AUSTRALIAN Wildlife

SUMMER Vol: 1/2023
$10 (non-members)

Celebrating a new century of wildlife preservation in Australia

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

2022

Colouring-in Competition

Ten-year-old Sarasi from Victoria

Seven-year-old Max from Queensland

Six-year-old Faith from South Australia

Ten-year-old Hansika from New South Wales

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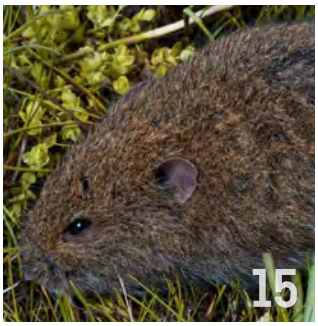

Regulars

Megan Fabian
Editor, *Australian Wildlife*

On the Cover:

Front Cover:
The beautiful waratah (*Telopea speciosissima*) is the best-known waratah with its large, bright red inflorescences. It is endemic to Australia and is the floral emblem of New South Wales. It is a protected species, and picking wild specimens is prohibited. Image: Brian Scarsbrick AM.

Back Cover:

Top Left: *Hakea bakeriana* is a shrub endemic to the Central Coast of New South Wales. Image: Jen Robinson.

Top Right: The fern-leaved grevillea (*Grevillea aspleniifolia*) is found naturally between Bowral and Katoomba. It typically occurs in rocky eucalypt woodland on shale or sandstone. Image: Megan Fabian.

Middle Left: *Grevillea* 'Dorothy Gordon' is a hybrid selection with parentage from Western Australia and Queensland. Image: Annie Nguyen.

Middle Right: *Hakea purpurea* grows in open forests in south-east and central Queensland, extending across the border into New South Wales. It is one of the best of the eastern hakeas because of its low-growth habit and colourful flowers. Image: Megan Fabian.

Bottom Left: Old man banksia (*Banksia serrata*) woodland is a rare and endangered forest community under the Regional Forest Agreements. Image: Annie Nguyen.

Bottom Right: Scarlet banksia (*Banksia coccinea*) attracts wildlife, including bees, nectar-eating birds, butterflies, and other insects. Its distribution in the wild is along the south-west coast of Western Australia. Image: Jorja Cenin.

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.

Print Post Approval No: PP 100024559

ISSN 0155-266X

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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

Dr Julie Old – President

The 2023 Wildlife of the Year is an iconic group of plants, the Proteaceae Family, a family which is distributed throughout all states of Australia and includes at least 1,100 species.

Welcome to the Summer 2023 Edition of *Australian Wildlife*

Another year starts with the Society continuing efforts to conserve Australia's unique flora and fauna, but what a busy year 2022 was! Many of the Society's activities are highlighted in the Society's newsletter – *Wildlife Wisdom*. If you are not already receiving the newsletter, please email us at accounts@aws.org.au, and we will add you to the list.

In this edition of *Australian Wildlife,* the Society celebrates the research undertaken by students sponsored by the Society's University of Technology Sydney Wildlife Ecology Research Scholarship to celebrate the tenth year since the establishment of this scholarship (Pages 20-21). The Society is immensely proud to support the next generation of conservationists and scientists who are conserving and protecting our unique flora and fauna into the future.

Recently, several Directors visited the Australian Reptile Park to see first-hand how the Society's funds were utilised to establish a broad-tooth rat (*Mastacomys fuscus*) breeding facility. Broad-toothed rats are listed as Endangered and are one of only a few native mice and rats (murids) endemic to Australia's alpine regions. In this edition of *Australian Wildlife,* on pages 13-15, you can read more about the visit by the Directors and why it is so important to conserve this species. Another article on pages 11-12 highlights other Australian native murids and the global significance of this group of animals, not just ecologically but also economically and culturally.

Other activities undertaken by some of the Directors included a visit to Aussie Ark's Barrington Tops Conservation Area, Cedar Creek Wombat Rescue Inc. and Hospital, Hunter Wetlands Centre Australia, the Sydney Basin Koala Network Community Launch, and the Australian Wildlife Management Society Conference in Napier, New Zealand.

At Aussie Ark, Directors were able to see first-hand how the Society's support has helped to save the iconic Tasmanian devil (*Sarcophilus harrisii*) from extinction and were updated on the conservation efforts of other species, including eastern quolls (*Dasyurus viverrinus*), long-nosed potoroo (*Potorous tridactylus*) and brush-tailed rock-wallabies (*Petrogale penicillata*).

At Cedar Creek, Directors were shown how funding to support the establishment of a new and improved hospital had enabled the treatment of bare-nosed wombats (*Vombatus ursinus*) with sarcoptic mange, and joeys whose mother's are victims of roadkill return to the wild.

Patrick Medway AM holding the 2022 NSW Not-For-Profit Governance Award certificate and trophy at the National Office. Image: Megan Fabian.

Funding provided by the Society to Hunter Wetlands Centre Australia has also been instrumental in helping to conserve essential wetland habitats for a range of species, including the endangered green and golden bell-frogs (*Litoria aurea*).

The Society joined the newly established Sydney Basin Koala Network to advocate for protecting koala (*Phascolarctos cinereus*) populations in the Sydney Basin.

Lastly, the Australian Wildlife Management Society Conference was a remarkable success, with 110 registrants. Several fabulous presentations took place over the three days, including the Society's talk and poster, *'Advocating for Conservation Action Nationally to Protect Native and Threatened Species'*. Please keep an eye out in the next edition of *Australian Wildlife*, the Autumn 2023 edition, for an article on the talks and events that took place during the conference.

A bare-nosed wombat (*Vombatus ursinus*) at Cedar Creek Wombat Rescue Inc. and Hospital. Image: Dr Julie Old.

In 2022, we highlighted amphibians as our Wildlife of the Year. In this edition of *Australian Wildlife,* we have an article on the conservation efforts undertaken to save the armoured mistfrog (*Litoria lorica*) from extinction (Pages 24-27). The frog is restricted to north-eastern Queensland and is listed as Critically Endangered.

With a new year now upon us, we can announce the Wildlife of the Year for 2023. Keeping in mind that the Society aims to conserve both flora and fauna, this year, the Directors have chosen to highlight flora rather than fauna for the first time. The 2023 Wildlife of the Year is an iconic group of plants, the Proteaceae Family, a family which is distributed throughout all states of Australia and includes at least 1,100 species. On the cover of this edition of *Australian Wildlife,* we have some stunning examples of members of this ecologically important family. On pages 7-8, Annie Nguyen, a volunteer member of our Conservation Committee, has written an article to introduce the Family to Society members.

I would also like to share with Australian Wildlife Society members that the Board of the Society was delighted to be recognised as the 2022 NSW Not-For-Profit Governance Award winner. It is a testament to the dedication of the team and our amazing Office Manager, Megan Fabian, that the Society functions as effectively as it does.

I would also like to highlight and congratulate the efforts of Emma Harding, one of our other incredible volunteers on the Publication Committee, who has written articles on amphibian and reptile viruses, viruses discovered in the transcriptomes of agnathan fish, and ancient viral integrations in marsupials. Emma was nominated as the Adult Volunteer of the Year with The Centre for Volunteering. Without the help and support of all the Australian Wildlife Society volunteers, the Society would not succeed.

We hope you enjoy this edition of *Australian Wildlife.*

Proteaceae

THE SOCIETY'S 2023 WILDLIFE OF THE YEAR

Annie Nguyen

The Proteaceae family contains more than 1,766 species in eighty genera. Its predominantly southern hemispheric distribution is an attribute of its ancient evolution from the Cretaceous period (145 to 66 million years ago), when Australia, Africa, and South America were one interlocking landmass called Gondwana.

There are presently 1,154 species described from forty-seven genera native to Australia. Though taxonomy is not a static discipline, this will continue to change with time as new species are discovered. On the cover of this issue is a vibrant red *Telopea speciosissima*, commonly known as the waratah, which is endemic to New South Wales and is the state's floral emblem. *Telopea* has four other species, all of which are endemic to the east coast of Australia.

Proteaceae is important because the family is so diversified, encompassing species that grow in sclerophyllous forests such as the *Banksia* and *Grevillea* to species that are restricted to rainforests such as *Hollandaea* and *Buckinghamia*. Furthermore, *Macadamia integrifolia* provides a source of income to the Australian economy. But what makes it important is not its economic value but its indispensable environmental value. The speciose family also provides food and shelter to many of Australia's native wildlife. Hence, protecting threatened Proteaceae species also protects habitats that Australia's wildlife call home.

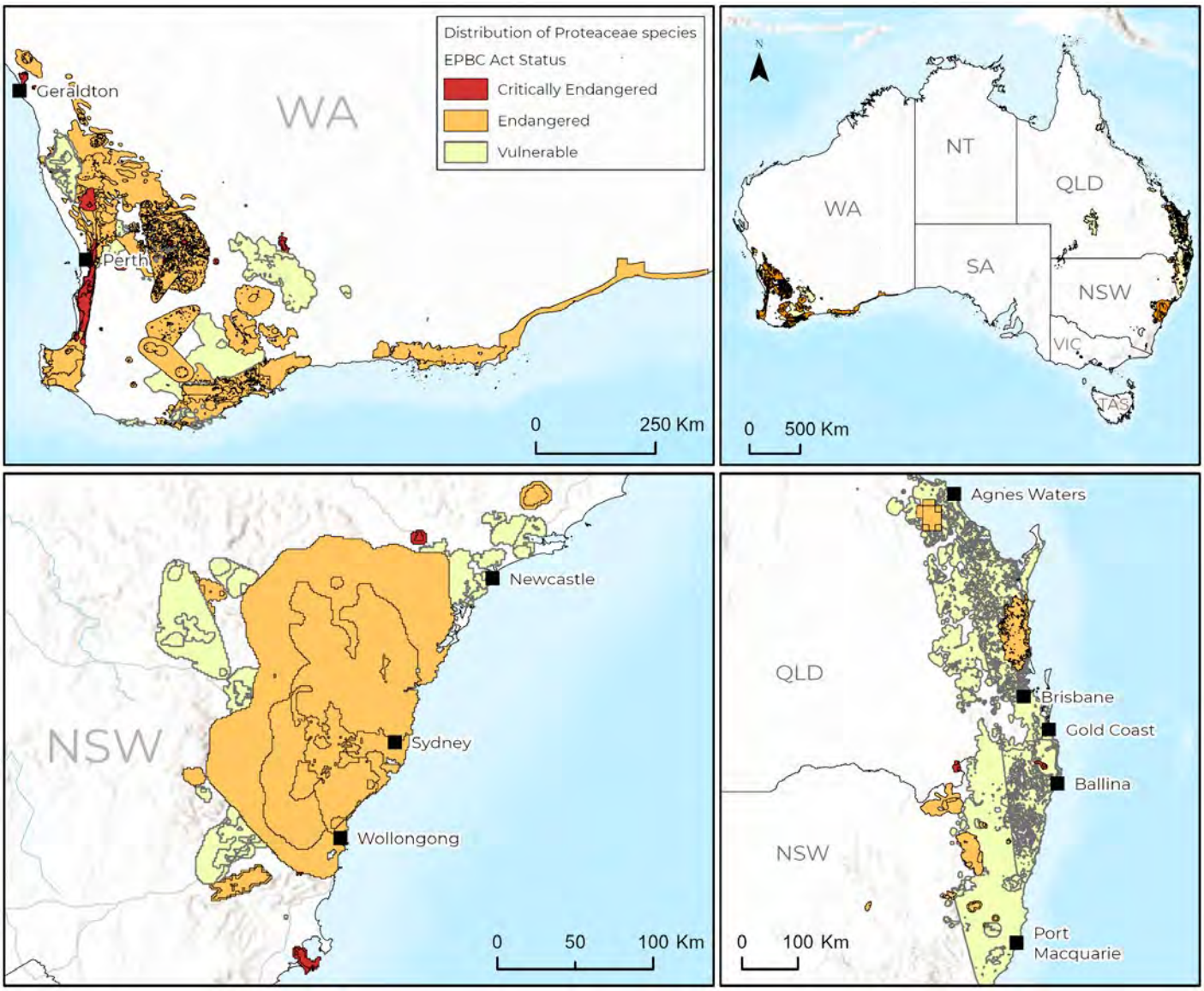
There are currently 1,374 plants listed as threatened by extinction in the *Environment Protection and Biodiversity Conservation Act 1999*. Of the 226 critically endangered and 564 endangered species, Proteaceae makes up nineteen percent of the critically

Top: Scarlet banksia (*Banksia coccinea*) are frequently displayed in bouquets and native gardens. Image: Annie Nguyen.

A rainbow lorikeet (*Trichoglossus moluccanus*) amongst *Grevillea*. Image: Malcolm Paterson.

endangered and twenty percent of the endangered species in the *Environment Protection Biodiversity Act 1999* list.

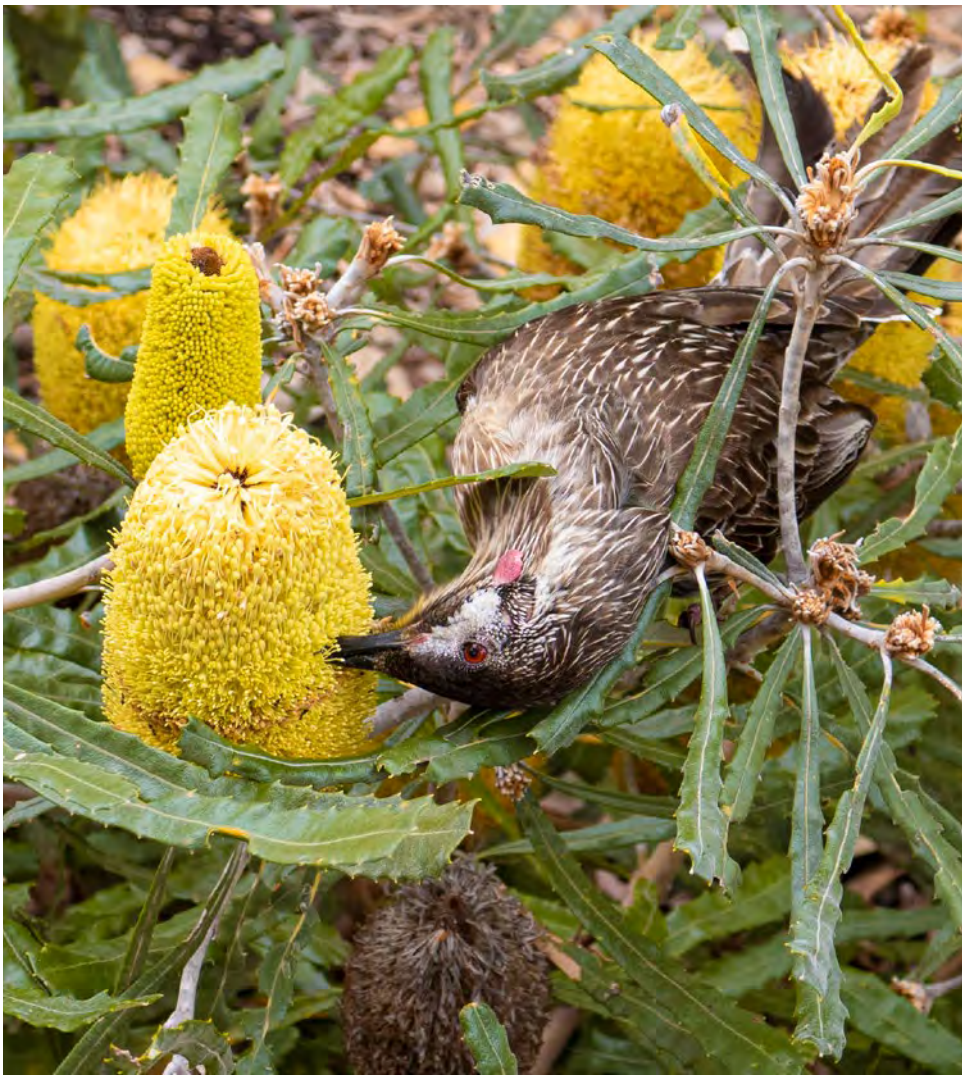
Lomatia tasmanica, possibly the oldest living plant, is a critically endangered species in Tasmania that has less than five hundred individuals left. Unable to produce seeds, *Lomatia tasmanica* are found in a single population that is a clone of itself dating back to at least 43,000 years old. The species is threatened by inappropriate fire regimes and 'root rot' caused by mould (*Phytophthora cinnamomi*) infections. Another ancient species is the *Cenarrhenes nitida* or the native plum. The native plum is the only species in its genus and is endemic to western parts of Tasmania. Macrofossil plant material of *C. nitida* has been found in Eocene assemblages dating back to ~ 30 million years old. Along with *Bellandena montana*, the native plum tree requires cool, moist shady conditions to thrive. However, forest fragmentation and changing climates could see further contractions in these paleoendemics.



A map of threatened Proteaceae species by state. Image: Annie Nguyen.

The Australian government has recently launched the *Threatened Species Action Plan 2022-2032,* which will focus on 110 priority species through $12 million in funding to community-led projects helping to conserve and manage those species. The Plan includes thirty plant species, of which four are in the Proteaceae family; these are the bulberin nut (*Macadamia jansenii*), Foote's grevillea (*Grevillea calliantha*), small-flowered snottygobble (*Persoonia micranthera*), and stirling range dryandra (*Banksia montana*). The priority species are chosen based on six fundamental principles, including their risk of extinction and benefit to other species. Keen individuals are encouraged to participate in these community projects by looking up the complete list of grant proponents from the Environment Restoration Fund on the Department of Climate Change, Energy, the Environment and Water website.

Other actions readers can take to increase biodiversity and support local fauna is by planting native species of Proteaceae such as *Grevillea*, *Banksia,* and *Hakea*. Planting native species is a great way to support the birds, beetles, bees, and butterflies in your neighbourhood.



A red wattlebird (*Anthochaera carunculata*) enjoys the delicious nectar from a *Banksia.* Image: Julia Kalinkina.

The critically endangered *Grevillea caleyi* is restricted to an eight-kilometre square area around Terrey Hills, Sydney. Image: Annie Nguyen.

Little drumsticks (*Isopogon anemonifolius*) can be found in many nurseries and attracts butterflies, birds, and bees. Image: Annie Nguyen.

Annual President's Luncheon

The President and Directors of the Board of the

Australian Wildlife Society

cordially invite you to the

Annual Luncheon to celebrate 114 years of wildlife conservation of the Society and the presentation of our prestigious Annual Awards

Wednesday 1 March 2023
Commencing at 12 noon

Level 4, Adam Room
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RSVP 17 February 2023
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Mice and Rats: They Are Not All Bad

Dr Julie Old

Rats and mice are often hated and regarded as pests. We associate them with sewers and as pests in our homes that steal our food. We have developed traps and poisons aimed explicitly at their eradication. They can famously irrupt into thousands during favourable seasons, destroying crops and spreading disease, as they are currently doing in many parts of Australia. Rats (and unfortunately not their fleas) are also associated with some of humanity's greatest pandemics, the Justinian Plague over two thousand years ago, the Black Death in the Middle Ages, and more recently, at the start of the 20th century. Even a phobia is especially dedicated to mice called musophobia or suriphobia, and Sir David Attenborough has stated rats are one of his least favourite animals. Nevertheless, rats and mice are intimately linked to us due to their wide distribution, with house mice the second most widely distributed mammal on earth, after us, and through our stories and mythology, regardless of country of origin or culture – think Mickey and Minnie Mouse, Pikachu, and Stuart Little. They are not all bad!

Of course, rats and mice are not always thought of negatively. In 2020, we celebrated the 'Year of the Rat'. The rat being the first of the zodiacs in the Chinese zodiac calendar. It is said the rat was given this honour by playing a flute on the back of an ox, and due to the generosity of the ox, the ox became the second zodiac in the Chinese calendar. In India, a temple called 'Sang Kancel' is dedicated to rats. In Papua New Guinea and Indonesia, rats are sourced as food due to their super-sized proportions. In Africa, giant African pouched rats (*Cricetomys gambianus*) have been trained to locate land mines, as their weight, being far less than a dog, ensures they do not detonate the land mine. Rats and mice are also kept as pets and are widely utilised in medical research. So perhaps we should think about rats and mice in a more positive light.

Rats and mice are rodents, members of the Rodentia Order, along with hamsters, squirrels, prairie dogs, porcupines, beavers, capybaras, and guinea pigs, which make up forty percent of all mammalian species. All rodents are characterised by two pairs of continuously growing incisors, which they must maintain by gnawing. Rats and mice, or murids, are further classified in the Family Muridae and are the only rodent species endemic to Australia. Murids are also essential members of the Australian environment, playing crucial roles in seed dispersal and as important food resources for reptiles, carnivorous marsupials, and raptors.

Native murids first arrived in Australia several million years ago from Papua New Guinea and Indonesia. A second introduction occurred more recently, as well as modern-day introductions, which include those of non-native species. Today, around a quarter of all endemic mammalian species in Australia are murids, and they can be separated into those termed old and new endemics. Old endemics or Hydromyinae include the vast majority of species, specifically the Hydromyini (water rats), Uromyini (mosaic-tailed rats), and the Conilurini, which includes rabbit-rats (*Conilurus* spp.), tree-rats (*Mesembriomys* spp.), rock-rats (*Zyzomys* spp.), *Pseudomys* spp., *Leggadina* spp., stick-nest rats, the broad-toothed rat (*Mastacomys fuscus*), hopping-mice (*Notomys* spp.), as well as the prehensile-tailed rat (*Pogonomys mollipilosus*). The New endemics include the seven endemic rats and the three introduced rats (*Rattus* spp.), as well as the introduced house mouse (*Mus musculus*).

Our native murids have adapted specifically to our environment, with well over sixty different species found throughout Australia, including those in the central deserts, snow-covered mountains, tropical rainforests, and waterways. Often their common names provide clues to their appearance, behaviours, or distribution. The hopping-mice are mostly associated with arid areas of Australia. They have characteristically long hind limbs and hop, as their name suggests. Pebble-mound mice and stick-nest rats build pebble mounds and stick nests, respectively, whilst the rakali (*Hydromys chrysogaster*), or Australian water-rat, is aquatic. Rock-rats live in rocky areas, and tree-rats are arboreal and live primarily in trees.

Given our 'sometimes' negative attitude towards murids, it is likely to have impacted their conservation in Australia. A recent study confirmed as much, stating that more charismatic species, such as the koala, gained far more funding than less charismatic species, and this has again been demonstrated recently with

Top Left and Right: Greater stick-nest rats (*Leporillus conditor*). Images: Melissa Tulk.

Top Middle: A black-footed tree rat (*Mesembriomys gouldii*). Image: Melissa Tulk.

Australia's water rat – the Rakali (*Hydromys chrysogaster*). Image: Nicholas Rowlands (Image supplied by Australian Platypus Conservancy).

regard to the bushfire disasters. Our own National Office Manager, Megan Fabian, also confirmed these suggestions in her research, that most people were more likely to support the conservation of iconic and culturally significant species such as the koala (*Phascolarctos cinereus*) compared to other species. Hence, Australia has lost thirteen murid species, and around half (29) are listed as Endangered, Threatened, or Rare.

So apart from the negativity towards our native murids, because of the impact of introduced murids and their association with disease and pests, what factors impact our native murids? Well, most native Australian murids are in a category of mammal called 'critical weight range', which was coined by Burbidge and McKenzie way back in 1989, and refers to mammals weighing between 35 and 5,500g, which includes most of our native murids. Mammals within this weight range are most at risk from predation from introduced predators: the European red fox (*Vulpes vulpes*) and feral cat.

Competition with introduced murids is also a problem, as they can displace our native murids and compete for resources. One specific example of this is the introduced black rat or ship rat (*Rattus rattus*), displacing the native bush rat (*Rattus fuscipes*) in the habitat surrounding Sydney Harbour. Conservation programs are currently being undertaken by Professor Peter Banks and his team to remove black rats and restore bush rats around Sydney's Harbour suburbs of Mosman and Manly.

Other reasons for the extinction, decline and threats to native murids are more specific to certain species. For example, the Bramble Cay melomys (*Melomys rubicola*) was classified as extinct in 2015 by the International Union for the Conservation of Nature and in 2019 by the Australian government, having not been observed on the five-hectare vegetated coral cay at the northern tip of the Great Barrier Reef since 2009. It was the only endemic mammal on the Great Barrier Reef and the first mammal to be officially recognised to have become extinct due to the impact of climate change in the world, specifically oceanic inundation.

Sadly, this is not our only native murid species to become extinct. Two native murids on Christmas Island became extinct around 1902 due to an accidental introduction by sailors of the black rat. Subsequently, it was reported that the native bulldog rat (*Rattus nativitatis*) and Maclear's rat (*Rattus macleari*) suffered a severe and complete die-off due to a disease. Furthermore, the species-specific tick, *Ixodes nitens*, also died out, and the number of Christmas Island red crab (*Gecarcoidea natalis*), believed to be one of the main dietary components of Maclear's rat, skyrocketed.

The central rock-rat (*Zyzomus pedunculatus*) is listed as Critically Endangered internationally and in the Northern Territory but listed as Endangered nationally. It has rarely been observed since it was initially classified in 1896 and was not seen for about thirty years until one was hit and killed by a frying pan thrown by a stockman in the MacDonnell Ranges in central Australia, having discovered it trying to steal his food. Since then, a captive colony has been established at Alice Springs Desert Park, but captive breeding has been problematic. Populations in the wild are threatened due to the extent of their occurrence, area of occupancy, the severely fragmented habitat in which they are found and extreme population fluctuations that occur due to adverse weather and climate. Introduced predators and habitat destruction as a result of grazing and burrow destruction from cattle and other large, introduced herbivores are impacting the species. Furthermore, inappropriate fire regimes in tussock and hummock grassland and low open woodlands in which they are found have been negatively impacted, thus reducing the amount of suitable habitat for the species.

Needless to say, Australia's unique native murids are essential to Australia's ecosystem, being both important as seed dispersers and as food sources for other species. We must value them just as much as the more iconic species to ensure their long-term conservation and our ecosystem health.

These three images exhibit a black-footed tree rat (*Mesembriomys gouldii*). Similarly to the rakali (*Hydromys chrysogaster*), black-footed tree rats have a dark tail with a white tip, which can be seen clearly in the image on the far right. Images: Melissa Tulk.

Supporting Broad-Toothed Rat Conservation at Aussie Ark

Megan Fabian

The Society has partnered with Aussie Ark to help prevent the endangered broad-toothed rat (*Mastacomys fuscus*) from becoming extinct. The broad-toothed rat is a medium-sized native murid with a broad face, short tail, and stocky body. Its fur is soft, dense, and brown-tinged, with rufous on the dorsal side merging to grey underneath, and its ears are small and round, with tufts of hair inside. Broad-toothed rats are gentle in demeanour and are very much an Australian native 'guinea pig' in character.

In New South Wales, the broad-toothed rat occurs in two widely separated areas: the wet alpine and subalpine heaths and woodlands in Kosciuszko National Park, adjacent Nature Reserves and State Fo rest in the south of the State, and on the Barrington Tops. In Victoria, it resides in South Gippsland and the Otway's, and in western Tasmania, it can be found in wet sedges and grasslands at lower elevations.

The broad-toothed rat lives in a complex of runways through the dense vegetation of its wet grass, sedge, or heath environment and under the snow in winter. Active in the runways underneath the snow during winter, the broad-toothed rat feed on the stems, leaves and seeds of grasses and sedges. Shrub foliage, fungi, bark, and moss are also eaten. Nests of grass are built in the understorey or under logs, where two or three young are born in summer. In winter, the broad-toothed rats huddle together in nests for warmth.

This species has declined significantly and is currently threatened by habitat loss and fragmentation, predation by foxes and cats, climate change, and catastrophic fire events. Catastrophic fire events and hazard reduction burning can cause localised population extinctions. Grazing by rabbits and hares may also impact suitable vegetation cover and structure, and habitat invasion by exotic weeds, including scotch broom (*Cytisus scoparius*), blackberry (*Rubus* spp.), and willow (*Salix* species), poses a threat. Climate change causes loss of snow cover, resulting in increased exposure to foxes and cats in alpine areas and competition with feral herbivores and native rodent species may also increase.

As part of our broad-toothed rat conservation efforts, Directors of the Society visited the Australian Reptile Park and Aussie Ark to see the sponsored broad-toothed rat conservation project first-hand.

On Friday, 28 October 2022, the Directors made their way to the central coast and stopped at the Australian Reptile Park. We were welcomed and briefed by Tim Faulkner, Director, Owner, and General Manager. We were then taken on a tour of the Aussie Ark facilities by Hayley Shute, Curator and Conservation Manager, and Jo Runciman, the new Director of Partnerships and Sponsorship. We were taken behind the scenes and saw several conservation projects in operation. We were excited to see the broad-toothed rat enclosures where board-toothed rats are set to be temporarily housed before being released to a newly created wetland sanctuary at Aussie Ark.

Top: L to R: Tim Faulkner, Megan Fabian, Dr Hayley Stannard, Dr Robin Crisman, Dr Julie Old, Hayley Shute, and Jo Runciman at the Australian Reptile Park. Image: Katie Pasfield.

An endangered greater gilder (*Petauroides Volans*) in Barrington Tops National Park. Image: Dr Hayley Stannard.

President, Dr Julie Old, standing in front of the sponsored green and golden bell frog (*Litoria aurea*) sign at Hunter Wetland Centre Australia. Image: Megan Fabian.

L to R: Dr Julie Old, Roz Holme, and Dr Hayley Stannard at Cedar Creek Wombat Rescue Inc. and Hospital. Image: Megan Fabian.

We continued our journey and stopped at Cedar Creek Wombat Rescue Inc. and Hospital to visit Roz and Kev Holme and, of course, the bare-nosed wombats (*Vombatus ursinus*). Roz and Kev were caring for several wombats that had fallen victim to vehicle strikes and dog attacks. We were lucky to see a couple of wombats on the verge of release – a bittersweet part of the wildlife rehabilitator role.

We continued to Aussie Ark, arrived after dark, and settled in for the evening.

The following day, 29 October 2022, a 10 am tour was scheduled with Tyler Gralton, Aussie Ark Supervisor. Tyler provided an introduction and guided us around the Aussie Ark sanctuary. Tyler showed us the Tasmanian devil (*Sarcophilus harrisii*), eastern quoll (*Dasyurus viverrinus*), brush-tailed rock-wallaby (*Petrogale penicillate*), spotted-tailed quoll

The broad-toothed rat (*Mastacomys fuscus*) breeding facility is under construction at Aussie Ark. Image: Aussie Ark.

(*Dasyurus maculatus*), and long-nosed potoroo (*Potorous tridactylus*) enclosures. He also pointed out where the new wetland sanctuary would be located, which would house the broad-toothed rats in the future. We posed for a photograph in front of one of the Tasmanian devil enclosures sponsored by the Society in previous years. Another highlight was the long-nosed potoroo that was keen to greet us all in return for a good scratch.

We went spotlighting that night in Barrington Tops National Park. We were privileged to see two brush-tailed possums (*Trichosurus vulpecula*), each carrying a baby on its back, and ten endangered greater gilders (*Petauroides Volans*) – a very memorable moment!

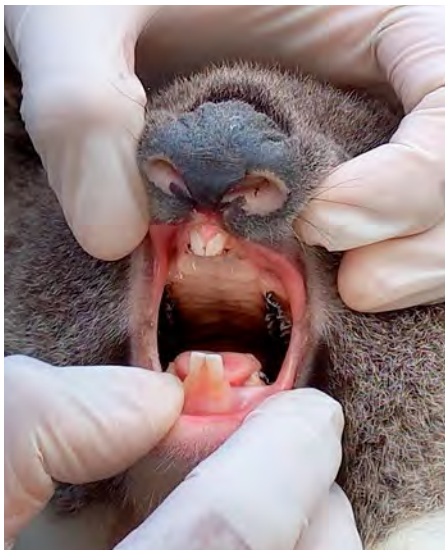
We checked out at 10 am the following day, 30 October 2022, and returned to Sydney. We stopped at Muswellbrook for a quick break and to see the colony of the grey-headed flying-foxes (*Pteropus poliocephalus*). We then continued to Hunter Wetlands Centre Australia, where we stopped to admire the high diversity of flora and fauna species and took the opportunity to pose for a photograph in front of the green and golden bell frog (*Litoria aurea*) sign, also sponsored by the Society.

Aussie Ark will be the pioneer for learning about the broad-toothed rat, including unknown behavioural traits. The Society has helped fund a captive breeding centre for the species, including constructing intensive breeding facilities, modifying sites for release to the Aussie Ark sanctuary, supplementing the wild population, and aiding research on the species. The information collected will be used to save the species in the wild from

The endangered broad-toothed rat (*Mastacomys fuscus*) is Australia's native murid. Image: Aussie Ark.

The broad-toothed rat (*Mastacomys fuscus*) enclosures where the board-toothed rats are set to be temporarily housed before being released to a newly created wetland sanctuary at Aussie Ark. Image: Megan Fabian.

L to R: Tyler Gralton, Megan Fabian, Dr Hayley Stannard, Wayne Greenwood, and Dr Julie Old at Aussie Ark. Image: Dr Jeanette Keir.



Koalas Characteristics and News of the Narrandera Koala Population

Dr Joanne Connolly, Dr Hayley Stannard, and Dr Geoffrey Dutton

The Koala – an Iconic Australian Marsupial

Koalas are one of the most recognised symbols of Australian wildlife. The empathy the koala generates among people is thought to be due to its appealing face rather than a muzzle, a trait it shares with us. The word koala is believed to be derived from the Dharug language of the greater Sydney region, meaning 'no drink'. Most water requirements of the koala were thought to be obtained from *Eucalyptus* leaves, but increasingly koalas have been drinking water to survive heatwaves and bushfires. The scientific name for the koala is *Phascolarctos cinereus* which means 'ash-coloured pouched bear', although they are marsupials, not bears. The most notable feature of marsupials is that they are born in an underdeveloped state (kidney-bean sized, naked, with undersized hindlimbs and tail) and further develop in a pouch.

Koalas are tree-dwelling (arboreal), medium-sized marsupials (adults weighing 4-15kg; southern populations are larger with longer fur) with virtually no tail. Males are fifty percent larger than females and have a squarer head and a scent gland on their chest. The koala has long, powerful limbs and curved claws adapted for climbing. They only come down to the ground to move between trees or to seek shade. They can run with a bounding gait and can swim. Their hands have two opposable thumbs and fingerprints, and their big toe is opposable and has no claw. The koala is solitary (except for a mother with joey), and koalas communicate by scent marking of trees by males and vocalisations (males bellow, females not wanting a male's attention squark, and joeys separated from their mother squeak). The koala maintains its body temperature of 35.4 – 36.8°C by stretching out, panting on hot days, and curling up on cool days with their backs to the wind and rain. Eucalypt leaves are difficult to digest, low in nutrients and contain deterrents. As a result, koalas have quite a reputation as fussy eaters,

Top left: A koala (*Phascolarctos cinereus*) in a Narrandera resident's garden. Image: Dr Joanne Connolly.

Top right: An old koala's mouth shows the wear of the upper premolar tooth and molar teeth. Image: Dr Joanne Connolly.

Bottom right: A young koala's teeth (1-2 years old) show no tooth wear. Image: Dr Joanne Connolly.

sniffing the foliage before deciding to eat. The koala is a hindgut fermenter with an enormous caecum (appendix-equivalent) and the slowest rate of food passage of any marsupial, thus allowing it to maximise its nutrition. They are most active at night (nocturnal) and sleep up to twenty hours a day to save their energy reserves.

The koala has a backward opening pouch (odd for animals climbing trees or sitting upright), as does the wombat, the koala's closest relative. Koala breeding occurs in summer, pregnancy (gestation) is about thirty-five days, and a single young (joey) weighing less than a gram at birth remains in the pouch suckling for seven months. Weaning starts around six months, with the joey pap feeding (ingesting soft faces from its mum to seed its gut with good microorganisms for gum leaf digestion. After leaving the pouch, the koala joey rides on its mother's back till fully weaned at around twelve months of age. The young usually disperse away from the area where it was born by eighteen months of age. Koalas become sexually mature at about two years, but males typically do not get an opportunity to breed until they have established their own home range. Koalas live an average of ten to twelve years but may live as long as eighteen years.

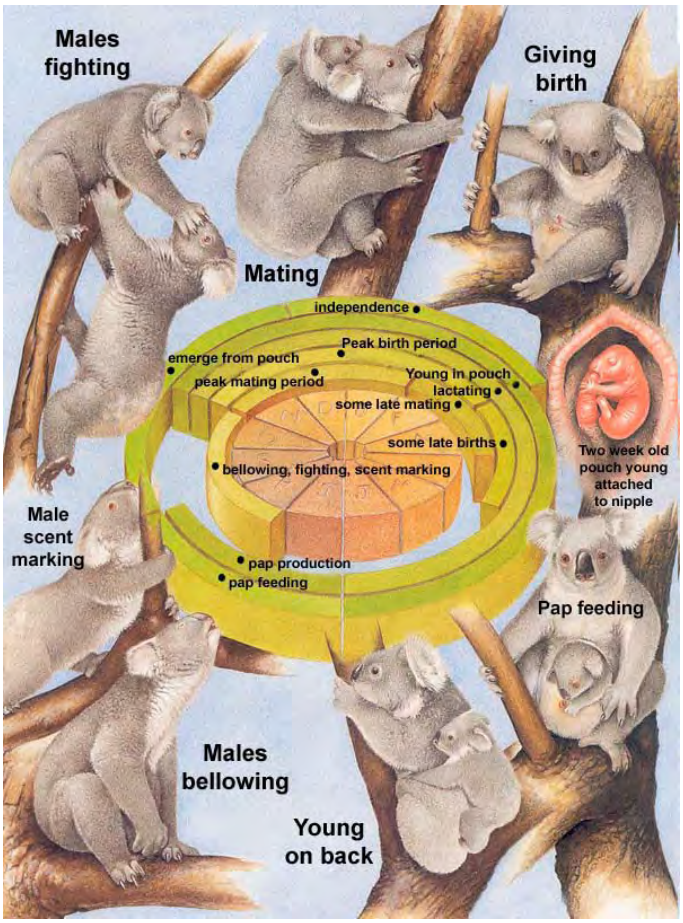
Koalas are distributed across the eastern states of Australia. They are more numerous in coastal regions but also occur in the drier woodlands adjacent to major rivers. Recently, northern koala populations in New South Wales, the Australian Capital Territory, and Queensland have been listed as Endangered. In contrast, some southern koala populations are locally overabundant and require management such as translocation. Prior to koalas being protected by law, their populations declined due to hunting for the fur trade. Nowadays, the most common reasons for koala declines are deforestation, climate change, dog attack, road death, and disease such as chlamydiosis, with the effects of inbreeding compounding problems in small populations.

History of Koalas in Narrandera

Local citizens began lobbying in 1968 for the koala to be reintroduced to the Narrandera area in New South Wales after no sightings of koalas in the region since 1900. With the support of the National Parks and Wildlife Service, John "Koala" Sullivan, the Rotary Club, and Councillor Ken Kiesling established the Narrandera Nature Reserve (koala reserve) as a regeneration centre to

The Narrandera koala research team. Back Row L to R: Adam Baus, Aditi Sriram, and Rachel Labador. Front Row L to R: Dr Joanne Connolly, Lee Reavley, Olivia Kemp, and Amy Miller. Image: Unknown passerby.

Dr Joanne Connolly releasing a koala to its original tree. Note the blue ear tag in the left ear indicating a male. Image: Tim Scanlon.

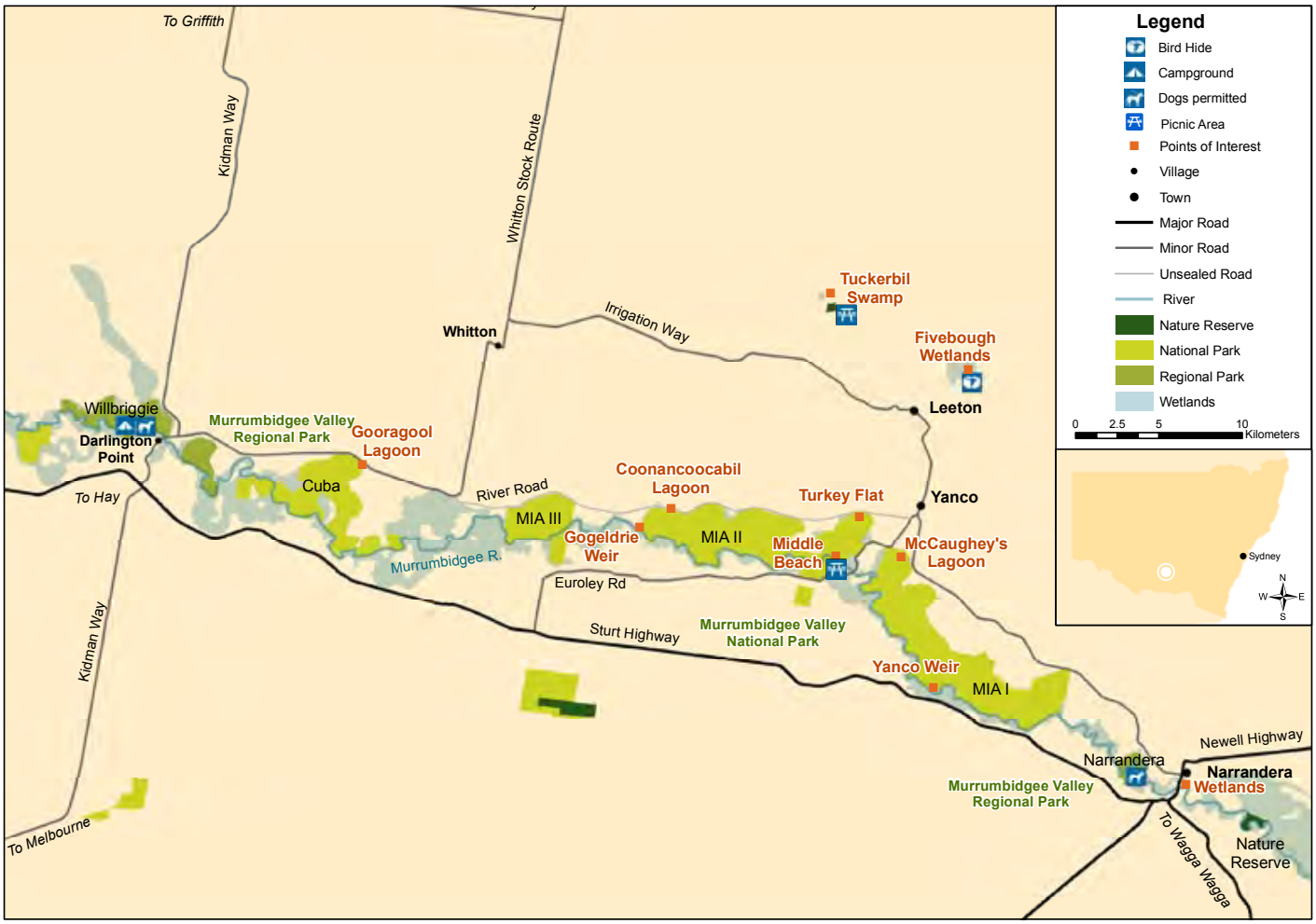


The life cycle of a koala. Image: P. Schouten, from '*Koalas, the little Australians we'd all hate to lose*', Bill Phillips AGPS.

reintroduce the koala in the early 1970s. The reserve, located within five kilometres of the Narrandera township, is a part of the Murrumbidgee Valley National Park. Four koalas were translocated from Tucki Tucki Nature Reserve near Lismore in 1972, ten koalas from French Island, Victoria in 1974, and unsubstantiated reports of another five koalas being released into the reserve from Queensland. The introduced koalas appeared to thrive on the river redgum (*Eucalyptus camaldulensis*) diet. Their numbers increased from nineteen to an estimated two hundred, with koalas spreading into the Narrandera Commons and beyond.

The local koala committee, wildlife rehabilitators, and veterinarians watch over the welfare of the free-ranging koalas on behalf of the Narrandera Shire Council. After increased deaths of koalas crossing the Newell Highway during the breeding season, a 'floppy top' koala exclusion fence was erected along either side of the Newell Highway, directing the koalas to safe underbridge crossings. Anecdotally, the Narrandera koalas are considered to be free of chlamydial infection and are seen as a sustainable population. Since 1988, volunteers and National Parks and Wildlife Service officers have monitored the koala population through annual Koala Spotting Days, with koalas being sighted sixty kilometres downstream at Darlington Point and twenty kilometres upstream at Grong Grong. The koala count draws families from throughout the Riverina to participate in the census, which does not provide absolute numbers but does indicate the koalas are plentiful in the nature reserve and the adjacent common.

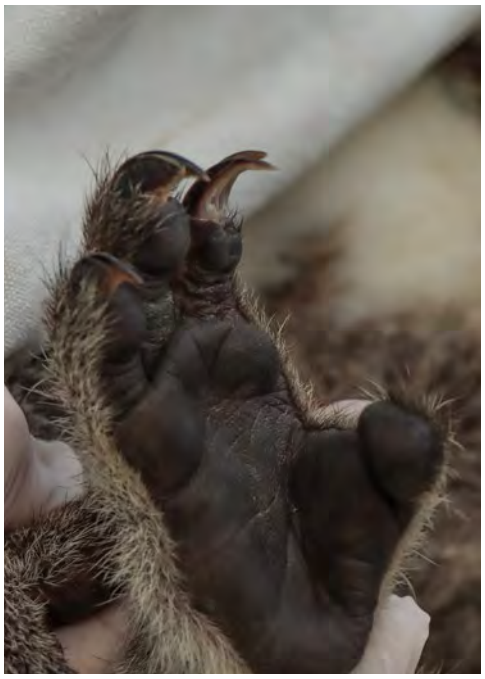
To date, there is no information on the population dynamics, home range, habits, health, or genetic diversity of the Narrandera koalas or the quality of their habitat and threats to this population. Discussions between Charles Sturt University



Murrumbidgee Valley National Park, including Narrandera Nature (Koala) Reserve. Image: NSW National Parks and Wildlife Service.

academics (Dr Joanne Connolly, Dr Hayley Stannard, and Dr Geoff Dutton), Nella Smith from Murrumbidgee Field Naturalists, Lindsay Hayes from Numeralla Wildlife Care, NSW National Parks and Wildlife Service, local veterinarians, and the Narrandera Shire Council took place in 2021-2022 regarding the local koalas. The inaugural research of the Narrandera koala population began on 26-29 June 2022, assessing the health and genetics of the population. A newly formed koala team from the Biodiversity and Ecological Health Branch of the NSW National Parks and Wildlife Service headed by Rachel Labador and Olivia Kemp, with veterinarians Aditi Sriram from NSW National Parks and Wildlife Service and Joanne Connolly from Charles Sturt University and George Madani, a professional tree-climber, conducted fieldwork on the Narrandera population. Koalas were located in Narrandera Common, Narrandera Nature Reserve, and the Narrandera Regional Park (part of the Murrumbidgee Valley National Park, the world's largest river red gum sanctuary). Samples were obtained, and koalas were microchipped and ear tagged before being released where they were initially caught. Samples are currently being analysed at the Koala Health Hub, the Wildlife Genomics Group at the University of Sydney, and Charles Sturt University.

While we await the outcome of the genetics and health survey of the Narrandera koala population and any resulting koala management decisions, a simple and scientifically valuable contribution involves the reporting of sightings of koalas in Narrandera. The public can contribute koala sightings to the New South Wales Government's BioNet Atlas database using the 'I Spy Koala' application. Communication to raise awareness and encourage public involvement in reporting sightings of tagged koalas and sightings of koalas further afield than the initial investigation could add value to this research and promote a feeling of community responsibility for the Narrandera koalas.



The koala's foot (pes) has a big toe without a claw, and the second and third digits are united and are used for grooming. Image: Tim Scanlon.

The koala's hand (manus) has two opposable thumbs. Image: Tim Scanlon

Droppings or scats from a healthy koala (*Phascolarctos cinereus*). Image: Tim Johnson.

CELEBRATING A DECADE OF SUPPORT FOR WILDLIFE RESEARCH at the University of Technology Sydney

The Australian Wildlife Society's Wildlife Ecology Research Scholarships are offered to postgraduate research students from Australian Universities undertaking a research project that is of direct relevance to the conservation of Australia's native wildlife (flora or fauna).

In 2022, the Society celebrated a decade of support for wildlife research at the University of Technology Sydney. We are delighted to highlight the ten recipients of the Society's Wildlife Ecology Research Scholarships at the University of Technology Sydney and their vital research projects over the past ten years. Their articles can be accessed on our website.

2013 - Ellen Curtis

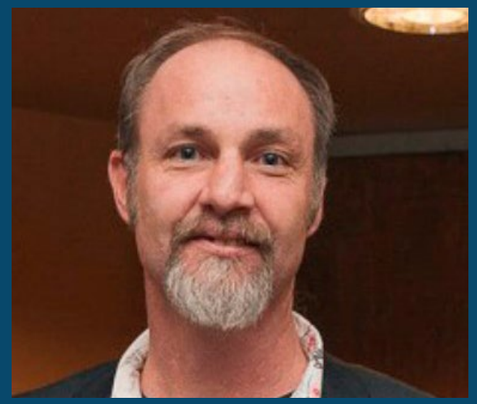
School of the Environment, University of Technology Sydney

Project Title: Response to and recovery from heat stress – thermal tolerance of Australian arid-land vegetation.

2014 - Sofietje Voerman

School of the Environment, University of Technology Sydney

Project Title: Native marine seaweed *Caulerpa filiformis.*



2015 - Ray Mjadwesch

School of the Environment, University of Technology Sydney

Project Title: Researching the history and status of the four large macropod species, the western grey kangaroo (*Macropos fuliginosus*), eastern grey kangaroo (*M. giganteus*), the wallaroo/euro (*M. robustus*) and the red kangaroo (*M. rufus*), in New South Wales.

2016 - Naomi Walters

School of the Environment University of Technology Sydney

Project Title: Safeguarding northern quolls from cane toads.

2017 - Reannan Honey

School of the Environment University of Technology Sydney

Project Title: Habitat Restoration.

2018 - Esty Yanco

School of the Environment, University of Technology Sydney

Project Title: Foxlights: A tool for coexisting with wildlife on production landscapes.

2019 - Laura Michie

School of Life Sciences, University of Technology Sydney

Project Title: Mitigation of cold water pollution using novel thermal curtain.

2020 - Chris Hasselerharm

Centre for Compassionate Conservation, University of Technology Sydney

Project Title: Provenance detection using novel real-time forensics and its application in the illegal wildlife trade.

2021 - Gwilym Price

School of Life Sciences, University of Technology Sydney

Project Title: The assessment and development of bioavailability-based guideline values for zinc in Australian and New Zealand Freshwaters.

2022 - Mitchell Brennan

School of Life Sciences, University of Technology Sydney

Project Title: Aquarium bred and released seahorses as a conservation method for the endangered White's Seahorse, *Hippocampus whitei.*

Working With Wildlife Specimens

Andrea Wild

Dr Clare Holleley is an evolutionary biologist at CSIRO. She works with the National Research Collections Australia, surrounded by fifteen million natural history specimens. The collections include pinned insects, pressed plant cuttings, taxidermied birds and mammals, skeletons, fish, and lizards stored in ethanol, and a historical egg collection. Clare's purpose is to find new ways to unlock the information about Australia's biodiversity that museums and collections hold.

Do Thicker Shells Protect Cuckoo Eggs From Their Hosts?

Many of the clutches in the historical egg collection at CSIRO contain an imposter, the egg of a cuckoo.

Cuckoos need strategies to avoid their eggs being detected and ejected by their hosts. Host birds usually need to be able to peck and puncture a cuckoo's egg to pick it up and eject it from their nest. Some species have evolved eggs that mimic the size, colour, or pattern of their host's eggs. But what about thicker eggshells? Have cuckoos evolved thicker eggshells to prevent this?

"Based on studies in Europe, many people believe cuckoo species have evolved thicker eggshells if their hosts have the ability to detect cuckoo eggs, and would help prevent host birds from breaking and ejecting them," Clare said.

"We decided to find out whether this is true for Australian cuckoos. Do they have thicker eggshells than their hosts?"

Clare and her team studied seventy egg clutches from the historical egg collection at CSIRO. They compared egg clutches from closed, dome-shaped nests with egg clutches from open, cup-shaped nests.

"Australian birds with dome-shaped nests tend to accept cuckoo eggs, whereas birds with cup-shaped nests, where the eggs are more visible, are much better at detecting and ejecting cuckoo eggs. Because of this, we expected cuckoo eggs from cup-shaped nests would have thicker shells than the eggs of their hosts," Clare said.

The teams used an industrial tool to measure the thickness of eggshells in the collection. It is normally used to test the thickness of products like plastic bottles, pipes, or car parts.

The results were unexpected and changed assumptions about the strategies cuckoos have evolved to work around their hosts' defences.

"We found the opposite of what we expected. Cuckoo eggs from dome-shaped nests had thicker eggshells than their hosts," Clare said.

This surprising result suggests that in Australian cuckoos, the purpose of thicker shells is not to prevent the host

Top: Imposters in the historical egg collection at CSIRO. Image: CSIRO.

birds from breaking and ejecting their eggs. Clare suspects thicker shells help cuckoos avoid egg breakage during laying.

"Cuckoo species that lay in dome-shaped nests need to drop their eggs from a height onto other eggs already in the nest. Thicker shells would help protect them from the fall," she said.

Old Specimens as a Source of DNA

A few years ago, Clare and her team had success sequencing DNA from fifty-year-old eggshells. Prior to this, DNA had only been extracted successfully from the eggs of birds with very thick shells, the ratites. This group includes emus, ostriches, and kiwis. Clare's work expanded this to all birds.

"Eggshells protect DNA from processes that would normally break it down, preserving it for research. There are millions of eggs held in museums and collections around the world. Imagine what their DNA could tell us. We can even look back in time," Clare said.

Clare and her team next turned to a group of specimens once thought unlikely to yield useful DNA, fish and reptiles that were preserved in formalin prior to long-term storage in ethanol. Her team has been taking the next giant leap from sequencing the DNA of a specimen. They are working out which genes were switched on when the animal was collected. That is thanks to formalin crosslinking DNA and the proteins associated with it, revealing which genes were active at the time.

"This is a unique advantage for museums and collections. Their specimens, collected over the last one hundred years or so, overlap with a period of rapid environmental and climate change. We can see clear differences when we compare specimens from different decades. They give us a window into how animals have responded to climate change."

"This breakthrough means historical collections are now a resource for research on how animals have responded to environmental change, and more importantly, whether they can adapt to future environmental stress," she said.

Clare is currently co-editing a textbook about environmental genomics, which covers using new DNA techniques to monitor and manage the environment.

If you found this article of interest, we invite you to learn more about getting DNA out of very old specimens at: https://bit.ly/DNAoldspec

Specimens from the spirit vault at the Australian National Wildlife Collection. Image: CSIRO.

Clare Holleley's work involves new techniques for getting DNA out of old formalin-preserved wildlife specimens. Image: Dr Clare Holleley.

The Armoured Mistfrog (*Litoria lorica*)

Narrowly Avoided Extinction but Remains on the Edge

Assoc. Prof. Conrad Hoskin,
College of Science & Engineering,
James Cook University

In the late 1990s, I started researching frogs in the Wet Tropics of north Queensland. Chytridiomycosis, a disease caused by the introduced fungus, *Batrachochytrium dendrobatidis*, swept through the Wet Tropics in the late 1980s and early 1990s with devastating effects. The fungal disease was novel to Australia and had already decimated some stream-dwelling species in south-east Queensland and the Eungella region, including causing the extinction of two gastric-brooding frog species (*Rheobatrachus silus and R. vitellinus*). By the mid-1990s, when I was first in the Wet Tropics region, four upland rainforest, stream-dwelling species had vanished. Wind forward thirty years, and three of those species are deemed extinct, but one of the species had a lucky escape. This story is the story of that species.

The armoured mistfrog (*Litoria lorica*) was discovered and named from the uplands of Thronton Peak in 1979. The common name refers to the large, spiny nuptial pads of the males (i.e., 'armoured') and the fact the frogs were only known from the misty uplands (i.e., 'mistfrog'). The species is completely restricted to waterfalls, where all life stages live. It appears to be the only mute frog in Australia – I have spent many hours around the frogs at night and never once heard a male call. Instead, males and females occur at high density on the waterfalls and probably find each other and interact visually. It is one of a small number of frogs in the world that live entirely on waterfalls.

Males amplex with females ('amplexus' is the breeding embrace), and the spiny nuptial pads at the base of the male's thumbs function as a none-slip-grip on the female in rushing water. The clutch of eggs is 'glued' to the rock surface in shallow flowing water (including on vertical rock surfaces), and the tadpoles hatch out into the flowing water. They then develop in the flowing water, moving along the rock surfaces using a large suctorial disc around their mouth. They feed on algae and other materials on rock surfaces. They then metamorphose as very small, mottled grey frogs that blend in perfectly with their granite background. From there, it is a life around the crashing water of the waterfalls, feeding on insects and other invertebrates. The armoured mistfrog co-occurs with a similar species of similar ecology called the waterfall frog (*Litoria nannotis*) – a familiar species to many who spend time on Wet Tropics streams at night.

The armoured mistfrog disappeared from the Thornton Peak uplands around 1990 and was not seen for eighteen years. When I turned up in the Wet Tropics, it was believed to be extinct, gone in the first wave of chytrid disease impacts. It was the missing species that always intrigued me the most and the species I always wished I had seen. The intrigue was that it was so poorly known when it disappeared and that it was essentially a small version of the waterfall

Top: An armoured mistfrog (*Litoria lorica*) in a splash zone at the new site. Image: Conrad Hoskin.

frog, living side-by-side with that species. Then the first unexpected thing happened. A researcher called Michael Cunningham (then doing his PhD at the same institution as me, The University of Queensland) found specimens of the armoured mistfrog in an American Museum, mislabelled as juvenile waterfall frogs. Interestingly, these specimens were collected (before the disease declines) from the upper Mossman River on the Carbine Tableland. This discovery extended the historic range south of Thornton Peak and greatly increased the possible area that an overlooked population may have been hiding out.

Further targeted searches failed to find the species. Indeed, to this day, it has never been found at any of its historic sites in the upland rainforests. Then, out of the blue, it was rediscovered in 2008 after eighteen years of being missing. A PhD student, Robert Puschendorf, was researching how waterfalls frogs were co-existing with chytrid disease in stretches of the stream flowing through rainforest and adjacent open forest on the western side of the Carbine Tableland. A number of us had noticed that some declined species, including waterfall frogs, survived better in open canopy areas than in the upland rainforest. We suspected it had something to do with disease tolerance in these hotter environments. One day, Rob looked further downstream than usual and, among the numerous waterfall frogs, found some small frogs that looked like juveniles of that species, but some had nuptial pads. He wondered if they were armoured mistfrogs, and he contacted me. Fortuitously, I was in the nearby lowlands at the time, up from Canberra (I was at Australian National University at the time) for my sister's wedding at Cape Tribulation. I met up with Rob, and over the following weeks, we determined they were indeed armoured mistfrogs, surviving at high density at that one site.

Rob and I received a National Environmental Research Program grant from the Australian Government to survey the region more extensively and hopefully find other populations in similar open canopy and waterfall areas. We would identify sites from Google Earth, walk or helicopter in, and survey the ideal habitat and upstream into the rainforest. Our surveys were thorough, but we did not find any other populations of armoured mistfrogs. However, we found numerous unknown populations

A male armoured mistfrog (*Litoria lorica*). Image: Conrad Hoskin.

A female armoured mistfrog (*Litoria lorica*). Image: Robert Puschendorf.

Nuptial pads of a male armoured mistfrog (*Litoria lorica*). Image: Robert Puschendorf.

Armoured mistfrog (*Litoria lorica*) habitat at the translocation site. Image: Conrad Hoskin.

L to R: Dr Robert Puschendorf and Dr Conrad Hoskin swabbing frog for chytrid disease. Image: Eridani Mulder.

of waterfall frogs and common mistfrogs, both endangered species at the time. We also detailed the extent of the single population of armoured mistfrogs. We found that the remaining population was restricted to a four-kilometre section of the stream and probably totalled less than 1,000 adults. Disease swabbing revealed that almost every frog has chytrid on its skin. Thermal imaging revealed that the frogs probably survive chytrid at the site because they emerge onto warm rocks at night, elevating their body temperature above the optimal range for chytrid fungus to proliferate. The species was probably saved from extinction by the heat from the lower elevation, westerly aspect, and open canopy at this site. Hot rocks equal healthy frogs.

The obvious question was what to do next to improve the chances of survival. First, a long-term monitoring transect was established to keep tabs on numbers, and I have kept doing this two or three times a year for over a decade. Second, the decision was made to translocate a small number of adults to a nearby site of similar habitat, to try establishing a second wild population. This translocation was a collaboration between myself, the Threatened Species Group of the Queensland Government, and the Western Yalanji People. In 2013,

Dr Conrad Hoskin inspects the habitat at a new potential site for the armoured mistfrog (*Litoria lorica*). Image: Conrad Hoskin.

the first forty frogs were moved – twenty males and twenty females. The translocation was done within a few hours at night, and the frogs hopped off together into their new home. The site was chosen because the stream habitat is ideal and thermal characterization of the site had shown it was also warm and, hopefully, a refuge from chytrid disease. In 2014, another twenty frogs were translocated to the same site; in 2015, a final forty frogs were moved.

I have monitored this site two or three times a year to learn how the frogs fared. The establishment was slow, with the first few metamorphs being found in late 2014. Finding the first youngster at the site was very exciting! Over the subsequent years, numbers have steadily increased (with natural fluctuations), and many juveniles have been seen. The adult population at the site is currently at least one hundred individuals, and I doubt any of these are the frogs we put there nearly ten years ago. The translocation is deemed a success, and fingers are crossed the population continues to grow.

That first translocation provided some 'insurance' for the species – two wild populations are better than one. But the new population remains small and, importantly, it is in the same catchment as the main population. The issue is that any threat introduced to that catchment, for example, another disease or invasive fish, could quickly impact the entire species. Therefore, approvals are currently being sought for another translocation. The next translocation site has already been identified – a habitat of similar environmental characteristics in a neighbouring mountain range. This translocation is planned for 2023, with generous financial support from the Australian Wildlife Society.

Compared to when I started research in the Wet Tropics, things are looking incomparably more positive for the armoured mistfrog. The main population persists, a second wild population is established nearby, and a third is planned. However, threats remain at the main site, which needs to be urgently addressed. An impact on that population would impact roughly ninety percent of the species, and the nearby second population would soon feel the same impact. Every effort must be made to ensure the protection of the main population, or this time we will lose the armoured mistfrog forever.

The first juvenile found at the translocation site. Image: Conrad Hoskin.

A cluster of armoured mistfrogs (Litoria lorica) in the splash zone beside a waterfall. Image: Conrad Hoskin.

Upland stream habitat from which the armoured mistfrog (*Litoria lorica*) and several other Wet Tropics frogs disappeared. Image: Robert Puschendorf.

2022 Australian Wildlife Society

University of New South Wales Australian Wildlife Society Wildlife Ecology Research Scholarship Recipient

Dingoes, Quolls, Foxes, Monitors: Competition Between Predators in Myall Lakes National Park, New South Wales

Brendan Alting

Recent improvements in ecological monitoring techniques have helped to shed light on how animals affect other species within their environment. Predator species, those which eat other animals to survive, have been shown to affect the structure and functioning of some ecosystems, particularly by consuming herbivores, which become overabundant in their absence, and by suppressing the impacts of other predators. The most famous example of this interaction is from wolves (*Canis lupus*), which were reintroduced to Yellowstone National Park in the United States in the 1990s, which increased the levels of fear in overabundant elk (*Cervus canadensis*) populations in the park. This fear caused the elk to change their behaviour and reduced their foraging of tree saplings, which previously had not been able to develop fully. The altered behaviour of the elk transformed parts of the park from open grasslands to a forest, benefitting many plant and animal species, such as willows and beavers.

While there were many winners from wolf reintroduction, there were also losers; coyotes (*Canis latrans*), numbers of which had expanded significantly after the removal of the wolf, experienced a significant population decline, as much as fifty percent in some areas. This population decline is an example of trophic cascade theory in action, particularly the mesopredator release hypothesis. This hypothesis suggests that larger, dominant predators, in this case, the wolf, 'interfere' with smaller predators, the coyote (one-third the size of wolves), by outcompeting them for resources and through killing when they come into direct contact with each other. This competition between species again has flow-on benefits for other species. For example, red foxes (*Vulpes vulpes*) in Yellowstone National Park benefitted from the presence of wolves, as the high densities of coyotes in the park were previously suppressing them.

The mesopredator release hypothesis has support in numerous ecosystems across the world. In Africa, lions (*Panthera leo*) suppress populations of smaller predators like African wild dogs (*Lycaon pictus*). In coral reefs, larger sharks suppress populations of smaller stingrays. In many environments in Australia, the dingo (*Canis dingo*) affects the abundance and behaviour of red foxes.

The negative impacts of the invasive red fox in Australian environments are well documented. Introduced to Australia in the 1850s, foxes have been implicated in the decline and extirpation of many of our unique Australian fauna, including species such as the bettong (*Bettongia penicillata*), greater bilby (*Macrotis lagotis*), and the bridled nail-tail wallaby (*Onychogalea fraenata*). Additionally, foxes are purported to impact some of our native Australian predators. The spotted-tail quoll (*Dasyurus maculatus*), our largest extant marsupial predator, has experienced severe population reductions and is listed as Endangered in Australia, and encounters competition with similarly sized foxes listed as a key threatening process. Similarly, the lace monitor (*Varanus varius*), in some areas of New South Wales, has higher population sizes in areas where foxes are lethally controlled than in areas where they are not.

Myall Lakes National Park, located on Worimi Country on the mid-north coast of New South Wales, is a highly biodiverse environment consisting of closed angophora woodland, coastal dunes, heathland, swamp, freshwater lakes, and patches of rainforest. Dingoes, Australia's apex mammalian predator, spotted-tail quolls, foxes,

Camera trap image from Myall Lakes National Park, showing a spotted-tail quoll (*Dasyurus maculatus*) investigating chicken from a bait tube. Image: Camera Trap Footage. Image: Dr Brad Smith.

Top: Brendan is a PhD Candidate in the Centre for Ecosystem Science at the University of New South Wales Sydney. Brendan has an interest in species interactions, particularly between competing predators.

and lace monitors (all mesopredators), are present in the park. Dingoes are highly visible in the area, often visiting campgrounds and occurring in high density in the town of Hawks Nest at the southern edge of the park. The dingo population in Myall Lakes has been studied since 2018 as part of the Myall Lakes Dingo/Dapin Project, in collaboration with the Centre for Ecosystem Science at the University of New South Wales Sydney, Taronga Conservation Society, MidCoast Council, NSW National Parks and Wildlife Service, and Karuah and Foster Aboriginal Land Councils.

Many individual dingoes in the area are known to the Myall Lakes Dingo/Dapin Project. This project aims to improve the management of dingoes, which can cause conflict when they come into close contact with people, by improving our understanding of their social dynamics, behaviour, and broader ecological impacts. In a prior population survey, twenty-seven adults and thirteen pups were individually identified, predominantly using camera traps. Camera traps, which take photos or videos when motion is detected in front of the camera, have revolutionised the studies of animals, particularly cryptic species which are difficult to observe directly in the wild.

Our study aims to estimate the densities and abundance of dingoes, foxes, quolls, and monitors in the Myall Lakes region and explore the relationships between their spatial distributions. While the relationships between dingoes and foxes have been extensively studied in some ecosystems, the relationships and interactions between all four predator species mentioned above have not previously been studied simultaneously. Additionally, previous studies looking at the relationships between predators in Australia predominantly used indices, such as track counts or spotlight surveys, to estimate abundance. Camera traps have enabled researchers to identify individuals of species with variable pelage patterns, such as quolls, dingoes, and monitors. This technology opens the possibility of using spatial capture-recapture (SCR) models to estimate density, which requires individual identification and is considered the 'gold standard' of population abundance estimation in wildlife monitoring.

To estimate the populations of monitors, dingoes, foxes, and quolls, sixty-one camera trap stations have been deployed throughout Myall Lakes National Park. These cameras will be serviced and monitored for three months during the summer of 2022-2023. Twenty-two road-based camera stations, consisting of two cameras placed on opposite sides of trails and roads, will target dingoes and foxes that predominantly use trails. Thirty-nine baited camera stations, pointed at an inaccessible food lure, will target quolls and monitors. The densities of each predator species will then be modelled by identifying as many individuals as possible from the camera trap images. The spatial relationships of each predator across the study area will be compared, as well as their interactions and visitation times at different camera stations.

A dingo (*Canis dingo*) pup born in 2021 was identified from camera trap footage during a dingo population survey in Myall Lakes National Park. Image: Camera Trap Footage.

Our study aims to highlight some of the ecological roles that dingoes play in this environment, which will aid in the management of dingoes generally. We expect that where dingo densities are high, the densities of foxes will be low, as predicted by the mesopredator release hypothesis. Mesopredators, quolls, and monitors may also be suppressed by high densities of dingoes, although a reduction in competition with foxes due to their suppression by dingoes may counter these effects.

FUNDS PROVIDED BY THE AUSTRALIAN WILDLIFE SOCIETY are critical to funding trips to service camera traps in Myall Lakes National Park as part of this project.


A dingo (*Canis dingo*) at Mungo Brush Campground is looking for a snack at a barbecue table. Dingoes are often a source of human-wildlife conflict when they become habituated to humans, particularly when they are used to receiving food. Image: Dr Neil Jordan.

2022 Australian Wildlife Society

University of Newcastle Australian Wildlife Society Wildlife Ecology Research Scholarship Recipient

Determining Critical Shorebird Habitat and Local Drivers of Shorebird Decline in the Hunter and Port Stephens Estuaries

Louise Williams

Migratory shorebirds are incredible endurance athletes that are in serious trouble. Some species, such as the bar-tailed godwit (*Limosa lapponica*), undertake record-breaking migration flights in excess of thirteen thousand kilometres between their breeding and non-breeding grounds – without stopping. Despite their athletic prowess, migratory shorebirds have suffered severe population declines in recent decades. This decline is attributed to many factors, including pressures faced by the birds along their migration routes as well as those present at their breeding and non-breeding grounds.

In Australia, the Hunter and Port Stephens estuaries of New South Wales are internationally recognised as critically important habitats for migratory shorebirds. These estuaries host more than one percent of the global population of the endangered far eastern curlew (*Numenius madagascariensis*), which underpins their Ramsar Convention and Key Biodiversity Area listings. Annually, significant populations of shorebirds spend the austral summer in these estuaries after migrating from their

Top: Louise Williams is a PhD Candidate with the Conservation Science Research Group at the University of Newcastle and has always been passionate about birds and their conservation. Image: A-One Fotomakers.

Bar tailed godwit (*Limosa lapponica*) in the Hunter estuary. Image: Louise Williams.

breeding grounds as far away as Siberian Russia and Alaska. However, shorebirds are declining within the Hunter Region disproportionately faster than other Australian regions, placing its Ramsar Convention listing at risk. The accelerated rates of decline in the Hunter may link directly to habitat loss at other areas of the flyway, but trends in local decline suggest that local-scale factors are also at play. These localised impacts and their effects on shorebird survival are the focus of my PhD research at the University of Newcastle.

This project addresses key questions regarding the conservation of migratory shorebirds in the Hunter and Port Stephens estuaries, intending to reveal local drivers of shorebird decline and determine areas of key conservation significance. Using a variety of methods, including observational studies, stable isotope and environmental DNA analyses, and GPS tracking, the following research questions will be addressed:

1. Which natural (e.g., substrate, vegetation, predator visitations) and human-derived (e.g., disturbance) variables best predict shorebird foraging behaviour and foraging success?
2. What prey species are ingested by different shorebird species and which primary producers lie at the base of the shorebird food web?
3. Do European red foxes (*Vulpes vulpes*) pose a threat to roosting shorebirds?
4. What are the environmental factors driving the prevalence of avian influenza in shorebird and waterfowl populations in the Hunter Region?

Bar tailed godwit (*Limosa lapponica*) landing on a sandbank in the Hunter estuary. Image: Louise Williams.

Given the heavy urban and industrial influences on both estuaries, the pressures facing shorebirds are likely to be substantial. To survive their arduous journey back to their northern hemisphere breeding grounds, the birds must be in optimal health. Their journey can only be achieved if stressors to the shorebirds are minimised within the Hunter Region. Therefore, it is vital to understand human activities and their impacts on shorebirds so management outcomes can be established to minimise their effects. Additionally, it is equally important to characterise and conserve critical shorebird foraging and roosting sites and habitats that support the shorebird food chain. Achieving this will maximise shorebird health and survival during their Australian non-breeding seasons and assist their successful return migrations to the northern hemisphere.

FUNDS PROVIDED BY THE AUSTRALIAN WILDLIFE SOCIETY will be allocated towards stable isotope and eDNA analyses to gain insight into the flow of nutrition in the shorebird food chain and the organisms directly consumed by shorebirds.

Louise Williams with a flagged bar tailed godwit (*Limosa lapponica*), Roebuck Bay, Western Australia. Image: Tegan Douglas.

Louise Williams and Dr Andrea Griffin surveying shorebirds at Stockton Sandspit. Image: Mattea Taylor.

2022 Australian Wildlife Society

University of Technology Sydney Australian Wildlife Society Wildlife Ecology Research Scholarship Recipient

Aquarium Bred and Released Seahorses as a Conservation Method for the Endangered White's Seahorse, *Hippocampus whitei*

Mitchell Brennan

White's seahorse (*Hippocampus whitei)* is a seahorse species endemic to the east coast of Australia. The species is relatively small, reaching a maximum length of sixteen centimetres and incredibly good at blending into their environment. They can effectively camouflage with their habitats and can be seen in a range of colours from yellow to orange to brown (the name White's seahorse comes from John White, the surgeon general of the first fleet – not their colour).

Like most seahorse species, the White's seahorse is a relatively poor swimmer. They spend most of their time using their prehensile tail to hold on to their habitats and display extraordinary site fidelity and habitat attachment. They rely on the availability of key habitats, such as seagrasses and soft corals, for anchorage and protection through camouflage.

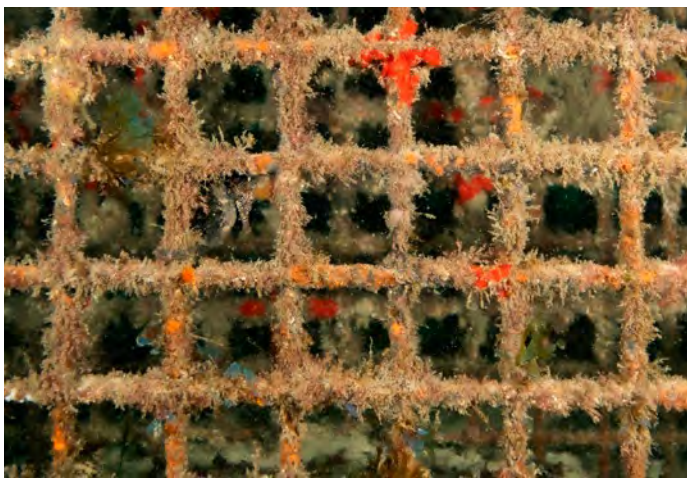
Unfortunately, human activity, dredging, installation of moorings, and climate change implications have significantly impacted the habitats of the White's seahorse. Habitats that the White's seahorse have been shown to prefer, including the seagrass (*Posidonia australis*) and the soft coral (*Dendronephthya australis*), have declined at alarming rates. This decline has subsequently impacted the populations of White's seahorses; without suitable habitat, the seahorses cannot survive. In areas such as Port Stephens in New South Wales, where habitats have been drastically lost, White's seahorse populations have declined by upwards of ninety percent across their range. It is estimated that the number of seahorses has reduced by up to fifty percent.

Due to these alarming population declines, the White's seahorse has been listed as an Endangered species by the *International Union for the Conservation of Nature Red List of Threatened Species* and in Australian state and federal legislation. It is clear that positive intervention is needed for the species to persist.

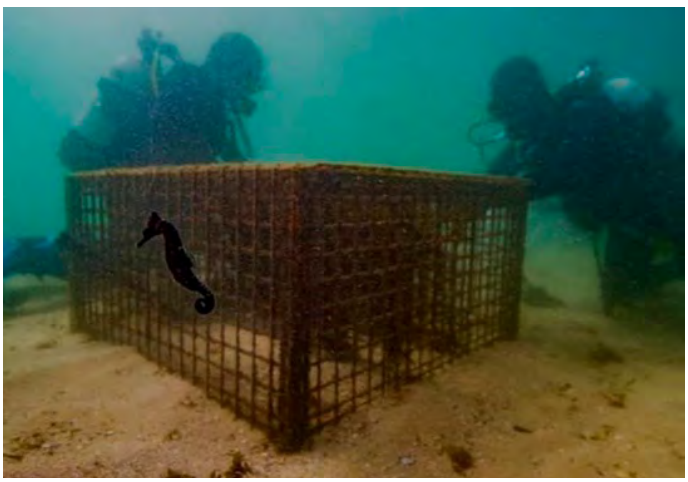
The research project aims to develop and refine conservation methods for the species and is doing so using two key methods. The first method is to provide critical habitat to White's seahorse populations. The second method is to restock wild seahorse populations through a breed-and-release program, a novel approach for marine fish and syngnathid conservation.

The provision of habitat is key to enabling seahorses to persist at

Top: Mitchell Brennan is a PhD Candidate with the Fish Ecology Lab at the University of Technology Sydney. He is a passionate marine scientist interested in threatened species, marine fish ecology, and conservation. Image: Tom Burd.



A seahorse on a seahorse hotel. Image: Tom Burd.



Seahorse hotel with divers. Image: Tom Burd.

their current sites and allow wild populations to recover. We have designed and installed a unique artificial habitat named 'Seahorse Hotels'. The metal cage-like structures are installed onto sandflats adjacent to existing seahorse habitats, such as seagrasses, and provide the seahorses with the holdfasts they require to grasp with their tail. Over time, the structures accumulate marine growth, including algae, bivalves, and sponges, which also brings small crustaceans such as amphipods and shrimps – a seahorse's primary diet. The metal slowly corrodes, and eventually, the marine growth will stand alone, leaving behind a small semi-natural reef that the seahorses can continue to use as their habitat. Meanwhile, research is being conducted with positive results on restoring their natural habitats through seagrass replanting and coral translocations. Together, the artificial habitat provision and habitat restoration will provide White's seahorses with a suitable place to live.

We aim to restock White's seahorse populations by breeding and releasing juvenile seahorses. Adult seahorses are collected locally and bred in specially designated aquarium facilities, including a new project at the Sydney Institute of Marine Science (SIMS) in Mosman. Male White's seahorses give birth to live young or 'fry', and can birth up to 150 fry in a single brood. Breeding occurs throughout the summer months from October through to February-March, and each male may have several broods throughout the season. Once born, the fry is approximately one centimetre long and, unfortunately, readily predated by other marine fishes and cephalopods. Juveniles will be reared until they are larger, approximately five centimetres, then released back into the wild – to increase their survival and replenish the wild populations. This project will focus on understanding the optimal husbandry methods (such as ideal temperatures and food types) for rearing juvenile seahorses to improve their growth rate and performance and ideally lead to greater survival of seahorses once they are released into the wild.

A wild White's seahorse (*Hippocampus whitei*) on a seahorse hotel. Image: Tom Burd.

To monitor the success of the breeding program, the seahorses will be tagged before their release using a Visible Implant Fluorescent Elastomer (VIFE) tag. The tag is a polymer injected just below the skin of the seahorse. Using combinations of various colours and body placements on the seahorse, each individual is given an identifiable tag combination. Through regular SCUBA diving and an exciting upcoming citizen-science monitoring effort, we can identify released juveniles in the wild to determine their survival and analyse how they use the habitats onto which they are released.

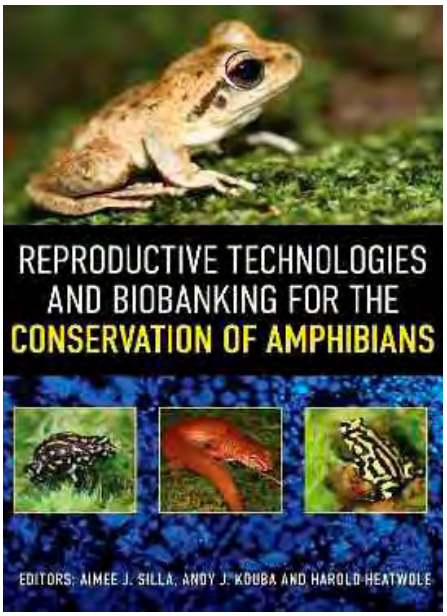
Looking to the future, we hope that the two conservation methods being designed and implemented provide the foundational work in driving the successful recovery of White's seahorse populations and that the long-term persistence and survival of the species are successful.

FUNDS PROVIDED BY THE AUSTRALIAN WILDLIFE SOCIETY will be used for equipment assisting in the in-situ SCUBA diving surveys, which monitor White's seahorse populations in Sydney Harbour and released captive-bred seahorses.

Mitchell Brennan with seahorses to be released. Image: SEA LIFE Sydney Aquarium.

Mitchell Brennan conducting a SCUBA diving seahorse survey. Image: Tom Burd.

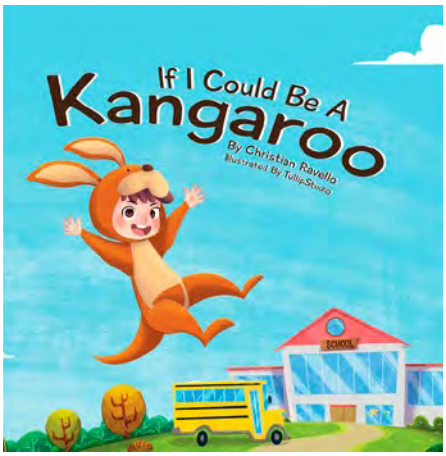
Book Reviews



Reproductive Technologies and Biobanking for the Conservation of Amphibians – *Aimee Silla, Andy Kouba, Harold Heatwole*

How to decelerate global biodiversity loss is one of our generation's most significant challenges. Reproductive technologies have enormous potential to assist the recovery of species by enhancing reproductive output, facilitating genetic management, and supporting the reintroduction of threatened species. Cryopreservation technologies and the establishment of global gene banks to conserve the remaining extant genetic diversity of threatened amphibians are of value. *Reproductive Technologies and Biobanking for the Conservation of Amphibians* brings together leading experts to provide a comprehensive overview of current best practices, summarise technological advancements, and present a framework for facilitating the integration of reproductive technologies and biobanking into conservation breeding programs for threatened amphibians. It is an invaluable reference for the next generation of conservation practitioners: captive breeding facilities, researchers, and policymakers involved with biodiversity conservation.

Publisher: CSIRO Publishing
RRP: $180.00



If I Could be a Kangaroo – *Christian Ravello and Tullip Studio*

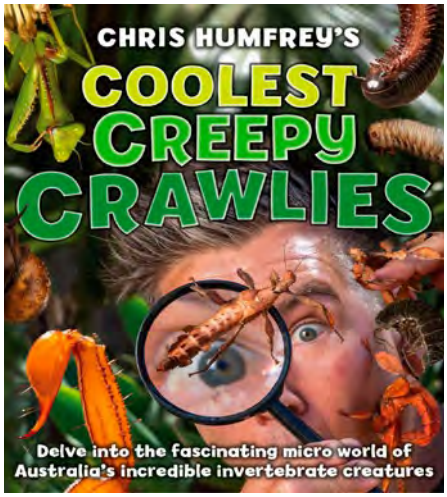
Jake loves animals, and he especially loves Australian animals. He wishes he could be a kangaroo: Jumping over cars, leaping onto the bus, hiding his books in his pouch, and so much more. *If I Could Be a Kangaroo* allows children to imagine the wild, fun-filled ride they could have if they became this popular, iconic Australian animal.

Publisher: Christian Ravello
RRP: $19.99

Why do Birds do That – *Dr Grainne Cleary*

An enchanting, informative book filled with answers to many of the frequent questions we ask about birds and their lives. For thousands of years, birds have fascinated us. We have observed what they do – their behaviours, their characteristics, their survival skills, the food they eat and their habitats – and wondered why they do it. *Why Do Birds Do That?* answers many of these often-asked questions, such as: Why do birds sing in the mornings? Why are some birds so colourful and others are not? and why do birds attack their own reflections? If you have ever wondered why birds behave as they do, you will find the answers in this book.

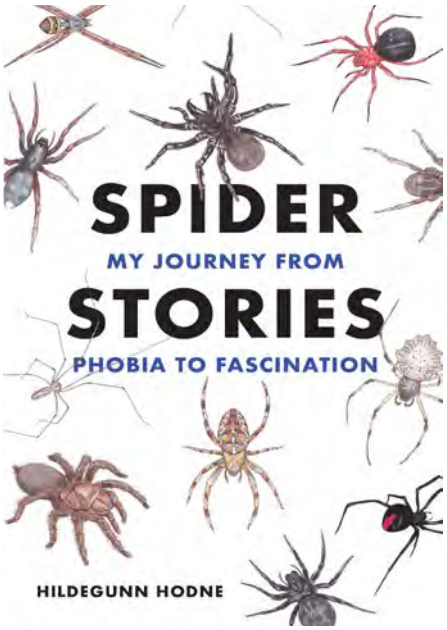
Publisher: Allen and Unwin
RRP: $32.99



Coolest Creepy Crawlies – *Chris Humfrey's*

The author invites readers to take a peek at the fascinating world of Australia's incredible invertebrates. A trail of QR codes that link to gripping video content will take young readers on a thrilling interactive journey through the wacky micro world. Get up close and personal with the stunning mimicry of the Monteith's leaf insect (*Phyllium philippinicum*) and the tiny garden slater (*Porcellio scaber*), which carries its young in a pouch like a kangaroo. Invertebrates do not always receive the pop-star status of other animals, but they have a huge role in maintaining healthy balanced environments. Understanding the vital role of each invertebrate in our ecosystem is essential to saving Australia's biodiversity.

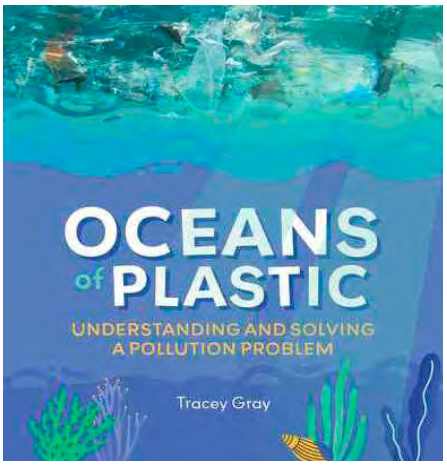
Publisher: The Buzz Group
RRP: $24.99



Spider Stories: My Journey from Phobia to Fascination – *Hildegunn Hodne*

What is a spider, and what makes these eight-legged animals so scary? With a touch of humour, deep curiosity, and an artist's eye, the author examines her phobia and the object of her fear. She describes her past and present encounters with spiders to understand her reactions to spiders better. The story takes her back to her childhood, her travels around Australia, and her relocation to Tasmania. She focuses on Australian spiders while including fine examples of these astonishing animals from elsewhere.

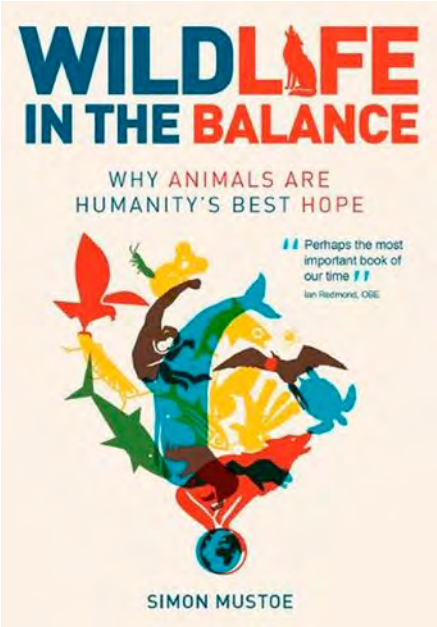
Publisher: Australian Scholarly Publishing | RRP: $29.95



Oceans of Plastic – *Tracey Gray*

Our oceans are filled with incredible marine animals essential for a healthy planet. But it is now estimated that more pieces of plastic are in the ocean than visible stars in the Milky Way. *Oceans of Plastic* explores how ocean systems and swirling currents bring plastics together into massive ocean garbage patches. It also uncovers the floating world of the 'plastisphere' – a mini community of microbes living on ocean plastics – and explains how plastic can even end up on your dinner plate! *Oceans of Plastic* is packed with great ideas and simple changes you can make to help our oceans. Become an ocean change-maker in your home, school, or community, and inspire others to join you in protecting the future of our oceans.

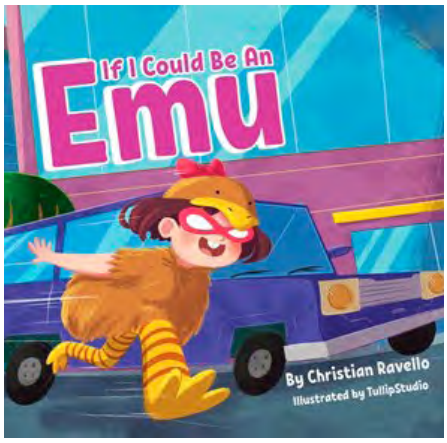
Publisher: CSIRO Publishing
RRP: $29.99



Wildlife in the Balance – *Simon Mustoe*

Wildlife is the only reason we exist. We have a choice: create the global change in values needed to allow wildlife to rebuild a more habitable world or succumb to the impressive power of nature. In this powerful new book, ecologist and author Simon Mustoe explains why animals are humanity's best hope. *Wildlife in the Balance* tells the story of how wildlife conservation is about to become our most significant and only chance to ensure a habitable Earth, our role in making a better future, and why we must act now to ensure our survival. Drawing upon extensive research and his experience as a conservationist, the author takes the reader on a fascinating journey through some of the planet's most spectacular wildlife events to learn how the world works, the origin of life, and our place in nature.

Publisher: Wildiaries Publishing
RRP: $34.99



If I Could be an Emu – *Christian Ravello and Tullip Studio*

Tahlia loves birds, and she especially loves Australian birds. She wishes she could be an emu: running fast through the garden, playing hide and seek, dancing in the rain, and so much more. *If I Could Be an Emu* provides children with a chance to imagine the exciting, joyful ride they could have if they became this unique, special Australian bird.

Publisher: Christian Ravello
RRP: $19.99

If I Could be a Wombat – *Christian Ravello and Tullip Studio*

Kianna loves furry animals, and she especially loves Australian animals. *If I Could Be a Wombat* gives children a chance to imagine the maze of burrows and mischief they could have if they became this furry Australian animal! She wishes she could be a wombat: sleeping in, taking it slow, digging holes in the garden, and hiding from the teacher at school.

Publisher: Christian Ravello
RRP: $19.99

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 ®

114th ANNUAL GENERAL MEETING

AGENDA

Wednesday 1 March 2023
Commencing at 11.30am

Level 2 Castlereagh Meeting Room,
Castlereagh Boutique Hotel
169 Castlereagh Street, Sydney, NSW

1. Welcome and recording of those present.
2. Apologies.
3. Minutes of the 113th Annual General Meeting held on Wednesday 2 March 2022.
4. President's Report for 2022.
5. Treasurer's Report for 2022. Receive and adopt the Balance Sheet and Income and Expenditure of the Society for the year ending 31 December 2022 in accordance with our Constitution.
6. Election for the Board of Directors of the Society:
   a) Stephen Grabowski retires in accordance with the Constitution (10.3) and being eligible, offers himself for re-election,
   b) Brian Scarsbrick AM retires in accordance with the Constitution (10.3) and being eligible, offers himself for re-election,
   c) Philip Sansom retires in accordance with the Constitution and will not stand for re-election, and
   d) John Creighton offers himself for re-election after filling a casual vacancy on the Board (10.5(b)).
7. Appoint the Auditor for 2023 – Peter J Varley CA.
8. 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 2023

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**
Telephone: 0424 287 297 | **Email:** info@aws.org.au | **Website:** www.aws.org.au

Membership Form

Membership

Become a member of the Australian Wildlife Society

Simply fill out this form.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909 ®

Name:.....

Address: .....

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

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

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

Membership category (please tick)

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

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

Three year membership (please tick)

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

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

Payment details (please tick)

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

Card Number:

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

Signature:.....

Amount $.....

Donation $.....

Total $.....

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

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

Membership Hotline: Mob: 0424 287 297

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

Membership Benefits

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

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

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

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

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

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

LEAVE A BEQUEST IN YOUR WILL

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

Benefits of Membership

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

Receive the **monthly e-newsletter.** Keep up-to-date with news from our members and the work of the Society. 2

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

3 Access the **Members' Resource Centre -** your destination for resources and materials on various wildlife-related topics.

Contribute to our **social media platforms:** Instagram, Twitter, Facebook, Linkedin, YouTube, and our Website. 4

5 You have the **right to vote** on important matters at Society general meetings (financial members only).

Receive other benefits such as **Awards, Scholarships, Grants,** and the opportunity to **network** with like-minded people. 6

REGISTERED CHARITY
acnc.gov.au/charityregister

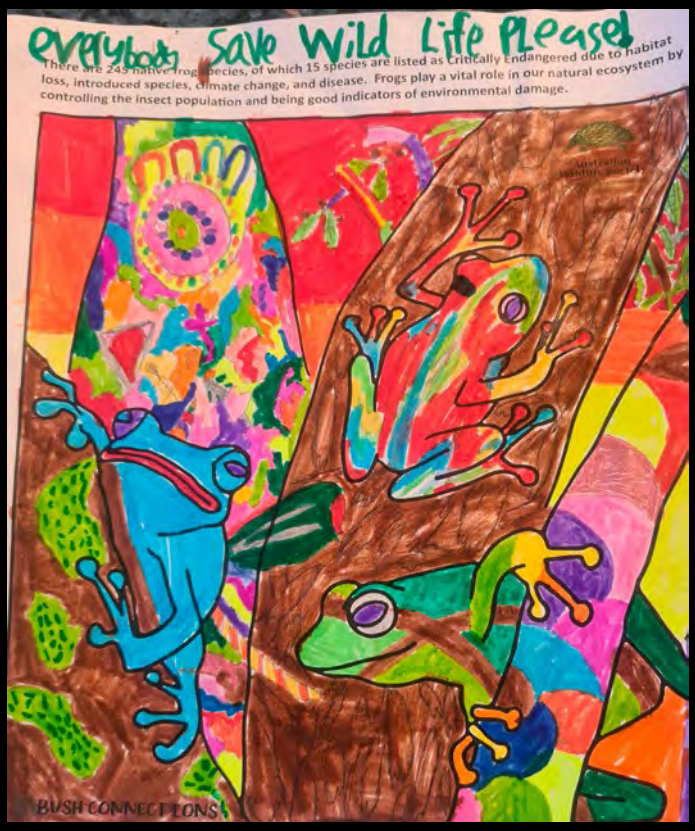
2022
Colouring-in Competition

Ten-year-old Xavier from the Australian Capital Territory

Eleven-year-old Gracie from Tasmania

Twelve-year-old Jesse from Western Australia

Seven-year-old Beau from the Australian Capital Territory

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