtual fences. Virtual fences are sound and light-based devices initially developed in Austria for domestic

pets and livestock. However, unlike a physical barrier, virtual fences still allow wildlife to move freely through the landscape. The results of the studies investigating the success of virtual fences in Australia have been mixed. In Tasmania, a study by Samantha Fox and colleagues found a fifty to ninety percent reduction in roadkill, whilst a study by Bruce Englefield and others failed to show this level of success with only a decrease of thirteen to thirty-two percent.

More recently, a study by Doctor Hayley Stannard and colleagues found a minimal reduction in road-killed wombats after the erection of a virtual fence in the Snowy Mountains, and suggested further studies are needed in more areas and on more species to determine the overall efficiency of virtual fences. A further study by Alistair Hobday and others in Tasmania concluded, in their research on roadkill, that wildlife with brighter coloured fur was more easily detected by drivers using high beams compared to low beams, but speed played a significant factor in driver detection, so slowing down at crucial times is likely the key to reducing road animal deaths and injuries.

Bare-nosed wombats (*Vombatus ursinus*) are particularly prone to roadkill because they have been suggested to prefer disturbed habitats, and this may also be the case for kangaroos. Both wombats and kangaroos are grazers, and grass growing beside a road is likely high quality because it is watered from road run-off.

Recently, Mayadunnage and colleagues determined the most significant season for a wombat to be killed by vehicle collision was July to September over a study period from December 2016 to February 2020. A similar finding was reported in Queensland by Rowden and colleagues over the period March 2004 to July 2007. They found, taking into consideration all native wildlife species, Spring and then Autumn were the seasons when most serious wildlife-vehicle collisions occurred. Also, although not statistically significant, male wombats were more likely to be killed than females, perhaps due to more extensive home ranges.

Take Action

The message is simple, watch out as there is wildlife about! Be vigilant, pay attention to road signs, and slow down when driving, particularly when wildlife is most active – between dawn and dusk. If you have struck an animal or seen an animal on the road that appears to have been hit, please stop to check the animal, and call your local wildlife rescue group.

A mob of eastern grey kangaroos (*Macropus giganteus*) grazing near the Northern Road in South Penrith, New South Wales.

For marsupials that have been struck (wombat or koala), check the surrounding areas for joeys that may have been thrown from the pouch upon impact. Look for movement in the pouch area and check inside the pouch. If you find a joey that is attached to a teat, do not attempt to remove it. It is best to seek expert advice on joey removal from the pouch to avoid further injuries such as a broken jaw. If the joey is not attached to the teat, remove it from the pouch and keep it warm and quiet. Try to handle the joey as little as possible, as the animal will most likely be stressed. Please do not offer it anything to eat.

You may like to be prepared and keep the following household items in your vehicle if you encounter an injured animal: a rescue basket or cardboard box, pillowcases, torch, hand sanitiser, gloves, and towels.

It is now up to you to take action and implement safe driver behaviour to play a role in conserving Australia's native wildlife.

A bare-nosed wombat (*Vombatus ursinus*) near the main road in Bundanoon, New South Wales.
Image: John Creighton, Wombat Care Bundanoon.

What is that sound?

Croaks, whistles, bleats, and barks – every frog species makes a different sound! By recording a frog call with the Australian Museum's FrogID app, you can discover which frogs live around you and gather the information needed to help conserve Australia's frogs.

FrogID

Is the Australian Museum's citizen science project that aims to identify where Australia's frogs are distributed and learn more about how frog populations are doing.

Scan here to download the free FrogID app

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AUSTRALIAN MUSEUM

Threatened Grassland Reptiles

of New South Wales and the Australian Capital Territory

Erika Roper and George Madani

Natural Grasslands

Grasslands, at a casual glance, can look like featureless paddocks. However, a closer look will reveal they are far from empty and provide critical habitat to many species, including threatened plants and animals. Grassland reptiles experience many threats, including habitat loss and fragmentation due to development activities, removal of essential habitat elements like rocks and logs, overgrazing and compaction of soil by livestock, predation by feral and pet animals (i.e., dogs and cats), humans, and a general lack of awareness and knowledge of the species living there. Many native grasslands are also threatened ecological communities that need protecting.

The Saving our Species program, led by the Biodiversity Conservation Division of the New South Wales Department of Planning, Industry and Environment, manages several threatened reptile species found in native grasslands in south-eastern New South Wales and the Australian Capital Territory, including the grassland earless dragon (*Tympanocryptis osbornei*), the striped legless lizard (*Delma impar*), and the little whip snake (*Suta flagellum*).

To manage the species and increase our knowledge, the Saving our Species regional team conduct targeted surveys at native grassland sites across south-eastern New South Wales. These targeted surveys allow the team to learn more about each species and their ecology, like what kind of microhabitat they prefer, where they are more likely to be found, what time of year they are more active, and when juveniles are present. Regular surveys also help the team to monitor population trends over time, particularly between productive and poor seasons.

To replicate the natural habitat of rocks and logs and assist in detection for monitoring, the Saving our Species team provide artificial habitat in the form of roof tiles and railway sleepers across the sites. They also replicate the grassland earless dragon's preferred refuge of spider holes tunnelled beneath rocks by installing small polyvinyl chloride (PVC) tubes into the ground. Early in the morning, while the animals are still asleep, they lift the tiles and sleepers, and peer into the pipes to see if any reptiles are present. The team also records environmental information like time of day, temperature, humidity, cloud cover, and the number of individuals present. Regular seasonal monitoring is a highly valuable tool in the conservation of threatened fauna species, especially where knowledge about the basic ecology of the species is lacking.

Grassland Earless Dragon (*Tympanocryptis osbornei*)

Grassland earless dragons are a highly cryptic species, only 16cm in total length, and are very hard to find. On average, you need to look under a thousand rocks in the right habitat to find one. They are so mysterious that up until recently, what was once considered one species is, in fact, four! Sadly, the Victorian grassland earless dragon (*Tympanocryptis pinguicolla*),

1: A striped legless lizard (*Delma impar*) with its eponymous stripes displayed. If you look closely, you can also see the vestigial limb flaps on the side of its body. Image: Wes Read.

2: A pair of little whip snakes (*Suta flagellum*) are found under a tile during spring. Left: male, long tail. Right: female, short tail. Image: Erika Roper.

3: The Monaro grassland earless dragon (*Tympanocryptis osbornei*) is only found in the Monaro Plains near Cooma, New South Wales, a cryptic dweller of temperate grasslands. Image: George Madani.

A male grassland earless dragon (*Tympanocryptis osbornei*) near Cooma, New South Wales. Note the yellow throat. Image: George Madani.

Ecologists measure a grassland earless dragon (*Tympanocryptis osbornei*) during processing near Cooma, New South Wales. Image: Matt Clancy.

A gravid (pregnant) female grassland earless dragon (*Tympanocryptis lineata*), full of eggs and hope for the future of the species. Image: Emma Carlson.

Grassland earless dragon (*Tympanocryptis osbornei*) habitat near Cooma, New South Wales. Image: Matt Clancy.

the state's only endemic reptile, is now considered extinct. The Bathurst earless dragon (*Tympanocryptis maccartneyi*), which is only known from a few individual records and has not been seen in many decades, is thought to have suffered the same fate.

The two remaining species are both listed as Endangered. The Canberra grassland earless dragon (*Tympanocryptis lineata*) has suffered extensive habitat loss and is restricted to a few remaining locations in the Australian Capital Territory. Lastly, the Monaro Plains grassland earless dragon (*Tympanocryptis osbornei*) is faring a little better with the population scattered across the 1200 km² that make up its native range.

Grassland earless dragons are surprisingly small, fitting easily into the palm of your hand. Unlike other dragon species, they have skin covering their ear holes, and while this doesn't hamper their hearing, it explains the meaning of their genus name *Tympanocryptis*. *Tympano*, meaning tympanum or ear, and *cryptis*, meaning cryptic or hidden. They have rough grey-brown patterned skin, with males also sporting a bright yellow throat. Individual dragons have unique patterns on their back, allowing the team to identify individuals and track their movements over time. Grassland earless dragons live in disused spider burrows and tend to stay close to home. They are very cute little lizards!

Striped Legless Lizard (*Delma impar*)

The striped legless lizard is a small lizard, up to 30cm long, with a pale grey-brown body, white belly, and a darker head. Some individuals sport prominent racing stripes, alternating dark and light stripes that run the length of their body and a pale-yellow throat. The striped legless lizard lives amongst grass tussocks, in soil cracks, and underneath rocks, where they actively hunt spiders, cockroaches, and crickets.

At first impression, legless lizards might have you fooled into thinking they are snakes. Their long bodies quickly wriggling through the grass can certainly give the impression of a slithering serpent, but they are actually more closely related to geckos than snakes!

The differences between legless lizards and snakes are subtle to the untrained eye, but a keen observer will notice a few key distinctions. Firstly, many legless lizards are not truly legless but have small vestigial limbs or flaps on their sides where their body ends and the tail begins, which can be seen if you look closely. Legless lizards also have visible ear holes on the sides of their heads, while snakes do not, and they have a broad fleshy tongue, while snakes have a forked tongue. Another way to

identify a legless lizard is to look at the tail. Generally, snakes have long bodies and short tails, whilst legless lizards have short bodies and long tails, which sometimes make up over two-thirds of their total length.

Little Whip Snake (*Suta flagellum*)

The little whip snake is a small (<30cm long) orange-brown snake with an hourglass-shaped black cap on the top of its head and dark edges to its scales, known locally as the cutest snake in the world. Male and female little whip snakes can be distinguished by tail length, with males having a longer tail and females having a short and stubby tail. Little whip snakes are mildly venomous but are usually very placid and have tiny teeth, so they are virtually harmless to humans. Even so, to avoid unnecessary stress, the team does not handle them. Unfortunately, little whip snakes are misidentified as juvenile brown snakes due to their size and similar appearance. The dark scale edges give the impression of a fishnet stocking, which along with different head markings, can help to distinguish them from juvenile brown snakes. Juvenile brown snakes are also much thinner than little whip snakes, which can be quite plump.

The little whip snake is classified as 'data deficient' under the Saving our Species framework, which means the team does not yet know enough about the species' ecology to manage it and its threats appropriately. Fortunately, regular surveys are enabling the Saving our Species team to learn more about the species.

Call to Action

Life in Australia would not be the same without snakes and lizards, so do your part to conserve them in your local area. Watch where you are stepping when out for a walk, keep your cats inside and dogs on a lead, and if one turns up in your backyard, please do not kill it (this is illegal). You can call a wildlife rehabilitator or trained snake relocator, who will safely catch any snake and move it away from your property.

Human pastime like rock stacking and collecting firewood can damage and remove critical habitat for many small critters and their prey, including the reptiles highlighted in this article. Avoid these actions while you are enjoying nature and encourage others to do the same.

Next time you're passing through what seems like a featureless paddock, spare a thought for what unique and special creatures might be out there living amongst the rocks and grasses.

For further information, please visit: https://bit.ly/SoSProgram

A close-up image of a striped legless lizard (*Delma impar*) showing the earholes and yellow throat near Cooma, New South Wales. Image: Wes Read.

A striped legless lizard (*Delma impar*), found under a monitoring tile at a grassland reserve in the Australian Capital Territory. Image: Emma Carlson.

A striped legless lizard (*Delma impar*) in the hand of an Australian Capital Territory ecologist. Image: Emma Carlson.

Juvenile little whip snakes (*Suta flagellum*) are very small, looking like miniature versions of the adults, complete with the hourglass-shaped black cap. Image: Erika Roper.

Despite the cold, little whip snakes (*Suta flagellum*) are often found during winter, curled up under the tiles with spotted marsh frogs. Image: Erika Roper.

A little whip snake (*Suta flagellum*) survey plot showing the artificial habitat of roof tiles and railway sleepers in a grassland reserve in Bungendore, New South Wales. Image: Erika Roper.

Jumping for Joy

Australian Frogs

Natalie Jane Parker

As a wildlife artist, my focus is on all of Australia's unique wildlife, including our fabulous frog species, of which 245 species are found only in Australia. Australia's amphibians are one of my most favourite animals to paint. As a child, I loved finding large green frogs on summer nights, and as a young artist, green tree frogs were always an enjoyable subject to hone my skills.

My home is nestled on fifty acres of land in the Hunter Valley region of New South Wales, and over the past seventeen years, along with my husband, we have planted hundreds of native trees and shrubs to encourage wildlife to return to our area. We have noticed over the years an array of fauna, including frogs moving in to share our home. While mowing one day, I came across tadpoles in a water trough, and I scooped a few out in a

Green tree frog (*Litoria caerulea*) vantage point.

Banksia seed pod and frog.

Unique introductions: featuring a willie wagtail (*Rhipidura leucophrys*) and green tree frog (*Litoria caerulea*).

container and brought them up to my house for my children to see. We fed the tadpoles boiled lettuce and watched them slowly morph into green tree frogs (*Litoria caerulea*) over the next month or so before releasing them on a rainy night.

When painting, I use my own reference photos as I have an extensive library of images featuring different frogs that I have come across over the years. Another really important factor to my artwork is to be able to get up close and personal with the animal I want to paint so I can capture the finer details. My paintings start with airbrushing the background and sketching the image. I then 'block in' the base colour of the frogs, and once that is dry, I paint the finer details of the frogs in acrylic paints. The finishing touch to nearly all my artworks is an ant.

Australia has such an amazing variety of frog species, many of which are not very well known. I must admit that I love tree frogs, with red-eyed tree frogs (*Litoria chloris*) being at the top of the list. I love to create interaction between one species and another in my art, and frogs are a great little addition to a large painting. In the future, I am very keen to paint more of the lesser-known species of frogs, like the little crucifix frog (*Notaden bennettii*) and the great barred frog (*Mixophyes fasciolatus*).

We all have a responsibility to take care of Australia's frogs, and through my artwork, I hope to highlight the diversity, uniqueness, and plight of these amazing animals. For further information and to see more paintings, please visit www.natalieparkerprints.com.au or follow me on Facebook at njpwildlifeart or Instagram at: natalie_jane_parker.

Natalie Jane Parker in her art studio. Image: Robert Virtue, ABC Newcastle.

Two brushtail possums (*Trichosurus vulpecula*) admiring a green tree frog (*Litoria caerulea*).

A resident green tree frog (*Litoria caerulea*) that lives in the downpipe of our water tank.

Green tree frogs (*Litoria caerulea*).

Australia's Amphibians: The So

Davies' tree frog
(*Litoria daviesae*)
Image by Wes Read

The Davies' tree frog is endemic to the eastern side of the Great Dividing Range in New South Wales. It is listed as Vulnerable and is at risk of local extinction due to its small population size, geographic range, and isolation. Further threats to this species include habitat loss, reduction in water quality, altered water streamflow due to agriculture, predation, and poor knowledge of the species. Wes spent a considerable amount of time wading around a freezing cold river to find the Davies' tree frog. It was outside their breeding season/calling time; however, Wes was lucky enough to spot and capture a photograph of this unique individual.

Cooloola sedge frog
(*Litoria cooloolensis*)
Image by Wes Read

This tiny frog species is entirely restricted to acidic wallum regions of south-east Queensland. Unlike most frogs, this species can be spotted clinging to reeds and other waterside vegetation during the day, although activities such as feeding and calling are still restricted to night-time hours. Wes photographed this calling male in the Great Sandy National Park. As darkness fell, the background chorus of calling frogs grew louder and louder until it was almost deafening. Hundreds of tiny green frogs appeared on the move, and Wes gradually moved around the lake until he found a male willing enough to keep calling whilst he took a photograph. Unfortunately, this species is Endangered due to its restricted distribution that is at risk of further fragmentation and disruption.

Northern corroboree frog
(*Pseudophryne pengilleyi*)
Image by Michael McFadden

The northern corroboree frog is a uniquely coloured frog with bright yellow, longitudinal stripes alternating with black stripes on its back and black, yellow, and white blotches underneath. This frog occurs in forests, sub-alpine woodlands, and tall heathlands of the Australian Capital Territory's Brindabella Ranges and the nearby Fiery Range and Bogong Mountains in New South Wales. They feed primarily on small black ants and other invertebrates. Listed as Critically Endangered nationally, activities to assist the survival of the species include protecting breeding sites from damage by feral animals and forestry operations, weed control, and breeding and reintroduction programs.

ociety's 2022 Wildlife of the Year

Green-thighed frog
(*Litoria brevipalmata*)

Image by Ross Coupland

The green-thighed frog is a species of endangered frog Ross hoped to find and photograph one day, and after many failed attempts, he managed to locate one south of Brisbane in city council bushland. It is a beautiful ground-dwelling tree frog that can be hard to find due to its small size and particular habitat requirements. They are also very specific about which weather conditions they will appear in, preferring extremely wet nights in areas prone to flooding. Their distribution has become highly fragmented due to urban and highway development. This development has destroyed suitable breeding habitats and has led to restriction of movement between populations, reducing genetic diversity and increasing the risk of disease.

Growling grass frog
(*Litoria raniformis*)

Image by Anna Turner

This photograph of the endangered growling grass frog was captured in private wetlands at Perry Bridge, near Sale in south-east Victoria. Although formerly widely distributed across south-eastern Australia, the species has declined markedly across most of its former range. The decline has been most evident over the past two decades. In many areas in south and central Victoria, populations have experienced apparent declines and local extinctions. The series of spring-fed wetlands on this property provides an important refuge for this beautiful, large frog, especially in dry summers. The photograph was captured during night-time frog surveys to collect data for the photographer's PhD research project.

Fleay's barred frog
(*Mixophyes fleayi*)

Image by Ethan Mann

This Fleay's barred frog was photographed in Springbrook National Park of south-east Queensland. Classified as Endangered, this species has small populations scattered across its former range in the rainforest and wet sclerophyll forest. Fleay's barred frogs have declined due to amphibian chytrid fungus, habitat degradation and loss, and threats from introduced species. Ethan wanted to see these frogs in the wild and photograph them down on their level, in their world, amongst the leaf litter.

Australian Wildlife Society

(ACN 134 808 790)

Formed in 1909 and dedicated to the conservation of Australia's wildlife

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

113th ANNUAL GENERAL MEETING

AGENDA

Wednesday 2 March 2022
Commencing at 11.30am

2nd Floor Meeting Room,
Castlereagh Boutique Hotel
169 Castlereagh Street, Sydney, NSW

1. Acknowledgement of Country.
2. Welcome and recording of those present.
3. Apologies.
4. Minutes of the 112th Annual General Meeting held on Wednesday 3 March 2021.
5. Annual President's Report for 2021.
6. Treasurer's Report for 2021. Receive and adopt the Balance Sheet and Income and Expenditure of the Society for the year ending 31 December 2021 in accordance with the Constitution.
7. Election for the Board of Directors of the Society:
   a) Dr Julie Old retires in accordance with the Constitution (10.3) and being eligible, offers herself for re-election,
   b) Ken Mason retires and will not stand for re-election,
   c) Philip Sansom retires in accordance with the Constitution (10.3) and being eligible, offers himself for re-election, and
   d) Dr Hayley Standard being eligible, offers herself for re-election (10.5).
8. Appoint the Auditor for 2022 – Peter J Varley CA.
9. Closure.

Issued by authority of the Board of the Wildlife Preservation Society of Australia Limited
Trading as Australian Wildlife Society.

Patrick W Medway AM
CHIEF EXECUTIVE OFFICER

15 January 2022

All members are cordially invited to attend the Annual President's Luncheon at the conclusion of the Annual General Meeting

National Office: 29B/17 Macmahon Street, Hurstville NSW 2220

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Ending Native Forest Logging in Western Australia

Shaquille Stirling,
Marketing Manager,
West Australian Forest Alliance

On 8 September 2021, the Western Australian Premier, Mark McGowan, announced that native forest logging would end in Western Australia by January 2024, and emotions have been flying high on the west coast since the announcement. The West Australian Forest Alliance is proud that Western Australia will be the first state in the nation to ban native forest logging. The win represents a culmination of hard work from forest advocates and activists since the early 1970s, and we applaud the Premier and his government for showing leadership and courage. We also thank them for listening to the people in delivering this significant and long-awaited breakthrough.

The West Australian Forest Alliance works with local conservation groups to protect Western Australia's south-west forests and wildlife and has spearheaded forest conservation advocacy in Western Australia since 1990. The south-west forests are incredibly precious, and they are vital to climate, wildlife, water, and culture. Many rare and endangered mammals and birds call Western Australia's south-west forests home, such as the iconic and endangered numbat (*Myrmecobius fasciatus*) and Carnaby's black cockatoo (*Calyptorhynchus latirostris*).

The protection of native forests and end to logging has especially been welcomed by climate activists and environmentalists who have growing concerns about the strong correlation between climate change and the exacerbation of wildfires – particularly after the 2019-2020 summer bushfires in Australia. Mainstream science tells us that native forest logging makes bushfires more challenging to control due to an overabundance of younger/smaller trees in logged forests that have been rehabilitated. These young trees have been proven to catch alight easier, increasing the chance that fire will reach the upper canopies of mature trees, which helps create a stronger fire that is harder to control. Consequently, the end of native forest logging in the state should bring relief to firefighters, those who live in rural towns, and wildlife rehabilitators and conservationists.

The West Australian Forest Alliance was delighted to receive support from the Australian Wildlife Society in the wake of the catastrophic Wooroloo bushfires in Western Australia that started on 1 February 2021. Funds received by the Society assisted the West Australian Forest Alliance to sponsor the Fire and Biodiversity Forum held in Margaret River on 4 June 2021. The forum was set up in response to a long history of issues with broadscale planned burning in the state and was designed to examine the effectiveness of prescribed burning and the ways it interacts with the natural landscape, including its impact on all living things. The forum's objective was to develop a further informed and nuanced conversation around fire mitigation, responses to fire, biodiversity, people, and places in the face of a changing climate. The forum included informative and engaging talks from academics, scientists, cultural custodians, and sustainability experts. The Alliance was delighted with the amount of interest and engagement in the forum. It was a great success with increased

Top: The West Australian Forest Alliance celebrates the announcement that native forest logging will end in Western Australia by January 2024.

Adjunct Associate Professor Philip Zylstra from Curtin University spoke about 'Cooperating with Country' at the Fire and Biodiversity Forum.

community support which the Alliance hopes to channel into a push for an independent review into fire mitigation in the state as soon as possible.

While the Premier's announcement has been a historic move for the state, it does not address all the threats to the native forests. Unfortunately, it does not end the clearing of jarrah forests for bauxite mining or deal with issues surrounding the thinning of degraded regrowth forests. It also does not address fire management. The West Australian Forest Alliance will continue to work hard for the next two years when the next Forest Management Plan is signed and sealed to ensure that the very welcome new direction results in the forest protection that we so desperately need. There will also be plenty of opportunities for the community to influence the significant issues facing the forests during the development of the new Forest Management Plan. The community can also take urgent action by writing to the Western Australian Premier or their local Member of Parliament to raise their voice and help protect our precious native forests.

For more information and to stay up to date on important matters concerning Western Australia's south-west forests and wildlife, please visit wafa.org.au and subscribe to our newsletter and follow us on Facebook @WAForestAlliance and Instagram wa_forestalliance.

Helms Forest Block is in the Jalbarragup area of Nannup, Western Australia, and is home to the Carnaby's black cockatoo (*Calyptorhynchus latirostris*).

A Coy Crustacean:

A Fifteen-year Search for the Swamp Yabby (*Cherax latimanus*)

Emma Harding

The Murray-Darling Basin covers more than one million square kilometres in the south-east of Australia and is home to hundreds of wildlife species. The basin is a valuable ecosystem for birds, mammals, fish, frogs, snakes, lizards, turtles, and insects, over ninety-five of which are threatened. In addition to the known species, it is estimated that much of the local flora and fauna has not yet been formally described.

"The first step to conserving biodiversity is discovering and naming new species, as we cannot protect something properly if we do not know it exists in the environment," said Doctor Tarmo Raadik, an ecologist who had studied wildlife in the Murray-Darling Basin for over twenty-five years.

To help address the lack of knowledge, the Victorian government announced the Protecting Victoria's Environment – Biodiversity 2037 long-term vision: a plan to characterise the diversity of plants and animals in Victoria to help understand the local wildlife and their population numbers. This plan aligned with the work of many scientists in the area who had researched the biodiversity of the area for decades and were always on the lookout for new species.

It was big news in September 2021 when a new species of yabby was described by scientists Doctor Raadik and Rob McCormack, however the story of its discovery spanned over decades. Doctor Raadik first heard reports of a new type of yabby in the area in the early 1990s and was compelled to investigate.

"We did hear rumours from landholders and river-users that there was a different and larger yabby living in the Barmah Forest – little did we know it would take so long to track it down."

It started with rumours of extra-large yabbies from fishers who frequented the river, and in 1995, the exoskeleton of a particularly large yabby was brought to Doctor Raadik for examination. It was immediately evident that this was not a common yabby (*Cherax destructor*) but was much bulkier and had wider claws.

However, the yabby proved elusive and few and infrequent reports followed in the years after. Occasional glimpses by commercial fishers and at fish markets were all that Doctor Raadik had to work with as he investigated this new species. It was not until Doctor Raadik began to search for the yabby by boring holes into dry clay pans – regions of dense clay in wetlands of the Murray-Darling Basin where sightings had been common – that he and Robert glimpsed their first live swamp yabby (*Cherax latimanus*) in a burrow more than one metre below the ground. After fifteen years of rigorous fieldwork, the group finally had enough information to describe the new species officially. The discovery was made possible with help from the Department of Environment, Land, Water and Planning (DELWP), Arthur Rylah Institute for Environmental Research (ARI), and the Australian Aquatic Biological (AABio) research firm.

Top: A swamp yabby (*Cherax latimanus*) claw. Image: Doctor Tarmo Raadik.

The swamp yabby (*Cherax latimanus*) has much larger claws than its relative, the common yabby (*Cherax destructor*). Image: Doctor Tarmo Raadik.

A swamp yabby (*Cherax latimanus*) exoskeleton. Image: Di Crowther.

Newly discovered swamp yabbies. Image: Doctor Tarmo Raadik.

A swamp yabby (*Cherax latimanus*) tunnel under clay pans in the Murray-Darling Basin. Image: Doctor Tarmo Raadik.

Two swamp yabby (*Cherax latimanus*) burrows under clay pans in the Murray-Darling Basin. Image: Di Crowther.

Dry clay pans of the Murray-Darling Basin where swamp yabby (*Cherax latimanus*) burrows are found. Image: Doctor Tarmo Raadik.

"This work demonstrates the commitment of our skilled scientists at the Department of Environment, Land, Water and Planning, highlighting how much work can go into locating and then formally describing a new species – especially one that is found deep underground," commented James Todd, Executive Director of the Diversity division of the Department of Environment, Land, Water and Planning.

The newly discovered swamp yabby is similar to the well-known common yabby, however it has much larger claws and is heavier. The swamp yabby can often be found in swamps, roadside drains, and cleared pasture areas that receive frequent moisture. The swamp yabby is one of only three *Cherax*-genus lobsters known to live in the Murray-Darling Basin and the first yabby discovered in the Murray-Darling Basin for eighty years.

"By formally describing the swamp yabby, governments and land managers are able to make the best management decisions, particularly during drought, to ensure its survival into the future," commented James Todd.

The arduous discovery of the swamp yabby highlights the difficulty in cataloguing and describing some of the more secretive residents of the Murray-Darling Basin. With the discovery of the swamp yabby, their populations and habitat can be closely monitored, however undescribed species do not yet have this luxury and may be declining without our explicit knowledge.

Species in the basin heavily rely on the natural cycle of flooding and drought unique to the Murray-Darling area. Recent human activity diverting water for agriculture and manufacturing, and the changing climate has changed the natural water cycles, impacting much wildlife in the area. The Murray-Darling Basin Plan is a government initiative to protect the basin by managing water consumption to ensure enough water remains in the rivers and wetlands. The plan involves managing groundwater levels, adjusting water diversion for human use, maintaining water quality, and constantly monitoring progress.

The discovery of the swamp yabby is a fantastic contribution to our knowledge of the Murray-Darling fauna made possible by the dedication and collaboration of many scientists. However, the initial sightings were made by fishers, farmers, and other members of the public. Every sighting of new flora and fauna is valuable and can help unravel the complex and unique biodiversity in Australia's habitats.

Can the Impacts of Plastic on Wildlife Change Our Behaviour?

Doctor Kim Borg and Doctor Jim Curtis

When the British Broadcasting Corporation's *Blue Planet II* first aired in 2017, a new term appeared in the United Kingdom media: *the Attenborough effect*. Internet searches for 'plastic recycling' increased significantly, organisations and institutes introduced new plastic reduction policies, and there was a significant reduction in reported use of single-use plastics among consumers.

While the show was not wholly dedicated to plastic pollution, the issue was raised on several occasions. Of note, was the final episode, which shifted away from the awe and wonder of wildlife in 'pristine' natural environments, instead focusing on the impact that human behaviour is having on those environments and their inhabitants.

One particularly memorable clip featured albatross nesting on the remote island of South Georgia, near Antarctica. The clip showed piles of plastic around the nests, having been regurgitated by the birds after being mistaken for food. It also featured birds that had died from consuming plastic debris (which can clog and perforate their digestive systems). These images provided a graphic account of how our plastic-related behaviours in the home and workplace can have far-reaching implications on wildlife.

But can such images in the media change our behaviour when it comes to avoiding single-use plastics? Media can be a powerful tool for raising awareness of environmental problems and highlighting what we, as individuals, can do to fix those problems. However, the way we talk about problems like plastic pollution in the media can both help and hinder behaviour change efforts.

Plastic Pollution

Plastic pollution is a significant global environmental crisis, and it has been associated with negative impacts on climate change, biodiversity loss, and human health. Each year between nineteen and twenty-three million tonnes of plastic waste enters aquatic environments around the world. It has even been estimated that, at the current rate, there will be more plastic in the ocean than fish by 2050.

The good news is that we are in the middle of a global shift away from single-use plastics. Evidence of this movement can be seen in the increase in mass media and social media attention on the issue and plastic reduction policies from governments and businesses worldwide. In recent years, many people have started avoiding single-use plastics by refusing items like plastic straws or using reusable alternatives, e.g., reusable bags, and food and beverage containers.

The shift in behaviour is partly motivated by beliefs that we will feel good, and the environment will benefit if we avoid plastic. But it is also motivated by beliefs that other people are avoiding single-use plastics too. These beliefs are known as social norms, the unwritten social rules about what behaviours are common, acceptable, and normal. If we believe that plastic avoidance is normal, we are more likely to avoid plastic ourselves.

When it comes to creating a sense of urgency to act, environmental communicators (such as documentary filmmakers) tend to emphasise the scale of environmental problems, like

Top: An Australian fur seal (*Arctocephalus pusillus doriferus*) in Port Phillip Bay, Victoria, with a plastic bottle stuck to its mouth. Image: A.T. Muir.

presenting mountains of plastic waste. However, focusing on the scale of the problem could also make plastic use seem common and normal. In behavioural science, we know that our perceptions about social norms typically influences our behaviour which means there can be unintended consequences of people gravitating towards the problem behaviour instead. We, therefore, explored alternative ways to influence people to avoid single-use plastics without highlighting undesirable behaviours.

Presenting the Problem with Plastics

An experiment was conducted using four short video clips taken from plastic-related documentaries that had been circulating on social media. The first two video clips focused on the impact that plastic has on wildlife: one was from *Blue Planet II,* featuring albatross that had died from consuming plastic, the other was from *Drowning in Plastic* which featured a flesh-footed shearwater chick regurgitating pieces of plastic. The other two video clips focused on the volume of plastic waste generation: one was from *A Plastic Ocean* that focused on global waste generation and featured mountains of plastic in a landfill, the other was from Australia's *War on Waste* series, which featured 'Australia's plastic Footprint' – or how much plastic waste Australian's generate every minute. The experiment measured people's beliefs and behaviours before watching the clips, immediately after watching, and then again one month later. The experiment also identified whether people were typically *users* or *avoiders* of single-use plastics.

After watching the short video clips, plastic users who saw the videos that focused on the impact of plastic pollution on wildlife were more likely to believe that plastic avoidance was common among other people and beneficial to wildlife. Even more promising was that they reported changing their behaviour and avoiding plastic more often one month later.

This change in behaviour highlights that short videos commonly shared on social media can influence behaviour among plastic users, even when such clips are not necessarily designed to do so. However, not all clips had positive effects. Plastic avoiders who saw the 'landfill' video clip believed that others avoided plastic significantly less often at the one-month follow-up. This result confirmed the suspicion that drawing attention to the scale of plastic waste can make undesirable behaviour (plastic use) seem more common and normal.

An Australasian gannet (*Morus serrator*) in Port Phillip Bay, Victoria. Image: A.T. Muir.

While environmental documentaries and other media are designed with the best intentions, they can hinder our efforts to change single-use plastic behaviours. The findings demonstrate that the way we talk about plastic pollution is important for encouraging positive behaviour change and avoiding unintended consequences. Given that more people are starting to avoid single-use plastics when talking about plastic pollution, we should not only emphasise the impact plastic has on wildlife, but the steps people are taking to help address the problem. Doing so can further foster a plastic avoidance social norm while also demonstrating that change is possible, and together, we can make a difference. For more information about the study, please view the article at https://doi.org/10.1080/17524032.2021.1956558

Doctor Kim Borg is a Research Fellow at BehaviourWorks Australia, based at Monash Sustainable Development Institute. Kim completed her PhD in Behavioural Science – Environment at Monash University, exploring the role of media in turning the social tide on plastic avoidance. Her research experience lies in social and behavioural research, where she has worked with several large organisations and departments such as the Department of Environment, Land, Water and Planning, Sustainability Victoria, and Zoos Victoria. She is currently overseeing a large multi-year research collaboration on Responsible Consumption.

Doctor Jim Curtis is a Senior Research Fellow at BehaviourWorks Australia. He has a PhD in Applied Social Psychology from Monash University. Before joining BehaviourWorks, Jim held research positions at the Monash Tourism Research Unit and Parks Victoria. His research focuses on gaining an intimate, theoretical, and applied understanding of the influences impacting the behaviour of a range of target audiences, leading and collaborating on teams across over one hundred projects. Jim has also acquired an intimate understanding of how the public sector interacts with research, working with multiple government partners in Victoria and New South Wales.

The Wooroloo Bushfire:

A Response from Native Animal Rescue

Kelli Ellemor, Chief Executive Officer, Native Animal Rescue

The bushfire started in Wooroloo, on the outer fringe of the Perth metropolitan area in Western Australia and burnt for five days reaching Bullsbrook and Ellenbrook. Over ten thousand hectares of land burnt, with many houses and a large amount of natural habitat destroyed in its path. The bushfire was hot and fast, with large ash falling over most of the northern suburbs. Native Animal Rescue partnered with Wildlife Care WA to rescue and rehabilitate bushfire-affected wildlife during and following the Wooroloo bushfire.

After the bushfire ended and the chaos subsided, wildlife that could retreat from the bushfire started to emerge and return home, and this was when our team was needed the most. Native Animal Rescue and Wildlife Care WA did their best to rehabilitate injured wildlife; however, we were also responsible for euthanising animals that could not recover from severe injuries and burns. In these harsh circumstances, sometimes the most humane thing that can be done is to euthanise an animal to relieve it from its pain and suffering.

Rescuing and rehabilitating wildlife from a bushfire-affected zone is a long-term and expensive commitment. Native Animal Rescue and Wildlife Care WA have fantastic team members that go above and beyond to support wildlife in need. We attended the Yanchep and Two Rocks bushfire zones to supply supplementary food and water and continued to do so until the end of February 2021.

Native Animal Rescue and Wildlife Care WA were granted access into Walyunga National Park three weeks post-bushfire. The bushfire zone was hazardous as there was a high risk of falling trees and hot holes in the ground. Consequently, training was required before entering the bushfire zone to ensure the safety of everyone involved in the wildlife rescue mission while engaging in 'black walks' to identify if supplementary feeding was required.

The Walyunga bushfire zone was relieved by some heavy rain which made the ground cool to walk on. Although logs were still smouldering and there was melted glass everywhere, large green pockets of vegetation had not been burnt, resulting in small refuge spots for wildlife. Regardless, before the rain set in, the brunt of the bushfire was so hot that even rocks had burnt entirely. Only one bird of prey was flying overhead looking for food, but nothing else was in sight.

Our team's first rescue call was to a large western grey kangaroo (*Macropus fuliginosus*) who had suffered injuries and burns to his feet. From the description, the kangaroo's condition was poor, and the injuries he had sustained were not something that we could treat, and humane euthanasia was the only option. However, our team spent the day looking for the large kangaroo in the last known reported location. Unfortunately, he could not be found, which was a disappointing result, as humane euthanasia would have stopped his suffering sooner. Unfortunately, you can spend many hours on the ground searching for an injured animal without any success, which causes much frustration.

Native Animal Rescue received another rescue call about a western grey kangaroo observed very deep in Walyunga National Park. Unfortunately, the reported kangaroo was also unable to be located, despite close contact with and guidance from the caretaker of the National Park, Ken. Ken is a very knowledgeable man with extensive knowledge of the park and its wildlife. Pre-bushfire, much wildlife visited his

Top Left: The western grey kangaroo (*Macropus fuliginosus*) in a burnt landscape and reported to Native Animal Rescue. Unfortunately, this old kangaroo was unable to be found at a later stage. Image: Native Animal Rescue.

Top Right: The much-needed rain made a difference for the remaining wildlife, including these western grey kangaroos (*Macropus fuliginosus*). Not only did the rain cool the ground, but it also enabled the vegetation to recover quickly after the bushfire. Image: Gail Wallace.

A deceased oblong turtle (*Chelodina colliei*) on its back along the edge of the water. Image: Lyn Manual.

A female brushtail possum (*Trichosurus vulpecula*) was brought into the wildlife hospital for an assessment with a Native Animal Rescue veterinarian. The female possum recovered and has since been released back into the wild. Image: Kelli Ellemor.

A Gould's monitor (*Varanus gouldii*) was one of only two reptiles spotted during the wildlife rescue mission. Image: Lyn Manual.

residence at night, including short-beaked echidnas (*Tachyglossus aculeatus*), southern-brown bandicoots (*Isoodon obesulus*), tammar wallabies (*Notamacropus eugenii*) and shingleback lizards (*Tiliqua rugosa*). However, Ken had only seen a couple of tammar wallabies post-bushfire.

Two wildlife cameras were installed near the water channel to monitor the wildlife that escaped and returned to the area after the bushfire had passed. The wildlife cameras identified that the water did not appear to be significantly impacted as there were many different species of waterbirds feeding in and around the water channel, including pacific black ducks (*Anas superciliosa*), Australian Shelducks (*Tadorna tadornoides*), pied cormorant (*Phalacrocorax varius*), and white-faced heron (*Egretta novaehollandiae*). An echidna and a few western grey kangaroos were also observed on the cameras, and it was a relief to see wildlife return to the area so quickly.

A small Gould's monitor (*Varanus gouldii*) and deceased oblong turtle (*Chelodina colliei*) were observed three weeks post-bushfire – the only reptiles spotted during the whole rescue mission. Unfortunately, there was also a sighting of the invasive red fox (*Vulpes vulpes*) returning to the area.

Six weeks had passed, and a small number of parrots were observed in the area, including four galahs (*Eolophus roseicapilla*) and a couple of ringneck parrots (*Barnardius zonarius*). Five western grey kangaroos, and a couple of young joeys, including a pouched joey, were observed and in good condition.

Eight weeks post-bushfire, Native Animal Rescue was no longer receiving reports of injured or bushfire-affected wildlife, and more and more vegetation started to appear. Native Animal Rescue slowly reduced their supplementary feeding routine as the vegetation grew enough to sustain the native wildlife naturally.

In addition to the wildlife rescue mission, a bushfire-affected female brushtail possum (*Trichosurus vulpecula*) was bought into the wildlife hospital for an assessment with a Native Animal Rescue veterinarian after being cared for by adopted rescue parents in Toodyay, Western Australia. The female possum recovered and has since been released back into the wild.

A special thank you to Wildlife Care WA for keeping the Native Animal Rescue team safe during the wildlife rescue mission. Native Animal Rescue is dedicated to treating sick, orphaned, and displaced native animals and rehabilitating them back to their natural habitat. For more information, please visit nativeanimalrescue.org.au

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2021 Australian Wildlife Society

University of New South Wales Wildlife Ecology Research Scholarship

Sick and Stressed in the City? Disease Susceptibility of Australia's Frog Species in the Anthropocene

Brittany Mitchell

For animals, disease transmission is usually higher in urbanised areas than non-urbanised areas due to animals living in closer proximity to one another, increases in novel species interactions because of changed community assemblages, and greater toxin and stress exposure leading to immune suppression. As such, wildlife diseases are emerging more frequently in the Anthropocene and are a massive threat to the persistence of biodiversity.

One taxon particularly affected by wildlife disease are amphibians. Globally, forty-one percent of all amphibian species are threatened, and hundreds of species are already thought to be extinct. A major driver of amphibian declines is chytridiomycosis, a disease caused by the amphibian chytrid fungus. The disease infects the skin of

Top: Brittany Mitchell is a PhD Candidate at the Centre for Ecosystem Science at the University of New South Wales and the Australian Museum Research Institute.

Like this green tree frog (*Litoria caerulea*), frogs have been found dead en masse across eastern Australia. The exact cause is still unknown.
Image: Suzanne Mcgovern, The Conversation.

amphibians and disrupts electrolyte balance, resulting in cardiac arrest and eventually death. A crucial component of a frogs innate immune system is contained within its glands within its skin. These glands produce a range of bioactive peptides, including antimicrobial peptides, which are documented to be an effective mechanism against a range of pathogens. Various studies have demonstrated the importance of antimicrobial peptides against amphibian chytrid fungus in addition to their traditional immune system.

Stressful life events, such as limited access to food resources and habitat disturbance, can increase stress hormones in frogs. When stress hormones are produced, they can suppress both innate and adaptive immunity, potentially making frogs more susceptible to disease. Despite the link between anthropogenic activity and increased stress hormone production, limited research exists examining the effects of anthropogenic pressures, such as noise and light pollution, on frogs' immune function. Furthermore, no research currently exists for Australian frog species. As a result, we have a limited understanding of how frogs and other animals in an ecosystem may be impacted in a world that is becoming increasingly more urbanised. Thus, a component of my research aims to determine the effect stressful anthropogenic activity has on the production of amphibian chytrid fungus and subsequent immune function in Australia's frog species. More specifically, it is hypothesised that frogs in more urbanised areas will:

1. Have higher levels of the stress hormone – corticosterone,
2. Have impaired immune function, and
3. Have different amphibian chytrid fungus profiles than frogs from natural areas, putting them at greater risk of infection and subsequent mortality.

Frogs across an urban gradient, potentially the Peron's tree frog (*Litoria peronii*), will have a small blood sample collected, in addition to two minimally invasive assays. Blood samples will measure the corticosterone levels as an indicator of a stress response in urbanised areas; and secondly, count the immune cells present. Next, the frogs will be injected with an immune stimulant in the foot, and swelling responses will be measured to gauge immune strength. Lastly, a skin sample will assess the frogs' amphibian chytrid fungus profile. The profiles between frogs living in urban and non-urban sites will be compared via a specialised form of mass spectrometry (MALDI-TOF).

This study will be the first in Australia to address the interaction between disease and urbanisation in frogs. It will allow us to focus our conservation efforts on mitigating threats and developing crucial methods in Australia, where frogs need it most. This study is especially relevant to the mass mortality events we are currently seeing across the eastern coast of Australia. It is highly applicable for threatened frog species currently persisting in highly modified environments such as the green and golden bell frog (*Litoria aurea*) and growling grass frog (*Litoria raniformis*). With this founding understanding, we can begin to answer other questions like whether the stress of urbanisation leads to reduced immunity and antimicrobial peptide production? Which species are likely to be most vulnerable in the future? What modifications can be made to the urban habitat to minimise impacts on immunity and better conserve our frog species?

Funds provided by the Australian Wildlife Society will be used to analyse antimicrobial peptides and allocated towards associated fieldwork costs.

The anticipated study species is a Peron's tree frog (*Litoria peronii*). Image: Doctor Jodi Rowley.

2021 Australian Wildlife Society

University of Technology Sydney Wildlife Ecology Research Scholarship

A Molecular Deep Dive: An Omics-Based Assessment of Protein and Metabolite Changes in Freshwater Microalgae When Exposed to Sublethal Concentrations of Zinc

Gwilym Price

Australia's freshwater systems play a vital role in supporting Australia's significant aquatic and terrestrial biodiversity. However, wildlife decline in freshwater ecosystems is occurring at a fast pace. To protect and conserve these important ecosystems, there is a need to ensure that they are managed effectively and protected with the most robust and up-to-date science. Freshwaters are often contaminated by pollutants from residential, industrial, or agricultural sources. Zinc is one of the most used and widespread metal contaminants that enter freshwater systems worldwide, with Australia being no exception.

The management of contaminants entering these water systems is regulated with the use of the Australian and New Zealand Water Quality Guidelines. These guidelines are derived for contaminants using ecological toxicity data to determine at what concentration a contaminant will have a negative effect on endemic species within an ecosystem.

The toxicity of metal contaminants to aquatic life depends on the chemistry of the freshwater system, such as hydrogen (pH), hardness, and dissolved organic carbon. These factors significantly affect metal bioavailability, and thus

Top: Gwilym Price is a PhD candidate at the University of Technology Sydney and CSIRO Land and Water. Gwilym chose to study environmental chemistry and ecotoxicology as he has always had a strong passion for the environment and science more broadly. He finds working at the intersection where human development meets nature fascinating, as it is so often portrayed as two incompatible areas. Image: Sally Carney.

Preparing test media. Image: Gwilym Price.

toxicity to aquatic life. Our guidelines for Australia currently account for the effects of hardness, however the data used for assessing these effects are primarily based on North American fish species. Such data may not be appropriate for the conservation of Australian species or ecosystems.

Australia has a diverse range of freshwater ecosystems and a large range of water chemistry, from the soft waters of Kakadu to the acidic tannin-stained streams in Tasmania. Given the great variability of Australia's freshwater chemistry, there are conditions where our current guidelines for metals are not appropriately protecting the ecosystem. The influence of hardness on zinc toxicity is understudied for Australian freshwater conditions, and the influence of dissolved organic carbon on zinc toxicity is understudied more broadly.

Advances in omics technologies have allowed for the study of metal stress-induced changes to the biochemical composition of microalga. Metals can alter the biochemical composition of microalgae, resulting in changes in the abundance of certain metabolites and proteins. These biochemical changes can have significant food web consequences by altering the availability of different organic molecules to higher trophic levels. Changes in biochemical composition have also been shown to occur at sub-lethal metal concentrations, demonstrating that metal contamination can have negative ecological impacts at lower concentrations than typically detected when using traditional methods.

Harvesting microalgae. Image: Gwilym Price.

The project aims to investigate the influence of water chemistry on zinc toxicity to a freshwater microalga. Understanding these influences on freshwater biota is a key step in developing robust and protective water quality guidelines that are adaptable depending on the ecosystem water chemistry.

The project also aims to investigate the influence of zinc at sublethal concentrations to understand biochemical changes which may have important ramifications for whole freshwater ecosystem health. Microalgae, as primary producers, play a critical role in freshwater ecosystem health through the oxygenation of the water column and as the base of the aquatic food chain upon which all aquatic biota directly or indirectly depend.

The project will model the relationship between water chemistry and zinc toxicity, and the results will be used to develop bioavailability-based guidelines for Australian and New Zealand Water Quality Guidelines.

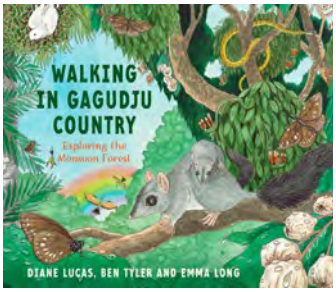
Funds provided by the Australian Wildlife Society will be used to access protein and amino acid analysis to gain important insights into how sublethal concentrations of zinc influence the biochemical composition of algae and greater insight into the mode of action of zinc contamination.

Gwilym Price in the field, taking samples from a freshwater system. Image: Doctor Darren Koppel.

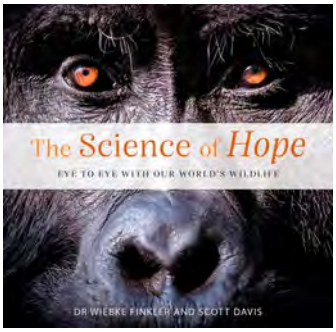
Book Reviews

Made for Each Other – *Georgina Taylor*
In the natural world, it benefits having a friend. Teamwork, or an unexpected partner, could make all the difference to survival – whether it is warding off predators, removing parasites, or aiding reproduction. *Made for Each Other* explores organisms that have learnt to adapt and co-exist in the wild. For example, researchers have recently discovered that false killer whales (*Pseudorca crassidens*) and bottlenose dolphins (*Tursiops truncates*) hunt and socialise together in one of nature's most fascinating symbiotic relationships. What uncanny symbiotic relationship will you discover next?
Publisher: Allen & Unwin
RRP: $32.99

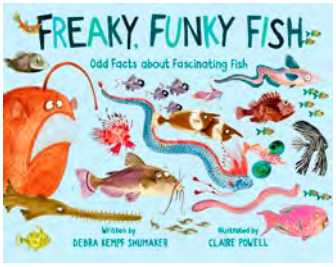
MerTales – *Rebecca Timmis*
Inspired by one of the authors' snorkelling trips, *MerTales* helps introduce readers to ocean studies, the importance of coral reefs in our ecosystem, and the diversity of sea life in the ocean. From dolphins to octopuses that squirt ink when they are scared, and seahorses to swordfish with special heaters near their eyes to help them hunt, it is time for a fantastic adventure in Cockleshell Cove!
Publisher: Allen & Unwin
RRP: $14.99



Walking in Gagudju Country: Exploring the Monsoon Forest – *Diane Lucas, Ben Tyler, and Emma Long*
Walking in Gagudju Country takes you on a journey through one of the Top End's magnificent monsoon forests in Kakadu National Park, learning about the flora, fauna, and Kundjeyhmi culture along the way. From the white bush apple (*Syzygium armstrongii*) or anboyberre, a medium-sized evergreen tree with masses of white flowers and small white edible fruits, to the rainbow bee-eater (*Merops ornatus*) or berrerd-berrerd, a spectacular bird with brightly coloured plumage that catches flying insects on the wing, you will be amazed by the diversity of wildlife in Kakadu National Park.
Publisher: Allen & Unwin
RRP: $29.99



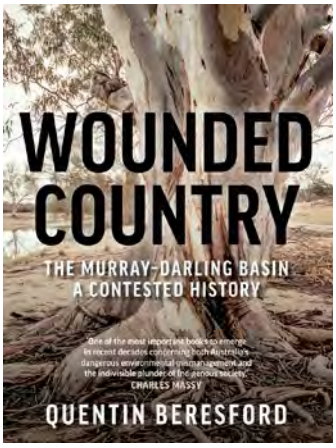
The Science of Hope: Eye to Eye with Our World's Wildlife – *Doctor Wiebke Finkler, and Scott Davis*
Showcasing hopeful conservation efforts worldwide, *The Science of Hope* is a remarkable visual journey exploring why certain animals capture our attention. From kangaroos, one of the world's most iconic species, to koalas, a well-known charismatic marsupial, these are some of the animals that become mascots for conservation campaigns. But why are these animals selected instead of other equally endangered animals? The answer lies in their cuteness or charisma. *The Science of Hope* informs as it educates, describing the psychology and science behind our desire to connect with these animals while promoting a message of hope by highlighting positive conservation efforts around the world, including several Australian researchers working towards a brighter future.
Publisher: Exile Publishing
RRP: $45.00



Freaky, Funky Fish – *Debra Kempf Shumaker and Claire Powell*
Fish have fins, gills, and tails. All fish swim and most have scales. But not all fish act or look the same. Read about the fascinating ways some fish spend their days in this fun celebration of everything fishy. Packed to the gills with facts, *Freaky, Funky Fish* captures the marvels of the underwater world and the wonder of our ecosystem. Dive deep into the incredible diversity that can be found beneath the waves.
Publisher: Allen & Unwin
RRP: $24.99

Earth Matters: Loving our Planet – *Carole Wilkinson and Hilary Cresp*
We cannot shield our children from climate change, but we can give them clear information about climate change, the tools to do something about it, empowerment through knowledge, and enabling children to reduce the effects of climate change through action. This beautiful book explains the science of climate change in a child-friendly way. From explaining our atmosphere to the overuse of fossil fuels and the increase in greenhouse gases to Global Warming, the author ensures she covers the issues currently facing our modern world. Renewable and non-renewable energy is also explained, as are facts about waste. The author also helps children see how their choices can make a tangible difference to the beautiful place they call home.
Publisher: Wild Dog Books
RRP: $24.99

The Accidental Penguin Hotel – *Andrew Kelly and Dean Jones*
The little penguin (*Eudyptula minor*) is the smallest of all penguins. The little penguin is a robust bird that has learnt to adapt to the intrusion of people. That is what happened in St Kilda, Victoria. Humans built a breakwater, and over time, the little penguins moved in, and it became an accidental penguin hotel. Their burrows are stacked up in the rocks at the breakwater, almost like hotel rooms. Penguins usually return to the place and the colony where they hatched from an egg. Mostly, but not always. Follow the story of one little penguin who makes the bay his home.
Publisher: Wild Dog Books
RRP: $24.99



Wounded Country – *Quentin Beresford*
The Murray–Darling Basin, exploited for nearly two hundred years, is under threat. Soil erosion, sand drifts, dust storms, salinity, algal blooms, threatened native flora and fauna, the drying out of internationally recognised wetlands, and steadily worsening droughts have repeatedly brought large parts of the Basin to its knees. Expert advice and warnings about long-term environmental effects have been continually disregarded. The author investigates the complex history of Australia's largest and most important river system, from denying local First Nations people their lands to irrigation schemes and agricultural enterprises focused on short-term profits. How can the Murray–Darling Basin be sustainably preserved for future generations?
Publisher: NewSouth Publishers
RRP: $34.99

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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).

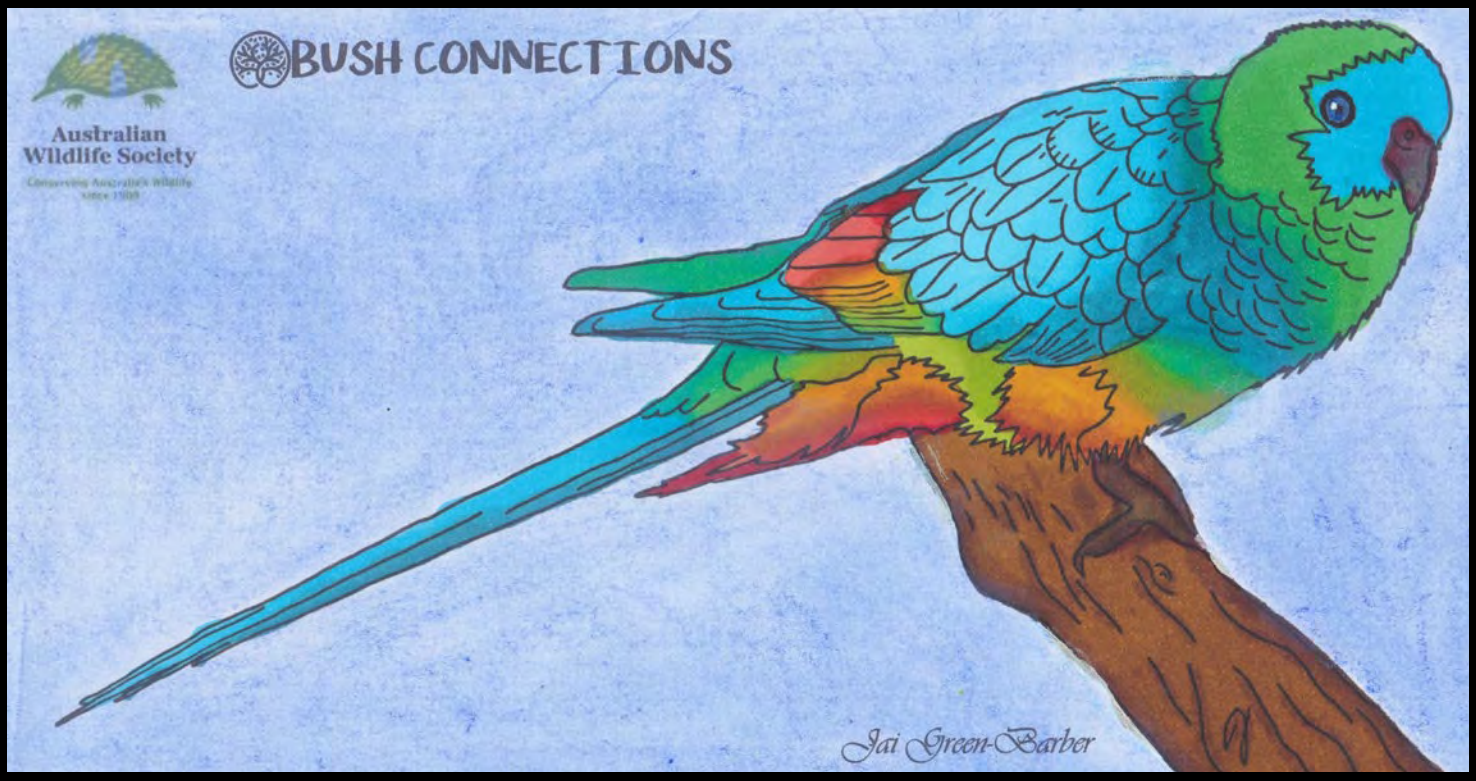
Other Benefits: Awards, Scholarships, Grants, and the opportunity to network with like-minded people.

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.

2021 Colouring-in

Eleven-year-old Eve from New South Wales



Ten-year-old Swaraj from Western Australia

Competition 2021

Nine-year-old Grace from Tasmania

Six-year-old Modamsuvee from Queensland