MARCH 2024 — VICTORIA'S FAUNA

SCIENCE VICTORIA

Back From the Dead

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Unwelcome Guests

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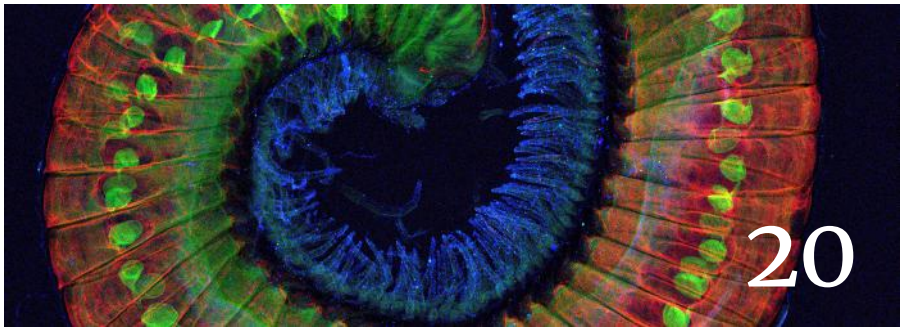
Photograph: Gilles Rolland-Monnet via Unsplash.

This Edition: Victoria's Fauna

Victoria is home to more than a thousand native animal species, but as at June 2023, 378 of these are under threat of extinction (FFG Act Threatened List, June 2023). As with our unique flora, the pressures from climate change risk this number rising unless we act. In this edition, we look at the value of and threats to our native animals.

On the Cover

A galah (*Eolophus roseicapilla albiceps*) walks across a grassy backyard before a storm. Photograph: Do Photography via Unsplash.



Upcoming Submission Deadlines

For all 2024 editions and deadlines, refer to page 45.

APRIL 2024	DUE DATE
The Four Planetary Crises	*5pm, 15 March*
MAY 2024	**DUE DATE**
Accessibility in STEMM	*5pm, 19 April*

From the Editor

SCOTT REDDIEX
Editor-in-Chief — Science Victoria

The evolution of a species is a very slow process. As we humans force the global climates to change, it puts immense pressure on every species in many different ways. It doesn't necessarily matter if there is more or less rain in a particular ecosystem, or it is hotter or colder, but that things are now *different* to what each species evolved with.

Some things are really tangible: if a plant you rely on for food doesn't grow as well in this new climate, it means less available food for you, greater competition, fewer young surviving. Other things are less immediately obvious, like the impact of temperature on fertility of many species,[1] or on the growth of a foetus during gestation.[2] One way that some animals can respond to a change in their environment is to move, and look for food and water elsewhere – in another species' ecosystem.

"A changing climate" doesn't mean that every point on the planet changes in the same way. What it means is that all of the different ecosystems are changing differently, and that means immense pressure on the wide range of species that currently live there.

Which brings us back to evolution. Evolution is still a very slow process – nothing has evolved since I last mentioned that. Importantly, evolution is a much slower process than a rapidly changing climate. In the competition between 'change' or 'die', 'change' isn't a choice for almost every species, leaving only the alternative.

Since the arrival of Europeans in Australia in 1788, more than 100 species endemic to Australia have become extinct.[3] Over 1,800 Australian animal and plant species are currently threatened with extinction.[4] Worldwide, this number is over 44,000.[5] We have really clear examples of what happens when humans change ecosystems – mostly, things die.

Victoria's fauna refers to all the weird, wonderful, and unique fauna that live in this corner of the country. If we don't actively work to change the current course we have chosen, many of them will be confined to a long list of previous tenants.

In this edition of *Science Victoria*, we focus on the wonderful fauna of Victoria. Lejla Kartal looks at the bee-cosystem, and Dale Christensen explains how the synchrotron takes a (very) close look at *Animalia*. Elsewhere, Dr Catriona Nguyen-Robertson looks at the project to de-extinct the thylacine, and also revisits the staggering impact of invasive species, reminding us that cats alone kill 1.6 *billion* native animals in Australia *each year*.[6] Billion. With a B.

We hope you enjoy reading this month's *Science Victoria*. If you prefer not to read on a screen, you can now purchase a physical copy of the magazine (printed on 100% recycled paper) from **rsv.org.au/shop**.

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SCIENCE VICTORIA

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Acknowledgement of Country
The Royal Society of Victoria acknowledges our headquarters are located on Wurundjeri land, never ceded, and convey our respect to Elders past and present. The RSV welcomes all First Peoples, and seeks to support and celebrate their continued contributions to scientific knowledge.

Subscribe to receive Science Victoria online at **eepurl.com/bg-fjH**

Is Nature a Priority for the Victorian Government?

ROB GELL AM MRSV
President — The Royal Society of Victoria

Since December 2014, when Dan Andrews became Premier of Victoria, we've had four Ministers for Environment, three during his term as Premier. The new Minister is Steve Dimopoulous MP – Steve's held three ministries since June 2022.

The reason I have checked this information is that, since the new year, we've had two very important decisions made about the future of wetlands and birds.

Early in January, the Federal Minister for the Environment and Water Tanya Plibersek vetoed Victoria's proposition to expand the Port of Hastings in Westernport Bay to support a significant offshore wind development programme, on the basis of "clearly unacceptable" impacts on internationally important (Ramsar classified) wetlands.[1] The Federal government is obliged under international treaty to protect Ramsar wetlands such as those in Westernport Bay.[2,3] (It would no doubt be good if the Federal Minister applied similar thinking to stop fossil fuel projects – but that's a conversation for another time.)

The proposed offshore wind farms are a breakthrough for Australia, the first in the country, and key to Victoria's world leading renewable energy transition and emissions reduction strategy. The *Australian Financial Review* quoted Premier Jacinta Allan as saying, *"…the energy transition must take precedence over protecting internationally renowned local wetlands"*.[4]

The development of the Port of Hastings has been shelved on two previous occasions on more or less the same grounds. In 2005 the Victorian Department of Infrastructure initiated a Port of Hastings Strategic Land Use and Transport Access Corridor Planning Study *"to cater for the future trade needs of the port, as well as any associated development that it generates"*, concluding in a 2017 report that *"gaining approval for the port development at Hastings would present significant challenges due to the level of impact on the Western Port Ramsar site."*[5] Then in 2021 the Victorian Government blocked AGL's proposal for a gas terminal at Crib Point near the Port of Hastings, Planning Minister Richard Wynne saying, the development would have *"unacceptable effects on the environment in Western Port, which is listed as a Ramsar wetland of international significance."*[6]

More recently, we have seen the Victorian Government reject the recommendation of the Parliamentary Inquiry that duck hunting should cease in the state, a recommendation still supported by some of the government's own members.[7] Minister Dimopoulos is quoted as saying that the government would instead introduce changes that would make the practice "more sustainable".[7] Presumably he acknowledges that it is currently not sustainable. The priority seems to be the safety of duck hunters.

"What don't they understand?" I hear you ask. In the context of rejecting a recommended ban on duck hunting,

Tankerton Creek, French Island, Western Port.
Photograph: Owen Pawsey via Unsplash

> The economy is a wholly owned subsidiary of the environment, not the other way around.[10]
>
> Senator Gaylord Nelson
> *Earth Day founder, 1970*

Sebastian Pociecha via Unsplash

which is opposed by some government members, and the Federal Government's rejection of the Port at Hastings development on Ramsar grounds, we can ask the question: "is biodiversity a priority issue with the Victoria Government?".

Is nature a priority? Is there a real understanding of our own state's Biodiversity Strategy, *Protecting Victoria's Environment - Biodiversity 2037*, which is the Victorian Government's ambitious plan to stop the decline of our biodiversity and achieve overall biodiversity improvement over the next (now only) fourteen years.[8]

The collapse of nature is recognised as an existential threat to the human species and one of the Royal Society of Victoria's four strategic pillars.[9] It will be essential that the entire community, including our political leaders, begin to understand the critical importance of elevating our knowledge and understanding on the relative importance of nature against economic development – even of important renewable energy projects.

As usual, your ideas are welcome as we continue to strengthen the RSV as a valuable independent voice supporting the need for evidence-based decision making based on good science. Email me directly at **president@rsv.org.au**.

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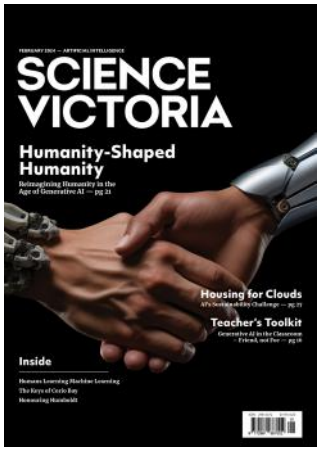

February 2024 Edition of *Science Victoria*

JOIN THE CONVERSATION

Share your thoughts, opinions, and expertise on articles, events, and issues relating to science in Victoria by sending us a letter. Refer to our Guidelines for Authors, and email **editor@ScienceVictoria.org.au**.

Trust in Scientists

DR MICHAEL BATTEN

> It is important for scientists wanting to communicate their findings to accept and understand that it is not possible to convince everyone to happily live with uncertainty.

I recently spent time considering the results of the 2024 Edelman Trust Barometer.[1] Three findings relating to science caught my attention:

- *Scientists are trusted to do what is right (77%).*
- *Scientists are expected to lead innovations (77%).*
- However, 47% of Australians say that *"Scientists do not know how to communicate with people like me".*

I was initially sceptical of a survey published by a public relations firm that trades in trust. I have no specific expertise in measuring or analysing such things, but believe the survey is worth considering simply due to its widespread influence and reputation. To convince myself that the observations were reasonably solid, I compared Edelman's results to a small selection of domestically-focussed news.[2,3] While there are differences, the overall picture presented by Edelman seems consistent with these reports, at least with respect to the above three points.

The first two observations (*"Scientists are trusted to do what is right" and "Scientists are expected to lead innovation"*) may not seem very surprising, but I think they're important to the third. Although I'm sure I've heard them before in some form, it is pleasing to read that these two views continue to be widely held, and it might be useful to work towards preserving or improving on them.

The third point (*"Scientists do not know how to communicate with people like me"*) should also not be surprising, but is definitely worth deeper consideration. Improving communication with people who feel this way – Edelman's 'missing 47%' – should strengthen trust in scientists to lead innovation. I'd expect some impact even where people in this group are already within the 77% of the first two observations.

For my part, science communication is a skill under development. I'd be interested to hear more on the hows and whys of addressing this situation in Victoria/Australia from the *Science Victoria* readership.

I have a few opinions, drawing from my personal interest in the philosophy of science. To put it simply, there are at least two parties to any conversation, and I think the present discussion can be characterised this way. One party, the audience (especially the 'missing 47%'), are likely to prefer hearing questions answered in terms of truth and falsehood. The other party, the scientists, seeks to communicate information that may be complex, is probabilistic, and might be proven incorrect by new data. How to best bridge this gap?

I feel it is important for scientists wanting to communicate their findings to accept and understand that it is not possible to convince everyone to happily live with uncertainty. The very idea that we are bound to unpredictability and uncertainty is potentially quite unnerving and, therefore, hard to get across.

I have some hope that demystifying science a little may help to bridge some of the remaining gaps of understanding and trust: for example, describing the intermediate failures and inductive exploration that place a team in the position to secure convincing data or even a deductive proof. Perhaps *Science Victoria* readers will have some depth of knowledge to contribute, or even be working directly on these issues? I would certainly appreciate hearing more on the subject.

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Securing the Future of the Gippsland Lakes

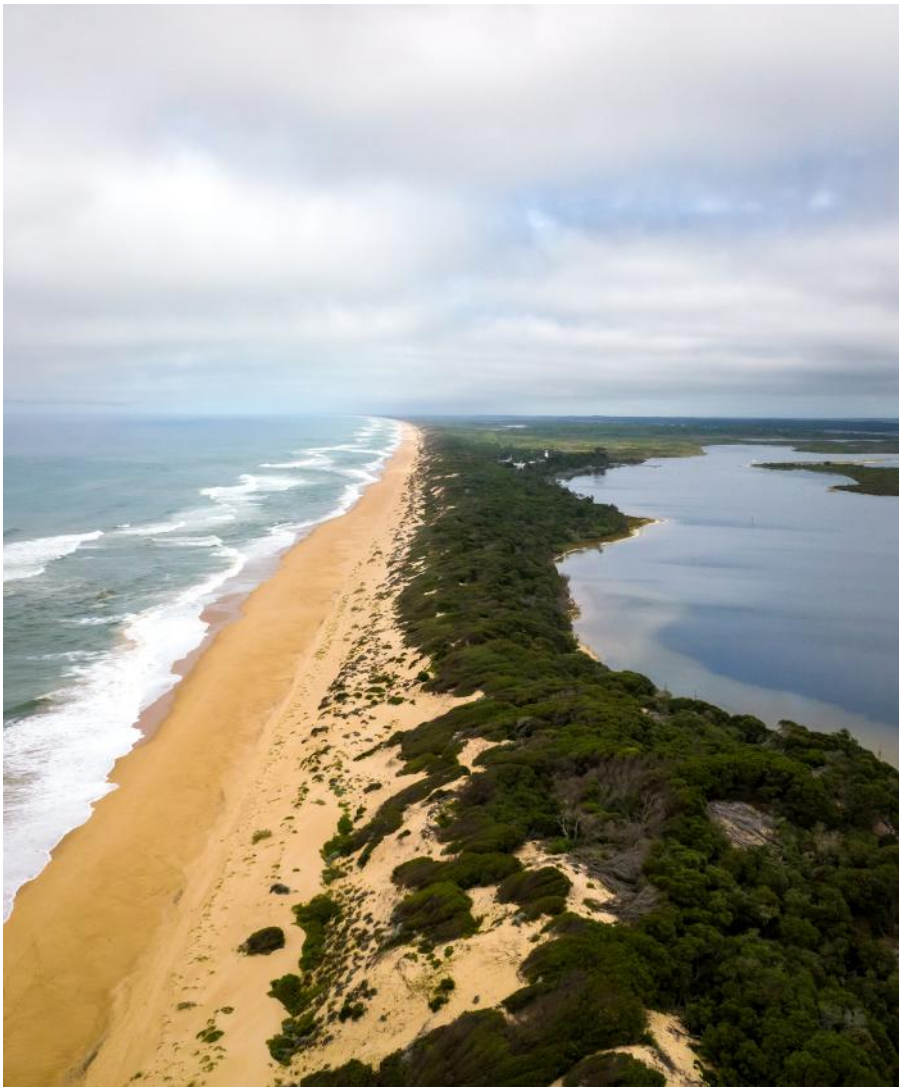
MIKE FLATTLEY
CEO, The Royal Society of Victoria

The RSV has now released its report from the 2023 roundtable, which convened scholars, knowledge holders and other proponents of wetland health and sustainability, titled "Securing the Future of the Gippsland Lakes."

The Gippsland Lakes comprise the largest estuarine lagoon system on the Australian continent and the largest coastal wetland complex in southeastern Australia, encompassing linked and isolated lagoons, swamps, active and abandoned river and tidal channels within the Gippsland Basin. The Lakes are one of 12 wetland systems in Victoria currently listed under the Ramsar Convention on Wetlands, an international agreement for the conservation of wetlands. The Lakes have been listed as a Ramsar site since 1982, covering over 600 square kilometres. Once the entire terrestrial catchment area is taken into consideration, the area of concern takes in 20,000 square kilometres.

This report and its recommendations from the RSV are released in the context of the East Gippsland Catchment Management Authority's renewal of the Gippsland Lakes Ramsar Site Management Plan, which aims to revisit and reestablish a framework for the maintenance of the Lakes' unique ecological characteristics through "the promotion of conservation and wise, sustainable use." It follows a concern with the nature and health of the Gippsland Lakes sustained by the RSV for almost 60 years, dating from the East Gippsland Symposium held in 1967 and the subsequent publication of related papers in the *Proceedings of the Royal Society of Victoria*.

This report draws on scholarship presented from a roundtable held at the RSV on 26 May 2023 involving research expertise with First Nations representation. It summarises the geomorphological character of the Lakes system, the current state of estuarine health, and anticipates the impacts of a drying regional climate and rising sea levels on the interaction of the marine and freshwater ecological conditions. Papers from the roundtable will be published in the 2024 volume of the *Proceedings*.



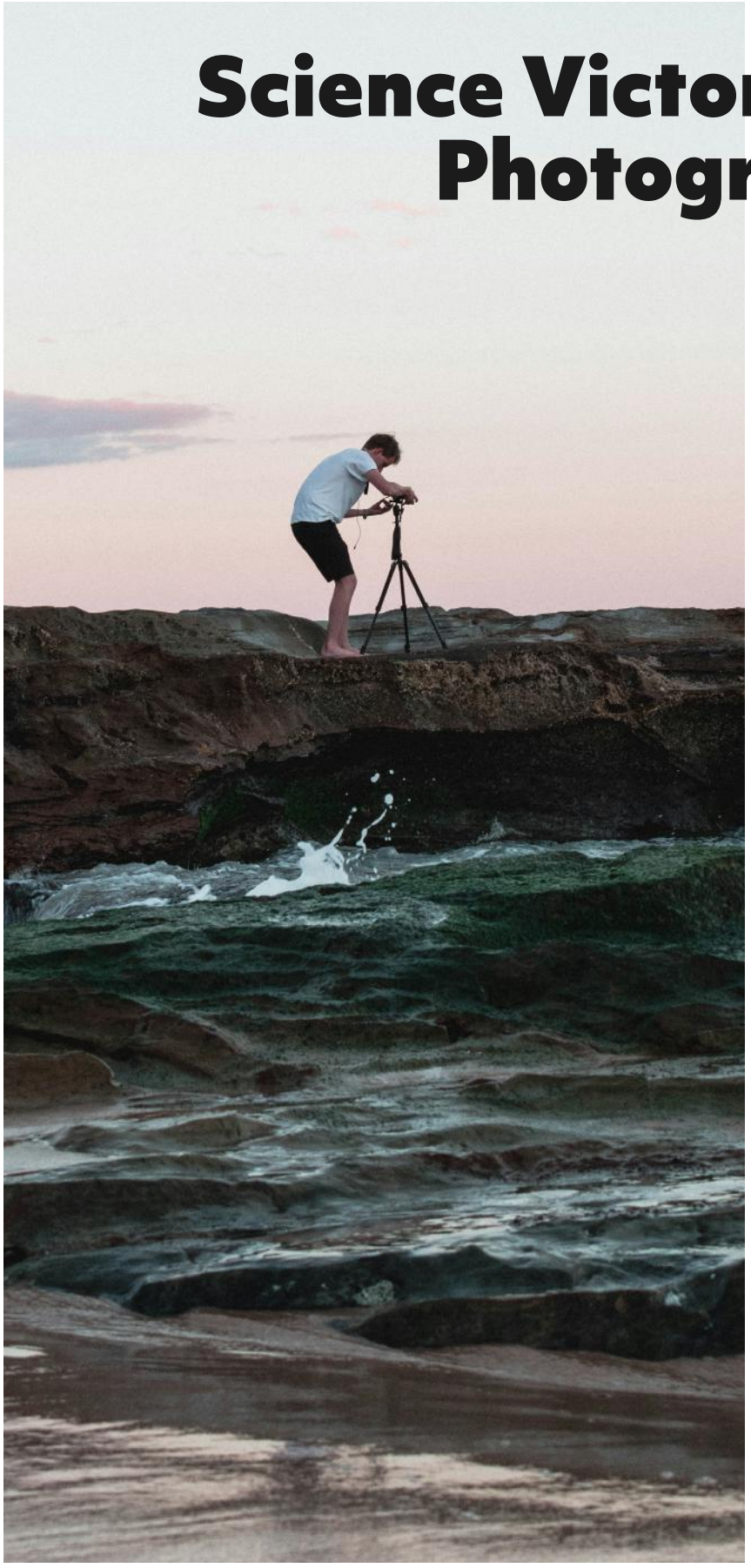
ABOVE: The Outer Barrier of the Gippsland Lakes, Ninety Mile Beach, looking across to Raymond Island on the Lakes' side. Photograph: Daniel James Aerial Art via Shutterstock

Recommendations in the report are grouped under these four categories:

- ▸ Share Knowledge for Collective Understanding
- ▸ Address Knowledge Gaps to Enable Adaptive Decision Making
- ▸ Establish and Maintain an Adaptive, Collaborative Governance Regime
- ▸ Intervene and Invest for Ecological and Cultural Resilience

The RSV is communicating the recommendations arising from the process to raise awareness of the threat to the iconic coastline of the Outer Barrier (90 Mile Beach) posed by rising sea levels, along with the manifold pressures placed on wildlife and habitats by the growth of human industries, activities and population. Ultimately, we call for sustained research to fill substantial gaps in our collective knowledge base to enable more informed and effective decision making as we "feel our way" to a desired future.

This RSV paper is independent, authoritative, and evidence-based, providing avenues for confronting a period of great uncertainty on points of governance, management and intervention to sustain the Gippsland Lakes as one of Australia's biodiversity success stories. You can view the report, and the abstracts collected for the 2023 roundtable, online at **rsv.org.au/gippsland-lakes**.



Photograph: Karl Hedin via Unsplash

Science Victoria STEMM Photography Prize

Win $300 and celebrate the world of STEMM.

We are excited to announce the first annual *Science Victoria* Photography Prize!

In 2023, we introduced the 'Snapshots of STEMM' section to our magazine, as a way to connect the images of everyday science with a general audience.

This year, the images published each month will form a shortlist, from which a winner will be selected at the end of the year.

Applications for the 2024 round are open until 15 November (the deadline for the December edition), and a winner announced in the February 2025 edition of *Science Victoria*.

The winner will receive a $300 prize, and a certificate.

Images must be original photographs that capture your day-to-day work in STEMM. These are not stock photos or overly posed images. Instead, they show what working and studying in a STEMM field is actually like.

PRIZE:
$300 prize, and a certificate.

RESOLUTION:
All photographs must be of sufficient size and quality for printing – as a rough guide, aim for >1.3 MB in file size.

SUBMISSIONS:
Submissions can be made by emailing **editor@ScienceVictoria.org.au.**

SUBMISSION DATE:
By 15 November

ENQUIRIES:
For any questions about submissions for the Science Victoria STEMM Photography Prize, please contact ***editor@ScienceVictoria.org.au.***

Snapshots of STEMM

Palaeontologist documenting and collecting fossil animal material from Mandelbrot Cave in Buchan. Photograph: Robert French/Museums Victoria.

The Eastern Barred Bandicoot (EBB) is a small marsupial endemic to south-western Australia. Here, the EEB Recovery Team and community members prepare to release bandicoots on French Island. Photograph: Zoos Victoria.

Space to the Rescue

Australia's National Dependencies on Space Technologies

The debate over the Australian federal government's investment in the "space sector" has intensified.

In 2023, the budget for the Australian Space Agency was reduced, leading to the cancellation of the National Space Mission for Earth Observation, and cuts to investment in launch sites. Uncertainty remains regarding the alignment of space technologies with AUKUS plans or the National Reconstruction Fund.

Despite competing priorities on Earth, understanding the importance of investing in space technologies is crucial. Space technologies and infrastructure play a significant role in Australia's dependencies, critical infrastructure, and national priorities. Issues such as climate change, disaster response, agriculture, mining, urban planning, housing, water and coastal region health, fisheries, Indigenous land and water management, and telecommunications hinge on space-based services and infrastructure.

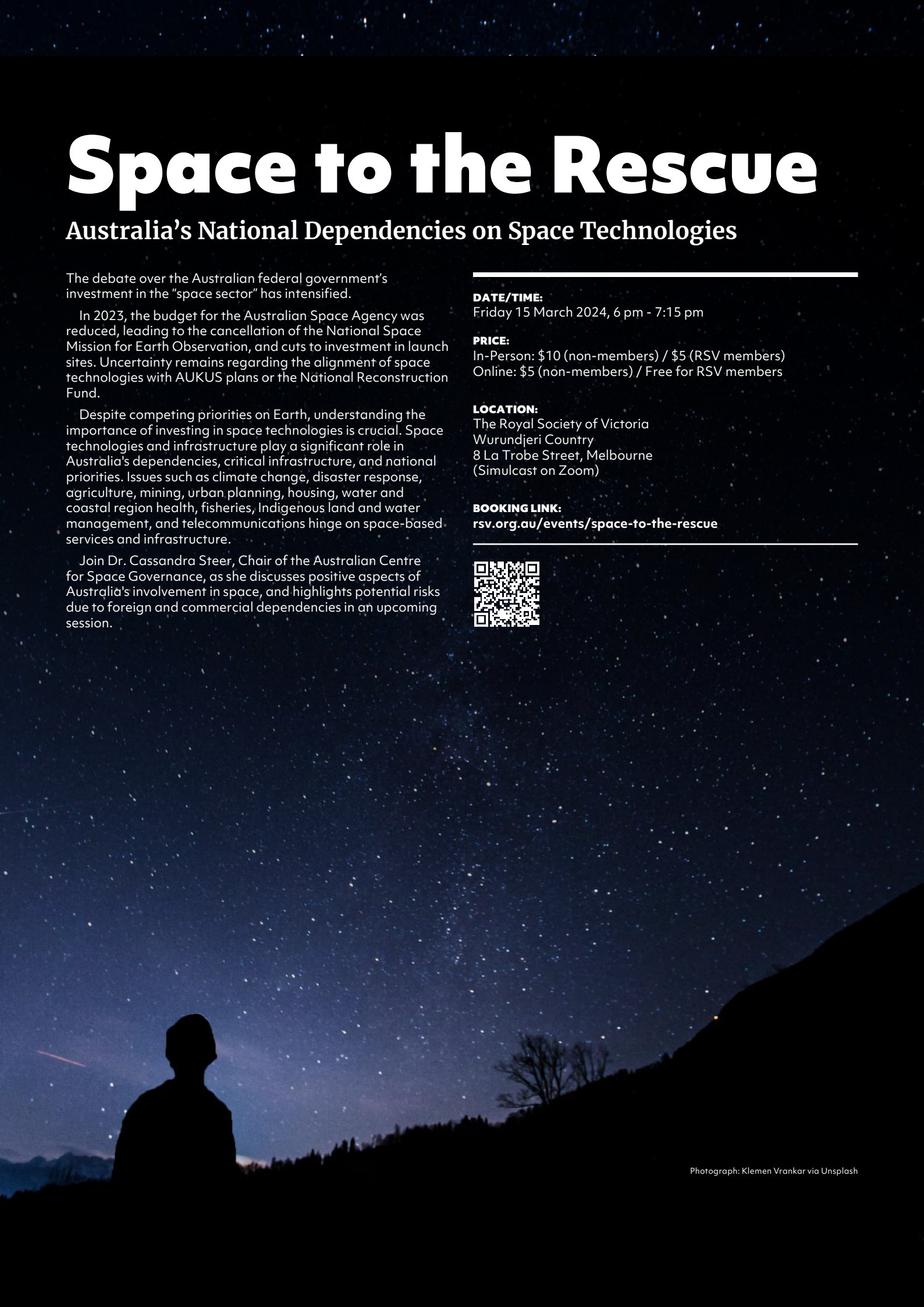
Join Dr. Cassandra Steer, Chair of the Australian Centre for Space Governance, as she discusses positive aspects of Australia's involvement in space, and highlights potential risks due to foreign and commercial dependencies in an upcoming session.

DATE/TIME:
Friday 15 March 2024, 6 pm - 7:15 pm

PRICE:
In-Person: $10 (non-members) / $5 (RSV members)
Online: $5 (non-members) / Free for RSV members

LOCATION:
The Royal Society of Victoria
Wurundjeri Country
8 La Trobe Street, Melbourne
(Simulcast on Zoom)

BOOKING LINK:
rsv.org.au/events/space-to-the-rescue



Photograph: Klemen Vrankar via Unsplash

Holocene Climatic Fluctuations in the Australian Region

From ~8,200 to ~5,500 years ago, temperatures were higher than today, on the land and in the oceans. Lake levels and rainfall were extraordinarily high, and vegetation was very different to the present day in many places. In contrast, air temperatures in Antarctica were at the opposite to those in Australia, and atmospheric CO2 levels were at their lowest for the entire Holocene. This period of time is referred to as the Holocene Hypsithermal.

Join acclaimed palaeontologist and 2023 RSV Medallist Professor Patrick De Deckker as he illustrates how human activities in southeastern Australia changed well after the Hypsithermal, with more sedentary activities along the major rivers and an enhancement of food production in organised settings suggestive of villages, in stark contrast with human migrations across North Africa during the Holocene.

DATE/TIME:
Thursday 18 April 2024, 6 pm - 7:15 pm

PRICE:
In-Person: $10 (non-members) / $5 (RSV members)
Online: $5 (non-members) / Free for RSV members

LOCATION:
The Royal Society of Victoria
Wurundjeri Country
8 La Trobe Street, Melbourne
(Simulcast on Zoom)

BOOKING LINK:
rsv.org.au/events/holocene-climatic-fluctuations

ABOVE: Blue Lake and snow covered mountains. Kosciuszko National Park, Australia. Photograph: Greg Brave via Shutterstock.

World Species Congress 2024

The World Species Congress, hosted by Reverse the Red (**reversethered.org**), will amplify our collective conservation efforts and facilitate critical connections that accelerate our impact for species.

Reverse the Red is a coalition of organisations, groups, and agencies, co-chaired by IUCN Species Survival Commission and the World Association of Zoos and Aquariums, committed to accelerating and amplifying successful species recovery efforts through collaboration, innovation, and national capacity support.

196 countries committed to the Kunming-Montreal Global Biodiversity Framework (**cbd.int/gbf/targets**), agreeing to meet Target #4 by 2030, meaning that threatened species are recovering, genetic diversity is being protected, and human-wildlife conflict is being managed.

The World Species Congress offers a forum for collaboration and a roadmap for success for anyone striving to create a healthier planet. We will celebrate and learn from successful strategies, tools, and partnerships in order to replicate, amplify, and accelerate action.

DATE/TIME:

8am Wednesday 15 May - 7am Thursday 16 May 2024

INFO & BOOKING:

reversethered.org/world-species-congress-2024

What's On

The RSV hosts many STEMM-related events, public lectures, and meetings throughout the year.

Most RSV events are hybrid, held both in person (at 8 La Trobe St, Melbourne) and broadcast online via Zoom and Youtube. Our public lectures comprise the "Science in Focus" component of the *Inspiring Victoria* program in 2024.

March

Space to the Rescue

Join us as Dr Cassandra Steer (Australian National University Institute for Space) presents *Space to the Rescue: Australia's National Dependencies on Space Technologies*.

DATE
15 March 2024

TICKETS
rsv.org.au/events/space-to-the-rescue

April

Holocene Climatic Fluctuations in the Australian Region (RSV Research Medallist 2023 Lecture)

Please note that this event has been rescheduled from December 2023 to April 2024.

Professor Patrick De Deckker, the 2023 winner of the RSV Medal for Excellence in Scientific Research, will present a lecture to RSV members and guests on the **18th of April at 6pm**, at which the Medal will be presented.

DATE
18 April 2024

TICKETS
rsv.org.au/awards-and-prizes/research-medal

Later

RSV Phillip Law Postdoctoral Award Lecture

Please note that this event has been rescheduled from November 2023 to mid 2024.

The winner of the RSV's Phillip Law Postdoctoral Award for 2023 will present their work to a special meeting of the RSV at a public lecture. This will be professionally filmed and shared online.

DATE
TBA

TICKETS
rsv.org.au/awards-and-prizes/phillip-law-award

Australasian swamphen *(Porphyrio melanotus)*, Phillip Island. Photograph: Richard Lin via Unsplash.

ESN EMERGING SCIENTISTS NETWORK

Are you a current uni student or recent graduate, looking for future pathways and opportunities in science?

The Emerging Scientists Network is for you.

Find us on Facebook at:
tinyurl.com/6ya4kkyp

Missed an RSV event?

You can catch-up on presentations from world-leading minds at **youtube.com/@RoyalSocietyVic**

Don't have time to watch a full presentation? Try one of the summary videos to catch the highlights.

YOUTU.BE/JL6SIKT9JSI
Aiming Higher: Improving Science Education in Victorian Schools

YOUTU.BE/ODSSDCSUO0O
Reimagining Humanity in the Age of Generative AI

YOUTU.BE/HJNBCCQ5N8G
Green Chemistry: Reinventing the Chemical Industry

YOUTU.BE/1SYKWQKZF48
Glaciers and Ice Sheets in a Warming World

Awards & Prizes

Nancy Millis Medal

NOMINATIONS OPEN *Thursday 15 February 2024*

Nominations for the 2025 round of the Nancy Millis Medal for Women in Science open on the 15th of February 2024.

The Nancy Millis Medal of the Australian Academy of Science has been established to honour the contributions made to science by the late Professor Nancy Millis AC MBE FAA FTSE and recognises her importance as a role model for women aspiring to be research leaders.

The award is open to women mid-career researchers, eight to fifteen years post-PhD in the calendar year of nomination except in the case of significant interruptions to a research career, in any branch of the physical and biological sciences. Recipients will have established an independent research program and demonstrated exceptional leadership.

► For more information, visit: **science.org.au/supporting-science/awards-and-opportunities/nancy-millis-medal-women-science**

National Cancer Institute via Unsplash

Bill Borthwick Student Scholarships 2024

CLOSING DATE *5 pm, Friday 8 March 2024*

The 2024 round of Bill Borthwick Student Scholarships is now open for applications.

The Victorian Environmental Assessment Council (VEAC) has established the annual scholarships for tertiary students to assist in the costs of research relating to public land in Victoria, including terrestrial, freshwater and marine environments.

The scholarships honour the vision of the Hon. Bill Borthwick, Victoria's first Minister for Conservation and Deputy Premier from 1981 to 1982, and a central figure in establishing the Land Conservation Council (LCC) to advise government on the use of Victoria's public land.

Applicants must be enrolled in an Australian university in 2024, undertaking an Honours, Masters or PhD research project related to public land in Victoria. Relevant fields of study include natural sciences, humanities and social sciences, economics, law and politics.

Scholarships will be awarded in the range of $500 to $2,500. Criteria for selection include the relevance of the research to public land, the potential outcomes for public land, and the quality and achievability of the project (in the context of the level of the enrolled degree).

► Any queries should be directed to Amanda Stajewski, at **veac@deeca.vic.gov.au**. For more information, visit **veac.vic.gov.au/about-us/student-scholarships**.

VEAC
Victorian Environmental Assessment Council

Geoffrey Moore via Unsplash

Gottschalk Medal

NOMINATIONS OPEN *Thursday 15 February 2024*

Nominations for the 2025 round of the Gottschalk Medal open on the 15th of February 2024.

The Gottschalk Medal recognises the contributions to science by the late Professor A Gottschalk FAA.

Its purpose is to recognise outstanding research in the biomedical sciences by researchers up to 10 years post-PhD in the calendar year of nomination, except in the case of significant interruptions to a research career. The award is made annually and is restricted to candidates who are normally resident in Australia and for research conducted mainly in Australia.

▸ For more information, visit: **science.org.au/supporting-science/awards-and-opportunities/gottschalk-medal**

Zac Porter via Unsplash

FNCV Environment Fund Grants

CLOSING DATE *3pm, Monday 8 April 2024*

Grant applications are now open for the 2024 round of the Field Naturalists Club of Victoria's (FNCV) Environment Fund.

These grants aim to:

▸ support and finance environmental research, in particular research into the biodiversity of Victoria.

▸ support and finance dissemination of information on the natural environment by any legitimate means, including public lectures, seminars, field trips, courses and publications.

▸ support and finance practical projects aimed at preserving and enhancing the biodiversity of Victoria.

Applications must be sent to **admin@fncv.org.au**, and contain:

▸ Project title.

▸ Project description (<250 words).

▸ How the project meets the aims of the Fund.

▸ Itemised budget, and any other sources of funding.

▸ Applicant name (individual, or organisation and representative applicant) and contact details, including mailing address/phone/email.

▸ Signature of applicant.

▸ Endorsement of organisation (signature of responsible person such as President, Secretary, Manager, Head of Department, include name and position held).

For more information, visit **fncv.org.au/environment-fund**.

Little Scientists Early STEM Education Awards

CLOSING DATE *Friday 31 May 2024*

Nominations are now open for Little Scientists Early STEM Education Awards, Australia's only dedicated awards to celebrate STEM excellence in early childhood education.

Our biennial awards proudly recognise the early childhood educators and early primary teachers driving STEM education for children aged 0-7 years across Australia.

Little Scientists Early STEM Education Awards has two categories:

▸ Category 1. Excellence in Early STEM Education Award recognises early learning services & early primary classrooms.

▸ Category 2. Outstanding Early STEM Education Leader Award recognises early childhood educators & early primary teachers.

The theme of this year's awards is: *Overcoming gender bias in early STEM education.*

About Little Scientists:

Little Scientists is a not-for-profit initiative supported by the Australian Government. Its mission is to champion inquiry-based STEM education for all young children across Australia by empowering early childhood educators and early primary teachers with STEM teaching skills through their pedagogy-based PD workshops.

▸ For more information, and to apply, visit l**ittlescientists.org.au/stem-awards-hub**

Reviving a Ghost of Tasmania

The Ethics and Feasibility of Thylacine De-extinction

DR CATRIONA NGUYEN-ROBERTSON MRSV
Senior Editor, Science Victoria

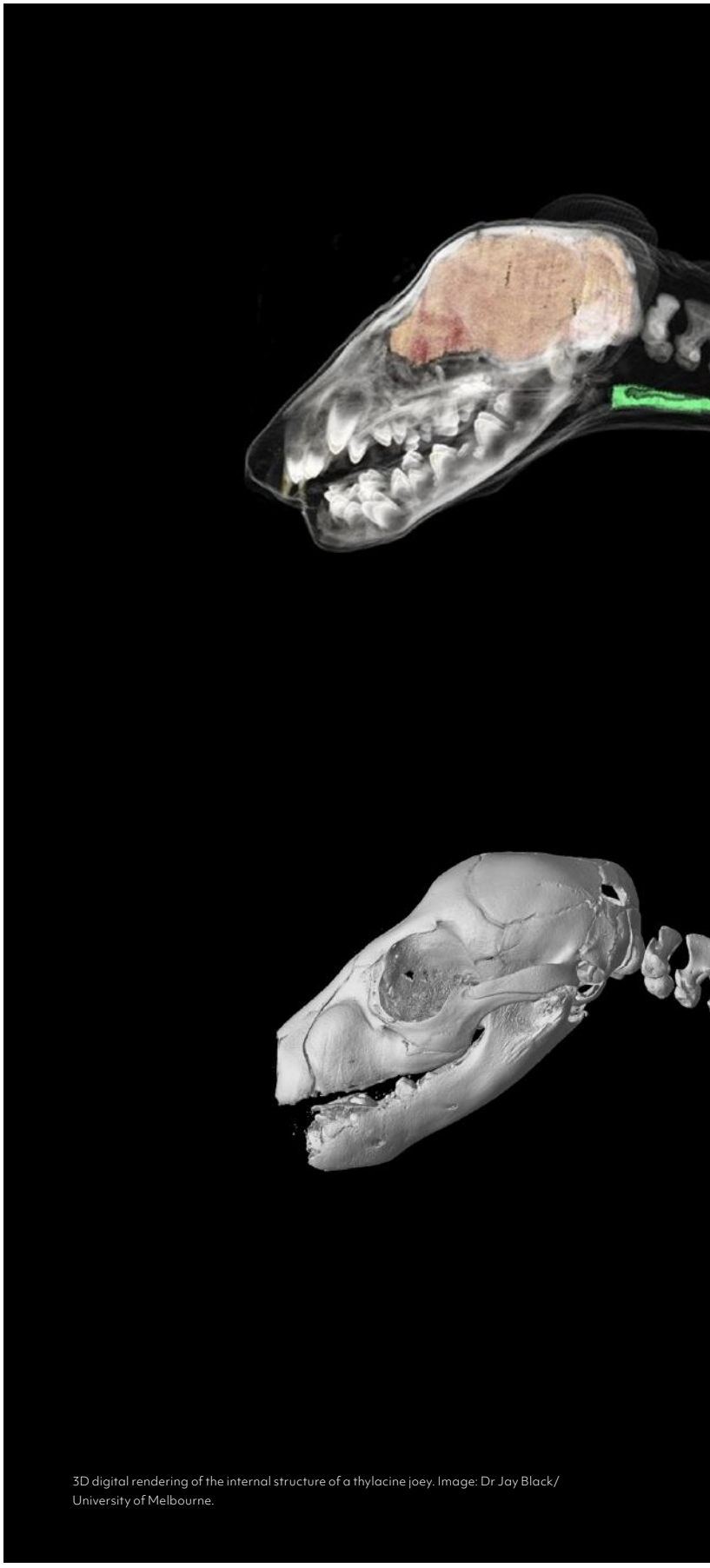
The thylacine (*Thylacinus cynocephalus*), or Tasmanian tiger, is an animal that for many Australians is almost a legend. Confined to history, they were driven to extinction. Yet, for an animal that was completely wiped out of existence nearly 90 years ago, it continues to hold a place of endearment in the eyes of the public.

The thylacine was a unique marsupial species that is unlike any around today. As an apex predator that looked physically like dogs and wolves, according to Prof Andrew Pask from the University of Melbourne, 'it was the king of the marsupials' until its extinction in 1936.

Unlike its common name suggests, the Tasmanian tiger was once broadly distributed around Australia. However the poor genetic health of the species (much worse than that of the Tasmanian devil in the present day), the introduction of dingoes, and other factors wiped the thylacine from mainland Australia.[1-4]
The arrival of Europeans in Tasmania heralded the beginning of the end for thylacine: following claims that they were attacking livestock, in 1888 the Tasmanian government placed a bounty of £1 for each Tasmanian tiger killed. The last-known thylacine died in captivity at the long-defunct Beaumaris Zoo in Hobart, and today, thylacines survive only in old photos, video footage, and preserved in museum collections.

Since its extinction, the thylacine has endured in the Australian consciousness as a symbol of regret for our role in its decline – and the decline of other species. But what if there was a way to bring them back?

And, if there was, should we?



3D digital rendering of the internal structure of a thylacine joey. Image: Dr Jay Black/ University of Melbourne.

ABOVE: Two male thylacines (adult and juvenile) at Beaumaris Zoo, Battery Point, Hobart c. 1912. Photograph: Tasmanian Museum and Art Gallery (Public Domain).

Piecing together a thylacine

The thylacine may be gone, but researchers at the University of Melbourne's TIGRR (Thylacine Integrated Genetic Restoration Research) Lab, led by Professor Andrew Pask, are working towards its de-extinction. No longer the stuff of science-fiction, bringing a species back from extinction is now a feasible scientific reality.

The first step in reviving an extinct species is to find a good source of its DNA. While DNA is fortunately quite hardy, it is subject to damage by various enzymes, chemicals, microorganisms, and UV light. This means that while there are numerous thylacine samples found in collections and museums, few have been stored in such a way to completely protect the DNA from degradation (although, this is good news for those concerned about a Jurassic Park situation as all dinosaur DNA has been long irreparably destroyed). Andrew pieced together the best-preserved DNA from thylacine specimens – a 10-million-piece puzzle – and sequenced the thylacine genome, providing all the instructions needed to make a thylacine.[1]

With the thylacine genome sequence at hand, the DNA of a closely related species can be manipulated to become a replica. The fat-tailed dunnart (*Sminthopsis crassicaudata*) appears to be the most suitable candidate. Once the thylacine genome is within a dunnart cell, that cell can be implanted into a fat-tailed dunnart as an embryo to be born. While the process may not produce an exact copy of a thylacine, it would result in the birth of a hybrid animal.

Just because we can, should we?

The thylacine de-extinction project has attracted a large amount of both funding and attention – $15 million of funding, in fact. While it could be argued that this money could be devoted to conservation of animals that are currently endangered, the reality is that they do not receive the same level of focus as the thylacine . "De-extinction" is a buzzword that reels people – and a lot of money – in.

Australia holds the record for the most mammal extinctions[5] and many of our animal species are suffering increasing pressures from introduced species, habitat loss, and climate change. This could be an opportunity to change that.

The TIGRR Lab is developing technologies and resources to help preserve and conserve other species. They are developing methods of working with marsupial stem cells, gene-editing marsupial genomes, and assisted reproductive techniques for marsupials. If we could edit the DNA of marsupials, we could potentially engineer a resistance to devil facial tumours for Tasmanian devils, or try to engineer in cane toad toxin resistance for quolls.

As populations of native fauna dwindle, the loss of so many individuals reduces the genetic diversity of populations. This decreases their genetic health and lowers the ability to adapt, putting a species on a fast track to extinction. A living biobank – or frozen zoo – of tissues and cells collected from animals and preserved in liquid nitrogen at -196˚C can counteract this issue. Using stem cells and assisted reproductive technologies, these cells can be used to create eggs, sperm, or entire embryos to ensure that we do not lose any further species or their genetic diversity.

An ecosystem haunted by the ghost of the Tasmanian Tiger

De-extinction is not about putting a carbon-copy of an 1800's thylacine back into the Tasmanian ecosystem of old. The thylacine co-evolved with the ecosystem in Tasmania over thousands of years, and this native environment remains mostly intact. Returning the native apex predator to that environment has the potential to stabilise it, and even save other endangered marsupials, as the thylacine competes for the niche currently occupied by introduced predators like feral cats.

But only if the thylacine can slip back into its old role. Coined in the 1980s, the "ghost of predators past" hypothesis suggests that even long after a predator disappears from the ecosystem, local prey species can retain their anti-predator behaviours. As many of these behaviours are inherited genetically, they can be passed down. Entire generations of prey animals who have never encountered their predator may still instinctively recognise them. This doesn't last forever, however, and predator recognition can disappear within 13 generations.[6] Andrew's team is currently investigating whether the ecosystem has moved on, especially by focusing on how Tasmanian wallabies react to life-sized thylacine models. Perhaps, the more other native animals remember the thylacine, the more the ecosystem would welcome them back.

Even if the ecosystem welcomes back the thylacine - or some version of it - many of the systems that caused it to go extinct in the first place still stand. The thylacine lived alongside other animals and First Peoples for millennia - and within 150 of the arrival of Europeans, it was gone. Extinction is still forever, and this project perhaps undermines the message "once it's gone, it's gone".

With a changing planet and destabilising ecosystems, we are losing animals like the thylacine at an alarming pace. We need to improve the resources and technologies that we have in our conservation toolkit to help save endangered species before it is too late.

It is already too late for the thylacine. The outcome of this de-extinction project may not be a thylacine of old, however, the outcomes of successful biobanking, and genetic engineering suitable for marsupials, will help many species.

► *What do you think? Should we bring back the thylacine? Professor Andrew Pask and Tasmanian artist Emma Bugg invite you to share your opinions and the reasons behind them in their work, Thylacine De-Extinction Project, currently on display at Science Gallery Melbourne (**melbourne.sciencegallery.com**). This display is part of the NOT NATURAL exhibition, which explores the growing friction between natural and artificial systems.*

Preserved specimen of a thylacine (Thylacinus cynocephalus) joey, prepared by George Harris in 1808 [C. 5755]. Photograph: Rodney Start/Museums Victoria (CC BY 4.0)

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Figure 2. XFM of a Portuguese millipede (*Ommatoiulus moreleti*). This false-colour image shows the distribution of copper (red), zinc (green), and iron (blue) within the millipede. The zinc-rich glands present along the middle of the abdomen are the source of the foul-smelling liquid released when the millipede is threatened. Image: Dr Daryl Howard, XFM beamline scientist at the Synchrotron.

Lighting the Way

The Australian Synchrotron

DALE CHRISTENSEN
Australian Nuclear Science & Technology Organisation (ANSTO)

From 1957 to 1984, Melburnians flocked in their thousands to the corner of Wellington and Blackburn Roads in Clayton. Here they peered up at massive steel structures, illuminated by powerful and expensive light sources – the Clayton Metro Twin drive-in theatre was as much a cultural icon as it was a technological and engineering marvel.

After a less glamorous interlude as a university car park, the site re-opened in 2007 as home to the Australian Synchrotron. Gone are the floodlight towers and enormous concave screens; in their place stands a particle accelerator the size of a footy field. The twin projectors have been replaced with a state-of-the-art light source a million times brighter than the Sun. The unassuming frontage along Blackburn Road masks a hidden gem of Australia's research infrastructure.

What is the Australian Synchrotron?

At its simplest, a synchrotron is a light source – illuminating samples of scientific interest with x-ray and infrared radiation. This 'synchrotron radiation' is produced when electrons are accelerated close to the speed of light and forced by strong magnetic fields to travel in a circular orbit. Light produced in this way is extremely bright, focused, and collimated (meaning that it doesn't spread out much as it travels). This allows scientists from around Australia to analyse their samples with greater resolution and on smaller timescales than is available through more conventional techniques.

The Australian Synchrotron is managed by the Australian Nuclear Science & Technology Organisation (ANSTO), and is the only synchrotron in the country. In fact, it is one of only two in the southern hemisphere, making it a melting pot of scientific inquiry, where some of the most challenging research questions are brought under one roof.

The Synchrotron welcomes about 5,000 scientists a year, investigating questions like: What geochemical factors help explain the development of the Kimberley's famous zebra rock formations?[1] Can we rapidly detect coronavirus markers in a saliva swab?[2] How can we modify cacao bean processing to reduce the amount of cadmium in chocolate?[3]

When visitors tour the facility, Synchrotron Director Prof. Michael James likes to play a game: "Pick a topic, any topic", he says, "and I will tell you how we make a difference to that, by research carried out at the Australian Synchrotron." In the spirit of that game, and in keeping with the theme of this issue of *Science Victoria*, allow me to give you a taste of some of the fascinating research being performed at the Synchrotron relating to Victorian fauna.

Researching Victoria's fauna at the Synchrotron

The plight of the critically endangered orange-bellied parrot has received a lot of publicity over the last decade, especially regarding the threat posed by wind turbines in its migratory path.[4] Unfortunately, this is not the only peril facing the iconic avian: psittacine beak and feather disease (PBFD) has devastated populations of this and other endangered parrots. PBFD results in beak and feather abnormalities, and is often fatal. It is caused by the highly infectious psittacine circovirus (PCV), which has only two genes: one for self-replication, and another to form sixty copies of a 'capsid' protein, which then self-assemble into a shell to contain the virus.

Scientists from Charles Sturt University, Monash University, Spain's National Microbiology Centre, and the Autonomous University of Madrid used the Micro Crystallography (MX2) beamline at the Synchrotron to analyse this capsid protein.[5] The interaction between synchrotron x-rays and an assembly of capsid proteins produced diffraction patterns – complex forms that can be used to calculate the precise molecular structure of the protein in question. This is an important step towards an eventual PBFD vaccine and treatment: if we know the structure of the capsid protein, we can pharmaceutically target key parts of it to disrupt viral replication and abort infection, or can design a vaccine that protects against infection in the first place.

Sticking with our migratory birds, the X-ray Fluorescence Microscopy (XFM) beamline has been used to analyse the feathers of three seabird species: the Flesh-footed, Short-tailed, and Streaked shearwaters.[6] Different chemical elements give off different light signatures, which the beamline uses to produce nanometre-scale maps of where these elements are distributed within a sample.

Scientists from James Cook University and the University of Tasmania were able to identify regular banding patterns of zinc within the shearwater feathers (Figure 1). These patterns were independent of mass, density, and colour changes within the feather, suggesting that this regular variation in zinc may be a part of the feather development process – somewhat like the

The Australian Synchrotron. 3,200 solar panels have recently been installed, providing a peak generation potential over 1.2 MW. Photograph: Craig Millen, head of electrical engineering at the Synchrotron.

rings in a tree trunk. If this is accurate, scientists may be able to use abnormalities in this pattern to detect stressors in a bird's recent past, such as dietary changes, or exposure to environmental contaminants. This analysis could also be completely non-invasive, since moulting is a natural process in birds.

The XFM team has analysed more than just birds: other highlights in Australian *Animalia* include the invasive millipede *Ommatoiulus moreleti* (Figure 2), and even diprotodon (ancient wombat-like megafauna) fossils, though this work is yet to be published. The Imaging and Medical beamline (IMBL) at the Synchrotron has also been used to study a variety of Australian animals, including possums and wallabies.

A bright future

With all this exciting scientific output, the Synchrotron's science team are not resting on their laurels but looking forward to further illuminating the research questions of tomorrow.

Dr Mitzi Klein, a staff veterinarian at the Synchrotron, is hoping to use the IMBL beamline to produce a 'digital zoo' – a thorough compendium of high-resolution scans of native fauna. "There are many, many species that have never been imaged at all," she said. "The value of a virtual dissection cannot be underestimated. These species are rare, and of value intact to museums. To have a collection of synchrotron scans would enable comparisons between species (that are often lumped together as being similar), and also within species. That information would be invaluable to all sorts of specialists – zoologists, ecologists, palaeontologists, and so on."

When you drive down Blackburn Rd in 2024, you won't see the drive-in theatre light towers, or the nostalgic "*SHOWING TONIGHT:*" sign. Instead, you'll pass the Australian Synchrotron: a crucial hub in the nation's research network. Without it, many Australian academics would be limited to data obtained from benchtop instruments, or be forced to make expensive international trips to synchrotron facilities elsewhere. We're building more beamlines, adding greater capabilities, and looking forward to answering Australia's most critical scientific questions for years to come.

► *Dr Dale Christensen is an analytical chemist by training, gaining a PhD from Monash University for his research in infrared biospectroscopy of dengue-carrying mosquitoes. He now works for ANSTO as an Accelerator Operator in the control room of the Australian Synchrotron.*

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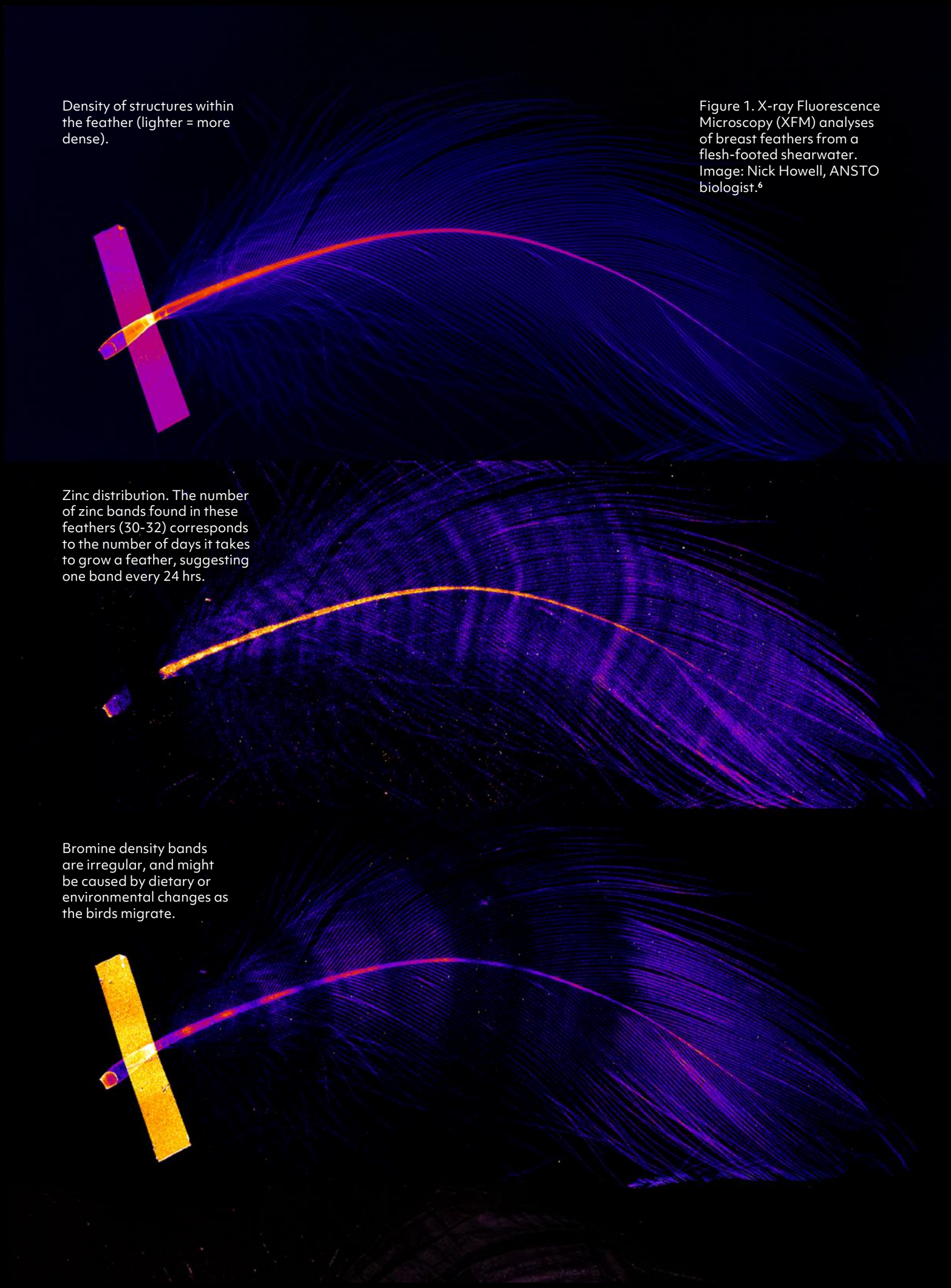

Figure 1. X-ray Fluorescence Microscopy (XFM) analyses of breast feathers from a flesh-footed shearwater. Image: Nick Howell, ANSTO biologist.[6]

Tackling Invasive Species

DR CATRIONA NGUYEN-ROBERTSON MRSV
Senior Editor, Science Victoria

How big is the problem of invasive species? In the words of Deakin University Professor of Wildlife Ecology and Conservation, Euan Ritchie, 'the short answer is: it's massive'. Invasive species are one of the biggest environmental problems facing Australia and are the number one cause of native animal extinctions.

Cats prey on birds and other small native animals, killing over 1.6 billion each year. Photograph: via PickPik.

We are sometimes oblivious to the fact that the pets or the garden plants we care for could be catastrophically dangerous to Australia's unique biodiversity if allowed to propagate in the wild. Invasive species multiply and spread through the environment so rapidly that they are destructive, threatening native species and burdening our health, economy, and society.

Most of the environmental impacts on threatened species in Australia are caused by 267 invasive species, of which 230 are non-native to Australia.[1] Importantly, even native species can become pests when they are introduced to different regions or lack natural predators to control numbers.

Since the 1960s, Australia has spent and incurred losses amounting to $390 billion due to invasive species.[2] The problem continues to grow, compounded by the impacts of land development, climate change, and other human-driven impacts on native plants and animals. We now face the challenge of containing the damage.

What are invasive species?

When we hear the term 'invasive species', we may think of animals like rabbits and cane toads. And we'd be right - the European rabbit is the top pest impacting Australia's threatened plants and animals.[3] The massive number of rabbits spread across Australia started from merely 13 that were brought to this country for one estate – from which they quickly escaped and proliferated across the landscape (they bred like rabbits) in the fastest known invasion by a mammal anywhere in the world.

Feral cats and foxes would also come to mind, as they are found in 80% and 99.9% of Australia respectively, and responsible for killing 2,646 *billion* animals each year.[4] "Friendly" neighbourhood pet cats are also part of the problem, with each roaming pet cat killing an average 110 native animals per year.[5] But the problem is much greater than these well-known offenders - although this article will focus on invasive vertebrates.

Feral animals steal the burrows of native animals, prey on native animals and degrade land and water through overgrazing in competition with livestock and native herbivores.[6] Farmers deal with a long list of invasive species, investing money, time, and effort to prevent feral animals from destroying soils, crops, and livestock. Accompanying this economic impact is the great mental health cost for farmers who witness their stock repeatedly attacked, their landscapes damaged, and livelihoods destroyed.

Another issue is the ever-increasing damage of invasive species to First Peoples' connection to Country. The Yugul Mangi Rangers in Southeast Arnhem Land (and other Traditional Owners of the land) are struggling to control feral animals, the worst offenders being pigs and cane toads. Feral pigs disturb freshwater wetlands and dig up edible plants, while cane toads kill small native animals like goanna and quolls, decimating a traditional source of bush foods and cultural practice. Elsewhere, in the Northern Territory – in fact, covering 40% of it – are feral camels.[7] The Ghan Railway was famously built with the help of camels, who travelled 200-300 km per day and lasted days without water. Once construction was complete, the camels were set loose in the outback, where they now destroy native vegetation and important Aboriginal cultural sites and waterholes.

What can we do about invasive species?

While it would be desirable to completely rid the Australian continent of the worst offenders, it is simply not feasible in most cases. Complex interactions between native and invasive species complicate decisions and actions around control. For example, in many areas, feral rabbits are a major food source for foxes and feral cats; reducing the number of rabbits may therefore mean that foxes and cats increasingly turn to native animals instead, while reducing the predators means less pressure on rabbits. It is also difficult to ensure that an invasive species does not easily re-invade once it is removed from an area.

Invasive species management focuses on minimising their impacts as cost effectively as possible. Given community concerns for animal welfare, pest control programs must also be humane and have minimal impact on non-target species. To this end, there is great promise in the development of new and emerging biological control strategies.

RABBITS

For decades, CSIRO has been leading an ongoing battle to ease the enormous detrimental economic, environmental, and social impacts of rabbits. In 1950, CSIRO released the world's first vertebrate pest biocontrol: myxoma virus, which killed 99.8% of infected rabbits.[8] But as we often see with evolution, rabbits became resistant. Other viruses have since been released to further curtail wild rabbit populations, but we need a solution that ensures that the numbers don't bounce back. CSIRO is currently trying to boost existing viruses and identify new pathogens that could be used to keep rabbit numbers down.

CATS

Many of us love our cats, and therefore do not necessarily want to consider biocontrol measures to manage them. However, with feral cats killing native animals every night, we urgently need an intervention. Dr Ellen Cottingham at the University of Melbourne is developing an innovative approach: immunocontraception, manipulating an animal's own immune system to target and attack its reproductive proteins, thereby inducing a contraceptive effect.[9] This does not lead to the death of animals; rather, it prevents an excessive number from being born in the first place. Immunocontraception has previously been used to curb African elephant overpopulation without any behavioural side effects.[10] Ellen now wants to develop this technology for feral cats.

FISH

Swimming in our waterways, pest fish such as the European carp and tilapia outcompete native fish for habitat and food. Their feeding and nesting habits can also directly degrade water quality. While the use of a virus to curb pest rabbits is familiar to many, perhaps less familiar is the application of biocontrol to fish. The tilapia lake virus, for example, kills tilapia quickly without impacting other fish,[11] suggesting that it could be used in Australia to curb invasive tilapia without harming native marine life.

Taking a different approach, Dr Chandran Pfitzner at Macquarie University is genetically engineering fish.

Genetically modified male and female "stock fish" are engineered to only generate male offspring. Furthermore, when they mate with pest fish in the wild, their offspring will be completely unviable. By manipulating carp reproduction to result only in viable males and no females, the population will eventually crash as they can no longer reproduce without both sexes.

GENE DRIVES

Gene drives are being increasingly considered to tackle multiple species including rodents, cane toads, carp, foxes, rabbits, and even mosquitoes. While most genes have a 50-50 chance of being inherited from either parent, a gene drive heavily favours the inheritance of a particular gene, supporting its spread through a population. Depending on the gene, it might then lead to the increase of a particular trait in that group. While gene drives do occur naturally, scientists can mimic this process to significantly bias the inheritance of an introduced gene. If a gene involved in reproduction has been modified to decrease fertility, or yield sterile offspring, a gene drive can be used to limit the population size of a species.[12]

What are the barriers to seeing these implemented?

As with any area of research, funding is a large barrier. Scientists can only research and develop solutions to tackle these problems so long as they have the funds to do so. But once we get there, for any research breakthroughs, concepts, and applications, we must consider underpinning knowledge & socio-political contexts. Even if we develop a great way to tackle invasive pests, it will not get off the ground if there is overwhelming public resistance.

One of the best ways to reduce invasive species in Australia is through education and awareness. Invasive species is a poorly understood issue; many people are unaware that certain species are in fact pests, yet Australians care about wildlife extinction. Without effective communication, we won't see change.

Many of these biocontrol approaches are still in early stages of development, and so their potential risks and consequences need to be carefully considered. With any approach that involves the modification of genes within an animal population, especially across generations, we need to ensure that we will have total control of the spread. For example, using a genetic modification in two separate genes, rather than one, could help prevent the spread of the gene drive to non-target animals – similar to two-factor authentication on our phones when we sign into accounts on our computers.

The European rabbit is one of the top pests in Australia, threatening both native flora and fauna. Photograph: Megan Clark via Unsplash.

When considering implementing gene drives or other genetic approaches, it is important that researchers model the process first to ensure that invasive species can be eradicated without impacting the rest of the ecosystem. We have repeatedly learned the lesson of using an uncontrollable "tool" with the best intentions, as was the case with cane toads to control cane beetles.

It is reassuring that so many researchers are on the case, as we will need multiple, multidisciplinary approaches to tackle the numerous invasive species that decimate the Australian landscape. Short-term solutions simply will not work, as an invasive population will often bounce back quickly, which is exactly how they were able to invade in the first place. Biocontrol measures are never a silver bullet, as they are not guaranteed to be effective for every single animal. It is therefore imperative to have these multiple bullets, with governments, researchers, industries, land managers, and Traditional Owners all working together.

► *If you are interested in learning more about how Australian researchers are tackling invasive species, you can view all three sessions of the Next-Generation Biocontrol of Invasive Vertebrate Pests symposium on the RSV's YouTube channel: each tackle 'The Problem,' 'The Technologies' and 'The Caveats' in succession. Watch now at* **bit.ly/next-gen-biocontrol**.

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Red deer near Hall's Gap, Grampians National Park, Victoria. Photograph: Rexness via flickr (CC BY-SA 2.0 DEED)

Cultural Dissonance and Invasive Deer in Victoria

MIKE FLATTLEY
CEO, The Royal Society of Victoria

Our European cultural roots are powerfully maintained by ancestral symbols of 'fertility and plenty' amid the seasonal impacts of ice and snow, where game animals kept our ancestors fed, clothed, and alive for thousands of years.

Rabbits at Easter. Deer and pine trees at Christmas. Long before St Nicholas made his merry way into Christianised European cultures, red-robed Woden/Odin was the Yule Father, flying around each December at the head of the Wild Hunt to punish the wicked and reward the good. Meanwhile, in early Celtic traditions, the mysterious Cernunnos appears as an antlered god of nature, animals and fertility.

The pseudo-totems and symbols of peoples Indigenous to Northern Europe remain fiercely potent in a colonised Australia. A point of persistent personal frustration to me is the regularity with which Australians from all cultural backgrounds mistake introduced mammal species, like deer, pigs, foxes, rabbits, cats, and many others, as 'native.' These species are exotic to Australia, and have become invasive, destructive pests across Australian landscapes and ecosystems..

Others recognise these animals are exotic, but argue that they *should* be here – and not just because many seek 'game' to legitimately hunt on a continent full of protected species, but for the same reasons the Acclimatisation Societies of the 19th and 20th centuries felt they had a licence to unleash so much damage on Australia's unique ecosystems: we are all a part of nature, and the plants and animals of 'home' are potent symbols of the cultural landscapes to which we 'belong,' differentiating each ethnic collective from other groups of humans. They are the source material upon which successive migrant generations reconstruct and perpetuate both individual and broader cultural identities.[1,2]

They remind us of who we are, and we colonise accordingly.

During the 2023 Christmas period I was confronted, once again, by the extreme dissonance of a dominant Australian culture heavily influenced by Europe - from lands and waters on the opposite side of the planet - with the continent we have occupied. An advertisement for Telstra featured an image of a child on a call in a roadside public telephone booth at sunset, overlooking a generic slice of forested Australian suburbia. The child was looking back, wide-eyed with wonder at an enormous reindeer that had appeared, lost, on the path beside the booth. *"Hello Christmas."*

LEFT: Looking out over the Cathedral, a granite tor, in Mt Buffalo National Park. Photograph: Mitchell Luo via Unsplash.
ABOVE: Red deer near Hall's Gap, Grampians National Park, Victoria. Photograph: Rexness via flickr (CC BY-SA 2.0 DEED)

Effective advertising holds up a mirror to our culture – it seeks to show us to ourselves in a form we can both recognise and embrace. This campaign by creative agency The Monkeys was released amid Melbourne's growing disruption from the invasive pests colonising suburbia's green corridors from the forests and farmlands beyond the city fringe; media have reported deer in multiple inner-city suburbs, joining a dense, growing urban population of foxes, rabbits, and feral cats across the metropolitan region.[3] Yet the presence of a deer in our Australian lives remains something 'magical,' a spirit from a lost world that still somehow belongs to us.

It's understandable, but jarring how slowly the favouring of European over local species is shifting in our culture. Despite campaigning for many decades by those committed to conservation, many appear oblivious or unmoved by the threat posed by invasive species to native plants and animals. Australia's unique native species evolved on this vast, geographically remote part of the world over millions of years, and sustained the Indigenous peoples of this continent for at least 65 millennia.

Another Telstra advertisement from November 2023 featured a reindeer walking alongside its closest Australian native equivalent (in terms of fertility symbolism and function as an ancestral game animal): a herd of kangaroos.[4] For Peter Jacobs, this is where comparisons between deer and native Australian herbivores end. "There's no other native animal like deer, a huge, hard-hooved, heavy animal, in the bush," he says. "The Australian environment just hasn't evolved with that sort of impact and has never been able to deal with it. It's a direct threat to 13 threatened flora species in 12 ecological communities just in East Gippsland."

Peter chairs the Mountains Specialist Group for the International Union for the Conservation of Nature's World Commission on Protected Areas (IUCN WCPA),[5] bringing long experience as a senior manager of conservation programs with Parks Victoria, Trust for Nature and, currently, as Executive Officer of the Victorian Deer Community Control Network for Australia's Invasive Species Council. For Peter, the concern for invasive species is less about the disruption of suburban Melbourne, and more about tackling the real damage to the ecological communities of the forests and mountains in the Victorian Alps, one of the most biodiverse regions of our state.

"There's a real history of people introducing things into our eastern forests for various reasons that have now become absolute, serious pests," Peter confirms. "Hunting and Acclimatisation Societies were very much responsible for introducing many of these pests that we now have in the Alps." Feral deer, foxes, hares, and feral horses are a serious problem in the Eastern forests and parks, largely the descendants of escapees from early settlers. "But also, worryingly, there are some deliberate releases as well for hunting and preservation of game species."

Invasive deer species are comparatively late European inclusions, but already one of Australia's most serious environmental and agricultural threats. Victoria has the largest population of deer in Australia, estimated by the Invasive Species Council (based on work from the Arthur Rylah Institute) to be about a million as of 2023 – and expanding quickly to invade new areas, particularly in eastern Victoria.[6] "Feral deer are capable of increasing 35 to 50 percent each year in population, so 30 deer become 500 in 10 years," explains Peter. A study published in 2016 found that four species of deer are well suited to the tropical and subtropical climates of northern Australia, meaning they could soon occupy most of the continent, including the arid, fragile rangelands of the interior.[7]

It's impossible to talk about a major herbivore without discussing the plant communities they predate on, and the flow-on impacts to the entire ecosystem. In Victoria, multiple human activities are driving a more frequent bushfire regime, which opens up forests to allow the rapid spread of invasive deer, which also consume shooting regrowth, trample scorched soils and wallow in ancient alpine peatlands to frustrate recovery.

Fallow ("Bambi") and large sambar deer are the most prevalent in Victoria's eastern forests, and in addition to driving hundreds of indigenous plant species (and their native animal dependents) closer to extinction, their impacts have been estimated to cost our community between $1.5 to $2.2 billion from agricultural management costs, vehicle accidents, impacts on agroforestry and loss of amenity and environmental values for users of Victoria's national and state parks over the next 30 years.[8]

Peter is grimly realistic. "There is no short-term fix to mitigate deer impacts now that the population has been allowed to grow to over a million animals spread across the state." But there are still urgent actions required that will make an enormous difference to how effectively we can manage the problem of invasive deer species in our state by preventing further spread and starting to eliminate the smaller populations.

FIRST

Remove the listing of introduced invasive deer species in Victoria's Wildlife Act.

Perversely, yet clearly flowing from the cultural issues identified earlier in this article, feral deer are recognised as protected wildlife in an Act created in 1975 when the population was small and largely confined to commercial farming operations. Deer are also proclaimed as 'game' by Governor-in-Council (the Victorian Premier and Cabinet with the Governor), which creates laborious, costly and, ultimately, ineffectual workarounds for agencies and communities trying to deal with the impacts of deer in our state.

"The Wildlife Act is there to protect a native species in their native environments, not to protect species such as deer, particularly when we see the sort of impacts that are occurring," Peter argues.

"There is no longer any justification for continuing to classify feral deer as protected wildlife in Victoria. The Victorian Government must, as a matter of priority, remove this protection so feral deer can be rightly classed as an established pest animal as recommended by the 2021 Senate inquiry."[9]

SECOND

Put knowledgeable people on the ground.

Peter highlights the importance of prevention and eradication, getting in early to deal with pests before they become major problems. For that, we need people who have the knowledge to care for the land, on the land. This is particularly pertinent in the context of the current, expedited exit of the forest industry from Victoria's state forests in the east.

While logging has now ceased, Peter considers a professional land management regime should remain in place to care for Victoria's forest estate as biosecurity professionals. This is achieved by activating "people that have been there before, through forestry operations, who know the country, can really do something about managing this country properly, and not just leaving it".

THIRD

Join up landscapes.

Connections to other plant and animal communities help species to sustain a healthy genetic diversity, and corridors offer a means of migration, adaptation and survival during periods of change and disruption. "We've got a lot of fragmented parks that have got gaps between them. Let's try and join them up a bit and create some really serious protected areas in eastern Victoria."

Peter sees an opportunity from the cessation of logging in Victoria's state forests: "The Alpine Walking Track should come into a protected area linking up Baw Baw to the Alps. The Carey Forest is an area inside the Wonnangatta-Moroka area that's always been set aside for logging. The link between Mount Buffalo and the Alps is a really important bit of connectivity there. The Tea Tree Range, the Dargo High Plains, Cobungra State Forests, it sort of goes on. But these are areas that I think strategically can be looked at seriously in terms of how they can be added to our protected area and of course, the linkages over there into eastern Victoria."

► *Mr Peter Jacobs recently presented his work to the Royal Society of Victoria in a presentation titled "The Major Invasive Species of Victoria's Eastern Forests" during a two-day public symposium on "The Future of Victoria's Native Forests" convened on October 26, 2023. You can view his talk at* ***youtu.be/ctz9hEu1VPE****.*

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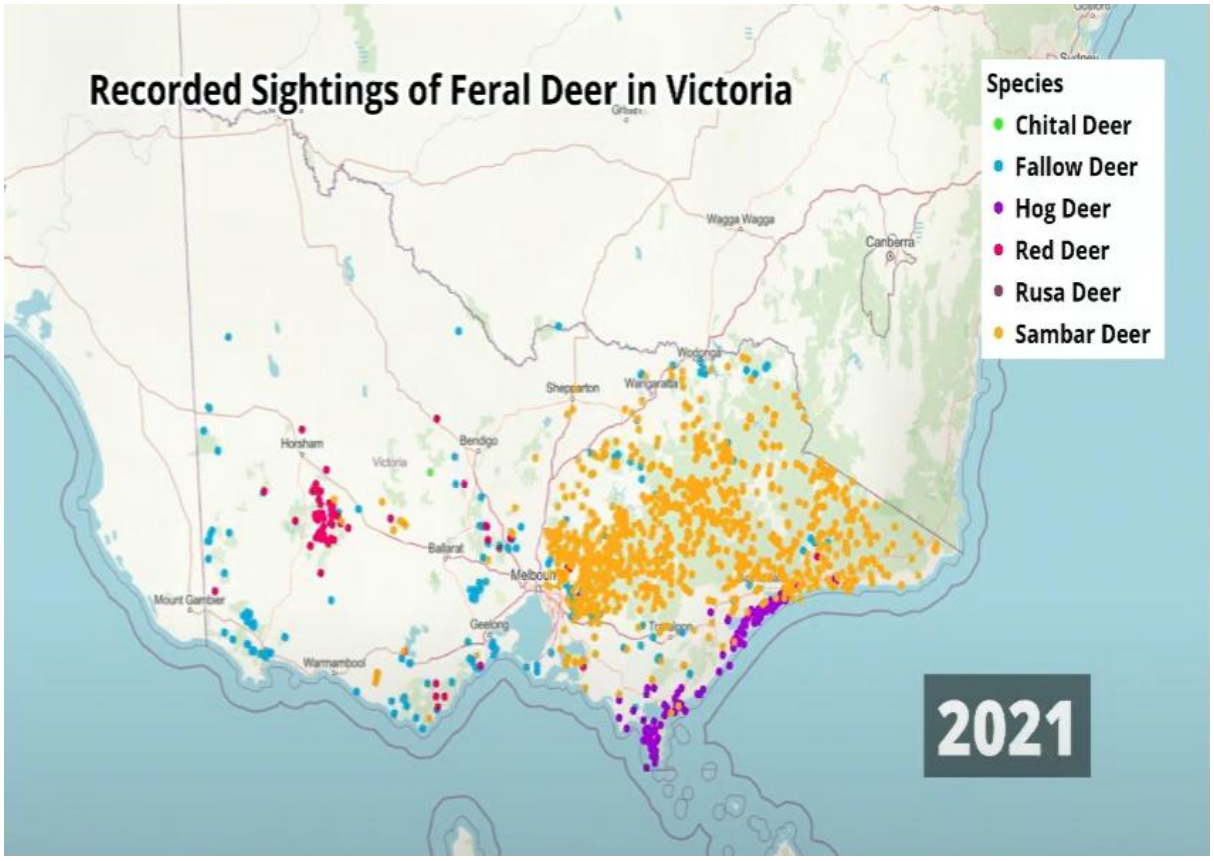

Deer numbers have exploded in Victoria since the 1970s. Image: Peter Jacobs.

A native blue-banded bee (*Amegilla cingulata*). Photograph: Buntysmum via Pixabay.

Saving the Bee-cosystem

How can we help our bees help the planet?

LEJLA KARTAL
The Peter Doherty Institute for Infection and Immunity

Bees play an essential part in the ecosystem, supporting countless plants and crops through pollination.

'Save the bees' has been a popular slogan for well over a decade - but while the slogan came about because of European honeybees dying in large numbers, bees may yet be in more trouble than we thought, particularly wild species.[1]

Catastrophic bushfires ravaged Australia in the 2019-2020 summer, with devastating effects on our wildlife. It has been estimated that the number of threatened bee species in Australia nearly quadrupled after these fires, jumping from 3 to 11.[2] Combined with overall declines in bee populations in recent years, this paints a grave picture for our bees' future.[3]

Fortunately, there are ways we can help!

Although backyard beekeeping has become quite popular, this mostly supports the European honeybee. Backyard beekeeping supports food production and promotes pro-environmental behaviour, meaning people are more likely to take care of the environment, but honeybees can pose risks to wild pollinators in cities.[4] However, European honeybees are not a replacement for wild, native bees, which are essential for maintaining biodiversity in the ecosystem.[1,5]

It's unclear exactly how many native species of bee there are in Australia, but it could be as many as 2,000.[6,7] Our native bee species are diverse in behaviour and appearance: many are solitary and build individual nests using plant materials like silk and resin, some burrow into the ground, and some native bees are even blue.[7]

How do we support them all?

The best way to support bees is by having diverse, native green spaces. By planting native flowers, shrubs, and trees, we give our bees the best chance of finding a home that suits them.[7] Even planting native plants scattered around non-native flowers or crops is enough to make a difference.[7,8] Having a classic bottlebrush (*Callistemon* spp.) or eucalyptus in the garden does wonders, especially in urban areas like Melbourne.[7]

Other ways to help native bees include making a bee hotel, or letting patches of garden become "messy" by less-frequent lawn mowing or leaving some dying vegetation to provide places for ground-nesting bees to hide and burrow.[7,9]

Supporting native bee populations in our gardens aids conservation efforts, benefits our gardens themselves, and also helps protect their important role as pollinators. In fact, native bees have actually been unaffected by the recent Varroa mite outbreak in NSW that has been so devastating for the European honeybee.[10] Native bees could potentially act as an insurance plan in the wake of the outbreak, as they have been shown to sufficiently pollinate crops in the US while European honeybees recover.[11]

Ultimately, maintaining a diverse garden has so many benefits for our environment, there's no reason not to. Plus, it means we can all play a part to help the bees, so they can continue to play their part in the bee-cosystem.

► *Lejla Kartal is a PhD student at the Peter Doherty Institute for Infection and Immunity. She has a Master of Science (Epidemiology) and is now studying how tiny viruses called bacteriophages can be used to kill antibiotic resistant bacteria.*

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1924

Many Mozzies

BY SCOTT REDDIEX MRSV

Unfortunately, mosquitos exist.

They exist everywhere except the coldest parts of the planet, and with surprising diversity: there are a total of 3,500 different species of mosquitoes spread across 112 known genera to comprise the family *Culicidae*.[1] Beyond the nuisance of their bites, their greatest impact on humans and other animals is their role as a vector for many diseases, including malaria, yellow fever, dengue, Ross River fever, and more.[2]

On the 13th of March 1924, a paper on the subject of mosquitos by Gerald F. Hill was read to the RSV. Hill was an entomologist at the National Museum of Victoria, and had published the paper *"The Distribution of Anopheline Mosquitoes in the Australian Region, with Notes on some Culicine Species."* in the *Proceedings of the Royal Society of Victoria*.[3]

Understanding the species and locations of mosquitoes in Australia would be essential for the subsequent implementation of any control measures. As Hill wrote, *"It is 26 years since Grassi discovered that malaria is conveyed from infected to non-infected persons by anopheline mosquitoes, yet the species of carrier or carriers is still unknown in Australia."*

"A knowledge of the distribution and habits of the various species existing in Australia and New Guinea is, therefore, of practical value in, if not an essential preliminary to, effective anti-malaria measures. A study of the literature on the subject and a personal investigation of conditions in the field, as well as a critical examination of a large number of specimens from various localities, convince the writer that our knowledge is totally inadequate to a thorough scientific study of the distribution of the disease, its disseminators and its eradication or reduction."

Hill drew from a 1924 paper by English entomologist Frederick W. Edwards, which he described as *"the first authoritative list of the Australian species"* of mosquitoes.[4] Eight species of Anopheles mosquitoes were mapped to various locations around the country, with a further seven species *"recorded in New Guinea, New Britain and adjacent islands."* Hill then described the anatomies of these different species, accompanying his observations with annotated diagrams.

While the eight species identified by F. W. Edwards was a starting point for the field, the number falls slightly short of the more than 300 species that have now been found to exist in Australia.[5]

OPPOSITE: A model of an *Anopheles* spp. mosquito, made for a 1949 exhibition on Malaria by Joy Dickins from the Museum of Applied Science of Victoria. Photograph: Rodney Start/ Museums Victoria (CC BY 4.0)

FROM: *Proceedings of the Royal Society of Victoria*, Volume 37 (New Series), 1925.

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The Eastern Barred Bandicoot at night.
Photograph: Zoos Victoria

Bringing Eastern Barred Bandicoots Back

DR CATRIONA NGUYEN-ROBERTSON MRSV
Senior Editor, Science Victoria

With **DR AMY COETSEE**
Threatened Species Biologist, Zoos Victoria

The Eastern Barred Bandicoot wouldn't be here without help.

Australia's biodiversity is declining. Around 100 endemic Australian species have been listed extinct – not even counting invertebrates, which could increase the number 10-fold. A further 1,700 plant and animal species are currently threatened. But Zoos Victoria, along with its partners, is working hard to ensure that local threatened species don't go extinct on its watch.

The Eastern Barred Bandicoot (*Perameles gunnii mainland subspecies*) (EBB) was once widespread across the Victorian grasslands and grassy woodlands. Their population dwindled, primarily due to predation from foxes and habitat loss, and the species was declared Extinct in the Wild in 2013. But in a story of hope, the decades-long fight to save them has been won. Their conservation status has since been reclassified, from Extinct in the Wild to Endangered, thanks to the perseverance and determination of the EBB Recovery Team*****. This change in status, combined with the closure of the captive breeding program because it is no longer needed, is a first for an Australian threatened species.

A population on the decline

In the 1970s, the EBB population had declined to around 1000 individuals, then within a decade, there were fewer than 150 left. The last refuge of the EBB in the wild was Hamilton, in south-west Victoria. In response to the continued population decline, the EBB Recovery Team was formed in 1988, and had to act quickly.

Bandicoots were collected for release into mainland reintroduction sites, and a captive breeding program moved to Zoos Victoria in 1991. Since then, with the help of its partners**^**, Zoos Victoria has bred more than 650 bandicoots.

Between 1989 and 2004, the EBB Recovery Team reintroduced bandicoots into eight protected areas on the mainland. But these populations relied heavily on fox control for continued survival, and now only the sites surrounded by a predator exclusion fence still have EBBs. 'We learnt that we can't establish populations in the presence of foxes,' says Dr Amy Coetsee, Threatened Species Biologist at Zoos Victoria.

Fences are costly to build and maintain, and require daily monitoring for any weak points, thus restricting the size of the reserve that can be fenced and therefore the number of bandicoots they can hold. As of 2004, only 740 hectares were fenced as a sanctuary for bandicoots in Hamilton Community Parklands, Mt Rothwell, and Woodlands Historic Park.

Amy specialises in EBB recovery, where she has over 19 years of experience. She is committed to seeing the EBB removed from the threatened species list when they are safe back in the wild. She needed to think of another solution for their long-term security.

The Eastern Barred Bandicoots' island havens

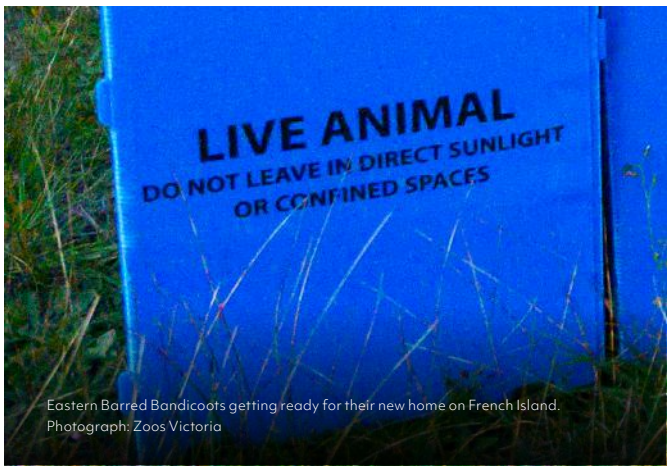
With the EBB populations unable to survive on mainland Victoria without stringent and costly fox control measures, the team turned to fox-free islands.

Amy and the EBB Recovery Team proposed a release of EBBs on French Island, Victoria's largest coastal island. Initially there was some resistance from locals as they were concerned that EBBs may change the way they manage their land or that bandicoots might become overabundant and cause damage (especially given that koalas introduced to the island are overabundant and damaging trees through overgrazing). They wanted reassurance. A lot of that reassurance came from Churchill Island.

In 2015, Phillip Island Nature Parks, with support from the EBB Recovery Team, released 20 bandicoots on Churchill Island. With the island being an even split of farm and bush land over its 52 ha, similar to the landscape of French Island, it was the perfect model for people to see for themselves the impacts bandicoots have on the land. Bandicoots quickly filled the space, especially given that the EBB has one of the shortest gestation periods of any mammal at just 12.5 days.[1] The Churchill Island population now fluctuates between 110 and 180 bandicoots.

Having been brought into the ecosystem of Churchill Island, the EBB found a home – which the bandicoots are improving by being there. Bandicoots adopt the role of 'ecosystem engineers', each digging approximately 13 kg of soil per night in the pursuit of food, which improves the properties and health of soils, and can even reduce fire risk.[2] Loosening the soil with their shallow digs increases water filtration, nutrient access and promotes seedling growth. EEBs can also have a role in agriculture by assisting pasture growth and condition, reducing topsoil runoff, and mitigating the effects of trampling and soil compaction from livestock.

The French Island community was starting to see the benefits. Pleased with the success on Churchill Island, Amy invited French Island residents to watch the bandicoots in action at night. She took around 100 residents across on a boat and shone spotlights to see the bandicoots. This demonstrated to the community what they might expect from an EBB release on their own island and helped win them over. In 2017, Phillip Island Nature Parks also established a population on Phillip Island. Now fox-free, the island provided bountiful habitat for the 67 EBBs released – that are expanding their range across the island and have grown to over 1000.



Eastern Barred Bandicoots getting ready for their new home on French Island. Photograph: Zoos Victoria

The success of these projects and evidence the new wild populations of bandicoots were thriving set the scene for a release at French Island in 2019. With the help of peanut-butter-and-oat bait, the EBB Recovery Team collected bandicoots from the Churchill Island, Hamilton and captive-bred populations, and released them on French Island the following night. Side-by-side with the local community – who had come on board – the team released 74 bandicoots to start a new population, which is now thriving.

Bouncing back on the mainland

With EBBs introduced on three islands, the EBB Recovery Team returned its focus to the mainland. As the looming threat of foxes had to be considered, the EBB was reintroduced into a fourth site surrounded by a predator exclusion fence. Tiverton, a privately owned, 1000-hectare working sheep farm, is the biggest fenced reserve in the state. EBBs were released there in 2020 and are doing well.

Zoos Victoria also trialled a release of bandicoots on private land under the watch of guardian dogs. Harnessing the power of guardian dogs to protect sheep from predation, by simply training dogs to not approach bandicoots, they can all live together. 'The dogs create a landscape of fear,' says Amy. Foxes tend not to hunt on lands guarded by dogs, negating the need for fences. More work is required in this area for this approach to be effective, but the future of agriculture and conservation working together opens the possibility of farming lands across the state being used to protect endangered species.

The EBB is well on the way to recovery, brought back from the brink of extinction. While the challenge to return EBBs to the wild on the mainland remains, populations now persist in seven safe havens, scattered across the state decades on from inception of the EBB Recovery Team. This provides hope that with persistence and dedication, collaboration between conservation organisations, land managers, and local communities, we can save them and other threatened species from extinction. Amy hopes that one day she will be out of a job once EBBs are no longer considered endangered (at which point she will move on to save another species!).

► *Dr Amy Coetsee is a Threatened Species Biologist at Zoos Victoria, and presented her EBB conservation progress to the RSV in September 2021. A recording of her presentation is available at* ***youtu.be/z17KhCddnBQ****.*

*Eastern Barred Bandicoot Recovery Team partners: Conservation Volunteers Australia, DELWP, Glenelg Hopkins Catchment Management Authority, Mt Rothwell Biodiversity Interpretation Centre, National Trust of Australia (Victoria), Parks Victoria, Phillip Island Nature Parks, the University of Melbourne, Tiverton Property Partnering, and Zoos Victoria.

^EBB Captive breeding partners: Dubbo Western Plains Zoo, Kyabram Fauna Park, Melbourne Zoo, Monarto Zoo, Serendip Sanctuary, Taronga Zoo, and Taronga Western Plains Zoo.

REFERENCES: [1] Parrott, M.L., & Edwards, A.M. (2023). Reproductive Strategies and Biology of the Australasian Marsupials. American and Australasian Marsupials, Springer, 1–49. doi.org/10.1007/978-3-030-88800-8_37-1

[2] Halstead, L. M., et al. (2019). Digging up the dirt: Quantifying the effects on soil of a translocated ecosystem engineer. Austral Ecology, 45(1), 97–108. doi.org/10.1111/aec.12833

A Mountain Pygmy Possum and (below) a Bogong Moth. Photographs: Zoos Victoria.

MOTH TRACKER

A Citizen Science Project with Zoos Victoria

Help scientists at Zoos Victoria track the migration of Bogong Moths to help them and the Critically Endangered Mountain Pygmy-possum!

Beginning in spring each year, Bogong Moths make an epic migration towards alpine regions in Victoria and New South Wales, where Critically Endangered Mountain Pygmy-possums are waking from their hibernation. Bogong Moths are a crucial spring food source for Mountain Pygmy-possums and declines in Bogong Moth numbers are an urgent threat to the possums' survival. After Bogong Moth numbers crashed by an estimated 99.5% in 2017-18, these small but mighty moths were sadly listed as Endangered by the IUCN in 2021.

Moth Tracker is a citizen science initiative which aims to gather open-source real time data on the dates, locations and numbers of Bogong Moths travelling during the annual migration period.

For the current migration season, Moth Tracker has already received 416 submissions, including 220 verified Bogong Moth sightings.

If you see a Bogong Moth, or a moth you think could be a Bogong Moth, take a photo and upload it to Moth Tracker. It's quick and easy, and will help scientists better understand how to help the moths and if they will make it to the mountains this year.

The migration season isn't over yet, and we are hoping to collect more valuable citizen science data on the epic migration of this Endangered species in the coming months.

Learn more about the moths, the possums who eat them, and the Moth Tracker project at **zoo.org.au/possums.**

Call for Scientific Papers

AVAILABLE ONLINE AT PUBLISH.CSIRO.AU/RS

The Proceedings of the Royal Society of Victoria is our refereed journal, published twice annually by CSIRO Publishing.

The Society invites contributions for the *Proceedings* from authors across the various disciplines of biological, physical and earth sciences, including multidisciplinary research, and on issues concerning technology and the applied sciences.

Contributions on topics that are relevant to Victoria and the south-eastern Australian region are encouraged. The journal also publishes Special Issues and themed collections of papers commissioned by the Council of the Royal Society of Victoria. It is published online in May and November, with two issues constituting a volume.

The *Proceedings* is one of Australia's oldest and longest-running science journals, a terrific platform for establishing an individual research presence, grouping papers derived from symposia on specific subjects, or simply joining a distinguished tradition of science published in or about our region that stretches back to the 1850s.

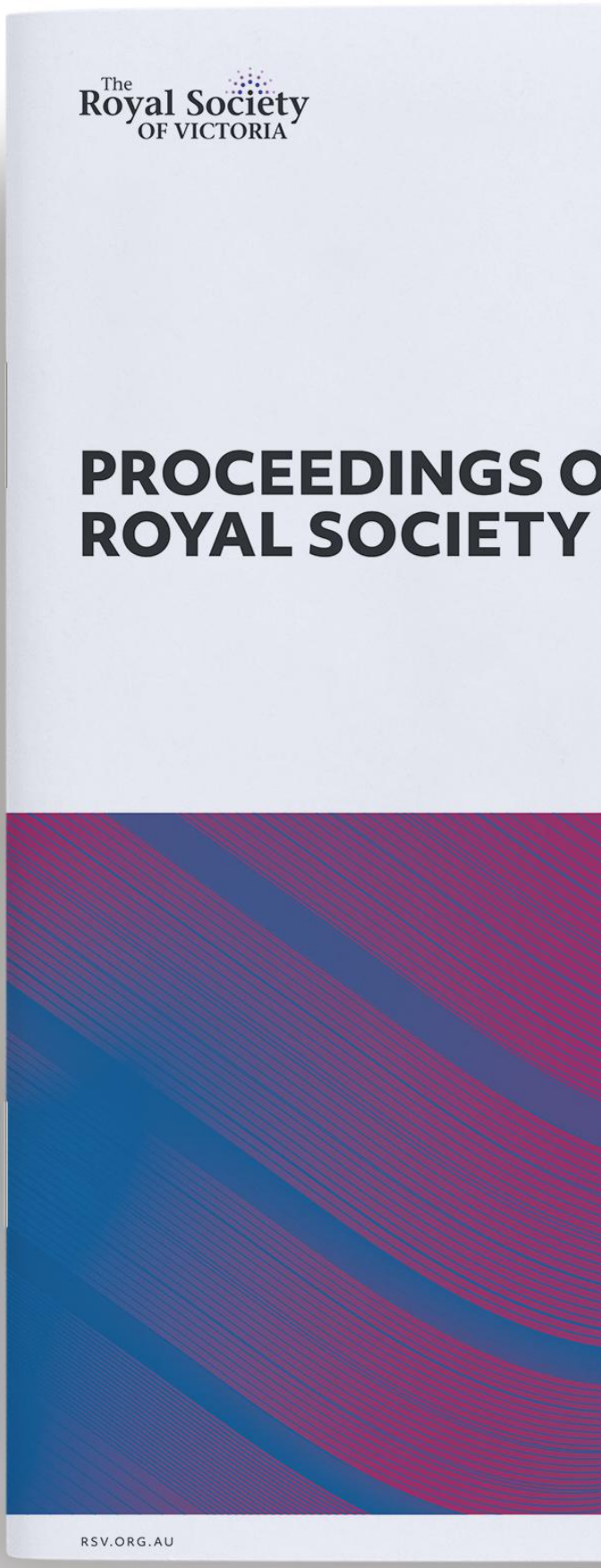
The journal began in 1855 as an irregular publication under the title *Transactions of the Philosophical Society of Victoria,* with the present name adopted in 1889. Since then, volumes of the journal have been published annually, often across one or more parts.

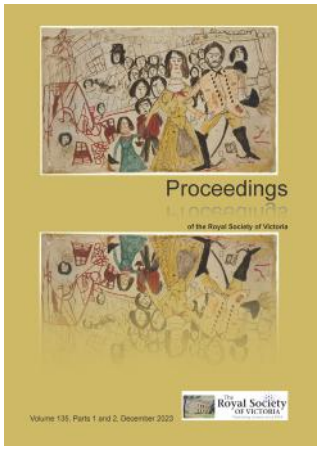
The online content published by CSIRO Publishing extends back to Volume 118, 2006, and is available at **publish.csiro.au/rs**.

All volumes of the *Proceedings* and its predecessors from 1854 to 2006 are also available free online at **biodiversitylibrary.org/creator/6984**.

Submissions

Those interested in submitting papers should review the Author Instructions at **publish.csiro.au/rs/forauthors/AuthorInstructions**. Manuscript submissions for the Proceedings are now made using the ScholarOne platform. Any enquiries regarding submission can be made to **editor@rsv.org.au**





Baron Alexander von Humboldt (1769 - 1859). Artist: Julius Schrader. Open access image courtesy of The Metropolitan Museum of Art.

Honouring Humboldt

Research for a Sustainable World

Volume 135 of the Proceedings of the Royal Society of Victoria is now available online, open access from CSIRO Publishing, hosted at publish.csiro.au/rs/issue/11551.

This volume is substantively dedicated to the theme 'Humboldtian Research Towards a Sustainable World,' drawn from the proceedings of the 19th Biennial Conference of the Australian and New Zealand Associations of von Humboldt Fellows in 2022.

There is an additional paper from Dr Thomas Darragh and Dr Ruth Pullin, translating letters from the celebrated German painter Eugene von Guerrard, then based in Australia, to the Ethnological Museum in Berlin from 1878 – 1880, along with the collected abstracts from colleagues presenting at the RSV's 2022 symposium on 'Next Generation Biocontrol of Invasive Vertebrate Pests.'

Alexander von Humboldt has been referred to as 'the forgotten father of environmentalism.'1 As early as 1844, he wrote that humans change the climate 'by cutting down forests, by changing the distribution of water bodies, and through the production of large vapour and gas masses at the centres of industry.'2 Humboldt also described the greenhouse effect in his opus magnum, 'Kosmos'. And time and again in his writings and in his lectures, he emphasised the interconnectedness of all living creatures on this planet. In times when the effects of climate change become ever more visible and palpable around the globe, it is imperative that the global academic community addresses the topic of sustainability in all its dimensions.

Dr Thomas Hesse
Deputy Chair, Alexander von Humboldt Foundation

REFERENCES:

[1] Andrea Wulf, 'The Forgotten Father of Environmentalism' in The Atlantic, 23 December 2015 (theatlantic. com/science/archive/2015/12/the-forgotten-father-of-environmentalism/421434/).

[2] 'durch Fällen der Wälder, durch Veränderung in der Vertheilung der Gewässer und durch die Entwicklung großer Dampf- und Gasmassen an den Mittelpunkten der Industrie' quoted in Frank Holl (2018), Alexander von Humboldt und der Klimawandel: Mythen und Fakten HiN XIX, 37.

Papers from Volume 135

Germantown Revisited

EMERITUS PROFESSOR GABRIELLE L. MCMULLEN
Australian Catholic University

Abstract:

Germans were among the earliest European settlers in the Geelong region — their presence was visibly identifiable in the early township of Germantown, now Grovedale. This paper makes a contribution to recognising the legacy of the pioneering Germans in the region and the Humboldtian visualisation of Geelong captured by German artist Eugene von Guérard. The stimulus for the paper was the contemporary German event in Geelong when Deakin University generously hosted the 2022 conference of the Australian and New Zealand Associations of von Humboldt Fellows at its Waterfront Campus.

▸ Read this article for free at **publish.csiro.au/RS/pdf/RS23001**

Stories About Symmetry

REBECCA A.H. WALDECKER
Mathematics Institute, MLU Halle-Wittenberg, Germany

Abstract:

In this note, I shine a light on topics where symmetry plays a role. Together we will explore how symmetry can be captured mathematically and how concepts involving symmetry help to understand viruses and self-organising materials, how they can be used to design better algorithms and how the classification of elementary symmetries leads to an exciting story about an unprecedented communal effort to prove a big mathematical theorem. I will give examples of open questions that still wait to be answered.

▸ Read this article for free at **publish.csiro.au/RS/pdf/RS23002**

WHERE ARE WE AT WITH SHAPE-MEMORY ALLOYS IN THIS 'HIGH-TECH' WORLD?
Trevor R. Finlayson
▸ pp. 58-63
publish.csiro.au/RS/pdf/RS23010

WAVES THAT APPEAR FROM NOWHERE
Nail Akhmediev
▸ pp. 64-68
publish.csiro.au/RS/pdf/RS23011

Current Government Consultations of Interest to Victoria's Science Community

*Projects open for consultation from **engage.vic.gov.au/project***

Daniel McCullough via Unsplash

Pat Whelen via Unsplash

CONSULTATION CLOSES 15 MARCH 2024

SE Shepparton draft Precinct Structure Plan

Learn about the draft plans for the Shepparton South East Precinct and draft Development Contributions Plan as part of the final consultation process.

engage.vic.gov.au/sheppartonsoutheast

CONSULTATION CLOSES 20 MARCH 2024

Victorian Landcare Facilitator Program Review

Have your say on the future planning for the Victorian Landcare Facilitator Program

engage.vic.gov.au/vlfp-review

Daniel Pelaez Duque via Unsplash

Daniel Quiceno M via Unsplash

CONSULTATION CLOSES 28 MARCH 2024

Reforming Victoria's animal care and protection laws

Have your say on the draft Animal Care and Protection Bill

engage.vic.gov.au/new-animal-welfare-act-victoria

CONSULTATION CLOSES 22 APRIL 2024

New land use planning regulations for animal production

Agriculture Victoria has drafted new land use planning regulations for the establishment and expansion of animal production facilities in Victoria.

engage.vic.gov.au/new-land-use-planning-regulations-for-animal-production

Submission Guidelines

Pitch it to us!

Have an idea for an article?
We want to hear from you!

Briefly outline your key message, why it should be shared in *Science Victoria*, and the proposed article type. Pitches can be submitted at any time, but check submission deadlines if you're interested in publishing in a particular edition.

All pieces will be reviewed prior to publishing, and may be edited for length and clarity (although we will not alter the message or context of your work).

Send pitches and any questions to **editor@ScienceVictoria.org.au**.

We welcome your pitches relating to current scientific research in Victoria, recent scientific discoveries, social and policy issues, technical innovations, and overviews of impactful research.

Science Victoria's articles are written in plain, non-academic language, and thoroughly referenced (see: References).This is not a platform for scientific journal articles or media pieces. For more information on what we're looking for, see below.

Style Guide

All pieces should have readability in mind. A good litmus test is knowing that most people have read a piece or been to a presentation that managed to make the most interesting topics incredibly boring and/or confusing. This is what you want to avoid.

A general guide for readability is that it should be understood by an educated 16-year-old – or ask a friend or family member to proofread!

Feature Articles

Recommended length: 600 - 1,800 words

Feature articles are more in-depth pieces on a specific topic related to STEMM. A key aspect of feature articles is the narrative – this isn't a journal article, so think about the story that your article is trying to tell.

Avoid using jargon, as it will quickly alienate anyone who isn't an expert in that field. Explaining one or two otherwise irreplaceable terms is fine.

Use of sub-headings and figures to break up longer pieces is strongly encouraged.

Not quite sure about the tone for your piece? Have a look at articles published in previous editions of *Science Victoria*, or in other scientific publications for a general audience, like *The Conversation, Cosmos, New Scientist, or Scientific American.*

Opinion Articles

Recommended length: 600 - 1,800 words

In contrast to a feature article, an opinion piece conveys your informed opinion on, or experiences with, a particular topic. Clearly state your argument, outlining the details of the problem you are addressing, and build to a strong conclusion.

For greatest impact, your choice of topic should be one that is broadly relevant to STEMM-related fields in Victoria. Examples of possible topics include how to address a climate-change related problem in Victoria; successes and failures common to STEMM engagement initiatives; ethical problems related to scientific projects or careers in STEMM; your experiences of a career in STEMM and thoughts on how to better support the next generation of researchers; existing STEMM-related studies or approaches that you believe could be applied in Victoria.

We welcome well-informed opinion articles from all authors, particularly from those with significant expertise in a given area. Articles may reference your own work; however, these are not promotional fluff pieces.

Letters

Recommended length: 200 – 1,000 words

Letters have minimal restrictions on style, structure, or subject matter. You are encouraged to submit your thoughts/questions/comments that broadly relate to STEMM in Victoria. Potential subject areas include responses to articles in previous editions of *Science Victoria*, seminars at scientific events, science-related issues and policies, or topics you'd like to see in future editions.

Letters are also the best format to share current or recent news relating to science, with an emphasis on science in Victoria or news that impacts Victoria's scientific community. News could relate to funding announcements/grant outcomes, new STEMM-related projects, high-impact publications relevant to Victoria, successes of Victorian scientists, or relevant STEMM-related policy news.

Where a specific question is asked, we will try to have the appropriate person respond to your letter.

What I've Been Reading

Recommended length: 600 - 1,800 words

This is a column for you to tell us about a book broadly relating to STEMM that you've read. These pieces typically include a summary of the book and its ideas, as well as your interpretations or conclusions. Possible questions to consider: Do you think the author was correct in any assumptions? Was the author's style of writing approachable? Did they do the subject matter justice? Who would you recommend this particular book to? What did it mean to you? What did you learn?

Images and Figures

Images are strongly encouraged, however please only provide files that are either completely original, in the Public Domain, or covered by an appropriate Creative Commons license. Images must include details of the source, license, and any relevant descriptions.

If suitable images are not provided, we may include relevant Public Domain/Creative Commons images.

All images must be of sufficient size and quality – as a rough guide, aim for >1.3 MB in file size.

References

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article. If references aren't provided, we will request them for specific statements.

References for all articles should use a modified APA 7th edition format: reference list in author-year format, with numbered in-text citations. Refer to articles in previous editions for examples. Please do not submit pieces that use MS Word's References/Footnote/Endnotes feature, as it forces us to manually re-write your references.

Submission Deadlines

MARCH 2024	**DUE DATE**
Victoria's Fauna	*16 February*

Everything *Animalia* in Victoria, particularly native fauna.

APRIL 2024	**DUE DATE**
The Four Planetary Crises	*15 March*

Biodiversity Loss, Climate Change, Pollution & Waste, and The Rise of Misinformation

MAY 2024	**DUE DATE**
Accessibility & Inclusion in STEMM	*19 April*

Supporting the education, employment, and engagement of everyone in STEMM.

JUNE 2024	**DUE DATE**
Victoria & Climate Change	*17 May*

The impacts of, research on, and responses to climate change in Victoria.

JULY 2024	**DUE DATE**
Building Scientific Competency	*14 June*

Empowering individuals and communities to understand the scientific method.

AUGUST 2024	**DUE DATE**
STEMM Throughout Victoria	*19 July*

The opportunities for learning and engaging with STEMM across the state.

SEPTEMBER 2024	**DUE DATE**
Pollution in Victoria	*16 August*

The different pollutants, sources, impacts, and responses required.

OCTOBER 2024	**DUE DATE**
Victoria's Ecosystems	*13 September*

The many and varied ecological niches across Victoria

NOVEMBER 2024	**DUE DATE**
Science & Policy	*18 October*

From lab bench to front bench: how scientific understanding can positively influence policy.

DECEMBER 2023	**DUE DATE**
Science & Business	*15 November*

Creating a sustainable industry, start-ups, med-tech, patents, and ethics.

Hold Your Next Event at the Royal Society of Victoria

The RSV engages communities with scientific knowledge through aligned partnerships, events, festivals, conferences, and education programs.

Services Available

We also provide a number of services to ensure your event is a success. Some of the services we provide are:

- Event management
- Meeting venues
- Grants and awards administration
- Social media campaign management
- Broadcasting and video production
- Recruitment of scientific panels
- Convening community engagement and deliberation processes where scientific work contributes to social, environmental, and economic impacts and benefits.

The Facilities

The RSV's facilities are available for hire to organisations, companies, or private groups.

Audio-visual and seminar equipment is available for use, including videoconferencing facilities for hybrid Zoom/MS Teams meetings.

There is a commercial kitchen on the ground floor, suitable for your own use or by a caterer. Limited parking is available on-site, and a commercial parking operator is adjacent on La Trobe Street.

▶ Take a Virtual Tour of the building at: **matterport.com/discover/space/royal-society-victoria**

▶ Email rsv@rsv.org.au to discuss your needs and ideas!

The Burke and Wills Room

The beginning and end of the ill-fated Victorian Exploring Expedition of 1860-61 is a beautiful, multi-function space with an adjoining kitchen, suitable for a range of events.

SUITABLE FOR

Workshops, roundtables, luncheons, dinners, seminars, and functions.

CAPACITY

Workshops	*≤30 people*
Dinners	*≤60 people*
Catered Functions	*≤80 people*

The Ellery Lecture Theatre

First-floor lecture theatre, with raked seating, speaker's podium, and audio/visual equipment. Perfect for lectures, presentations, and conferences.

SUITABLE FOR

Presentations, seminars, lectures.

CAPACITY

Any Booking	*≤110 people*

The Millis Room

A versatile room on the ground floor, with views of the Carlton Gardens. Suitable for smaller meetings, group/individual work, or seminars.

SUITABLE FOR	CAPACITY	
Meetings, group/individual workspace, and seminars.	*Any Booking*	*≤15 people*

The Cudmore Library

A picturesque room with videoconferencing and projection equipment. Great for larger meetings and seminars, with in-person or hybrid attendees.

SUITABLE FOR	CAPACITY	
Meetings, seminars, and videoconferencing.	*Any Booking*	*≤15 people*

The Von Mueller Room

A light-filled room on the first floor, perfect for smaller meetings and seminars, or group/individual work.

SUITABLE FOR	CAPACITY	
Meetings, seminars, and videoconferencing.	*Any Booking*	*≤15 people*

Support Victoria's Science Society in 2024 and help us to engage individuals and communities with STEMM

WHO WE ARE

Founded in 1854, the Royal Society of Victoria (RSV) is our state's science society.

We are a membership based, non-government organisation, advocating for the importance of science, technology, innovation, and building the skills for Victoria's future industries, governments, community leaders, and research superstars.

WHAT WE DO

We manage the Inspiring Australia program in Victoria (inspiringvictoria.org.au), meaningfully engaging communities with science.

We encourage, profile, and celebrate the achievements of Victorian scientists through public lectures, awards, and prizes, which are supported by the donations and bequests to the RSV Science Foundation.

WHERE YOUR DONATIONS GO

Your donations allow us to continue the work we have been doing for Victoria for more than 160 years. This includes hosting organising/hosting/running STEMM events, running a public lecture series (in-person and online), producing the magazine *Science Victoria*, celebrating Victorian scientists through awards and prizes, publishing Victorian science in our academic journal (the Proceedings of the Royal Society of Victoria), and empowering the next generation of scientists.

HOW TO SUPPORT

We also support a number of smaller organisations, which are listed at **rsv.org.au**.

You can donate online now at **rsv.org.au/support-the-rsv**, or alternatively contact us at **rsv@rsv.org.au** for information about other payment methods.

Become a Member of the RSV

We bring together an independent community of science practitioners, educators, industrialists, and enthusiasts to promote an understanding and utilisation of scientific knowledge for the benefit of the state of Victoria.

	STUDENT $40 PER YEAR	FULL $120 PER YEAR	ORG. $1000 PER YEAR	SCHOOL $1000 PER YEAR	AFFILIATE $500 PER YEAR
Special Membership rates at RSV and affiliate events.	✓	✓			
Networking opportunities – national and local.	✓	✓	✓	✓	✓
Recognition of membership through use of post-nominal affix	MRSV	MRSV			
Science Victoria Digital Edition (Printed copy available for an additional fee).	✓	✓	✓	✓	✓
Free monthly printed copies of *Science Victoria* for school libraries.				✓	
Recognition of achievements through awards programs.	✓	✓			
Discounted advertising in *Science Victoria*			✓	✓	✓
Discounted facility hire at 8 La Trobe Street, Melbourne.			✓	✓	✓
Discounted membership rate for eligible full-time students.	✓				
Discount on purchases from CSIRO Publishing	✓	✓			
'Schools Supporting Schools' Membership Program*				✓	
Listing of membership on the RSV.org.au website.			✓	✓	✓

New Individual Members

MR JACK HOLMES
PhD Candidate, Griffith University

MR TIMOTHY TODHUNTER
Retired, formerly General Manager at ICI Australia

MR JUSTIN DOERY
Engineering Geologist, Chadwick Geotechnics

MR SIMON GOODING
Science Coordinator, Melbourne High School

For more information:
rsv.org.au/how-to-join

* The 'Schools Supporting Schools' membership program allows a school to sponsor the membership of one or more schools at a discounted rate of $750/year, allowing less-resourced schools the same benefits and opportunities of RSV membership.

Echidna on the walking track between Torquay and Jan Juc Beach. Photograph: Enguerrand Blanchy via Unsplash.

Science Victoria
The Royal Society of Victoria
Wurundjeri Country
8 La Trobe Street, Melbourne, VIC 3000

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Scan the QR Code or go to:
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