The Royal Society OF VICTORIA
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Inspiring AUSTRALIA Victoria

SCIENCE VICTORIA

SEPTEMBER 2023

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From the Archives

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SCIENCE VICTORIA

This Edition: Victoria's Flora

Victoria is home to tens of thousands of native plant species, but as at June 2023, 1,618 of these are under threat of extinction in our state (FFG Act Threatened List, June 2023). As the impacts of climate change are increasingly felt, there is a risk that this number will rise unless we act. In this edition, we look at the value of our flora, how we can support ecosystems in a changing climate, and whether the European model of seasons is unsuited to our part of the world.

On the Cover: A bee visits an orange flowering gum in Riddells Creek, Victoria. Photograph: Nicole Patience via Shutterstock.

Please note that the submission deadline for content to be included in the October 2023 "Science and Food" edition of *Science Victoria* is **5pm, Friday 15th of September 2023.**

SEEING THE FOREST FOR THE TREES

Mike Flattley
CEO, The Royal Society of Victoria

The annual transition from the cold and dark is upon us here in Victoria, and as always the plants are the first to announce the change!

So what better time to focus an issue on Victoria's flora and the qualities of our regional climate? Sadly this won't be a pre-launch issue of *Gardening Victoria*, but we do have some excellent pieces to exercise the mind on the issues confronting the persistence and management of floral species endemic to south-eastern Australia.

Peering through the moist, verdant foliage from a late La Niña cycle, looming large on the horizon is the unsettling approach of our region's next bushfire season. This comes in the context of a marching wave of wildfires in the northern hemisphere, seemingly striding across the Pacific from Canada to Hawai'i in their hot months, like some kind of slow motion reboot of *On the Beach*. It's fair to feel a little unnerved.

Further context is provided by the cessation of logging in Victoria's native forest estate in the interests of meeting the state's emissions reduction targets, with a side serve of biodiversity conservation, with the attendant cessation of broader land management operations in state forests by the departing logging industry.

It feels like the dust is starting to settle on a chapter - hopefully the whole book - of Victoria's forest wars, leaving us with the niggling question: "what now?" We are entering an El Niño cycle, with a high likelihood of long, severe drought periods, in the context of a climate tending towards drier and warmer conditions generally, with a higher frequency of "extreme weather" events. How do we conserve our predominant eucalypt forests, which we understand will be increasingly likely to perish under a regime of more frequent, high intensity bushfires? Once we have a plan for that, who does it? Who pays for it, and how? And have we remembered that a forest is about much more than its trees?

While we can't possibly hope to solve such a complex puzzle in a single issue, our contributors have brought an excellent range of thoughts and research outcomes to this scenario, canvassing both Settler and Indigenous approaches to interpreting regional seasons, the role of fire as a tool to sustain biodiversity, the role of forest structures in mitigating fire intensity and the management of native forests to enable their persistence through climate change. With planning underway with our colleagues at the Alluvium Foundation, Victorian National Parks Association and the Friends of the Earth, we hope to engage everyone further in discussion on the future of Victoria's native forests at an open conference later this year, and hope you can join the conversation. Stay tuned, and have a great month!

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CEO Mr Mike Flattley
Membership, Business & Facilities
Mr James McArthur

Membership
James McArthur
james.mcarthur@rsv.org.au

Events and Commercial
Mike Flattley
ceo@rsv.org.au

Editorial
Editor Mr Scott Reddiex
Associate Editor Dr Catriona Nguyen-Robertson
Layout Design x Rosie

Contributors
Dr Catriona Nguyen-Robertson, Mr Scott Reddiex, Ms Kate Bongiovanni, Prof Tim Entwisle, Mr Gordon Noble, Ms Priya Mohandoss, Ms Tanya Hendy, Ms Ellie Claringbold, Mr Robert French

Letters
editor@sciencevictoria.org.au
Please note that letters may be edited for length and clarity

Advertising
rsv.org.au/media-kit

Contact Us
The Royal Society of Victoria
8 La Trobe Street, Melbourne,
VIC 3000
rsv@rsv.org.au
+61 3 9663 5259

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Acknowledgement of Country:
The Royal Society of Victoria acknowledges the many First Peoples of our continent, their vast history and connection to the lands and waters within and beyond the State of Victoria, and the valuable cultural and scientific knowledge held by the Elders to care for Country. We acknowledge our headquarters are located on Wurundjeri land, never ceded, and convey our respect to Elders past and present. The RSV welcomes all First Nations people, and seeks to support and celebrate their continued contributions to scientific knowledge.

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VICTORIA'S FLORA - IS 'NATURE POSITIVE' POSSIBLE?

Rob Gell AM MRSV
President, The Royal Society of Victoria

We're not meeting our climate goals, and we're a long way from meeting our biodiversity goals. We do now have global consensus to halt and reverse biodiversity loss,[1] however, we seem to have some way to go in Australia to both present and respond to the issue.

> "97% of Australians want more action to conserve biodiversity, and most consider that 'every person in Australia' has a responsibility to act, including all levels of government. Most Australians are aware of the uniqueness and benefits of Australian biodiversity (our plants, animals and other living things)."
>
> — Biodiversity Concerns Report[2]

Australian landscape restoration organisations like Greening Australia have long been proponents of large scale, scientifically justified, biodiversity investment projects, in an endeavour to correct the continued net loss of habitat on our continent.

On a recent Geography Victoria fieldtrip,[3] I had the pleasure of visiting the Yalukit Willam Association's wonderful 'Chain of Ponds' project. The project is the first stage of the Elsternwick Park Nature Reserve Masterplan, and aims to restore the Elster Creek as an urban woodland on the site of the former Elsternwick Golf Course.[4]

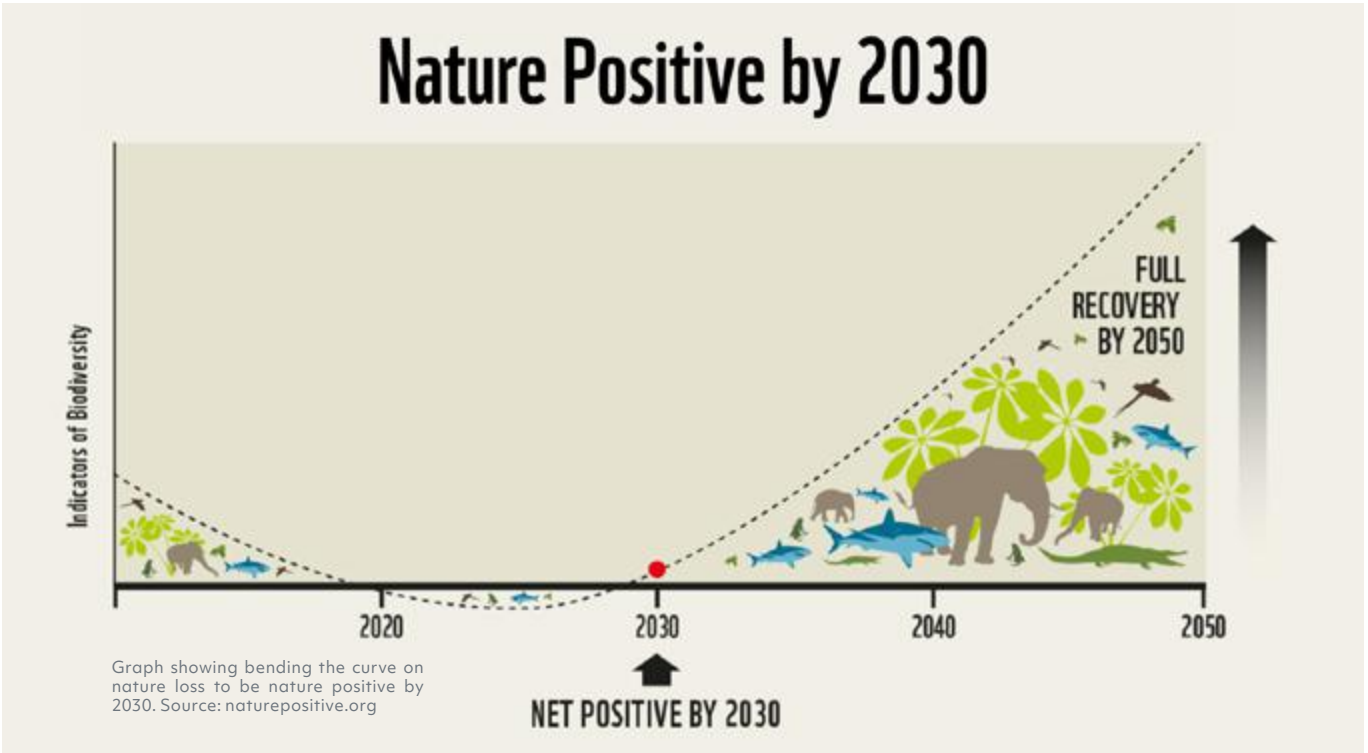
It's important to note that the focus of this ecological restoration project is not simply 'more trees', but rather an understanding of the potential to introduce smaller plant species – the 'short pricklies' – and ground cover species that will encourage invertebrates, in turn encouraging mammal and bird species to (re)populate the site.

How might we ensure that this approach is undertaken in other Victorian urban neighbourhoods? How can we promote the importance of such valuable investments in the enhancement of local biodiversity?

It starts with informed conversation and improved dialogue from our political leaders at all levels, and should then flow to government departments and agencies.

The recently released 'Shrine to Sea' Masterplan is an example of a lost opportunity to both increase community awareness of the need to invest in local biodiversity, and also to fulfil the desire of Australians for more action and better communication.[5] The proposed project for a new, 'enhanced, green boulevard' valuably includes Bunurong branding and First Nations engagement in its project design for climate resilience, local storytelling, and commuter safety. In the biodiversity space, there'll be a woody meadow, but also more Canary Island Date Palms (Phoenix canariensis) and Jacarandas (Jacaranda mimosifolia). It is a lost opportunity to establish a connected landscape that might have included coastal grasses, salt-tolerant species at Port Phillip Bay, and important native grassy woodland species through Albert Park Lake to ANZAC Station and the Domain precinct. It seems an unimaginative, anthropocentric, human amenity design focus – landscaped 'open space' – rather than an opportunity to invest in and celebrate Victoria's flora.

Biodiversity 2037 is the Victorian Government's ambitious plan to stop the decline of our biodiversity and achieve overall biodiversity improvement over 20 years. It makes the case for increased effort, and defines a modern approach to managing our biodiversity. It is underpinned by ground-breaking science that allows us to get upstream of the problem of Victoria's



Graph showing bending the curve on nature loss to be nature positive by 2030. Source: naturepositive.org

Melbourne BioLink – a proposed 'green corridor' from Royal Park in Melbourne's north, through to Albert Park Lake in the south.

biodiversity decline. The RSV has recently focussed strongly on the issue of biodiversity loss and completed our substantive position in 2022 as 'Towards Conservation & Recovery of Victoria's Biodiversity – Report for Changemakers'.[6]

No doubt biodiversity is referred to in the 'Shrine to Sea' Masterplan, however, little detail is provided, and it certainly is not the focus that it should be in this initiative. Opportunities like this are not readily available.

I might note that as President of Greening Australia and Environment Ambassador to the 2006 Commonwealth Games in Melbourne I advanced a project called 'Melbourne Biolink'. This proposition was at scale - from Royal Park to Albert Park Lake, intentionally linking parks and gardens through the city with new plantings to provide a real identity for a city traversing biodiversity corridor. Perhaps if we'd started in 2006?

The proposal built on the vision and initiative of the London 2012 Olympic Games Organising Committee that proposed a new London Biodiversity Partnership vision for "a city where the conservation of biodiversity is integrated with social, cultural and economic values."[7] This initiative continues today as the London Biodiversity Action Plan and the Greenspace Information for Greater London CIC that includes a London Priority Species List.[8] There is now an initiative to introduce beavers to a site in urban Ealing for the first time in 400 years as an important step in the national rewilding project, as wild beaver populations in Kent and Oxfordshire move closer to London.

There is no doubt that we must significantly increase our discussions about the value and need to reinvest in Victoria's flora as a cornerstone to enhancing habits for biodiversity. This should be a collective effort of all open space managers and organisations including the Committee for Melbourne, Zoos Victoria, Museums Victoria, the Royal Botanic Gardens Victoria, and local and state government agencies.

As always, I invite your comments, criticisms, thoughts, and ideas on how the Royal Society of Victoria can contribute to discussion about important matters of science. Email me at **president@rsv.org.au**. We continue to engage more strongly with the science industry sector and invite organisations to join as members – see the Members section for details.

References:

1. COP15: Final text of Kunming-Montreal Global Biodiversity Framework available in all UN languages. (2022). Convention on Biological Diversity. cbd.int/article/cop15-final-text-kunming-montreal-gbf-221222
2. Borg, K., et al. (2023). Biodiversity Concerns Report: 97% of Australians want more action to protect nature. biodiversitycouncil.org.au/media/uploads/2023_6/202305_biodiversity_concerns_survey_report.pdf
3. Geography Victoria http://geogvic.org
4. Yalukit Willam (formerly Elsternwick Park) Nature Reserve. (2022). Have Your Say - Bayside City Council. yoursay.bayside.vic.gov.au/elsternwick-nature-reserve
5. Shrine to Sea Masterplan - Draft. (August, 2023). DEECA. engage.vic.gov.au/shrinetosea
6. Towards Conservation & Recovery of Victoria's Biodiversity – Report for Changemakers. (2022). The Royal Society of Victoria. rsv.org.au/biodiversity-recovery/
7. Towards a one planet 2012. London 2012 Sustainability Plan. (November, 2007) London Organising Committee of the Olympic Games and Paralympic Games. 2007. data.parliament.uk/DepositedPapers/Files/DEP2007-0171/DEP2007-0171.pdf
8. London Priority Species. (n.d.). GIGL. gigl.org.uk/about-gigl/planning-projects/londons-biodiversity-action-plan/london-bap-priority-species/

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RETHINKING AN ACADEMIC JOURNAL

What are the major problems facing Victoria and Victorians, now and into the future, that science can help us to address?

We are a student team from Monash University, working with the RSV to reimagine our state's long-running, peer-reviewed scientific journal, the Proceedings of the Royal Society of Victoria. As a team we are passionate about communicating science to society, and conscious of how research underway in Victoria can transform decision and policy making for the betterment of the state.

With this in mind, we are exploring the potential of the Proceedings to become a valuable tool for interdisciplinary research collaboration and translation into useful actions by governments, industries and communities.

We would love to know your thoughts on what major issues Victorians would like the Society to canvass through the journal, so we can make it as relevant as possible to people seeking a consolidated body of scholarship that can directly inform decision making.

Your answers to this survey will help inform upcoming themed editions of the Proceedings. You can leave your suggestions and feedback by using the QR code or visiting **surveymonkey.com/r/WQTPSM3**. Make sure to keep an eye out on next month's edition for more information!

Lauren Tran, Jasmine Hendry, Sophie Nolan, Andrew Stuart-Smith
Student Project Team Consultants Advanced Science *Global Challenges Monash University*

Pictured Below:
(L-R) Jasmine Hendry, Lauren Tran, Sophie Nolan, Andrew Stuart-Smith

GEOGRAPHY VICTORIA EXPLORED THE LOST CITY OF MELBOURNE

As many of you will know, Geography Victoria is a new organisation affiliated very closely with the Royal Society of Victoria. Our aim is to provide a diverse array of opportunities to explore our city and our state. On Sunday July 23 it was a "full house" for an exclusive Geography Victoria viewing of the documentary The Lost City of Melbourne at the Thornbury Picture House.

This documentary traces the fascinating and turbulent history of central Melbourne. During the gold-rush Melbourne was the fastest growing, and richest city in the world. One consequence of this is a rich history of very early movies preserved at the State Library of Victoria and the National Film and Sound Archive. Using these remarkable early movies (and engaging commentary from key experts) this film was able to portray the vibrancy, and complex geography, of this early city and the boom in construction of spectacular private and public Victorian-era buildings.

Like a classical tragedy, the audience knew that trouble was coming. Sure enough, by the 1950s Melburnians viewed their city as old-fashioned and archaic. We saw how all of the gorgeous cast-iron verandas in Collins Street were torn down for the Queen's coronation visit and for the 1956 Olympics. We saw how Whelan the Wrecker moved in, and without any opposition ripped down building after building in this orgy of 'modernisation'. Not only that, but Whelan's workers were also seen as celebrities, as they went about their pre-OH&S gymnastics atop these venerable buildings. However, the film also showed how, in many cases, it was difficult to modernise and use these buildings.

The same urge for modernity resulted in the destruction of many splendid old buildings across the Western world during the same era. The Lost City of Melbourne, whilst mourning the loss of many of the Marvellous Melbourne's most splendid Victorian buildings, finishes on a positive note celebrating the fact that Melbourne has a much richer legacy of remaining Victorian buildings than almost any other city. Three major theatres survived in Melbourne and now drive a huge industry in musicals and live theatre. This film reminds us of the power of protest (which eventually saved old buildings such as the Regent Theatre) and the importance of appreciating and protecting our past.

The Lost City of Melbourne was produced and directed by Gus Berger (and the music curated by his partner Lou) during lockdown when they were forced to close the doors of their fabulous Thornbury Picture House. Interestingly, the film explores the rise and fall of Melbourne's numerous Victorian and art-deco movie theatres, with many being demolished for petrol stations. Ironically, the Thornbury Picture House is housed in one of Melbourne's first drive-through petrol stations. It was a great venue for Geography Victoria to hold a screening of the documentary, providing an excellent space to catch up and share refreshments afterwards.

If you would like to know more about Geography Victoria and its activities please contact Ian Rutherfurd (**idruth@unimelb.edu.au**) or Libby Hillman (**hillmanlibby@gmail.com**).

Right: In 1968, Whelan the Wrecker demolished the former Melbourne Town Hall Chambers, located on the north-east corner of Swanston and Little Collins Streets. Constructed in 1890, the building was removed for the space to sit empty, before then becoming a car park. Since 2006, the site has been occupied by the Council House 2 (CH2) building.


WHELAN
THE WRECKER
IS HERE
PREMIER FURS
REAL ESTATE

SNAPSHOTS OF STEMM

Images from everyday science.

Participants of the *STEMX Speed Networking: For women and gender diverse humans* event at Science Gallery Melbourne. The event was held as part of the National Science Week *Social Animals* program.

Photograph: Science Gallery Melbourne

SNAPSHOTS OF STEMM

Charlie Disher, a Museums Victoria Sciences Volunteer, shared fun facts about stick insects and how to spot one in a special Science Bites presentation for National Science Week at Melbourne Museum.

Photograph: Dr Catriona Nguyen-Robertson/RSV

SNAPSHOTS OF STEMM

Dr Pria Ramkissoon at The University of Melbourne node of the ARC Centre of Excellence in Exciton Science, investigating the chemistry of solar energy conversion.

Photograph: Exciton Science

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Convenor, The Australian Career Book Award, Royal Society of Arts

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GIS Coordinator, Alpine Resorts Victoria

Mr Bruce Easton
Manager, Ecovantage

Ms Helen Silvester
Director, Casey Tech School

Mr Harrison Cope
Lighting Designer & Technician, After Dark Theatre

Mr Jonathan Salmon
Communications & Promotions Officer, Port Phillip Libraries

Mr George Sanos
Director, Deem Projects

Mr Brendan Cohen
Student, Monash University

Miss Leloba Jefferis
Student, Monash University

Mr Alexander Mahoney
Student, Monash University

Mr Danny Watt
Student, RMIT University

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Mr Alex Peh
PhD Candidate, Monash University

Ms Courtney McLean
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The Royal Society of Victoria is the State's oldest scientific society, a part of Australia's intellectual life since 1854. 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.

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For students enrolled full-time at a recognised Victorian education and/or research institution (proof of current, full-time enrolment required for Student Membership commencement/renewal)

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UNDERSTANDING CLIMATE CHANGE: ALL THE NATURAL AND HUMAN CAUSES

Presented by Professor Raymond Cas, Monash University

Although anthropogenic (human made), post-industrial revolution greenhouse gases are commonly attributed to be the cause of climate change, there are in fact many factors that contribute to climate change and global warming, past and present.

Geological evidence indicates that global climate has changed throughout Earth history, including contributions from long-term heat loss from the Earth to the atmosphere, Earth's orbital behaviour, and a number of plate tectonic processes. In addition, atmospheric and oceanographic dynamics and the way that tectonic plate and continental movements control these, also play a part in changing global climate. Volcanism constantly releases gases to the atmosphere producing contradictory effects on atmospheric temperature and in some cases, global climate.

And then, there is the elephant in the room – human generated greenhouse gases. How does their effect stack up against all the previous causes? All will be revealed!

ABOUT THE SPEAKER

Professor Raymond Cas is an Emeritus Professor in Volcanology in the School of Earth, Atmosphere and Environment at Monash University, where he taught, undertook research and was Head of the former School of Geosciences. He is well known internationally in the volcanology research community for his research on volcanic eruption processes and volcanic hazards on modern volcanoes around the world, as well as having been President of the International Association for Volcanology (IAVCEI, 2011-2015). Ray also undertook research in collaboration with the mining industry to develop a better understanding of mineral ore deposits such as gold, silver, copper, lead, zinc, nickel and diamonds hosted in ancient volcanic rock successions. He is the (co-) author of over 150 research papers, one book on volcanology, with another currently in production and has supervised over 50 postgraduate students.

Ray is still undertaking research at a relaxed pace as an Emeritus Professor.

UNDERSTANDING CLIMATE CHANGE: ALL THE NATURAL AND HUMAN CAUSES

Date/Time:
Thursday, 7 September 2023, 6pm

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

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

Reserve your spot at:
rsv.org.au/events/understanding-climate-change/

SPONSORED EVENT

PEARCEY ORATION AND ENTREPRENEUR AWARD 2023

Join us for the 2023 Pearcey Oration, presented by Professor Michelle Simmons AO.

With the increasing volume and complexity of data, the desire for ever increasing compute power continues to grow with intensified research in alternative approaches for creating logic devices of the future. In this talk Professor Simmons will describe the emerging field of quantum information.

During her Oration, Michelle will focus on the development of a silicon-based quantum computer using a globally unique approach pioneered in Australia to build processors atom-by-atom.Prior to the Oration, the 2023 Victorian Pearcey Entrepreneur Award will be presented by the Hon. Ben Carroll MP, Victorian Minister for Industry and Innovation, Manufacturing Sovereignty, Employment and Public Transport.

For more information, and discounted ticket pricing, visit **eventbrite.com.au/e/681230678297/?discount=RoyalFriendsofPearcey2023**

Date/Time:
Wednesday, 6 Sep 2023 6 pm - 10:30 pm

Price:
Full price: $299
Science Victoria readers: $270
Science Victoria readers receive 10% off ticket prices with the code RoyalFriendsofPearcey2023

Location:
Melbourne Connect
Wurundjeri Country
700 Swanston Street, Carlton VIC 3053

RSV YOUNG SCIENTIST RESEARCH PRIZES 2023

As part of its promotion and advancement of STEMM in Victoria, the Royal Society of Victoria fosters and recognises the excellence in Victoria's early career researchers through the annual RSV Young Scientist Research Prizes.

These four prestigious competitive prizes are open to Victorian students in their final year of doctoral candidature, in all areas of the **Biomedical & Health Sciences**, **Biological Sciences (Non-human)**, **Earth Sciences**, and **Physical Sciences**.

Judges of the RSV Young Scientist Research Prizes have forged distinguished careers within these areas, and will select eight PhD finalists (two from each category) to present their work to a general audience.

Following the presentation from finalists, judges will determine the winner from each category.

Join us in-person or online to hear about the latest science from our emerging scientists, and to support and celebrate the achievements of Victoria's upcoming high achievers.

This event will be simulcast online with the support of the Inspiring Victoria program (**inspiringvictoria.org.au**).

Please note the date of this event has changed from the 17th of August to the 28th of September.

RSV YOUNG SCIENTIST RESEARCH PRIZES

Date/Time:
Thursday, 28 September 2023, 6pm - 9pm

Price:
Free

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

Reserve your spot for in-person or online attendance at:
rsv.org.au/events/ysrp-2023/

UPCOMING RSV EVENTS

The RSV hosts many STEMM-related events, public lectures, and meetings throughout the year. These are predominantly held at the RSV Building at 8 Latrobe St, Melbourne (unless otherwise indicated), and simulcast online via YouTube. Our public lectures comprise the "Scientists in Focus" component of the Inspiring Victoria program in 2023.

7 SEPTEMBER

SEMINAR: UNDERSTANDING CLIMATE CHANGE - ALL THE NATURAL AND HUMAN CAUSES

Prof Raymond Cas will explore the geological evidence of global climate change throughout Earth's history, including contributions from long-term heat loss to the atmosphere, orbital behaviour, atmospheric and oceanographic dynamics, and a number of plate tectonic processes, including volcanism. How do their effects stack up against human influences?

Join us in person or online, **Thursday 7 September**, from 6pm.

For more information, visit
rsv.org.au/events/understanding-climate-change/

28 SEPTEMBER

RSV YOUNG SCIENTIST RESEARCH PRIZES

Please note the date of this event has changed from the 17th of August to the 28th of September. Finalists of the RSV's annual Young Scientist Research Prizes will present their work and the winners announced at this event in September.

For more information, visit
rsv.org.au/awards-and-prizes/young-scientist-research-prizes

12 OCTOBER

RSV + AATE MEETING & PUBLIC LECTURE

Please note the date of this event has changed from the 12th of October to the 2nd of November.

Joint Meeting and Public Lecture with the Australian Academy of Technology and Engineering.

23 NOVEMBER

RSV PHILLIP LAW POSTDOCTORAL AWARD LECTURE

The winner of the RSV's Phillip Law Postdoctoral Award will present their work to a special meeting of the RSV at a public lecture scheduled for the evening of Thursday, **23 November 2023**. This will be professionally filmed and shared online.

For more information, visit
rsv.org.au/awards-and-prizes/phillip-law-award/

7 DECEMBER

RSV RESEARCH MEDALLIST LECTURE

The winner of the annual RSV Medal for Excellence in Scientific Research will present a lecture to RSV members and guests on the evening of **Thursday, 7th December 2023**, at which the Medal will be presented.

For more information visit:
rsv.org.au/awards-and-prizes/research-medal/

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OUR MARINE PARKS GRANTS

Round four of the 'Our Marine Parks' grants is now open.

Grant funding of $8.6 million for projects between $30,000 and $500,000 is now available to support organisations to build their capacity and take an active role in the management of Australian Marine Parks, support evidence-based decision making, and improve ecosystem health.

This grant is open to a wide range of applicants including First Nations organisations, community groups, scientists and marine users.

Applications for Round Four of the Our Marine Parks Grants program close **9pm, 27 September 2023.**

For more information, visit:
parksaustralia.gov.au/marine/management/partnerships/our-marine-parks-grants/

Applications can be made at:
grants.gov.au/Go/Show?GoUuid=18109a9e-b0a4-4050-ac36-c23a3d82c8f9

AUSTRALIAN LAUREATE FELLOWSHIPS

Applications are now open for the Australian Laureate Fellowships scheme, for commencement in 2024.

Up to 17 five-year Australian Laureate Fellowships may be awarded each year, providing funding for Australian Laureate Fellow salary towards a Professional Level E (or equivalent) salary, funding for 2 Postdoctoral Research Associates (5 years), 2 Postgraduate Researchers (4 years), and up to $300,000 per year project funding.

Two named Australian Laureate Fellowships may be awarded to successful female Australian Laureate Fellows. A Kathleen Fitzpatrick Australian Laureate Fellowship will be available to a highly ranked female candidate from the humanities, arts and social science disciplines, and a Georgina Sweet Australian Laureate Fellowship will be available to a highly ranked female candidate from the science and technology disciplines.
Dr Georgina Sweet O.B.E., MRSV, DSc., was the first female author in the RSV's academic journal, the *Proceedings of the Royal Society of Victoria*, in 1896.

Applications close **5pm, 10 October 2023.**

For more information, visit:
arc.gov.au/funding-research/funding-schemes/discovery-program/australian-laureate-fellowships

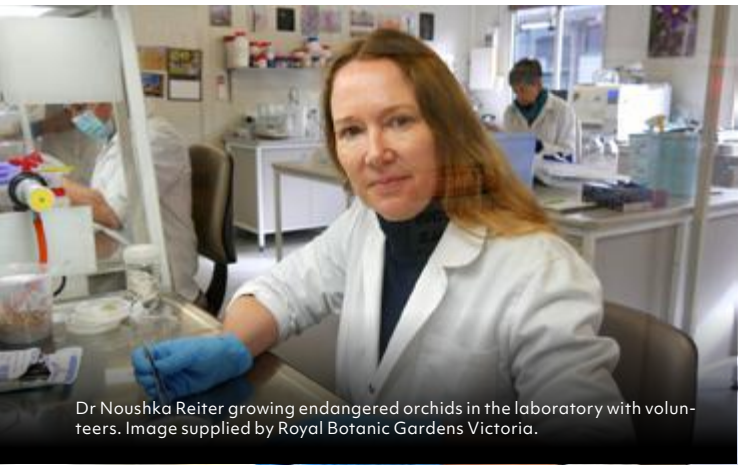
Applications can be made at:
grants.gov.au/Go/Show?GoUuid=253dd471-c963-44db-80bb-79f1ef2368ab

VICTORIAN EUREKA PRIZE WINNERS 2023

Please join us in congratulating the following Victoria-based science practitioners, communicators, and advocates on their recognition in the Australian Museum's 2023 Eureka Prizes on 23 August.

A full list of winners from around Australia can be found at **australian.museum/get-involved/eureka-prizes/2022-eureka-prize-winners/**.

2023 Eureka Prizes Awards Ceremony Winners Group. Photo: Mel Koutchavlis

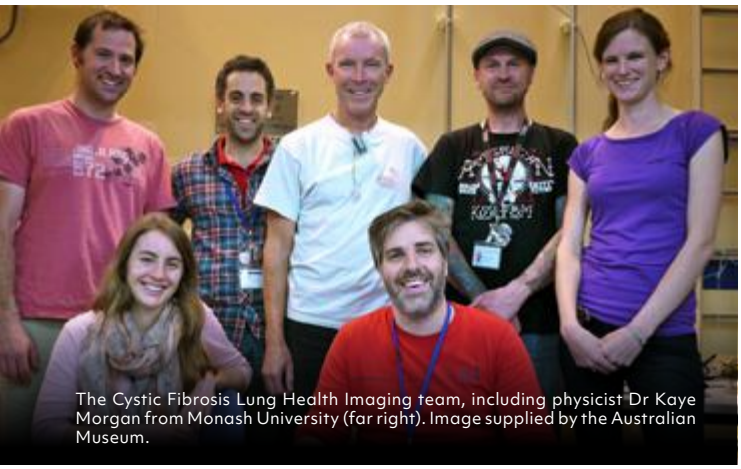


Dr Noushka Reiter growing endangered orchids in the laboratory with volunteers. Image supplied by Royal Botanic Gardens Victoria.

AUSTRALIAN INSTITUTE OF BOTANICAL SCIENCE EUREKA PRIZE FOR EXCELLENCE IN BOTANICAL SCIENCE

Dr Noushka Reiter
Royal Botanic Gardens Victoria

Dr Noushka Reiter leads an internationally recognised orchid conservation program, which has bolstered the populations of 14 endangered species by up to 260%. Using innovative methods to study pollinators and symbiotically propagate over 20,000 plants across 80 endangered species, her work safeguards Australia's unique botanical diversity, providing a blueprint for global plant conservation.

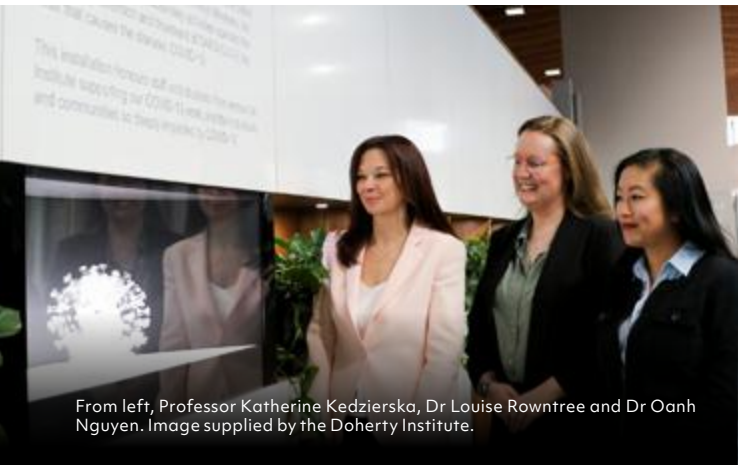


The Cystic Fibrosis Lung Health Imaging team, including physicist Dr Kaye Morgan from Monash University (far right). Image supplied by the Australian Museum.

ASPIRE SCHOLARSHIP EUREKA PRIZE FOR EXCELLENCE IN INTERDISCIPLINARY SCIENTIFIC RESEARCH

Cystic Fibrosis Lung Health Imaging
University of Adelaide; Women's and Children's Hospital, Adelaide; 4D Medical Pty Ltd; and Monash University

To treat children with cystic fibrosis (CF), it is critical to know the location and extent of abnormal airflow. Combining expertise across physics, medicine and engineering, this interdisciplinary team developed a novel medical imaging method called X-ray Velocimetry. With further development it promises to help detect, treat and monitor CF and other lung diseases.



From left, Professor Katherine Kedzierska, Dr Louise Rowntree and Dr Oanh Nguyen. Image supplied by the Doherty Institute.

AUSTRALIAN INFECTIOUS DISEASES RESEARCH CENTRE EUREKA PRIZE FOR INFECTIOUS DISEASES RESEARCH

The Corona Queens : Professor Katherine Kedzierska, Dr Louise Rowntree, and Dr Oanh Nguyen
University of Melbourne and Peter Doherty Institute for Infection and Immunity

The Corona Queens, a three-person research team, has advanced the medical community's understanding of how the human immune system fights against COVID-19. The team's work on immune responses in high-risk groups – including children, the elderly, pregnant women and cancer patients – accelerated global research into infection and vaccination.

AWARDS, PRIZES, AND FELLOWSHIPS

UNIVERSITY OF SYDNEY EUREKA PRIZE FOR INNOVATIVE RESEARCH IN SUSTAINABILITY

The Economic Fairways Mapper Team
Monash University and Geoscience Australia

The Economic Fairways Mapper Team developed an open-source toolkit to facilitate renewable energy and mineral projects for a net-zero emissions future. It integrates advanced mapping technology and diverse datasets to identify the most sustainable locations for resource development. This work has informed Australian policy, attracted industry investment and is being replicated globally.

The Economic Fairways Mapper team, including (from left): Monash Engineering's Dr Stuart Walsh and Mr Israel Lutalo, and Geoscience Australia's Dr Zhehan Weng, Dr Marcus Haynes, Dr Andrew Feitz, Dr Changlong Wang, Stephanie Rees and Claire Patterson. Image supplied by the Australian Museum.

UNSW EUREKA PRIZE FOR SCIENTIFIC RESEARCH

Associate Professor Tim Thomas and Professor Anne Voss,
Walter & Eliza Hall Institute of Medical Research

Over more than a decade, Associate Professor Tim Thomas and Professor Anne Voss identified and investigated a complex family of enzymes that contributed to cancer growth but were resistant to drug development efforts. A recent breakthrough from their research is an entirely new class of drugs that can stop the growth of lymphoma cells and liver cancer cells.

Associate Professor Tim Thomas and Professor Anne Voss have been working together for over a decade to explore a new class of drugs that can stop the growth and spread of tumours, without damaging the cells' DNA. Image supplied by WEHI.

DEPARTMENT OF INDUSTRY, SCIENCE AND RESOURCES EUREKA PRIZE FOR INNOVATION IN CITIZEN SCIENCE

1 Million Turtles Team
Western Sydney University; La Trobe University and University of New England

The 1 Million Turtle Team's Community Conservation Program uses the TurtleSAT app to involve citizen scientists in hands-on activities such as habitat construction and restoration, nest protection and fox management. Emphasising STEM literacy and First Nations knowledge, the Australia-wide program has influenced policy, and saved over 1000 freshwater turtles and 200 nests in 2022 alone.

Image supplied by the Australian Museum.

AUSTRALIAN MUSEUM EUREKA PRIZE FOR SCIENCE JOURNALISM

Jo Chandler
Griffith Review

Jo Chandler's longform essay Buried Treasure follows the most ambitious Australian Antarctic endeavour in a generation. The award-winning journalist had tracked the story for over a decade before pitching her article, which skilfully navigates urgent questions about science, our heating planet and the human condition. Published in the Griffith Review (Edition 77: Real Cool World), 2 August 2022

Jo Chandler in Antarctica. Image supplied by the Australian Museum.

Biographies by Elizabeth Plant, Australian Museum.
Images supplied by the Australian Museum.

A PATHWAY TO VALUE VICTORIA'S FLORA

By Gordon Noble MRSV

One of the challenges with the silent destruction of Victoria's flora is how to make it part of the Victorian community's consciousness. In a world where there are so many problems competing for attention, flora struggles for attention. Three nudges are proposed that are simple, immediately actionable that can drive long term investment to protect and restore Victoria's flora.

ENVIRONMENTAL COPS ON THE BEAT

Victoria has a planning regime in place that is designed to protect native vegetation. To remove native vegetation, landholders must apply for a planning permit from their local council. If a permit is granted, a native vegetation offset must be secured before the native vegetation is removed.[1]

The problem is that the policy is not working. According to the Victorian Auditor General, Victoria is not achieving its objective of no net biodiversity loss from native vegetation clearing on private land.[2] A key reason identified by the Victorian Auditor General is the extent of unauthorised land clearing. The Department of Environment, Land, Water and Planning (DELWP) estimates that Victoria loses some 10,380 Ha of native vegetation on private land every year.[2]

Victoria is not alone in establishing a policy for offsetting environmental destruction. Environmental offset schemes were first developed in Germany in the 1970s and California in the 1980s as a mechanism to address the mitigation and compensation of impacts stemming from developments and projects.

The foundation of any environmental offset scheme is a mitigation hierarchy, defined as 'avoid - mitigate - offset', where environmental offsetting is the last resort. For an environmental offset scheme to be effective, it is essential that the 'avoid' component is enforced. In Victoria it is not.

A best practice example of enforcement is France. The French Office Français de la Biodiversité (OFB) is a statutory body with powers to protect and restore biodiversity in Metropolitan France and its Overseas Territories. In 2021, the OFB had 2,800 agents, whose functions include environmental inspections.[3]

To stop the silent destruction of Victoria's flora there is a need to urgently stamp out unauthorised land clearing. A combination of environmental cops on the ground, aerial and satellite images, together with legal actions that send a signal that destruction of the environment will result in prosecution, can enforce the laws that are already in place.

NATURE-POSITIVE LEARNING FOR EXECUTIVES AND SCHOOL KIDS

One of the challenges with any area which is technically complex is that a gulf can emerge between those that have knowledge and the rest of the community. The more technical the subject, the greater likelihood that it is 'left to the experts'. The question is, how can the expertise that exists be harnessed?
A commitment to broad based learning is required. France again provides a best practice case study.

France trains senior civil servants in the 'challenges of the ecological transition'. By the first half of 2023, around 200 Directors-General of Ministries and members of ministerial cabinets will be trained on biodiversity and climate.[4] Training includes a theoretical component coupled with field visits.

The Australian Government has committed to hosting a Global Nature Positive Summit.[5] Whilst global summits are important to build consensus, there is an opportunity to build broad based understanding of Victoria's flora through nature-positive learning programs. Requiring all government executives – local, state, and federal – to participate in nature-positive learning programs is not expensive in comparison to hosting global summits.

Beyond government officials, there is an opportunity to take learning into the classroom. When I was in primary school, my grade 4 teacher, Mr Miller, had Gould League posters across the classroom.[6] He turned naming Victoria's birds into a game, something that I still remember today. One wet and soggy Melbourne afternoon, he took us out to the oval to watch a pair of Spur Winged Plovers that were nesting. Football was banned for the time being. Mr Miller taught us about nature because he was passionate about it. How much better would it be if our teachers had more support.

Supporting teachers to provide Victorian children with an understanding of nature can easily complement educating government officials. Both are easy to achieve with the benefit that the depth of knowledge that exists in Victoria is translated to those that need it to make decisions.

DISCLOSE NATURE ON PROPERTY SALES

There is a global discussion on disclosing the financial risks of nature through the Taskforce on Nature-related Financial Disclosures.[7] The idea is that corporates, banks, and investors will begin making harmonised disclosures around the way they are managing nature risks. This is a positive development, but like most international initiatives the pace of progress is slow, and it will take time to flow through the system.
Rather than wait, Victoria can demonstrate leadership by integrating nature into property sales. A simple nudge is to require that a property sale over a certain size, say $5 million, is required to include a standardised disclosure on nature.

What would a nature property disclosure look like? There are plenty of models around what should be disclosed, with TNFD providing a framework for disclosure metrics. At its simplest, a property sale should include a statement on the environment attributes of the property.

The reason disclosure is important is because it creates the data that ultimately underpins the lending decisions of banks and investment decisions of institutional investors. If nature is integrated into finance, then the incentive that a landholder has to land clear will reduce. Importantly it will open opportunities to value nature.

HOPE FOR THE FUTURE

The final chapter of CSIRO's Australia's Megafires ends on a positive note.[8] The authors argue that the 2019–20 wildfires "showed us that the rate of change is now so rapid we can recognise the fragility of the future, and that it is within our hands to shape it – or to do too little and allow that future to wither". Our future can be one of "continually mopping up after natural disasters of our making" or investing for a better future. Change will require big and small commitments. Some of the easiest nudges can be made today without huge financial costs.

References:
1. A quick comparison of first party and third party offset sites. (n.d.). Retrieved August 18, 2023, from environment.vic.gov.au/__data/assets/pdf_file/0023/329450/Info-sheet-A-quick-comparison-of-first-party-and-third-party-offset-sites.pdf
2. Offsetting Native Vegetation Loss on Private Land. (2022). Victorian Auditor-General's Office. audit.vic.gov.au/report/offsetting-native-vegetation-loss-private-land
3. Mettre en œuvre la séquence "éviter-réduire-compenser." (n.d.). Office français de la biodiversité. Retrieved August 18, 2023, from ofb.gouv.fr/mettre-en-oeuvre-la-sequence-eviter-reduire-compenser
4. Les hauts fonctionnaires se forment aux enjeux de la transition écologique. (2022). Office français de la biodiversité. Retrieved August 18, 2023, from ofb.gouv.fr/actualites/les-hauts-fonctionnaires-se-forment-aux-enjeux-de-la-transition-ecologique
5. The Global Nature Positive Summit 2024 - DCCEEW. (2022). DCCEEW. dcceew.gov.au/environment/international/nature-positive-summit
6. Gould League. https://gould.org.au/
7. TNFD – Taskforce on Nature-related Financial Disclosures. https://tnfd.global
8. Stephen van Leeuwen, Wintle, B. A., John C.Z. Woinarski, Rumpff, L., & Legge, S. M. (2023). Australia's Megafires. CSIRO PUBLISHING.

Below: Land cleared for a new housing estate in Yarrawonga, Victoria

THE BURNING PLANET

CHANGING FIRE REGIMES IN AUSTRALIA AND THE WORLD.

By Kate Bongiovanni

This article was written in October 2019 following a presentation to the Royal Society of Victoria by Dr Luke Kelly titled "Pyrodiversity: Fire and Wildlife in the Anthropocene," but its distribution was delayed due to the publication of related scholarly articles in the meantime.[1] Ironically, the Black Summer of 2019-20 was then upon us, followed by a global pandemic. Our sincere apologies to all, particularly Kate, for the long wait!
— Mike Flattley, CEO, The RSV

Both natural and human-instigated fires have long been part of Australia's landscape and climate, particularly during the Holocene, an era of about 10,000 years defined by mild, stable climatic conditions favourable to the rise of a global human civilisation.

However, many assert we are now living in a new era, the Anthropocene, where human activities are the prevailing influence on Earth's climate and have impacted the geologic record. No species has ever caused such rapid climatic changes.

Fire patterns are linked to climate conditions, and thus have been undergoing changes in recent times. It is imperative to understand these changes in order to more effectively forecast fires and manage them for both human safety and the preservation of biodiversity.

The rapid climatic changes of the Anthropocene are widely discussed and debated in the scientific community, and in the media. However, research on the effects of fire on Earth's climate is still developing. Studies on pyrodiversity, the varying effects of fire on our environment and local ecologies, are still in their early stages. Dr Luke Kelly, Senior Lecturer and Centenary Research Fellow from the School of Ecosystem and Forest Sciences at the University of Melbourne, works with a group of colleagues to change this picture. Luke is conducting field research on animal and plant responses to fire and climate change.

Scientific research from field studies such as Luke's are just one source of Australia's store of wisdom on fire; the knowledge base of Australian Indigenous peoples extends back many thousands of years. Many other Australians also have firsthand, intergenerational experience of bush fires. Over the last hundred years or so, government agencies, community organisations, private industries and traditional custodians have added to our trove of knowledge about fire, how the use of fire is changing and strategies to manage fire cycles.

While many ecosystems in Australia depend on fire to flourish, they require specific kinds of fires, differing in intensity and timing with local germination and breeding cycles. Therefore, changes to fire regimes can lead to the demise of species and ecosystems. For example, the Alpine Ash forests of south-east Australia's central highlands are experiencing increased

Alpine ash (*woollybutt*) trees at the summit of Mount Donna Buang - Warburton, Victoria

frequency of fire, resulting in the trees being unable to sow their seeds as they are incinerated prior to maturity. If this continues unabated, the alpine ash is likely to be wiped out of the region entirely and threatened with extinction.

This is not an exclusively Australian story. Similar transformations and threats to the persistence of forests are in evidence in the western USA, where bigger, hotter fires are devastating tree species in iconic areas such as Yellowstone National Park. The devastating fires in the Amazon Rainforest over recent months presents an alarming example of changing conditions. In the last year, there have been over 50,000 outbreaks of fire, causing severe environmental degradation and loss of ecological value, unlike in the Australian bush landscape where fire is a normal and necessary element for the survival of an adapted ecosystem. The Amazon rainforest environments do not require fire and do not traditionally burn. Instead, these fires have been deliberately lit to speed land clearing for large-scale farming, and have been exacerbated by hotter, drier climate conditions.

Meanwhile, Spain's reforestation projects have been in motion in Pont de la Train since the mid-1900s. These schemes promote tree growth and provide habitat for various animals; however, they also cause a higher risk of fire outbreak, particularly with fewer people located in rural areas to monitor and manage the forests. In addition to researching Australian flora and fauna, Luke is part of a fellowship at the Fire Research Centre in Catalonia, Spain, where he collected data in the area and analysed it to investigate the effect of different variables, such as wetness and temperature, on fire probability. Luke found that many of these factors were simply overridden by climate influences; extreme, sustained high temperatures are the dominant condition for wildfires.

Yet the increase in fires and extension of fire seasons (the number of hot, windy days conducive to starting and maintaining fires) is not a ubiquitous global phenomenon. Where forests are cleared to make way for farmland, fire fuel is reduced along with the likelihood of fires, along with the destruction of habitats for plant and animal communities, which is clearly a poor outcome for biodiversity.

Other negative impacts on biodiversity from changing fire regimes are found in the vulnerable periods after fires, when introduced animals prey on native animals. Luke's research surveys the effects of fire in Australian ecosystems by examining the ningaui species in the Murray-Mallee region. Ningaui are small, native marsupials, first discovered by scientists in Victoria in 1977. Luke and his team use bucket traps to safely catch various ningaui species at about 300 sites in arid areas in order to investigate what the marsupials require from their habitats. The data is used to create models, incorporating climatic influences, soil composition and other land use changes to discover the kind of pyrodiversity ningaui require and, from this, determine which locations they will most likely thrive in. This research can be used to devise a management plan for the persistence of ningaui and similar small species to prevent their extinction. This research is important, as changes to fire regimes has thus far led to the extinction of thirteen Australian marsupial species.

However, the size of the fire, duration, intensity and time interval between fires all have important implications for the conservation of biodiversity, and can be factored in as a management response to counter the degree to which wildfires can devastate forest ecologies. The importance of fire severity is demonstrated by the black-backed woodpecker of North America. Following a big hot fire, the burnt forest hosts a prevalence of worms which the woodpecker relies on for food. Changing fire severity is challenging the woodpecker's survival. In Australia, the survival of the Hooker banksia tree has been tested by variations in the time interval between fires. This banksia is very sensitive to fire time intervals, requiring fires every 10-30 years to avoid expiry.

> The efforts of "ecological engineers" could play a role in reducing fire activity. When small animals such as bilbies and bandicoots make their burrows, they modify the ground and water flow in a way that potentially reduces fire fuel and limits the spread of fire.

Wild southern ningaui (*Ningaui yvonneae*) in arid, mallee habitat at dusk.

Banksia hookeriana - Hooker's banksia

This knowledge helps us set objectives for the desired pyrodiversity in different forest ecologies. Different fire regimes can support a range of different species at different times. For instance, a forest recovering from a fire in the last decade can encourage the coexistence of multiple species through a more diverse expression of tree size, species and expression, whereas a mature forest can facilitate the persistence of a narrower, and different, range of species. Essentially, biodiversity requires a fire regime to manage forest and habitat diversity in ecologies adapted to fire. As we take action on pyrodiversity we need to consider the kind of burning we want to promote "mosaic" forests.

Once we have set our objectives, we then need to think about how we can achieve them. For example, could we target our fire suppression priorities during wildfires to include threatened ecological assets? Should we have planned burnings? And if so, how should these be carried out, and by whom? Careful planning and research needs to be done when performing prescribed burning to prevent risks to human safety, forests and extinction of species in the burned region. The Royal Commission into bushfires following Black Saturday in 2009 examined the effects of fire on human safety and biodiversity, and the influence of preventative measures such as prescribed burning.

New research models simulating different kinds of burning can help us figure out the "optimal" burning. The model simulations can factor in different scales and different shapes (like strip burning) of fires and allow us to examine their effects on landscapes and biodiversity. The Murray Sunset National Park is one such area where large strips of forest are burnt to reduce fire fuel in the area and hence prevent future fires from spreading.

As well as prescribed burning, there are many other ways to mitigate disruptions to ecosystems from fire. The efforts of "ecological engineers" could play a role in reducing fire activity. When small animals such as bilbies and bandicoots make their burrows, they modify the ground and water flow in a way that potentially reduces fire fuel and limits the spread of fire. An additional way of inhibiting the span of a fire is by using "green firebreaks," strips of low flammability vegetation with limited fire risk that can act as barriers between species with higher flammability while still providing vital habitat support.

The disruption to the long-standing, traditional management of forests and fire by Indigenous communities following European colonisation have led to a lack of small, recurrent, low-intensity burns. This is causing an increase in the large, climate-driven fires that inhibit pyrodiversity. However, the re-emergence of traditional management of fire could alleviate this effect. Similarly, in the USA, too much fire suppression has led to uncontrollable "mega fires". Perhaps simply allowing bushfires to burn in moderate conditions could be beneficial in preventing larger, more destructive fires in peak conditions. It's a difficult proposition.

Another area of investigation is the adaptation of species in zones with high fire occurrence versus zones with low occurrence. It raises the question of how fast plants can evolve and how we can use evolutionary knowledge strategically in order to aid translocations and adaptations.[2]

Fire science is helping us understand changing fire regimes and our changing climate. This understanding is imperative in an increasingly warmer world with elevated green-house gas emissions. We must aim to reduce these emissions to mitigate climate change and further changes in pyrodiversity. However, the climate is not the only thing changing in our world today. People are becoming more disconnected from landscapes and each other. In order to adapt and survive, we, as individuals, need to come together in our local communities, with governments and researchers, to share our knowledge and learn from each other. Collaboration and research will continue to expand the number of actions available to promote the optimal pyrodiversity.

References:
1. Kelly, L. T., et al. (2020). Fire and biodiversity in the Anthropocene. Science, 370(6519). doi.org/10.1126/science.abb0355
2. Gomez-Gonzalez, S., et al. (2011). Anthropogenic fire drives the evolution of seed traits. Proceedings of the National Academy of Sciences, 108(46), 18743–18747. doi.org/10.1073/pnas.1108863108

DECOLONISING FIRE SCIENCE: WALKING IN PARTNERSHIP WITH FIRST PEOPLES AND COUNTRY

By Dr Catriona Nguyen-Robertson MRSV

This article follows a presentation to the Royal Society of Victoria on 13th July 2023 titled "Decolonising Fire Science", delivered by A/Prof Philip Zylstra (Curtin University), in conversation with Wurundjeri Elder, Uncle Dave Wandin.

The people of the Kulin nation - the Traditional Owners of Naarm (Melbourne) and the surrounding area - believe that Bunjil, the Wedge-tailed Eagle, created the land. Bunjil's First Law is that you must respect and look after your mother. Our mothers look after us when we are young, and as they grow older, we, in turn, take care of them. This law does not only refer to our physical mothers, but also to the spirit of our mother: our Country. Mother nature provides us with many resources. 'When we walk on Country, we're walking on her body' says Uncle Dave Wandin. 'When we swim in the waters, we're swimming in her veins.' She is tired and weary, and we need to care for her.

First Nations people have been caring for Country for tens of thousands of years. They have been and continue to be scientists, observing the land, water, and sky to gain knowledge and understanding. However, it has taken a long time for this knowledge to be regarded as "science", simply because it doesn't fit with European ideas of the scientific method or knowledge dissemination. 'We didn't write books – we read Country,' says Uncle Dave.

Only by walking Country together with the land's Traditional Owners – and cooperating with the land itself – can we heal Country together.

AUSTRALIA'S LANDSCAPE OF FIRE

The gradual drying of the Australian continent over tens of millions years has nurtured a landscape prone to fire.[1] It has the right conditions for fire: wet enough for things to grow, and dry enough for them to burn. Over time, animals and plants adapted. And over millennia, First Nations people also developed sustainable fire regimes.

Remote area firefighter-turned-ecologist, A/Prof. Philip (Phil) Zylstra, realised that fire management has become entrenched in discredited ideas that do not reflect reality and can lead to poor decision-making. He argues that poor colonial fire science reinterprets First Peoples' knowledge to justify prescribed burning regimes that decimate carbon storage, threaten the existence of many species, and deepen the catastrophic impact of bushfires.

Current fire management by government agencies focused on prescribed burns to reduce fuel loads are presented as vital to limiting the spread and intensity of bushfires. The idea is that bushfire fuels are made up of leaf litter, twigs, and bark that burn and carry a fire. Reduce the fuel load, and we reduce the spread and intensity. These prescribed fires are said to mimic First Nations peoples' cultural burning practices, however, Phil points out that this is not quite the case. The use of fire in healing and managing Country is much more complex.

THE COMPLEXITY OF FIRST PEOPLES' KNOWLEDGE

'It is often said that First Peoples' knowledge was lost. But we need to be more brutal: it was stolen and taken,' says Phil. But some knowledge remains in the culture of survivors and in the landscape itself, 'like seeds waiting to grow'.

Uncle Wayne Webb and his son, Iszaac, are the last two speakers of the Wadandi language, holding onto their knowledge of the tall red tingle forests. Red tingles are among the tallest eucalypts, growing up to 70 metres. They grow only in a 6,000-hectare stretch along the south coast of Western Australia. The Menang and Goreng Traditional Owners of these forests say that fire should be used in specific locations, burning only what is needed in small, strategically placed patches. They are aware that tingle trees regenerate well after fire, but are sensitive to frequent fires, no matter how mild. Flames can enter the tree and hollow it out – and the next fire will cause its collapse. Uncle Wayne advised government agencies that Traditional Owners deliberately exclude fire from tall red tingle forests – but those agencies, in turn, claim to be following cultural burning practices with their prescribed burns. Surely it would be Uncle Wayne who would know what the cultural burning practices for that area are.

First Nations people have detailed, complex knowledge of the landscape, having observed it over millennia. Each local language group cares for their Country using fire as a tool according to their own laws and philosophies. They know their Country. As Uncle Dave points out, 'you know the stories and connections in your Country. You know where fire belongs. If you are coming into someone else's Country, you come in as an infant.'

SETTLER "MIMICRY" BURNING PRACTICES AND DEBUNKING THE "SCIENCE" BEHIND IT

The most immediate problem with the idea of settler mimicry burning practices is the term. "Settler" is a gentle term – after all, 'we tend not to talk about an asteroid settling among the dinosaurs,' says Phil. Secondly, it suggests that "settlers" learned and copied the practices of Traditional Owners, however you cannot learn 65 million years of knowledge by merely watching.

European farmers observed cultural burnings and started using fire themselves. They wanted the benefits of having more green shoots following the low-intensity burning of grasses to feed their livestock, as well as the prevention of trees bouncing back on their newly established grazing lands. It was the beginning of prescribed burns.

Prescribed burns, or fuel-load reduction, is based on the idea that the amount of fuel in a forest determines how flammable it is. The idea comes from fire behaviour modelling – for entirely different trees – imported from the United States in the 1960s. Europeans wanted science to support their processes, and a simple equation published by an American fire researcher fit the bill: a fire's heat output (or intensity) is equal to the amount of energy stored in the fuel, multiplied by the amount of fuel, and multiplied again by the speed the fire spreads and consumes it.[2]

The argument that fuel-load drives the rate of spread in Australian forests was based on nine data points in a leaflet.[3] They stated that if we halve the fuel load – the leaf litter on the ground – we can halve the speed of fire. This data was never backed by evidence, but in the absence of something better it became the foundation of Australian fire management.

But in 1999, Neil Burrows disproved this idea that fuel-load drives a fire's rate of spread. In both laboratory experiments and in the field, he found that the rate of spread of fire in Jarrah Forest was independent of fuel quantity.[4] Over 20 years later, CSIRO's Project Vesta conducted more experimental burns in the dry eucalypt forests of southern Australia to further support this finding.[5] What is generally considered "fuel-load" - debris on the ground - could only drive low-intensity fires with small flames. Finally, infra-red line scans of many bushfires in diverse forests showed that fuel load had little influence on the rate of spread of those fires.[6]

A second outdated argument for prescribed burns is that 'fuel-load and rate of spread together drive fire intensity and thus the impact of fire'. Project Vesta, however, demonstrated that the forest understorey drives fire behaviour more than any other component of the forest.[5] The issue is not how much leaf litter or bark is present, but whether flames will span the gaps from burning fuel on the ground to ignite plants higher up.

Project Vesta showed that it is more about whether shrubs are present, as they are better able to carry a fire forward and higher compared to leaf litter on the ground. The understorey of red tingle forest consists of tall shrubs that become less dense as they age. As the understorey ages, the lower branches of taller plants "self-prune", shedding their dead leaves and twigs. Phil and his colleagues developed a fire modelling tool to understand how this impacts fire behaviour; when this litter is on the ground, it begins to decay and poses a much lower fire risk than if it were still higher up.[7] Further, allowing forests to age – without regularly burning them – allows the lower plants to grow into tall plants that act as a shelter to slow the wind and calm the fire.[8] Given that many native flora species evolved in a fire-prone landscape and adapted to require fire for effective germination, regular burns encourage dense understorey regrowth. Phil argues that this is more of a risk for future devastating fires, as it provides more low-lying plant matter to burn.

Poorly managed prescribed burning can lead to catastrophic outcomes, including the decimation of critically endangered wildlife populations when controlled fires escape their containments. Phil documented the annihilation of 77% of the Western Ringtail Possum (*Pseudocheirus occidentalis*) in Warrungup Spring bush reserve in 2018.[9] The possum – or ngwayir in the language of Traditional Owners – is critically endangered and only found in a small patch of southwest Australia. When fires rage through, the air around tree hollows can approach 500 °C – if possums and other arboreal animals hang around, either they or (at the very least) their respiratory tracts will burn. Phil urges us to move away from bad fire science to prevent similar tragedies.

MOVING FORWARD

The fire "science" behind prescribed burning practices has been largely debunked. Instead of burning large areas of forest to reduce fuel loads, the evidence is clear: we need to cooperate with vegetation. The regrowth period of dense understorey in forests tends to be when flammability is the highest. By letting forests age over time, they self-thin and become less likely to burn. Prescribed burning disrupts this process, and current practices need to be halted.

In addition, we need to listen to First Peoples. Cultural burning practices are precise and focused. Unlike with prescribed burns, Indigenous fire practitioners like Uncle Dave do not attempt to burn vast areas at once. They carefully control what burns, when, and where, cooperating with and reinforcing natural processes such as self-thinning, so that Country is allowed to age. Listening to Phil, Uncle Dave is happy to see modern science catching up and backing up what First Peoples have always known. You need the 'right fire, for the right Country, at the right time,' he says. And Victoria is catching on – Uncle Dave is a major contributor to the Victorian Traditional Owner Cultural Fire Strategy launched in 2019 that supports Traditional Owners to practise cultural burning and ensure knowledge about fire is sustained through generations.

Australia's forests have controlled their own fire risk for millennia. We should respect, rather than disrupt, these ancient natural processes. We need to stop thinking of ourselves as separate from the ecosystem. We should cooperate with Country rather than try to dominate it, because we are part of it.

You can watch Adjunct Associate Professor Philip Zylstra's presentation at: ***youtube.com/watch?v=ahilyWGPd1c***

References:

1. Crisp, M. D., et al. (2011). Flammable biomes dominated by eucalypts originated at the Cretaceous–Palaeogene boundary. Nature Communications, 2(1), 1–8. doi.org/10.1038/ncomms1191
2. Byram, G. M. (1959). Combustion of Forest Fuels. In Davis, K. P. (Ed.), Forest Fire Control and Use (pp. 61-89). McGraw-Hill Book Company.
3. McArthur, A. G. (1967). Fire behaviour in Eucalypt forests. Forestry and Timber Bureau Leaflet 107. In: 9th Commonwealth Forestry Conference p. 26 Canberra, ACT.
4. Burrows, N.D. (1999). Fire behaviour in Jarrah forest fuels: 1. Laboratory experiments. CALMscience 3, 31–56.
5. Cruz, M. G. (2022). An empirical-based model for predicting the forward spread rate of wildfires in eucalypt forests. International Journal of Wildland Fire, 31(1). 81-95. doi.org/10.1071/WF21068
6. Storey, M. A., et al. (2021). Derivation of a Bayesian fire spread model using large-scale wildfire observations. Environmental Modelling & Software, 144. doi.org/10.1016/j.envsoft.2021.105127
7. Zylstra, P. (2021). Linking fire behaviour and its ecological effects to plant traits, using FRaME in R. Methods in Ecology and Evolution, 12(8), 1365–1378. doi.org/10.1111/2041-210x.13615
8. Zylstra, P., et al. (2023). Mechanisms by which growth and succession limit the impact of fire in a south-western Australian forested ecosystem. Functional Ecology, 37(5). 1350-1365. doi.org/10.1111/1365-2435.14305
9. Zylstra, P. (2022). Quantifying the direct fire threat to a critically endangered arboreal marsupial using biophysical, mechanistic modelling. Austral Ecology, 48(2). 266-288. doi.org/10.1111/aec.13264

SPRUMMERTIME

SPRINTER AND SPRUMMER: WHY AUSTRALIA SHOULD SCRAP THE FOUR SEASONS

By Professor Tim Entwisle

This article revisits a piece first written by Professor Tim Entwisle for ABC Radio National's Ockham's Razor.[1]

September is considered the start of spring by most Australians, but I think we have it all wrong. In the south at least, we should be celebrating an 'early spring' in August and September—when the wattles are blooming *en masse*—and a 'late spring' in October and November. Yet most Australians don't acknowledge or even notice that things are different in the great southern land.

That's partly because we organise our lives in minutes, hours, days, and months —sowing crops, attending meetings, picking up kids from school, and so on. For most of us, seasons are for noting, celebrating, and tracking the changes in the world around us. If we get them wrong, we don't lose our crops, our jobs, nor our children.

Indeed, no-one has responsibility for approving the seasons, and they are not anchored by Greenwich Mean or International Atomic Time. Yet they are part of our inherited culture, part of the ritual of living on Planet Earth. Our responses to seasons—like the seasons themselves—vary from place to place.
The definition of a season seems simple enough but, as I argue in my book Sprinter and Sprummer: Australia's Changing Seasons, the term is misunderstood, misinterpreted, and misused. Why should we have four seasons? Why must they each take up three months of the year?

First Nations communities have always known that Australia's climate is more complex than a simple four-season arrangement suggests.

FITNESS FOR PURPOSE

When I began my book in 2010, I wanted to make two somewhat contradictory points. First, there is a peak flowering period in most Australian gardens and bushland, and it happens before what we normally call spring. Second, plants flower all year round, not just in 'spring'.

Then, three years ago, I moved to England, the source of many of our cultural traditions including our idea of four neat seasons, each three months long. I gained first-hand experience of 'true seasons' and the plants that either define them or respond to them, depending on your perspective.

I found that even in England, the four seasons don't always match the annual cycles of nature. I therefore expanded the scope of the book to address a more fundamental question about whether seasons are ever really 'fit for purpose'. Perhaps it's not only Australia that needs a thorough review of its seasons.

THE CASE FOR UNIQUELY AUSTRALIAN SEASONS

Since 1788, we have laboured and partied under a set of four European seasons that make no sense in most parts of the country. We may like them for historical or cultural reasons, or because they are the same throughout the world, but they tell us nothing about our natural environment. Instead, we could reject these seasons, and adopt a system that brings Australians more in tune with their plants and animals; a system that could help us respond to climate change.

Australian Garden at Royal Botanic Gardens Cranbourne in April, the start of Tim's autumn.
(Photograph: Tim Entwisle)

I propose that we instead have five seasons, based on the climatic and biological cycles we observe around us.

I start with the origins and theory of the traditional seasonal system—which I've nicknamed the Vivaldi Option—then review the different First Peoples seasonal classifications used across Australia, followed by my five-season proposal.

ON THE ORIGINS OF SEASONS

Seasons have been with us since early in recorded human history. In fact, we could argue that breeding and feeding seasons occur in cycles for many animals, and that our species, Homo sapiens, has merely extended this concept a little. The key element of human seasons is our division of the solar year into segments that start at predefined times.

In ancient Mesopotamia, the year was divided into two: one half beginning with the sowing of the barley (autumn), the other with its harvesting (spring). Early Egyptians, living beside the Nile, added an extra season and brought in the concept of cold and hot seasons: 'flood', winter, and summer.

The Vivaldi Option of four neatly defined seasons appears to have originated in the Mediterranean region, though it may have also emerged independently in China, and in places with less well documented histories. The Sumerians and Babylonians were the first in the region to use equinoxes and solstices to define four evenly timed seasons. The four-season system was taken up by the Greeks, and then by the Romans. It spread through

Europe, and eventually to colonial countries such as Australia. The seasons start regularly on the first day of a month, or sometimes the 21st or thereabouts, depending on local habits and quirks.

Others before me have suggested a new set of seasons, but we seem reluctant to change, as with the Union Jack in our flag or the monarchy. In the 1990s, environmental educator Alan Reid encouraged members of the Gould League of Victoria to record their seasonal observations as part of his 'Timelines' project, leading to a six-season proposal for Melbourne. Retired Sydney school teacher Rick Kemp devised an eight-season system based on the relative positions of the Earth and the Sun, but prefers to focus on transitions rather than stasis. Like me, he wants to move the first day of spring, Wattle Day, from the 1st of September back to the 1st of August.

Our many First Nations communities have observed the world around them over tens of thousands of years, and have two to thirteen seasons to suit their local area. I found only one example of First Australians using four seasons; six is the most common number. We could embrace one or more of these seasonal systems, but I fear this suggestion would struggle to gain widespread support across the continent.

Instead, I propose a modified Vivaldi Option for southern Australia - by which I mean south of around Brisbane.

SPRINTER, SPRUMMER, SUMMER, WINTER

It's a tweaking of the current system. The familiar anchors - summer and winter - are there, but the bits in between and the duration of the seasons are adjusted for the southern Australian climate.

Sprinter (August and September) – early Australian spring and the start of my seasonal year. It's when the bushland and our gardens burst into flower. Also, when that quintessential Australian plant, the wattle, is in peak flowering across most of Australia.

Sprummer (October and November) – the changeable season, bringing a second wave of flowering, particularly for trees.

Summer (December to March) – extending into March, when fine warm days continue in southern Australia. A subdued season for plants.

Autumn (April and May) – barely registering in Sydney, but needed further south where there can be good autumn colour on exotic trees. It's also peak fungal fruiting time.

Winter (June and July) – a short burst of colder weather, when the plant world prepares for the sprinter ahead.

The first season, sprinter, makes the most sense. It is easy to recognise, and backed up by good observational data from nature and preserved herbarium specimens (as I explore further in my book). The other four seasons are perhaps more aspirational: concepts to test and probe a little further.
Then there is climate change, and the fact that the seasons are changing, whether we like it or not. Perhaps we need an evolving system of seasons. However, we should at least get it right in the first place.

There are no 'perfect' or 'correct' seasons. I am happy for my system to be rigorously debated and tested, and I would be thrilled if, through further observations and monitoring of the natural world by others, I have to totally redesign it. I'm sceptical by nature, but I've happily included conjecture and perception alongside peer-reviewed evidence and analysis given that we have so little data on how our Australian plants and animals respond to our climate.

That said, I'm pleased to see more research on this topic over recent years, mostly driven by the need to understand the impacts of accelerated climate change. I'm also a big supporter of ClimateWatch, a citizen-science program set up by Earthwatch and other partners to help track more accurately the seasonal and other changes around us. The English biologist Thomas Huxley once said that science is nothing but trained and organised common sense. That common sense has me convinced that September 1 is not the first day of spring. Instead, September is the second half of sprinter, the characteristically early flowering season of southern Australia.

SEASONS REVISITED

In the early 2010s, when I first wrote this piece for ABC Radio National's Ockham's Razor, I was convinced that most people don't care about which seasons we use, or what we call them. No one seemed to have responsibility for seasons – other than, vicariously, the Bureau of Meteorology – and in any case, I didn't expect Australia's seasons would ever be changed to reflect the country in which we live. That still holds true today, but 'most people' doesn't include our First Peoples.

Aboriginal and Torres Strait Islander people do care about seasons, they do have (many) names for them, and if anyone has inherent 'responsibility' for them it is the land's Traditional Owners. I was very aware that seasons should vary across the country, at the very least with changes in altitude and latitude, and my system was a very rough first cut to get people thinking. I thought that, in time, we would be mature enough as a nation to seek advice from Traditional Owners, and with their approval, share and adopt the seasons used by the many nations in this country. I foresaw complications in that many of these seasonal systems would challenge western minds, such as my own, that want seasons to start on a particular date each year. But that challenge would be a good thing.

Since the publication of Sprinter and Sprummer, I've given hundreds of talks and interviews, with mixed but mostly positive reception. Mostly, people like the idea, particularly the early spring (sprinter). As acknowledged upfront in the book, though, there is little incentive for us to change seasons. Nothing depends upon them, and nobody oversees their nomenclature. Maybe it's just curmudgeonly old taxonomists who worry about such things.

—

Professor Tim Entwisle recently left Royal Botanic Gardens Victoria after ten years as Director & Chief Executive, and over three decades running botanic gardens in Sydney, London, and Melbourne. Tim has written extensively on the unsuitability of Australia's seasonal system, including a book, Sprinter and Sprummer: Australia's Changing Seasons (2014, CSIRO Publishing).

Tim returned to this topic in his latest publication, 'Evergreen: The Botanical Life of a Plant Punk' (2022, Thames & Hudson), where he describes what drew him to a life in botany, and botanic gardens, with a bit of music and algae thrown in.

References:
1. Sprinter and sprummer: why Australia should scrap the four seasons. (2014, August 29). ABC RN. abc.net.au/radionational/programs/ockhamsrazor/sprinter-and-sprummer/5705564

RESILIENT FORESTS: ENSURING VICTORIAN FORESTS SURVIVE A CHANGING CLIMATE

By Dr Catriona Nguyen-Robertson MRSV

This article revisits Professor Patrick Baker's presentation to the Royal Society of Victoria in March 2021 and discusses where we are two years on. Patrick Baker is a Professor of Silviculture and Forest Ecology at The University of Melbourne.

Approximately 6.4 million hectares of public land in Victoria are covered by forest.[1] But we started out with more – since European Invasion, over 14 million hectares have been cleared, and Victoria's urban expansion continues to increase the pressure on our forests.[1] We need to protect what we have left.

Forests are essential for the health and wellbeing of all Victorians. They filter the water we drink, purify the air we breathe, buffer the effects of climate change by storing carbon, nourish soil, and are an essential part of history and culture for Victoria's Traditional Owners and other communities. They are also home to entire ecosystems, providing shelter to Victoria's diverse array of plants and animals, as well as providing essential resources from timber to food and medicinal plants.

Recently, the Victorian government committed to ending native forest logging in early 2024. In a world that is warming rapidly and relentlessly, the forests, once threatened by overharvesting, are also threatened by fires and droughts. Professor of Silviculture and Forest Ecology Patrick Baker investigates how better forest management practices can ensure our forests are resilient to global warming and extreme weather events.

THREATS TO OUR FORESTS

Australia has warmed by just over 1°C since the early 20th century, with most of the warming having occurred within the last 50 years.[2] This warming has seen an increased frequency of extreme heat events and severity of drought conditions. Patrick warns that the oceans are also steadily heating, which will contribute to future warming of the planet in decades to come – even if we stop all emissions today.

Droughts are becoming longer and more severe. Water availability in the Australian landscape has varied greatly over the past 500 years – and Patrick and his colleagues measure tree rings to determine just how much. The colour and width of tree rings provide snapshots of past climate conditions, dating back centuries. Periods of drought are evident in narrower rings, as trees grow less with less water. Trees in Southeast Australia have experienced drier and wetter periods, with the worst drought in the past 550 years being back in the early 1500s. But Patrick warns that future droughts will inevitably be worse – even of greater magnitude than the Millennium Drought of 2003-2009.[3] And, he cautions, we need to prepare our forests for these.

While climate itself is increasingly seen as a disturbance to the landscape, it also drives additional threats such as fire. Intense

Mountain Ash trees on the Black Spur near Narbethong, Victoria

fires can scar the wood of trees, leaving a historical record of past fires. Patrick studies this record to understand the history of the landscape. In the Australian Alps, for example, fires were not as widespread in the past, nor were they hot enough to put charcoal into the landscape. The charcoal from more recent intense, catastrophic fires is now evident in sediment cores, and trees that were once resilient are now being killed. This has flow-on effects for native animal populations whose habitats are being consumed in the fires, and even if the forests bounce back, it is not fast enough. In addition, climate-sensitive animals retreat to higher elevations and suitable climates. Threatened animals, such as the greater glider, are being forced to retreat to increasingly limited areas.[4]

Another factor to consider in forest management is native forest logging. In November 2022, the Supreme Court of Victoria found that the state-owned logging company VicForests had failed to protect threatened greater gliders and yellow-bellied gliders – and that its methods to carry out surveys for them prior to logging an area were inadequate.[5] In a separate case a month earlier, the Court ruled that the harvesting and regeneration burning practices of VicForests had likely led to the loss of 'significant numbers of mature Tree Geebungs'.[6] These judgements triggered a chain of events, including the shutdown of Australia's last white paper mill in the Latrobe Valley and the Victorian Government announcing the end of native forest logging in May this year, six years earlier than originally planned. However, Patrick is concerned as to what this will mean for the future of forest management given that this decision to stop native forest logging did not articulate whether there will still be active forest management in those areas going forward.

MANAGING OUR FORESTS TO WITHSTAND THESE THREATS

Patrick investigates ways that forest management can help buffer threats. He compared forest areas with different tree

coverage and found that areas with lower tree density produced larger, more vigorous trees that were better able to survive limited water availability during the Millennium drought (2003-2009).[7] When packed closely together, there are fewer resources available per tree, which limits the availability of any individual tree to invest in new roots and leaves. This makes the trees more vulnerable to extreme climatic conditions.

A tree's size and the age of a forest stand (a community of sufficiently uniform trees) also influence resilience to bushfires. One study revealed that older Mountain Ash stands have a reduced risk of losing their canopy in fires, while those between the ages of 7-36 were at the highest risk of scorching and having their canopies being consumed by flames.[8] Many studies from Australia and elsewhere show that larger trees tend to fare better than smaller trees in fires. However, tree species also differ in their susceptibility to fire. Studying native tree species responses after the 2009 bushfires, Patrick's team found that *Eucalyptus obliqua* trees essentially cannot be eliminated by fire once their diameter is greater than ~30 cm.[9] Species that are more susceptible to fire have to be larger – often much larger – to have a chance of surviving fires. Patrick advises that we need to ensure that at least some of the trees in a stand will grow faster so that they can reach "fire-safe" sizes faster. Shifting to a landscape that supports a greater proportion of more fire-resistant species and thinning denser population may help to reduce the impacts of fires.

KEEPING TRACK OF PROGRESS

In an era of rapidly changing landscapes and climate, it is important to observe forests over time. Patrick's research team spent 15 months documenting the size, species, and location of 51,324 individual trees over 16 hectares - "The Great Tree Census of 2023".[10] The project established a forest dynamics plot near Starvation Creek, the first Australian plot in the Smithsonian Institution's Forest Global Earth Observatory (ForestGEO), a network of large-scale, long-term studies that monitor the dynamics of forests around the world.

Australian Mountain Ash (*Eucalyptus regnans*)

Victoria's unique tree flora and its variable – and at times extreme – climate have created complex forests with complex histories that had not yet been monitored at this scale and level of detail. Our forests are dominated by Acacia and Eucalyptus species, and the Starvation Creek plot in the Central Highlands of Victoria included 47 species of trees and woody shrubs.[10] The eucalypts were particularly diverse, with 13 species occurring in close proximity – and in some places as many as eight eucalypts within a 20 x 20 m^2 area. This raises a new question of why so many eucalypt species coexist in the Australian landscape, as well as other questions about the dynamics of our remarkable forests that Patrick and his research team will continue to investigate.

Patrick also specifically studies old-growth forests. They support many plant, animal, and insect species; they provide hollows for nests and coarse, woody debris as food, they protect soils, and they can supply more water runoff than younger forests. Old-growth forests are defined differently depending on the forest type and the region. As they are defined in Victoria, old-growth forests are rare: the area of old-growth Mountain Ash forests has declined to 1.16% of ash-type forests in the Central Highlands.[11] Patrick's team recently used remote sensing data to map all old-growth and high-conservation value forests in the Central Highlands and East Gippsland. This revealed that there is more than twice as much old-growth forest than previously estimated – although at approximately 2.5% of the landscape, this is still much less than pre-Invasion levels. Furthermore, each vegetation type has its own ecological characteristics and age structures that need to be considered rather than simply using a one-size-fits-all approach. These variations raise important issues about how current definitions of old-growth forest may distort how and what we protect.

To 'spread risk across the landscape', Patrick believes we need more forests with large, old trees, rather than large areas of dense trees that are all the same age. This would more closely align with the impacts of natural fires and would increase the resilience of Victoria's forests to many of the threats that climate change will throw at them in the coming decades. Climate events are shaping our forests, and with better forest management, we can help make them more resilient.

You can watch Professor Patrick Baker's presentation at: ***youtu.be/gRVJWXt__Vo***

References:

1. Commissioner for Environmental Sustainability. (2018). State of the Forests Report 2018. ces.vic.gov.au/sites/default/files/publication-documents/State%20of%20the%20Forests%202018%20Report.pdf
2. GISTEMP Team. 2023. GISS Surface Temperature Analysis (GISTEMP), version 4. NASA Goddard Institute for Space Studies. Accessed 12 August 2023. data.giss.nasa.gov/gistemp/
3. Cook, B.I., et al. (2016). The paleoclimate context and future trajectory of extreme summer hydroclimate in eastern Australia. JGR Atmospheres, 121(21), 12,820-12,838. doi.org/10.1002/2016JD024892
4. Wagner, B., et al. (2020). Climate change drives habitat contraction of a nocturnal arboreal marsupial at its physiological limits. Ecosphere, 11(10). doi.org/10.1002/ecs2.3262
5. Environment East Gippsland Inc v VicForests (No 4) [2022] VSC 668 (4 November 2022). (2022). Supreme Court of Victoria. austlii.edu.au/cgi-bin/viewdoc/au/cases/vic/VSC/2022/668.html
6. Warburton Environment Inc v VicForests (No 5) [2022] VSC 633 (25 October 2022). (2022). Supreme Court of Victoria. austlii.edu.au/cgi-bin/viewdoc/au/cases/vic/VSC/2022/633.html
7. Horner, G. J., et al. (2009). Mortality of developing floodplain forests subjected to a drying climate and water extraction. Global Change Biology. 15(9), 2176-2186. doi.org/10.1111/j.1365-2486.2009.01915.x
8. Taylor, C., et al. (2014). Nonlinear Effects of Stand Age on Fire Severity. Conservation Letter. 7(4), 355-370. doi.org/10.1111/conl.12122
9. Trouve, R., et al. (2021). The effect of species, size, and fire intensity on tree mortality within a catastrophic bushfire complex. Ecological Applications, 31(6). doi: 10.1002/eap.2383
10. Baker, P. (3 June 2023). The Great Tree Census of 2023. Pursuit. pursuit.unimelb.edu.au/articles/the-great-tree-census-of-2023
11. Lindenmayer, D. & Bowd, E. (2022). Critical Ecological Roles, Structural Attributes and Conservation of Old Growth Forest: Lessons from a Case Study of Australian Mountain Ash Forests. Frontiers in Forests and Global Change, 5. doi.org/10.3389/ffgc.2022.878570

The Stuart Mill Spider Orchid (*Caladenia cretacea*)

THE STUART MILL SPIDER ORCHID

AN ELUSIVE GEM OF THE BUSH

By Priya Mohandoss MRSV

Victoria has more than 400 species of native orchids with many occurring nowhere else on Earth.[1] Among these is the endangered Stuart Mill spider orchid.[2]

The species is aptly named, as it is found in a protected pocket close to the Victorian town of Stuart Mill, in the John Colahan Griffin reserve about halfway between Bendigo and the Grampians/Gariwerd. Unlike other areas nearby, where much iron-bark forest had been cleared during early settlement, this reserve has been left intact. Consequently, this 'ancient woodland', with several species of eucalypts over 300 years old, is able to act as a natural corridor that protects and provides for the spider orchid and other native species.[3]

A SPECIES UNDER THREAT

With its conservation status of much concern, the population of these species has dwindled due to significant habitat loss. A number of external threats such as introduced plant and animal species, land clearing, stock grazing, and the impacts of climate change influence its chance of survival.

The Stuart Mill spider orchid can adapt to drier climates, staying dormant in dry years and only resurfacing after enough rainfall; however, this is unlikely to be enough to overcome other impacts associated with the variability of weather. Climate change has led to plants budding later than usual after summer dormancy, lower numbers of flowering plants, and shorter flowering times, thereby reducing the species' ability to undergo pollination and survive.[4]

Furthermore, unprecedented weather changes such as drier, shorter seasons may lead to its tuber (the underground section for nutrient storage) becoming smaller, resulting in fewer resources for the next season, and a plant less likely to endure.

CONSERVATION EFFORTS

Within the North Central region of Victoria, a program has been set up in 2008 to propagate this species. Ecologist Julie Radford - "the orchid whisperer" - has worked with threatened native orchids for more than a decade and runs an orchid conservation program in central Victoria.[5]

To grow the seeds, the first stage involves hand pollination, where pollen is removed from one species and put into another one. After a few months, seed capsules form and are gathered. Each one contains a multitude of seeds that look like finely ground pepper. These seeds, along with specimens of plant tissue, are sent to the Royal Botanic Gardens Victoria as part of their Orchid Conservation Program for the remaining stages.

Research ecologist, Dr Noushka Reiter, who leads the Orchid Conservation Program, starts the process of germination. She grows seeds in petri-dishes on top of a fungus that encourages them to sprout, allowing for tubers to grow. After about three to five years, the young specimens are then ready to be introduced into the reserve.

Julie and others that assist with this program have increased the number of Stuart Mill spider orchids from 12 in 2008 to about 186 in 2017, with the goal of achieving 1500 self-sufficient plants across the Stuart Mill area by 2030.[6] While these conservation efforts provide optimism, this species needs to be closely followed and supported to ensure its continued survival.

Priya Mohandoss is an RSV member and has a Bachelor of Science and both Masters of Journalism and Communications and Media Studies from Monash University.

References:

1. Orchid conservation (2023). Retrieved from rbg.vic.gov.au/support-us/orchid-conservation/
2. Stuart Mill Spider-Orchid (2023). (Caladenia cretacea) Retrieved from inaturalist.rg/taxa/949144-Caladenia-cretacea
3. John Colahan Griffin (2023). Retrieved from bushheritage.org.au/places-we-protect/victoria/john-colahan-griffin
4. Legislative Council Environment and Planning Committee. (2021). Inquiry into ecosystem decline in Victoria.
5. Gibson, B. (2019, December 14). Julie Radford is Victoria's 'orchid whisperer', propagating rare native orchids one tiny seed at a time. Retrieved from abc.net.au/news/2019-12-14/julie-radford-is-victorias-orchid-whisperer/11788832
6. Lyons, J. (2018, June 25) Orchid rescue. Bushtracks Bush Heritage Magazine. bushheritage.org.au/getmedia/640aaeae-022b-496c-9e4e-62e792a2f4f3/Bush-tracks-winter-2018

Subterranean Clover (*Trifolium subterraneum L.*).
Photograph: Reiner Richter via iNaturalist Australia/Atlas of Living Australia
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1973

DIRTY ROTTEN ROOTS

By Scott Reddiex MRSV

The 1973 Proceedings of the Royal Society of Victoria features a piece from an international collaboration of researchers into botany and plant pathology, with the authors hailing from around Australia, India, and the USA. The subject of their research was the subterranean clover (*Trifolium subterraneum L.*), specifically the decline of its pastures in Victoria.

The decline warranted concern due to the importance of the clover for agriculture. It is the most common annual pasture legume in southern Australia, sown over an estimated 29 million hectares across southern Australia – an area almost five times greater than the size of Tasmania.[1]

The authors took many samples from many related cloves, and extensively explored the literature on root rot in these species – the first literature review on this subject. From this work, they identified the culprit: fungi. While many different types of fungi were isolated from the diseased roots of their collected samples, they found that the species *Fusarium roseum* and *Pythium irregulare* were the most pathogenic in their tests.

The results of this work suggested that the root rot of the subterranean clover is caused by a complex combination of different fungal species, and provided the basis for further work to protect this agriculturally (and economically) important crop from disease.

The risk of not identifying, understanding, and managing risks from fungi to plants can be substantial. As one example, a different species of *Fusarium* (*Fusarium graminearum*) is responsible for 'Fusarium Head Blight' (FHB) of barley and wheat crops, and resulted in economic losses of almost USD$8 billion between 1993 and 2001 in the USA.[2]

From:

Proceedings of the Royal Society of Victoria, Vol 86 (New Series), 1974. Article 3. The Biology of Fungi Associated with Root Rot of Subterranean Clover in Victoria. By L. W. Burgess, H. J. Ogle, J. P. Edgerton, L. L. Stubbs, P. E. Nelson.

References:

1. *Subterranean clover.* (2021). WA DPIRD. agric.wa.gov.au/pasture-species/subterranean-clover
2. Nganje, W. E., Bangsund, D. A., Leistritz, F. L., Wilson, W. W., & Tiapo, N. M. (2004). Regional Economic Impacts of Fusarium Head Blight in Wheat and Barley. Review of A*gricultural Economics,* 26(3), 332–347. doi.org/10.1111/j.1467-9353.2004.00183.x

The old Melbourne Herbarium building (1861-1935). Located in the Domain near the Shrine of Remembrance, it was built at the request of Baron Sir Ferdinand von Mueller to house his collection of over 45,000 samples.[4]

1921

ALL THE PLANTS WE MET ALONG THE WAY

By Scott Reddiex MRSV

If no human eyes have characterised, recorded, and made known the existence of a species, it's very difficult to get the complete picture of an ecosystem. Considering that less than 1% of all life becomes fossilised,[1] and that we are potentially on the verge of a mass extinction event,[2] there's a good chance that many species will become extinct without leaving a trace.

For many species of plants, algae, and fungi that we have discovered, samples are collected, characterised, and stored in the collection of the National Herbarium of Victoria.[3] This collection – the State Botanical Collection of Victoria – is the largest of its kind in Oceania, comprising more than 1.5 million preserved specimens.

On the 8th of December 1921, a piece by botanists James R. Tovey and Patrick F. Morris was read to the RSV, providing insight into the process of discovery and description for a small number of new entries into the herbarium's collection. This paper, '*Contributions from the National Herbarium of Victoria – No. 1.*', *"contains the descriptions of two species new to science, both from Western Australian localities. A new variety has also been established, a native of the alpine regions of Victoria, New South Wales and Tasmania. Three foreign plants have been recorded for the first time, whilst the orchid Corysanthes bicalcarata, a native of New South Wales, Queensland and Tasmania, has been added to the Victorian Flora. In addition several new records of the regional distribution of native and introduced plants are given."*

Tovey and Morris note, for example, that the swamp paperbark (*Melaleuca ericifolia*) has been observed by D. J. Paton in November 1921, in the Bendigo suburb of Epsom. However, native species are the minority in their article, outnumbered by entries like that of the '*Cape Pond Lily*' *(Aponogeton distachyum): "This South African plant has escaped from cultivation, and is now spreading in several parts of the above-named creek, where it will no doubt become naturalised."*

The National Herbarium of Victoria was founded in 1853, making it the oldest scientific institution in Victoria. Its founder was the celebrated botanist Baron Sir Ferdinand von Mueller, who was also the first President of the Royal Society of Victoria.

From:
Proceedings of the Royal Society of Victoria, Vol XXXVI (New Series), 1924. Article XXI. - Contributions from the National Herbarium of Victoria - No. 1. By J. R. Tovey and P. F. Morris. (With 2 Text Figures)

References:
1. Prothero, D. R. (2017). *Evolution*. Columbia University Press.
2. Finn, C., et al (2023). *More losers than winners: investigating Anthropocene defaunation through the diversity of population trends.* Biol Rev. doi.org/10.1111/brv.12974
3. National Herbarium of Victoria, Royal Botanic Gardens Victoria. *rbg.vic.gov.au/science/herbarium/*
4. Pescott, R. T. M. (1982). *The Royal Botanic Gardens, Melbourne : a history from 1845 to 1970.* Oxford University Press; New York.

Photograph of the west of Melbourne, taken from the roof of the building 'Rostella' (468 Lonsdale Street). Taken by John Noone in 1869, the lone chimney in the back right of the image belongs to the Melbourne Gas Works. Source: State Library of Victoria, H92.150/803 (Public Domain)

1870

UNDERGROUND BREAKDOWN

By Scott Reddiex MRSV

Humans rarely migrate alone – when they move to a new location, they tend to take their way of life with them. The early European arrivals in Australia were no exception to this, and they attempted to transplant much of their old home to their new one (to varying degrees of success).

On the 14th of February 1870, a submission by Mr George Foord was presented to the RSV, on something that hadn't worked as expected in the new environment of Melbourne.

That something was pipes. As Melbourne expanded, there was of course a need to supply its population with essentials like water and gas. These were transported from their sources, like the Yan Yean Reservoir or the West Melbourne Gas Works (in what is now Docklands), to their destinations through underground pipes.

The problem that Mr Foord had brought to the RSV for discussion was that these gas pipes were 'decaying' in particular parts of Melbourne.

"*The facts of the case are the following:- Close to the site of the Melbourne old Exhibition building [located at the corner of William and Little Lonsdale Streets[1]] it has been found that the gas-mains are subject to an unusually rapid decay.*"

The prime suspect was the "white mottled clay" that the cast-iron pipes were laid in. As a chemist and geologist, Foord was determined to uncover the scientific cause of the problem, and upon receiving a sample of decayed pipe had subjected it to as many chemical tests as he could.

Foord noted that his observations were similar to the impacts of salt water on "iron pipes, or pumps drawing salt water from mines". This led him to the conclusion that it was the salt content of the soil that was damaging these conduits, and at a much faster rate than would be expected based on English observations.[2] In response, he suggests that the pipes should be somehow checked, perhaps monitoring the conductivity for sound, heat, or electricity, so that the earliest stages of the chemical changes can be detected.

George Foord published many articles in the *Proceedings* and other journals, becoming a member of the Society in 1872, as well as being a Fellow of the Chemical Society (FCS).

From:
Transactions and Proceedings of the Royal Society of Victoria, Volume X, 1872. Article IV - Decay of Gaspipes in certain Soils, by George Foord, Esq.

References:

1. *State Library Victoria Melbourne's first Exhibition Building.* (2022, January 7). blogs.slv.vic.gov.au/our-stories/melbournes-first-exhibition-building/
2. Hughes, S. (1853). *A Treatise on Gas-works and the Practice of Manufacturing and Distributing Coal Gas ... Including Also a Chapter on the Hydrocarbon Or Water Gas, and on the Rating of Gas-works in Parochial Assessments.*

The **Inspiring Australia strategy** was developed by the Australian Government to increase engagement and interest in the sciences. The **Inspiring Victoria** program is jointly funded by the Australian and Victorian governments with the Royal Society of Victoria.

Inspiring Victoria encourages involvement in STEM through initiatives (such as **National Science Week Victoria**) that are delivered by the RSV's program partners:

- **Public Libraries Victoria**
- **Neighbourhood Houses Victoria**
- **Parliament of Victoria**
- **Museums Victoria**
- **Royal Botanic Gardens Victoria**
- The **Commissioner for Environmental Sustainability**
- **Questacon**
- The **Arthur Rylah Institute for Environmental Research**
- **Zoos Victoria**

Mandy Thomson (Nursery Team Leader) and John Arnott (Manager of Horticulture), Royal Botanic Gardens Victoria. Photograph: RBGV

CARING FOR THE RARE AT OUR BOTANIC GARDENS

By Tanya Hendy

Botanic gardens play a critical role in the conservation of rare and threatened species, through research and protection in seed banks and in living collections. The Royal Botanic Gardens Victoria is dedicated to conserving rare species for future climates and have therefore established the Care for the Rare project. The following is an interview with John Arnott, Manager Horticulture, Royal Botanic Gardens Victoria, about the program.

WHAT IS THE CARE FOR THE RARE PROJECT?

Care for the Rare is a Royal Botanic Gardens Victoria (RBGV) and Botanic Gardens of Australia and New Zealand (BGANZ) initiative to support regional botanic gardens in Victoria to actively participate in ex situ plant conservation and display. The program is one part of RBGV's overarching Raising Rarity program, and was made possible thanks to the generous support of the Helen Macpherson Smith Trust.

Care for the Rare supports regional botanic gardens to conserve plants important to their local areas and allows conservation collection sites to be spread across Victoria. Holding threatened species across multiple sites is a sensible strategy to ensure that material in living collections is not lost to extreme weather events or potential losses in one location. Another aim of the program is to build awareness and highlight the importance of plant conservation, the role that botanic gardens play, and local conservation stories.

A pilot program was established with six gardens, which were selected as being representative of the broader botanic gardens community in Victoria: Australian Botanic Gardens Shepparton, Ballarat Botanical Gardens, Colac Botanical Gardens, Dandenong Ranges Botanic Gardens, Sale Botanic Gardens, and Wilson Botanic Park in Berwick.
RBGV staff worked with the gardens staff and developed Conservation Collection Plans for each garden, including detailed species lists and a planting schedule. The team then sourced, propagated, produced, and delivered the living plant stocks identified for each participating garden.

WHY DID YOU ESTABLISH THE PROJECT?

Approximately one third of Victorian plant species are rare, vulnerable, endangered, or critically endangered. In 2020, a survey of the 40 botanic gardens across Victoria indicated that very few were involved in plant conservation activities or identified plant conservation as an attainable goal. Many gardens believed they had a 'lack of skills and resources' necessary to manage rare and threatened species in their collections. Care for the Rare was established to support other botanic gardens to establish their own conservation collections and become a part of the Care for the Rare network.

WHAT SORTS OF PLANTS ARE YOU PROTECTING THROUGH THE PROJECT? WHAT HAVE YOU ACHIEVED SO FAR?

The process is not a 'cookie cutter' and 'one-size-fits-all' approach. Each botanic garden has different attributes and opportunities at different physical locations and a range of approaches need to be taken.

RBGV supported the Dandenong Ranges Botanic Garden with a significant number of rare and threatened alpine and sub-alpine plants, to add to the collection that they were establishing at Serenity Point. The Australian Botanic Gardens Shepparton were developing a climate resilient garden, and our team worked with their Landscape Architect on integrating rare and threatened plants that had conservation significance in the Shepparton region. Colac Botanic Gardens had developed a taxonomic collection of wattles, and we introduced a suite of wattles with conservation significance into their existing collection.

WHAT IS THE PROCESS OF COLLECTING PLANTS FROM THE WILD AND BRINGING THEM INTO CULTIVATION?

In 2016, we developed a Masterplan for Royal Botanic Gardens Cranbourne (RBGC), which stated that we should be placing increasing emphasis in the living collection of plant species that occur in Victoria and South-Eastern Australia.

Since then, we have wild collected over 1,000 new species and have added them to the living collection of RBGC. We targeted plants in over 50 field trips and built a collection of Victorian and South-Eastern Australian plant species.

The seeds and cuttings from field trips were taken back to the RBGC nursery where they are produced and propagated, and ultimately planted into the Australian Garden or elsewhere. The whole process can take three years from research to having a plant in the Garden. In some instances, the team also took a specimen for pressing and inclusion into RBGV's National Herbarium of Victoria.

The RBGC Horticulture team partnered with the RBGV Science team (including geneticists) in bushfire recovery and Victorian Conservation Seedbank work. RBGV is making a significant contribution in this space, and are recognised as leaders globally in the emerging field of conservation horticulture.

WHAT IS YOUR HOPE FOR THESE PLANTS IN THE FUTURE?

The best-case scenario is that threatened populations continue to sustain themselves in nature and persist. However, in the absence of that, these conservation collections provide living plant resources for population enhancement, translocation, and re-introductions. The objective is to conserve plants in the wild with the support of populations in the collections.

There is a very strong appetite within Victorian regional botanic gardens to participate in the program. RBGV is very keen to continue the program and we are looking for further funding to support another round of gardens beyond the pilot program.

WILL YOU HAVE TO CONTROL THE ENVIRONMENT THAT THESE PLANTS ARE GOING INTO?

We are not putting plants into sites to set them up to fail. Instead, we are translocating species into sites in a sophisticated way, by looking at the ecological requirements of that plant. For example, when Senior Research Scientist, Dr Noushka Reiter, takes orchids into the wild, the ecology of the sites needs to be right, and success relies on the presence of the plant's pollinator and symbiotic fungi.

A different multi-site conservation program that RBGV is taking a lead role in, the TROMPS project (Tropical Mountain Plant Sciences project), is another example of where we are supporting the establishment of a meta collection of endemic plants that occur in the mountain peaks of far north Queensland. We have built up a living collection of these plants and are now starting to distribute some of this material to other botanic gardens in Australia. Interestingly, the most likely gardens to be successful with this material are in Tasmania, or those with cooler climates - Mount Tomah (NSW), Mount Lofty (Adelaide Hills), and Dandenong Ranges Botanic Gardens. These gardens are nicely climate-matched, even though they are more than 3000 km from the source site. Ironically, while close to the source material, the Cairns Botanic Gardens would not be successful in cultivating these plants without use of a cool house.

IF MANY OF THE PLANTS HAVE NEVER BEEN PROPAGATED BEFORE, HOW DO YOU WORK OUT WHAT WORKS FOR THESE DIFFERENT SPECIES?

Trial and error. That is one of the joys of working in a Botanic Garden; there is a remit for us to work on developing the protocols for plants that have never been cultivated and a responsibility for us to work it out. If there are no protocols and the plant needs to be grown, we need to establish the protocols.

SPACE TO LEARN DURING SCIENCE WEEK

By Ellie Claringbold

Mars rover robots took over Queen's Hall at Parliament House for National Science Week, as students from Pascoe Vale Girls College worked together to decide which industries are necessary for a successful terraforming mission to the Red Planet.

The program, developed by the STEM Centre of Excellence at Science Gallery Melbourne, in collaboration with the Australian Space Agency and Parliament of Victoria, offered students a unique blend of science, civics and art.

Named Mission Control, the learning program mirrored the parliamentary process and gives students the opportunity to act as members of parliament while they share information, debate ideas and solve problems.

"We created the program to demonstrate the clear links between civics and science, and the importance of those two things being blended together when it comes to making decisions in a place like parliament," said Science Gallery Melbourne educator and program presenter, Jesse Chambers.

He hopes the program will help students develop a number of their personal and social capabilities including collaboration, creative and critical thinking, and ethical understanding.

Jesse Chambers from Science Gallery Melbourne convening the Mission Control program in Queen's Hall at Parliament House. Photo: Mike Flattley

Dr Samantha Ratnam MP addresses students in the Legislative Assembly Chamber.

Photo: Mike Flattley

For the students from Pascoe Vale Girls College, Mission Control has allowed them the opportunity to make their decisions in the same seats of power held by the MPs that represent them.

"It's brilliant that parliament's able to offer us not only a space for us to run the program, but to provide their expertise about parliamentary process and procedure because it elevates the program," Chambers said. "Students are able to see the relevance of civics education when they're taking part in a program as rigorous as this, in a place like this.

"They're able to see that parliament's a place for them."

Pascoe Vale Girls College science teacher, Carolyn Drenen, said programs like Mission Control help to broaden the minds of students, exposing them to the world outside the 'ecosystem that we have at school'.

"It teaches them the soft skills of listening, speaking, negotiation and also the process of thinking and taking in everything before voicing an opinion," she said.

She celebrates the opportunity for her students to learn and practise their skills.

Science Gallery Melbourne is part of the University of Melbourne and boasts a variety of exhibitions and learning programs created for and by young people.

These learning programs are intentionally designed to be anti-disciplinary.

"We never put a label on them," Chambers said. "Our programs blend together a whole bunch of different subject areas because we know that when young people go out into the world, they're not existing in subject silos.

"They're going out and existing and using all of the skills and knowledge that they've garnered over their educational journeys to live fulfilling lives."

MPs Anthony Cianflone, Samantha Ratnam and Evan Mulholland joined the students for Mission Control's opening session, offering words of encouragement.
"I'd really encourage you to maintain a strong interest in the sciences because it not only sparks your curiosity…but also for you going forward in terms of career progression and skill opportunities, they are really going to be at the forefront, I believe, of the next chapter of Victoria's economic history," Cianflone said.

Although currently small, Australia's space industry promises rapid growth and new employment opportunities with the sector expected to triple in size by 2030.

"I hope not only that you come away with new ideas about science and an interest in science that you might take away in your career, but also, in these seats, an interest that you might take away in public service," Mulholland said.

Dr Samantha Ratnam also urged the students to consider running for parliament in the future and highlighted the importance of hearing from a diverse range of voices.

"Our parliaments need more scientists. They need more people who think in a different way," she said. "When you have differences across these seats, you have much better decisions and you have much better outcomes for the community."

For most of the students from Pascoe Vale Girls College it was their first time visiting Parliament House.

"It was really interesting because I've never been inside Parliament House and I think it's a really great experience," year 10 student Rahmakhan said. "It's really nice to go inside and look at how the government works."

The program has already inspired fellow student, Hind, to consider a future career in politics. "It was actually a great experience," she said. "I'm thinking maybe I can be a role model and create a better future. Maybe I can be a representative."

Providing young people with inspiration and facilitating their exposure to the world are core aims of learning programs like Mission Control.

"If you can't see yourself doing it, it's really hard to go on and do that as a career later on in life," Chambers said. "It's important to run events like these so that students can get excited about STEM education. They can get excited about science and the relationship science has to other learning areas."

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This piece was originally published online 19/08/23 at ***new.parliament.vic.gov.au/news/general-news/space-to-learn***

The *Taungurungia garrattii*, fossil plant, now at Melbourne Museum.
(Source: Museums Victoria / Photographer: Rodney Start)

INSIGHTS INTO THE EVOLUTION OF LAND PLANTS

By Robert French, Digital Storyteller at Museums Victoria

A 400-million-year-old fossil land plant unearthed in Victoria, *Taungurungia garrattii*, sheds new light on the early evolution of land plants globally and is now housed at Melbourne Museum.

On a hot January day in 2015, Fearghus McSweeney happened upon a miraculous fossil find. It was in an unlikely place too—a roadside on Taungurung country, near the central Victorian town of Yea, about 100 kilometres north of Melbourne.

'It's on the main road, so the cars zoom past there. It's actually not a great place to be looking for fossils,' says Fearghus, a palaeobotanist at RMIT University and Honorary Research Associate at Museums Victoria, who specialises in early land plants.

'At the time I was more of an amateur, just doing this as a hobby.' He was with an expert though, Dr Michael Garratt, who had previously studied the spot. The pair thought they'd have a look and a few minutes later, with only a few taps with a hammer, the fossil popped out of the rock.

'It was just there; I was really surprised…that has never happened, and I doubt it will ever again, it was really very lucky.'

What he had found was an entirely new genus, and one of Victoria's earliest plants, Fearghus and his co-authors have since described in the scientific journal Memoirs of Museum Victoria.[1] *Taungurungia garrattii* is one of the earliest known examples of a plant that combines features essential for successful survival on land. The unearthing provides significant new insights into the global evolution of early land plants. And while the story of the find itself is incredible, what the plant had to go through to get there is even more remarkable.

A BARREN LAND

400 million years ago, in the Early Devonian Epoch, the land we now know as Victoria was largely underwater. Australia was attached to the supercontinent Gondwana, and our ancestors were still getting around with fins. It was a warm, harsh, unforgiving landscape; oxygen levels were lower than today and ultraviolet radiation higher. Some fungi were massive, such as *Prototaxites* towering metres above anything else.

Amongst all this were the earliest forms of vascular plants trying to gain a foothold on land. Vascular plants use conductive tissues to transport food from root to tip and support their own weight. 'The first plants, which were non-vascular, were quite similar to what mosses look like,' says Fearghus. 'They were really small, so they had to evolve a vascular system in order to get much bigger.'

Taungurungia garrattii is an early example of this, growing to about 20 centimetres high. The only other plant that would have been bigger in Victoria was the lycopod *Baragwanathia*, which grew up to 2.7 metres high.

Most plants from this period fall under three categories: rhyniophytes, lycophytes, and zosterophylls; zosterophylls being further divided into two groups. *Taungurungia garrattii*, explains Fearghus, 'Is a mish-mash of different characteristics from these two zosterophyll groups'

It also has abnormally large fruiting bodies, known as sporangia, that allowed it to generate spores to reproduce.

'The size of the sporangium is absolutely massive, it's huge compared to anything I've come across,' says Fearghus. 'At least double to triple the size of most.'

This would have required a lot of energy to grow. Plants use photosynthesis to convert sunlight, water, and carbon dioxide into energy in the form of glucose. And *Taungurungia garrattii* is no different, except that this was millions of years before the appearance of leaves.

'It has what's called emergences on it; they look like little triangles on the stem,' explains Fearghus. 'What these appear to be is an area for increased photosynthesis…and are akin to an early form of leaves.' These emergences are not common in plants for Victoria, there are only a small handful that have them. Only Victoria's *Baragwanathia* had what we could easily recognise as leaves, called microphylls, which were narrow and strap-like with one central vein.

LONG WAY FROM HOME

Another challenge prehistoric plants had in these early years was a lack of soil to support them, which is part of the reason Fearghus found the plant where he did. 'Because there was very little soil and there were very few plants affecting the flow of rivers, rivers didn't meander as much,' he says. 'They tended to flood out onto the plains and push everything with them.'

While it is impossible to know exactly where this ancient plant originally grew, Fearghus says it was most likely from what is now western Victoria (that was above sea level at the time) or Antarctica (it was still attached as part of Gondwana). It therefore must have been a big flood to bring it all the way to what is now central Victoria.

'It was likely growing along the banks of a river or marshy area and all that stuff would have been pushed out with a debris flow…before falling out of the water column and settling on the ocean floor and then covered with sediment.'

Once sealed away from anything that would destroy the plant, it had to be undisturbed for millions of years while subjected to massive pressure and heat. Plant fossils are rare compared to fossils of bones, teeth and shells, but under the perfect conditions, the plant would have lost its water and eventually mineralised into the fossil we see today.

The likelihood of this happening though is infinitesimally small. 'It is a very rare event so we are very fortunate to have it,' Fearghus says. 'The vast majority of life on Earth will never fossilise.'

The next hurdle in *Taungurungia garrattii*'s path came about 10 million years later, when Victoria was subjected to a lot of tectonic activity. 'What was part of Victoria then was compressed and about 40 percent of it was lost, so we could have lost the land that it came from,' says Fearghus.

Fortunately, though, the fossil was instead pushed up out of the water with the land, bringing it closer to the surface. While this was happening, what may have been this plant's distant relatives were evolving into trees and beginning to congregate as forests, filling the atmosphere with oxygen. Larger and more complex life took advantage of this kinder environment and, over the next few hundred million years, evolved into the humans who built the road right next to it.

There it remained, undisturbed, until the day Fearghus came along with his hammer. 'I was bagging and numbering specimens because I was hoping one day I could give them to the museum and have someone else describe them, I wasn't planning to do it myself.'

Fearghus studied the plant as part of his doctoral thesis on early Victorian land plants, and it took six months of painstaking work to prepare the fossil.

When it came to a name for this new genus though, he says that was an easy decision. 'That was one of the first things that popped into my mind—wouldn't it be nice to name it after the Indigenous people of the area.' Fearghus was granted permission by the Taungurung Elders to use the name Taungurungia. By naming the genus after the Traditional Owners, he hopes that it will highlight that Australia's First Peoples cultures have survived longer than any other worldwide and that, at a local level, it will encourage people to not just look at the surface, but what is beneath. He then named the species garrattii in honour of Dr Michael Garratt, who helped to find the fossil.

Fearghus' research, the first in almost 40 years in this area, has uncovered a number of new species, showing Australia's flora during this period was a lot more diverse than previously thought. He hopes this research will be a forerunner for far greater discoveries.

As for the fossil itself—it has now reached the end of its 400-million-year journey and resides in the Melbourne Museum, as part of the Victorian state collection.

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This piece was originally published as The chance discovery of one of Victoria's oldest fossil plants, 400 million years in the making at ***museumsvictoria.com.au/article/the-chance-discovery-of-one-of-victoria-s-oldest-fossil-plants-400-million-years-in-the-making/***

References:
1. McSweeney, F.R., et al. (2022). Taungurungia gen.nov., from the Lower Devonian of Yea, central Victoria, Australia. Memoirs of Museums Victoria 81, 43-53. museumsvictoria.com.au/media/18972/043-053_mcsweeney-shimeta-buckeridge_2.pdf

Fearghus McSweeney and the fossil he found on a roadside in central Victoria (Source: Museums Victoria / Photographer: Robert French)

SOCIAL ANIMALS: INSPIRING VICTORIA'S MAIN NATIONAL SCIENCE WEEK PROGRAM

By Dr Catriona Nguyen-Robertson MRSV

Another National Science Week draws to a close. We learned new things, we celebrated STEMM, we sparked curiosity, and most importantly, we partied together. After all, we are Social Animals.

Social Animals was a series of special events held at Science Gallery Melbourne in collaboration with the Royal Society of Victoria as Inspiring Victoria's main program for National Science Week. Young people questioned academics, enigmatic dark matter was on display, science was comically debated, and STEM enthusiasts came together – everything was about bringing us back together to socialise and share a love of science.

KIDS VS SCIENCE

A panel of children put seven scientist's science communication skills to the test as they asked the tough questions. 'What if you just don't like science?', 'Is it too late to stop climate change?', 'How does x work?' – each scientist was challenged to dispense with the jargon and explain themselves. The academics who took turns in the "hot seat" included reproductive biologist, Ebony Ciarrocchi; science communicator, A/Prof Jen Martin; experimental particle physicist, Prof Phillip Urquijo; geologist, Dr Ashleigh Hood; materials engineer, Dr Mohammad Taha; psychology lecturer, A/Prof Simon Cropper; and data scientist, Renee Key. The audience was packed full of adults and children, all of whom were keen to know what the future of science holds.

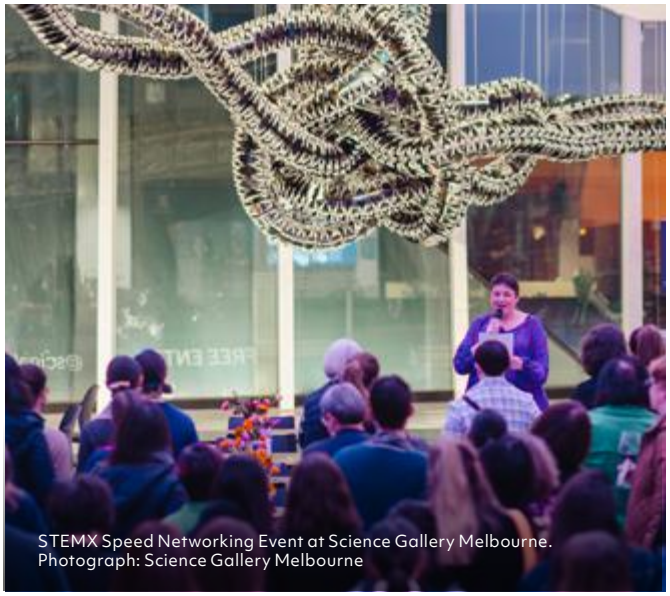
STEMX SPEED NETWORKING: FOR WOMEN AND GENDER DIVERSE HUMANS

People from research, major technology companies, engineering firms, media, and academia were paired with young people to share intimate conversations about their careers. With five-minute sessions of one-on-one time with mentors, mentees were encouraged to think about career strategies, discuss their interests and goals, and connect with industry-leading women and gender-diverse people working in STEM. The attendees were so engrossed in conversation that they hung around to continue networking and chatting nearly an hour after the close of the official event proceedings.

SOCIAL ANIMALS PARTY

The doors to Science Gallery Melbourne's DARK MATTERS exhibition stayed open after dark for a special late-night viewing. Dark matter is thought to account for approximately 85% of the matter in the universe, yet it remains mostly a mystery given that it is difficult to detect. People were invited to wander through the unseen, the unknown, and the unspoken as they explored the fundamental essence of life and the universe. As a nod to the "animals", all the while, zebra roaming performers pranced through the gallery and there was a toast to those who have helped us better understand the world of animals.

'I'd like to toast to the small carnivorous dinosaur, Oviraptor – Latin for 'egg thief' – so named as the first known specimen was found fossilised looming over a clutch of neatly arranged dinosaur eggs. A carnivorous dinosaur found next to a nest; case closed – this must be egg theft. Over time as technology improved it became increasingly clear that the eggs in the nest were the Oviraptor's, and that that individual died shielding her unborn babies from the impending sandstorm that consumed and ultimately fossilised them all.' – Rohan Long, Curator of the Harry Brookes Allen Museum of Anatomy and Pathology, University of Melbourne.



STEMX Speed Networking Event at Science Gallery Melbourne. Photograph: Science Gallery Melbourne

CITIZEN SCIENCE AND ART COLLIDE WITH MUON OPEN STUDIO

Muon particles are fundamental subatomic particles, like electrons, comprising everything in existence - yet they are invisible to human perception. But with the use of DIY sensors and LED light pulses, artist Jon Butt can connect us with the brief presence of a muon for 2.2 microseconds. Each muon strike leaves a delicate trail of electrons in its wake, making a unique cosmological image on the detector that he uses to compose a soundtrack titled 'μ MUOGRAPHY'. Over two days, Jon and his collaborator Lewis Gittus used the particle detector as a musical instrument to create musical passages on site at Science Gallery Melbourne, pairing art and science to comprehend the mysterious and incomprehensible.

SCI FIGHT SCIENCE COMEDY DEBATE

Scientifically speaking, we are animals. We may have diverged from the rest of the animal kingdom, but have we forgotten the roots from which we evolved? Comedians Erin Michelle and Elyce Phillips, author Nicholas J Johnson, anatomy researcher A/Prof Michelle Rank, and reproductive biologists Dr Marissa Parrot and Ebony Ciarrocchi debated whether we should embrace our animal nature. They wrestled with the existential question of who we are and whether we would be happier forgetting the fetters of society by returning to a simpler, more primal existence.

These gatherings of brilliant and inquisitive minds have kindled a flame of curiosity that will hopefully continue to burn long after the conclusion of National Science Week. Seeing so many people at different points of their lives and careers come together highlights that the knowledge gleaned from these events is not meant to be confined to lecture halls; rather, it is embedded in art, is part of ongoing discussions, and is a collective torch passed from one generation of thinkers to the next.

CALL FOR SCIENTIFIC PAPERS

The *Proceedings of the Royal Society of Victoria* is our refereed journal, published twice annually by CSIRO Publishing. Current and recent editions are available online in open access format from **publish.csiro.au/rs.**

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*, the present name being adopted in 1889. Since then, the journal has appeared on a regular basis, at first annually but varying from one, two or four parts per year. Since 1889, the parts issued each year were deemed to make up a volume. The online content extends back to Volume 118, Number 1, 2006.

Those interested in submitting papers should review the **Guidelines for Authors**. All enquiries and manuscript submissions should be forwarded via email to **editor@rsv.org.au**.

Please note copies of the *Proceedings* 1854 to 2006 are freely available online at the State Library of Victoria website in their 'Digitised Collections.'

SOCIAL MEDIA
Follow the journal on social media using the hashtag *#ProceedingsRSV*

CURRENT GOVERNMENT CONSULTATIONS OF INTEREST TO VICTORIA'S SCIENCE COMMUNITY

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

Victorian Murray Floodplain Restoration Inquiry and Advisory Committee.

Learn about the Standing Inquiry and Advisory Committee appointed to advise on the proposed Victorian Murray Floodplain Restoration Projects and their potential effects

Ongoing:
engage.vic.gov.au/VMFRP-SIAC

Government Land Standing Advisory Committee

Have your say on changes to planning provisions for surplus government land to be sold or land proposed to be acquired for priority projects by the Victorian Government.

Ongoing
engage.vic.gov.au/glsac

Shrine to Sea Draft Masterplan

Have your say in the creation of a boulevard for Melbourne, connecting Domain Gardens to Port Phillip Bay along Albert and Kerferd roads.

Consultation closes 10 September 2023:
engage.vic.gov.au/shrinetosea

Strengthening Victoria's Waste, Recycling and Resource Recovery Sector

Have your say on the proposed risk, consequence, and contingency regulations in the waste, recycling, and resource recovery sector.

Consultation closes 12 September 2023:
engage.vic.gov.au/risk-consequence-and-contingency-regulations

PITCHING AND WRITING FOR SCIENCE VICTORIA

Science Victoria seeks the discussion and promotion of scientific topics of relevance to people living in the State of Victoria. We are particularly interested in new research, in-depth articles, or exploration of subjects where scientific work and thinking can directly address or deepen our understanding of environmental and socioeconomic challenges.

We welcome your pitches and pieces for news, features, opinion, and analysis articles on current scientific research in Victoria, recent scientific discoveries, related social and policy issues, technical innovations, and overviews of impactful research. We cover a broad range of topics around Science, Technology, Engineering, Mathematics, Medicine/health (STEMM) under an overarching theme of "science and society."

Science Victoria's articles are written in plain, non-academic language, pitched at an intelligent and naturally curious audience that does not necessarily hold subject-matter expertise. This is not a platform for scientific journal articles nor media pieces. For more information on what we're looking for, please read our article submission guidelines below.

HAVE AN IDEA FOR AN ARTICLE?
PITCH YOUR IDEA TO US!
Send your idea to **editor@sciencevictoria.org.au,** along with any questions you have regarding your pitch.

In your email, please outline:

- In one sentence, what is your key message? (No more than 50 words)
- Why should this key message be shared with the readers of *Science Victoria*? (No more than 100 words)
- Which style of article are you proposing to write? (See below for a guide to article types)

Article pitches can be submitted at any time, but please keep in mind the article submission deadlines for the next month's issue. Note that we may accept your pitch, but suggest it is more suitable for another style of article.

ARTICLE SUBMISSION
Once your pitch has been accepted, you can submit completed pieces that comply with the style guide below. Completed articles to be published in the next issue of *Science Victoria* must typically be submitted 2 weeks prior to the beginning of the next month.

All pieces will be reviewed prior to publishing and may be edited for length and clarity (although we will be sure not to alter the message or context of your work). We will also endeavour to fact-check and confirm any grey areas with you ahead of publishing in the interests of accuracy.

All published pieces will be accompanied by a by-line, and a short (<50 word) biography of the author (title, institution, qualifications, current projects, contact email) to be submitted with your piece.

Images and figures to accompany your piece are strongly encouraged, however please ensure that you only provide original images produced by yourself or those that already exist in the Public Domain. Images must include details of the source and any relevant descriptions. If you do not provide any images, we may include Public Domain or stock images that we deem suitable for visual communication of your content.

REFERENCES
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, or contact **editor@ScienceVictoria.org.au**.

WRITING FOR SCIENCE VICTORIA: ARTICLE FORMATS

STYLE GUIDE
To successfully engage the largest audience, all pieces should have readability in mind.

Readability can be determined using a Flesch-Kincaid readability test, aiming for a score between 50-60. This score means that your piece should be easily understood by an educated 16-year-old (a year 10 student).

If drafting your piece in Microsoft Word, **you can easily view your document's readability statistics** at Home>Editor>Document Stats. Alternatively, you can use one of the many free online calculators.

FEATURE ARTICLES
Recommended word count (600 - 1,800)
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.

Your audience is intelligent members of the general public, who share an enthusiasm for scientific topics, or who are members of the scientific community outside of your particular field.

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.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Feature articles typically run between 600 and 1,800 words (including references). 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 magazines for a general audience, like *The Conversation, Cosmos, New Scientist* or *Scientific American*. A good litmus test is knowing that most of us have read a piece or been to a presentation that managed to make the most interesting topics incredibly boring. This is what you want to avoid.

LETTERS
Recommended word count (400 - 1,000)
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 and/or the Royal Society of 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.

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

WHAT I'VE BEEN READING
Recommended word count (400 - 1,000)
This is a column for you to tell us about a book broadly relating to science that you've read. These pieces are typically between 400 – 1,000 words and include a summary of the book and its ideas, as well as your interpretations or conclusions.

Possible questions to consider when writing this column:
- 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?

OPINION ARTICLES
Recommended word count (600 - 1,000)
In contrast to an unbiased news or feature article, an opinion piece conveys your informed opinion on, or experiences with a particular topic. This is where your expertise on a subject can shine. 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,
- changes in your particular field of expertise
- 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,
- ethical problems related to scientific projects or careers in STEMM.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Opinion pieces should aim to be 600-1000 words. For anything shorter, consider submitting it as a Letter instead. 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.

NEWS ARTICLES
Recommended word count (400 - 1,000)
News Articles are for the discussion of current or recent news relating to science, with an emphasis on science in Victoria or news that impacts Victoria's scientific community.

These articles should be concise, avoid use of jargon and personal opinion, and be referenced as appropriate. News pieces should be between 400-1,000 words in length.

Reports 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.


THE ROYAL SOCIETY OF VICTORIA
Promotion and Advancement of Science

HOLD YOUR NEXT EVENT AT THE ROYAL SOCIETY OF VICTORIA

The RSV engages communities with scientific knowledge through aligned partnerships, special events, festivals, conferences, and education programs. Email **rsv@rsv.org.au** to discuss your needs and ideas!

FACILITIES FOR HIRE

The Royal Society of Victoria's facilities are available for hire to organisations, companies, or private groups. This heritage-listed building opposite the Carlton Gardens is suitable for a wide range of events, including conferences, seminars, meetings, and private functions.

Limited parking is available on-site and a commercial parking operator is adjacent on La Trobe Street.

The RSV has audio visual and seminar equipment available for use, including videoconferencing facilities. There is a commercial kitchen on the ground floor, suitable for your own use or by a caterer.

SERVICES AVAILABLE

We 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
- Campaign management
- Recruitment of scientific panels
- Convening community engagement and deliberation processes where scientific work contributes to social, environmental, and economic impacts and benefits.

The Burke and Wills Room

Multi-functional space with adjoining kitchen.

Capacity:

Workshops	≤30 people
Dinners	≤60 people
Seminars, functions, catering, etc	≤80 people

The Von Mueller Room

Seminar room great for smaller meetings and seminars.

Capacity:

Meetings, seminars, etc	≤15 people

The Ellery Lecture Theatre

Raked seating great for lectures, presentations, and conferences.

Capacity:

Raked seating	≤110 people.

The Cudmore Library

A picturesque room great for larger meetings and seminars.

Capacity:

Meetings, seminars, etc	≤24 people

We are registered as a Certified Social Trader working for the benefit of Victorian communities, which makes our services eligible under the Victorian Government's Social Procurement Framework, as well as the social procurement guidelines of the governments of New South Wales and Queensland. Our certification also assures industries of our authenticity in building social procurement into services and supply chains. For more information and bookings please contact our Business Manager at **james@rsv.org.au** or on +61 3 9663 5259

SUPPORT VICTORIA'S SCIENCE SOCIETY

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.

We manage the Inspiring Australia program in Victoria, 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. Your donations allow us to continue the work we have been doing for Victoria for more than 160 years.

To make a donation, please fill in the form below and return to the Royal Society of Victoria, 8 La Trobe St, Melbourne VIC 3000. Alternatively, you can donate online at **rsv.org.au/support-the-rsv**

RSV 2023 FUNDRAISING CAMPAIGNS

The area of greatest need, as identified by the Society's Council	$
Inspiring Victoria – Community Science Engagement Program	$
Science Awards & Prizes	$
Science History & Heritage	$
Science for All - Citizen Science Programs	$
BioQuisitive Community Lab	$
The Phoenix School Program	$
The BrainSTEM Innovation Challenge	$
Australian Indigenous Astronomy	$
Science Victoria - Magazine and Web Content Production	$
TOTAL	**$**

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I enclose my cheque or money order made out to The Royal Society of Victoria.

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

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rsv.org.au/news/science-victoria

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