NATURAL COOLERS
Using urban parks to beat the heat

MOTHER TONGUE
Preserving Indigenous languages

INTO THE GROOVE
How rhythm helps kids speak

FUTURE-MAKERS

CREATING RIPPLES

Protecting the platypus with western Sydney's waterway warrior

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UNIVERSITY

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ABOUT THIS MAGAZINE
Future-Makers is published for Western Sydney University by

nature research custom media

part of Springer Nature.
Level 8, 227 Elizabeth Street, Sydney, NSW 2000 Australia
 The information in this publication was correct at the time of going to press in November 2024.

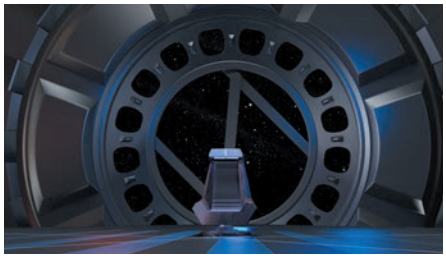
Some of the research contained in this publication was supported by the Australian Government through the Australian Research Council (ARC) or the National Health and Medical Research Council (NHMRC). The views expressed herein are those of the authors and are not necessarily those of Western Sydney University, the Australian Government, the ARC or the NHMRC. Aboriginal and Torres Strait Islander peoples should be aware that this publication may contain the images and names of people who have passed away.

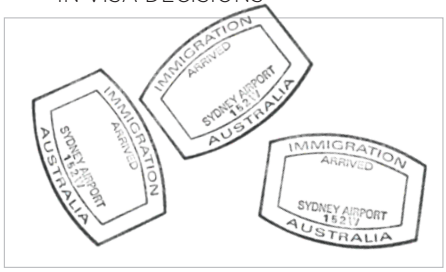
ABOUT

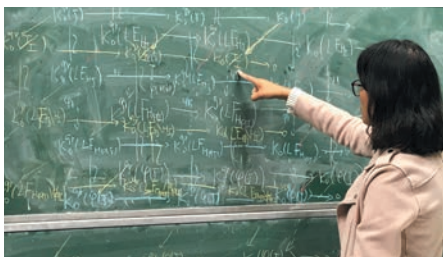
Western Sydney University is a large, student-centred, research-led university. Established in 1989, the University proudly traces its history to 1891 through the Hawkesbury Agricultural College. Today the University has more than 200,000 alumni, 47,000 students and 2,600 staff.

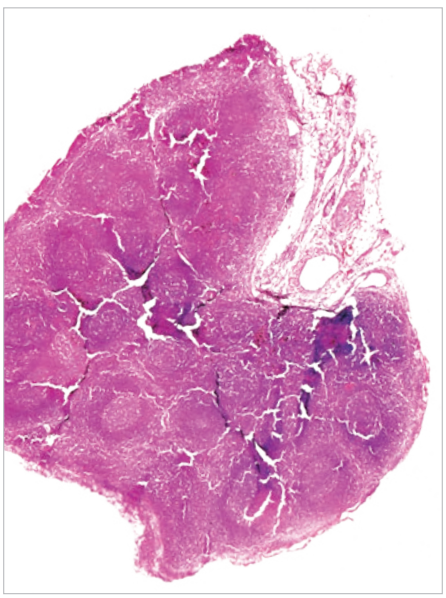
The University is now ranked in all major global university ranking systems, and is in the top 2% of universities worldwide. It has achieved number one in the world for its social, ecological and economic impact in the 2022, 2023 and 2024 Times Higher Education (THE) University Impact Rankings.

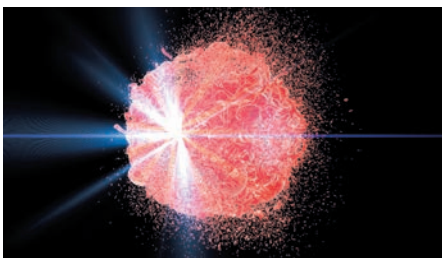
Through investment in its academic strengths and facilities, the University continues to build its profile as a research leader in Australia and is nurturing the next generation of researchers.











#1 IN THE WORLD

When it comes to sustainability, we're committed.

Our teaching, research, outreach and stewardship for the UN Sustainable Development Goals have been recognised again in the Times Higher Education Impact Rankings 2024

TIMES HIGHER EDUCATION IMPACT RANKINGS WINNER
2022 | 2023 | 2024

- → **1st** in the world Overall
- → **1st** for SDG 5 Gender Equality
- → **3rd** for SDG 15 Life on Land
- → **4th** for SDG 13 Climate Action
  SDG 12 Responsible Consumption and Production
  SDG 17 Partnerships for the Goals
- → **8th** for SDG 10 Reduced Inequalities
- → **9th** for SDG 6 Clean Water and Sanitation

THREE YEARS IN A ROW
UNLIMITED.

ON THE COVER

↗ By helping protect NSW's playtpuses, Dr Michelle Ryan is safeguarding western Sydney's waterways.
page 25

Cover image:
Matthew Abbott

NEW DIRECTIONS

Welcome to the eighth issue of *Future-Makers*, which highlights our impactful research and celebrates some important milestones in Western's history.

This year, we celebrated the tenth anniversary of Research Week — Western's annual festival that showcases a wide range of research initiatives and their real-world impacts. The theme for 2024 was: The Next Decade of Discovery: Better Futures, Now.

We were honoured to add 2024 Stella-Prize and two-time Miles Franklin Literary Award winning writer Alexis Wright as a member of our Distinguished Professor cohort.

We also celebrated being ranked first overall in the Times Higher Education (THE) Impact rankings for the third year in a row. These rankings identify and celebrate universities that excel across multiple United Nations Sustainable Development Goals (SDGs).

In this issue, we've created an infographic that illustrates the broad range of topics covered by Western researchers, which institutions we work with, and where we sit in the global research ecosystem. We also present stories about platypus protection efforts, pure mathematics and parenting help. And we delve into the concept of hyper-real religion, the preservation of Indigenous languages, and the *Sydney Review of Books*, Australia's preeminent literary-criticism journal.

This is just a taste of the stories in this issue. We hope you enjoy the rest of the magazine, and we encourage you to connect with our amazing researchers.

Distinguished Professor George Williams AO
Vice-Chancellor and President

Professor Deborah Sweeney
Senior Deputy Vice-Chancellor and Vice-President (Research, Enterprise and Global)

SUSTAINABLE DEVELOPMENT GOALS

The UN Sustainable Development Goals (SDGs) are a blueprint towards a better, more sustainable future (see: sustainabledevelopment.un.org). Western Sydney University has many research projects aligned with these goals. We have indicated the most relevant SDG above each article in this issue of Future-Makers where applicable.

RESEARCH AT WESTERN

Western Sydney University is an institution with a genuine commitment to the United Nations Sustainable Development Goals. This is reflected by Western placing first overall in the Times Higher Education Impact rankings in 2022, 2023 and 2024.
Western prizes its connections with domestic and global collaborators and in 2024, established its Surabaya campus in Indonesia. Western's Chancellor, Professor Jennifer Westacott AO, notes that the campus will "create life-changing opportunities for local students to graduate with a globally recognised degree and will support Indonesia in its economic transformation."

COLLABORATION IN THE SCIENCES

The Nature Index captures affiliation information from 145 top tier natural- and health-science journals. Of Western's institutional collaborations in the index, 77.4% are international, with the remaining 22.6% domestic.

Domestic
22.6%
78 institutions
(out of 822 institutions)

International
77.4%
744 institutions
(out of 822 institutions)

TOP 5 INTERNATIONAL COLLABORATORS

Western's top five collaborators for 2023 from the Nature Index were from North America and China.

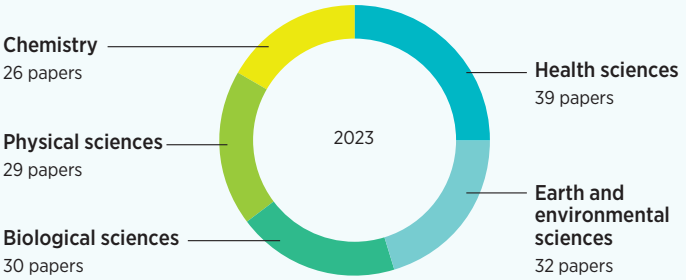
1 **University of Minnesota**
2 **Chinese Academy of Science**
3 **University of Wisconsin-Madison**
4 **University of Toronto**
5 **University of Michigan**

from Nature Index
1/1/23-31/12/23

(International) Katerina_Andronchik/iStock/Getty; (Domestic) undefined undefined/iStock/Getty

OUTPUTS IN EVERY FIELD

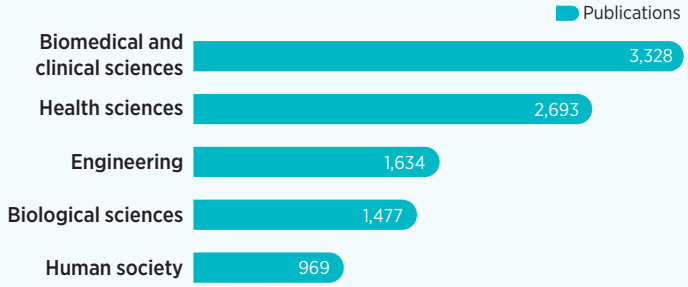
In the 2023 Nature Index, Western had a balanced spread of 156 publications, with the health sciences topping the number of publications by a small margin.



Sources of data: www.nature.com/nature-index

TOP FIELDS BY NUMBER OF PUBLICATIONS

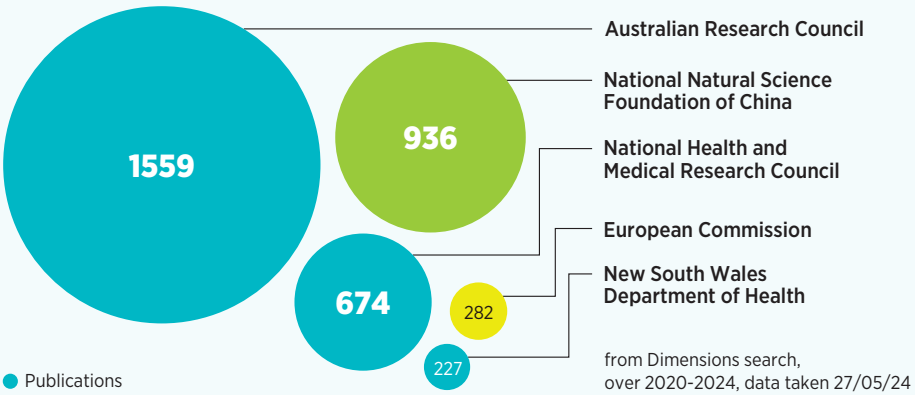
Dimensions is the world's largest research information database, with more than 140 million publications. From 2020 to 2024, Western's top 5 research fields (2-digit FOR) by publication are shown below.



from Dimensions (www.dimensions.ai); from 2020-2024, data taken 27/05/24

TOP FUNDERS

A Dimensions search revealed Western's top funders by publication count, with the Australian Research Council leading the pack at 1,559 publications citing an ARC grant between 2020 and 2024.



from Dimensions search, over 2020-2024, data taken 27/05/24

PARTNERSHIPS AND FORMAL AGREEMENTS

Western has formed a wide international network of strategic relationships and collaborations to advance the University's research, teaching and innovation.

International institutions
more than 320

Organisations
53 countries

TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS 2024

The THE 2024 World University Rankings include more than 1,900 universities across 108 countries and regions.

In the TOP 350
Overall

TOP 175
Education

TIMES HIGHER EDUCATION YOUNG UNIVERSITIES RANKINGS 2024

The THE Young University Rankings 2024 include 673 universities across the globe that are 50 years old or younger.

In the TOP 50
Overall

QS WORLD UNIVERSITY RANKINGS 2025

The QS World University Rankings include more than 1,500 institutions across 104 locations.

384
Overall

In QS 2024 Subject ranking 49
Nursing

THE HYPE AROUND 'HYPER-REAL RELIGION'

Beyond being a source of enjoyment and escapism, movies and other aspects of popular culture have the power to inspire religion and spirituality, says a Western academic.

The term 'hyper-real religion' describes how pop culture, including sci fi, can inspire spirituality.

Natalia_80/iStock/Getty

In the early 2000s, Adam Possamai was a young PhD student studying new age spiritualities at Melbourne's La Trobe University. At that time, for followers of these belief systems, "religion was no longer about going to a congregation and listening to what a priest had to say," he reflects. "Instead, religion had become more individualised, with people thinking about religion for themselves, by themselves."

Possamai, who is now a professor of sociology at Western Sydney University, recalls watching with fascination as a new 'religion' exploded into the mainstream: Jediism. Inspired by the *Star Wars* film franchise, followers live by a doctrine centred around peace, mindfulness, positive emotions, self-improvement, and spiritual growth. They also focus on the concept of 'The Force' — a fictional metaphysical energy field depicted in the movies that is deemed to be the "underlying, fundamental nature of the Universe," Possamai says.

People, he observed, were increasingly seeking inspiration for their spirituality and religion from a new source: popular culture, which includes music, television, books and films such as *Star Wars* and *The Matrix*.

"What came out of my research was that people were picking and choosing various elements of religion and philosophy together, some of which includes popular culture," says Possamai, who first defined the 'hyper-real religion' concept in his 2005 book *Religion and Popular Culture: A Hyper-Real Testament*.

"The concept emphasises the replacement of authoritative external forms of conventional religious authority, such as imams, priests and rabbis, as well as sacred texts," he explains.

NEED TO KNOW

- People are increasingly finding spirituality in popular culture, outside of traditional religion, philosophy, and nature.
- Western's Adam Possamai calls this phenomenon 'hyper-real religion'.
- Nearly 20 years on, the concept remains useful for describing societal trends.

A LIFE OF ITS OWN

The idea was revolutionary. "Possamai's argument was quite radical because he stated that religion is not so much about a transcendent God anymore, or new age spirituality, but that people find spirituality in popular culture narratives," says Professor Stef Aupers, a cultural sociologist at KU Leuven, a Catholic institution which is Belgium's oldest university.

It's been nearly two decades since hyper-real religion was conceived, and the concept has "taken on a life of its own," says Possamai.

Today, various universities offer hyper-real religion as a key topic of learning, and other researchers have used it as a springboard for their own work — including Aupers, who previously explored how *World of Warcraft* players became more interested in religion and spirituality after experiencing the popular online game's magical and paganistic elements.

Hyper-real religion has even been used to describe a range of new social practices that have emerged from texts in popular culture. These include the game of quidditch from the *Harry Potter* stories, chess boxing from Enki Bilal's graphic novels, and Real-Life Superheroes — a movement in which people dress up as superheroes to patrol the streets for crime and help the homeless.

More recently, bloggers and journalists have even applied the theory to describe QAnon, the far-right American conspiracy-theory group.

"Hyper-real religion is still a very valid and interesting theory," says Aupers. "There are all kinds of new phenomena out there."

EVOLUTION OF AN IDEA

Over the past few decades, Possamai has further developed his concept of hyper-real religion. For instance, he's examined how social media has hugely accelerated the spread of popular culture.

He is currently exploring the sociology of horror, which he describes as "how ideas from horror fiction and movies are coming into everyday lives through things like gothic or dark tourism, zombie walks, and hell houses." The new research will be published in his next book, due out next year.

His focus has shifted slightly from hyper-real religion's early days. As he explains: "My research now is to see how popular culture can inspire or influence everyday life practices outside of just religion."

Featuring the work of:

Prof. Adam Possamai

School of Social Sciences

CONSTRUCTIVE CRITICISM

Australia's leading literary journal is supporting workers in the arts and cultural sectors.

4 QUALITY EDUCATION

"Stories have a great power in changing the way people understand their lives," says Associate Professor Kate Fagan, the director of Western Sydney University's Writing and Society Research Centre.

Boosting this power of stories is something that the *Sydney Review of Books* (SRB) — Australia's leading critical journal, located at Western's Parramatta campus and hosted by the Writing and Society Research Centre — supports through open-access publication of in-depth longform reviews and literary essays.

"There's a tendency to think of reviews or criticism as an extension of publicity or marketing," says Dr James Jiang, the journal's editor. But the SRB conducts criticism as a collaborative and community-based activity. "We aim to create a circuit between readers and writers," adds Jiang.

The idea of community is something that was baked into the SRB from its inception in 2013, particularly as a part of Western.

"Many of the communities of students, readers and families attached to our university have a wonderful relationship to diasporic communities around the world," says Fagan. "Western Sydney is speaking to the world, and with the world, all the time. That is tremendously exciting in terms of the opportunity for the SRB to position itself for an international audience, too."

The SRB pays industry best-practice rates, and since 2019 has published nearly 700 articles and disbursed close to $880,000 in fees for contributors in the process. By doing so, the journal has supported the careers of active critics, whom Jiang notes are often precariously employed.

He adds that SRB contributors have consistently been in the running for the Walkley-Pascall Prize for Arts Criticism, Australia's sole prize for literary criticism, with former editor Dr Catriona Menzies-Pike winning the prestigious award in 2023.

Dr James Jiang, editor of the *Sydney Review of Books*.

NEED TO KNOW

- The *Sydney Review of Books* is Australia's leading literary criticism journal.
- Headquartered at Western, it is entering its second decade.
- It conducts criticism as a community-based endeavour.

The SRB is one of a handful of leading arts organisations to secure major four-year funding ($600,000) this year from Creative Australia, which will support their dynamic review programme across 2025–2028 and enable the appointment of a new deputy editor. And in June 2023, the SRB won the bid to host the City of Parramatta's Laureate Programme, a $50,000 award paid to a highly regarded writer who has made an outstanding contribution to literature and is actively making new work with strong links to the Parramatta region.

The inaugural Laureate is Yumna Kassab, author of the Miles Franklin Literary Award-shortlisted novel *The Lovers*. "Now, I can work towards projects that are actually important to me — the award has opened up possibilities beyond just being a writer," she says. "It has changed the way I think about the world, and the way I want to engage with it."

Kassab says it is crucial having both the SRB and Western Sydney University's literary imprint, Giramondo Publishing, based in Parramatta, in order to support the stories and literary cultures beyond those currently in the mainstream.

Distinguished Professor Alexis Wright is an award-winning and internationally celebrated Waanyi author, whose most recent accolades include the 2024 Miles Franklin Literary Award, the 2024 ALS Gold Medal, the 2024 Stella Prize and the 2023 Creative Australia Lifetime Achievement Award. She attests to the benefit of having a comprehensive analysis of her work published in the SRB, noting: "I have appreciated the many positive flow-on effects from the very high standard of analysis in these reviews, that have helped to promote my work."

In addition to championing writers and critics, the SRB team has engaged in advocacy across the literary sector, from writing reports on the state of literary journals in Australia, through to participating in government roundtables and contributing to the creation of the upcoming industry body, Writers Australia, under the Creative Australia umbrella.

Now in its second decade, the SRB plans to continue leading conversations around the revaluation of literature, to advocate further for inclusive digital publishing, and to expand platforms for First Nations writers, editors and critics. "The books in the SRB bring forward the voices of artists who may not necessarily have a public platform in other areas, and show us what we care about as communities," says Fagan.

Featuring the work of:

Dr James Jiang and A/Prof. Kate Fagan

- Writing and Society Research Centre

Sally Tsoutas

SAVING TOMORROW'S TREES TODAY

Scientists are looking at how species selection can make urban trees more resilient to climate change.

A recently planted tree in a Sydney street failing under hot and dry conditions.

11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION

Climate change has already put more than half of the world's urban tree species at risk of stunted growth or death. Work led by two Western Sydney University scientists now shows that anticipated future change will put up to 70% of our urban trees under stress by 2050.

"It's not just the warming, but the creation of urban heat islands and more extreme heat waves," says biologist, Dr Manuel Esperon-Rodriguez, who has worked with Associate Professor Paul Rymer and a team of international researchers to reveal the findings.

According to Professor Mark Tjoelker, associate director of Western's Hawkesbury Institute for the Environment, the most beneficial outcome of the work, with broad practical applications, is the comprehensive analysis of the climate risk for urban trees worldwide.

"It's an amazing database of tree species that are commonly planted here in Australia and elsewhere, and it provides a framework for assessing climatic risk in the current urban forestry portfolio," Tjoelker says. "If you're an urban planner, or someone who's interested in trees in your backyard, having that new tool for risk assessment unlocks a lot of potential for planning."

Beyond their beauty, urban trees provide a wide range of benefits for people and nature. "Urban forests are extremely important to support local biodiversity and ecosystem services, including nutrient cycling, carbon capture, water purification, and pollution capture," says Rymer. "They also provide people with essential public green spaces important for physical and mental health. As cities grow it is critical to support and build robust and diverse urban forests."

Rymer's team is expanding research to investigate the adaptive capacity of native plants in urban forests across Australia. Esperon-Rodriguez is exploring the social aspect of how people interact with green spaces and how urban trees affect human health.

To increase the odds of survival for urban forests, homeowners and urban planners need to think carefully about what they plant today. "It's not just about the number of trees planted, we need to plant species that will survive in a changing climate," Esperon-Rodriguez says. "2050 is just around the corner, we're running out of time."

NEED TO KNOW

- Urban trees are under threat by an increasingly harsh climate.
- Researchers from Western have created a database that analyses climate risk for species commonly planted in Australia and elsewhere.
- This database will be invaluable for urban planning and keeping cities cooler.

Featuring the work of:

Dr Manuel Esperon-Rodriguez and A/Prof. Paul Rymer

- Hawkesbury Institute for the Environment

SWEET SUCCESS FOR LOCAL POLLINATORS

As the threat of the *Varroa* mite becomes a reality for Australian agriculture, farmers are looking for alternatives to European honeybees.

At Bill Shields' apple orchard in the Blue Mountains of New South Wales, there's almost as much focus on flowers as there is on fruit.

An abundance of plants in flower flourish between rows of trellis-trained apple trees and in surrounding garden beds. Depending on the season, these blooms range from the broad, bright yellow faces of sunflowers to delicate, blue, star-like inflorescences of borage plants.

This floral display is not just for show. It's there to act as an enticing buffet for local pollinator communities, including the native stingless bee (*Tetragonula carbonaria*). "On our farm, there are lots of flowers, and even flowering weeds, so there's always something around for pollinators," Shields says.

Dozens of insect species visit his flowers, and around half carry pollen. He knows this because Shields Orchard, located just outside the town of Bilpin, New South Wales, was involved in a Western Sydney University-led project investigating the role of native pollinators in sustainable food production.

Around 75% of Australian crops benefit from pollination. Some — including most apple cultivars — can't produce fruit without it. Most pollination is enabled by commercial hives and feral nests of the introduced European honeybee (*Apis mellifera*).

But overall, insect pollinators have declined worldwide in recent years, due to pesticide use, pathogen exposure, habitat destruction and climate change. Now, another major threat looms in Australia, a mite known as *Varroa destructor*.

The rapidly spreading parasite can wipe out honeybee colonies. Despite biosecurity controls, Varroa was detected near Newcastle in 2022, and in September 2023, the National Management Group, which coordinates the national *Varroa* mite response, declared that the species had established itself beyond the possibility of eradication.

Entomologist Professor James Cook, from Western's Hawkesbury Institute for the Environment, says farmers can no longer take honeybee pollination for granted.

NEED TO KNOW

- *Varroa* mite has established itself in Australia.
- It poses a serious threat to agriculture that is reliant on honey bees as pollinators.
- Native insects, such as stingless bees, may offer a solution.

And there's plenty at stake: the Australian apple industry alone is worth more than half a billion dollars each year. In light of this, farmers and scientists are investigating whether native wild insects — which are not directly attacked by *Varroa* — might pick up some of the pollination slack.

EATING A BALANCED DIET

While the lion's share of Australia's crop pollination work currently falls to honeybees, native insects ferry pollen around crops too.

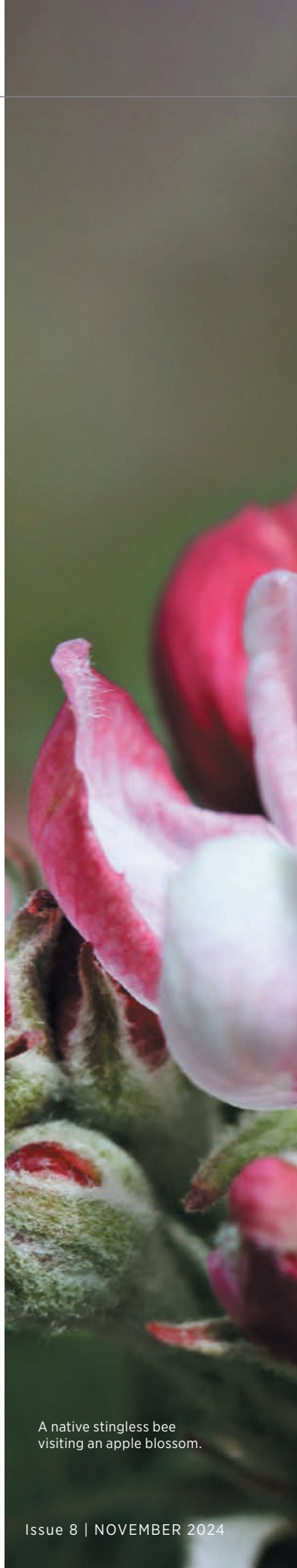
To discover how much they contribute to orchard pollination, a fieldwork team led by ecologist Dr Amy-Marie Gilpin, also from Western, conducted insect surveys at other NSW apple orchards in Bilpin and Orange.

During the 2017 and 2018 springtime flowering seasons, the team identified and counted insect visitors to blossoms from the Granny Smith and Pink Lady varieties of apples in nine orchards.

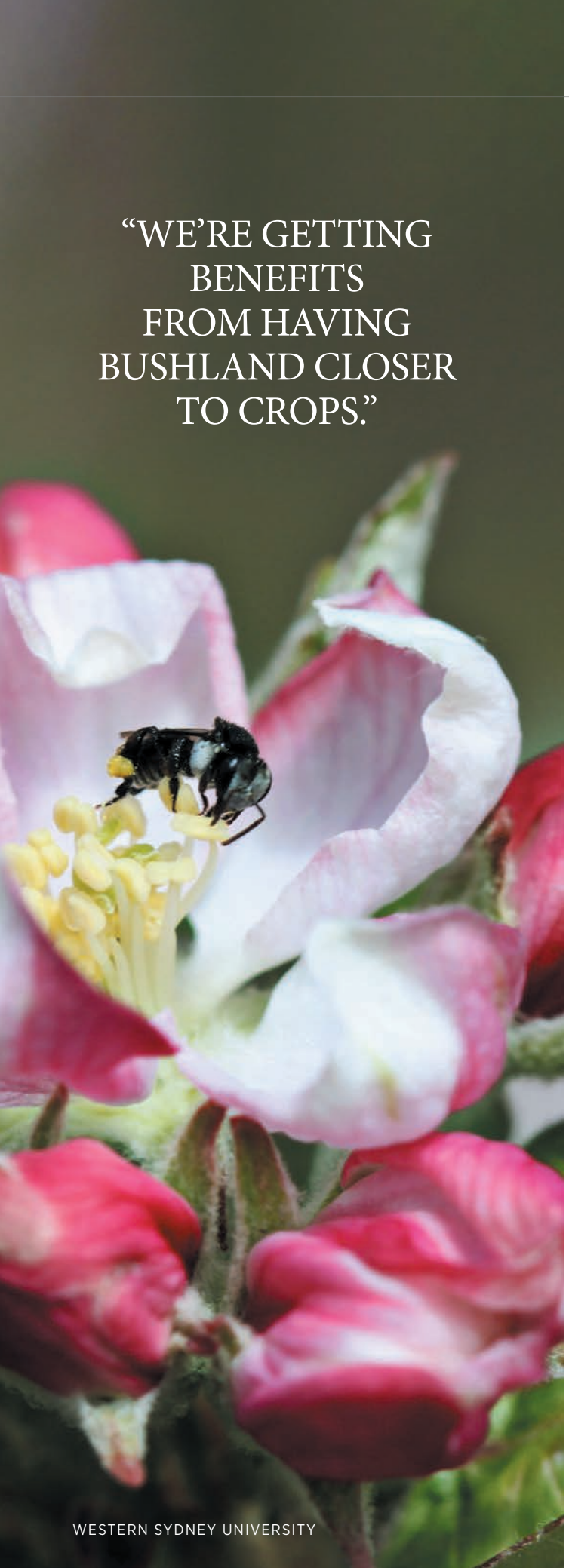
They found honeybees dominated orchards in Orange, accounting for at least 85% of apple flower visitors. At Bilpin, honeybees were also common visitors, but the native species *Tetragonula carbonaria* frequently dropped by apple flowers too.

During warmer weather, stingless bees easily outnumbered honeybees. Stingless bees don't like the cold, and won't leave their home until the air temperature hits around 18°C. But when it was warm enough, they emerged en masse, and the researchers sometimes counted 20 stingless bees to every honey bee, Shields adds.

Orchards with a diverse range of flowering plants growing around fruit trees were visited by pollinators more often than those with fewer flowers.



A native stingless bee visiting an apple blossom.



"WE'RE GETTING BENEFITS FROM HAVING BUSHLAND CLOSER TO CROPS."

Like humans, insects have food preferences, and might prefer to visit a tasty lavender spike and leave the apple blossoms alone. But also like us, insects benefit from a balanced diet. So while they might only visit apple flowers part of the time, Gilpin says a diverse choice of flowers in an orchard keeps them coming back, increasing overall crop pollination.

The Western team conducted a similar study at sweet cherry (*Prunus avium*) orchards in Bilpin, Orange and further afield in Young, New South Wales, and found the same trend.

"All of our research indicated that there are only benefits for crop pollination from having co-flowering plants within orchards," Gilpin says.

ATTRACT POLLINATORS

Data from Gilpin and Cook's project, which was primarily supported by Horticulture Innovation Australia, a not-for-profit, grower-owned research and development company, will help inform farmers of new approaches to maximise pollination.

For instance, growers in the past would clear vast swathes of native bushland around fruit trees, thinking pollinators would be forced to stay inside the orchard and maximise pollination.

"But actually, we're getting benefits from having bushland closer to crops, not just for floral resources, but also native pollinator habitat," Gilpin says.

Maintaining habitat close by is important because native bees don't generally roam as widely as honeybees. Even stingless bees, which live in large colonies, tend to stay within a few hundred metres of their home, Cook says.

"So if you're looking for free pollination benefits from wild bees, you don't want them to have to travel very far."

To help growers attract and maintain their pollinator army, Dr Lena Schmidt, who is now at the University of New England, has collaborated with Greening Australia to develop a native wildflower seed mix tailored to Bilpin's pollinating inhabitants.

The idea is to give pollinators access to nectar and pollen year-round, so when one plant species stops flowering, another has already begun.

Cook, Gilpin and colleagues are also studying the types of pollinators visiting other crops such as mangoes, macadamias and avocados, and examining ways to support the expansion of managed stingless bee hives across the country.

In Bilpin, Shields continually adds to his orchard's floral ensemble to shore up his local pollinator population. When *Varroa* mite inevitably reaches his orchard, he and his apple trees will be as ready as possible.

"If we've got any spare land, we will quite often plant some bee seed mix in it, to encourage bees to stay around. We're very sympathetic to the bee population," Shields says.

"I've always been keen to have researchers on the property, because I can pick their brains and learn quite a lot. And that's had a big impact on the way we've managed the place."

Featuring the work of:

Dr Amy-Marie Gilpin

↗ School of Science

Prof. James Cook

↗ Hawkesbury Institute for the Environment

GETTING THE RIGHT COMBINATION

As more patients combine traditional and prescription medicines, the Integrative Medicine Gateway database provides clinicians with evidence-based insights on potential interactions.

3 GOOD HEALTH AND WELL-BEING

Though effective on their own, certain prescription drugs can have adverse effects when taken with others. For example, combining a blood thinner with a nonsteroidal anti-inflammatory drug can increase the risk of bleeding. Many such drug–drug interactions are documented in databases that physicians and patients can refer to.

However, much less is known about how complementary medicines interact with prescription medications, although it is common for both to be used simultaneously. "If the patient is taking traditional Chinese medicine without informing their general practitioner, it can be hard to identify the causality when there is an adverse reaction," says Dr Phoebe Zhou, a research support programme fellow at Western Sydney University's NICM Health Research Institute.

To address this gap, Zhou and her collaborators at UnityHealth, an independent health information and technology services company, are pioneering a new database focused on interactions between pharmaceutical drugs and traditional Chinese medicinal herbs. The database, to be delivered via the Integrative Medicine Gateway (IMgateway), provides evidence-based information to support informed decision-making. Through a user-friendly, colour-coded system, users can quickly assess the level of risk associated with each interaction, ranging from adverse effects (red) to potential benefits (green).

NEED TO KNOW

- Combining prescription medication with complementary medicines can lead to adverse effects.
- A new database is providing information about the interactions between pharmaceutical drugs and traditional Chinese medicinal herbs.

Information on more than 100 herbs has been validated so far, and the database will be publicly released when there are 200 entries, Zhou explains. "The western herbs database is already used by pharmacists across Australia. IMgateway can be integrated with any drug information system around the world so we look forward to our interactions database being actively used across many countries," she says.

Once launched, the next step will be to educate pharmacists in Australia and beyond on how to get the most out of the database, Zhou adds. In the future, there could also be a chat function where consumers or patients could talk directly to a pharmacist, rather than making a trip to their GP.

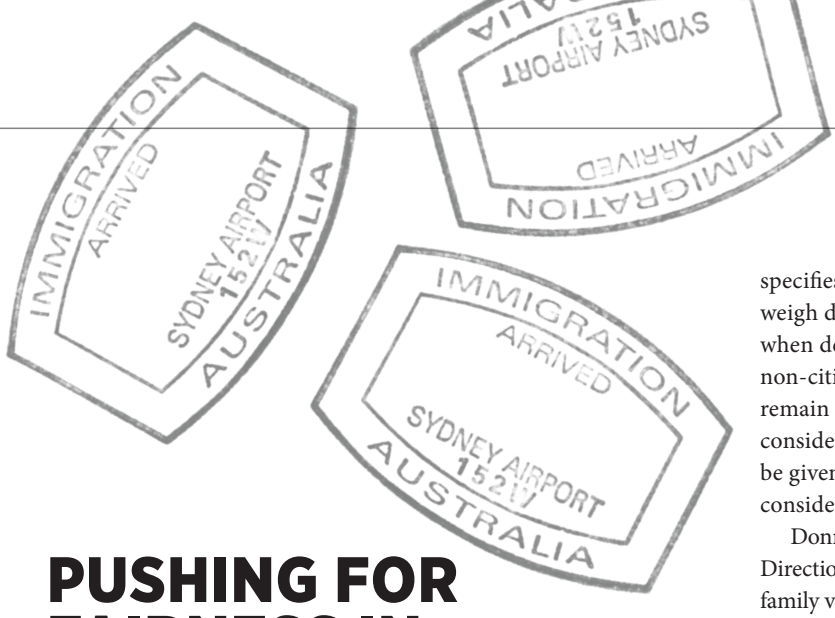
"The ultimate goal is to support patients in self-care and improve the therapeutic relationship they have with their healthcare provider," says Peter De Lorenzo, UnityHealth's CEO. "We highly value our collaboration with the team at NICM HRI at Western which has advanced the IMgateway drug–herb interaction platform and enhanced the scientific evidence supporting the database."

In addition to UnityHealth, the project was supported by grants from the Australian Department of Education's National Industry PhD Program, as well as the Graduate Research School and NICM HRI at Western. The project was initiated in 2017 by Professor Alan Bensoussan, and is now led by Zhou at NICM HRI.

Featuring the work of:

Dr Phoebe Zhou

NICM Health Research Institute



PUSHING FOR FAIRNESS IN VISA DECISIONS

Double counting of offences in migration law erodes Australia's commitment to international human rights, says a Western law researcher.

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

All his life, Dr Jason Donnelly has felt a strong connection to migrants.

His mother grew up in a refugee camp in Chullora, New South Wales, after her parents migrated from Poland and Germany following the Second World War. As a child in the 1980s, Donnelly lived amid a diverse and vibrant community in the south-west Sydney suburb of Cabramatta, which included many refugees who had fled to Australia after the Vietnam War.

So immigration law seemed a natural focus for him when he decided to study law at university: first as an undergraduate at Macquarie University and Western Sydney University (where he graduated with the University medal in the Bachelor of Laws (Hons 1) program) and then as a PhD student at the University of New South Wales.

"Immigration is the closest thing under Australia's domestic law where you're dealing with human rights in a very direct way," says Donnelly, who in addition to running a large pro bono refugee legal practice in Australia, is a senior lecturer in law at Western. He is also the course convenor and founding author of Western's Graduate Diploma in Australian Migration Law.

DOUBLE DIPPING

Immigration appeals fall under administrative law, which regulates government decision making. Such appeals are handled by the Administrative Appeals Tribunal (AAT), where various members are political appointees. The Labor Government is seeking instead to introduce the Administrative Review Tribunal (ART), being a fairer and more transparent decision-making body.

Of particular interest to Donnelly is Ministerial Direction 99, which deals with government policy for non-citizens impacted on character cases under the Migration Act 1958 (Cth). It specifies how the AAT should weigh different considerations when deciding on whether a non-citizen is permitted to remain in Australia. Primary considerations should generally be given more weight than other considerations.

Donnelly's concern with Direction 99 is the way in which family violence is considered by the AAT. While family violence is explicitly factored into the primary consideration of 'Protection of the Australian Community', Direction 99 mandates that it is also considered as a separate primary consideration. "It's double counting," says Donnelly.

Where things become more complicated is that administrative law is not subject to the same rules of evidence or proof as a criminal court. "In some cases, tribunals have found mere allegations of family violence to be independent and authoritative evidence of the act of family violence," says Donnelly. "In my respectful opinion, that's absurd because it hasn't actually been tested through the court process."

With Direction 99, released in March 2023, Donnelly was disappointed to find that Australia's international obligation under The United Nations Convention Relating to the Status of Refugees – to protect refugees and asylum seekers – was to generally be treated as a secondary consideration. "It doesn't look good for our obligation to protect and advance human rights," he says.

If a migrant is expelled from the country because their visa is refused or cancelled, the consequences are serious for both them and their families, Donnelly notes. "The impact is perhaps the same, if not more severe, than for someone who goes to jail for a few years."

Aside from studying Direction 99, Donnelly has extensively researched the AAT itself and the need for merit-based appointment. He has given evidence and submitted documents to parliamentary inquiries at the Commonwealth level.

"I'd like to think that my small contribution has added to the body of voices that have persuaded the current government to introduce legislation to abolish the AAT and replace it with a new, transparent, merit-based appointment process," says Donnelly.

Donnelly views the impact of his research and practice as a subtle building up of knowledge and awareness in the public and academic spheres.

His colleague, Professor John Juriansz, director of the Whitlam Institute at Western, is more effusive. "A deeply committed and skilful advocate for the disempowered and disenfranchised, Jason is the embodiment of the hope, potential and the highest aspirations of Western Sydney University," he says. "He is proof positive of the fulfilment of our mission."

NEED TO KNOW

- Immigration appeals fall under administrative law.
- Western's Jason Donnelly has reservations about how the tribunal weighs considerations in visa revocations.

Featuring the work of:

Dr Jason Donnelly

School of Law

Jamesbowyer/iStock/Getty

GETTING INTO THE RHYTHM TO TREAT LANGUAGE DISORDERS

Listening to a rhythmic beat can enhance how well children with language processing difficulties repeat sentences.

4 QUALITY EDUCATION

Children with language processing difficulties

showed a marked improvement in their ability to repeat sentences after listening to regular rhythms, a study by researchers from Western Sydney University has found. This discovery could speed up therapy for language disorders.

Dr Anna Fiveash, the lead author on the paper, is fascinated by the way music enhances the brain's language processing abilities. "Music and language share pathways in the brain, making music a useful tool for improving language processing," she says.

This field of study combines two of her passions: "My academic background is in cognitive psychology, and I've been playing music since I was young," says Fiveash, who sings in a choir and plays the guitar and ukulele. "So it's natural for me to explore connections between music and language, and how we can use music to boost language processing."

Children with a condition known as developmental language disorder (DLD) often struggle with communication, understanding and answering questions, and following instructions. "They often have a hard time comprehending sentences and tend to make grammatical mistakes in sentences when they speak," explains Dr Enikő Ladányi, a cognitive scientist at the University of Potsdam, Germany, and a co-author on the study.

This can disrupt both their social development and education. "If you have trouble with language processing, it can be really detrimental to your education and life," notes Fiveash, who is an ARC DECRA research fellow at the MARCS Institute for Brain, Behaviour and Development at Western.

"When children struggle to understand their teachers and peers, it can significantly affect their learning and their abilities to make friends and integrate into society," adds Ladányi.

An estimated 5-7% of children suffer from DLD, but Fiveash suspects that may be an underestimation. "In reality it's probably higher because the disorder often goes undiagnosed," she says. "People can dismiss it as a behavioural problem."

"DLD is frequently overlooked or only identified when the child is older, partly because it isn't well known and there isn't enough research on it," says Ladányi. "This oversight can have serious consequences."

NEED TO KNOW

- Children with developmental language disorder can have trouble with communication.
- This can lead to difficulties in social development and education.
- Studies have shown that listening to rhythm can improve language processing.

Dr Anna Fiveash.

LISTENING TO LEARN

Children diagnosed with DLD require speech pathology sessions, which can be a slow and costly process when using traditional approaches.

There is growing evidence for the beneficial effects of music on learning. In particular, after listening to regular rhythms (compared to irregular rhythms), children performed better in assessing whether a sentence was grammatically correct.

Now, Fiveash and her colleagues have found that children with DLD were better able to repeat sentences after listening to around 30 seconds of regular rhythms.

"Previous studies had asked children to detect whether a sentence has a grammatical error, which is more to do with perception skills," explains Fiveash. "But this is the first time to show that rhythm can enhance

Jacob Wackerhausen/iStock/Getty

Incorporating rhythm can help improve language processing skills.

DEVELOPMENTAL LANGUAGE DISORDER (DLD) affects

1 IN 14 PEOPLE

(infographic) Yulia Sutyagina/iStock/Getty; statistic from Norbury et al. J. Child Psychol. Psychiatry. 57, 1247 (2016).

language production, which is really exciting."

The findings support the view that musical rhythm and grammar processing are strongly intertwined within the brain, say the researchers.

The mechanism is thought to involve the entrainment of brainwaves by the regular rhythms, which then are activated and ready to process language. "We think that playing this rhythmic music sets up, or entrains, neural oscillations, which continue even after the music stops," says Fiveash. "And they then help to boost language processing."

Harnessing this effect could help to add a new dimension to speech pathology. Fiveash says it may be possible to use rhythm as a supplementary treatment that could help boost conventional methods.

"These results lay the groundwork for future research looking to explore the potential benefits of including rhythmic priming in therapy for children with DLD," adds Ladányi.

Fiveash plans to optimise the rhythms for improving language processing. She is also keen to work with schools. "It would be great if there are schools interested in working with us on this," she says. "We'd love to collaborate and find out what their needs are and how this kind of paradigm could fit into a classroom."

For Fiveash, the study is just the tip of the iceberg, providing one example of the power of music to enhance lives. "I think that music is a largely untapped resource that can improve people's lives in many ways," she says.

Featuring the work of:

Dr Anna Fiveash

↗ The MARCS Institute for Brain, Behaviour and Development

PROTECTING LANGUAGES TO SAVE KNOWLEDGE

Studying the endangered languages of Croker Island has led a Western Sydney University researcher down many research paths, including bush medicine, ecology and the preservation of sacred sites.

3 GOOD HEALTH AND WELL-BEING

10 REDUCED INEQUALITIES

Aboriginal and Torres Strait Islander peoples are advised that information in this story may be culturally sensitive for some individuals and communities.

Robert Mailhammer, a professor of linguistics at Western Sydney University, has been documenting the Indigenous languages of the Northern Territory's Croker Island for the past 15 years.

As there are few people still alive who can speak the island's traditional languages, Mailhammer began his research by studying old recordings of spoken Amurdak, a language thought to be extinct. However, on his first visit to Croker Island, in western Arnhem land, he met some elders who could still speak the language, although it had not been used in many years. He was able to work with these people, most of whom have now passed away.

While documenting Amurdak, Mailhammer received an ARC grant to also research Aboriginal English on the island.

"It seemed that everyone was speaking their own version of English," he says. "My background is in historical linguistics, looking at how language has changed, particularly under influence from other languages."

LANGUAGE DOCUMENTATION

In 2013, Mailhammer began a long-term collaboration with Dr Patrick Caudal, a linguist from the University of Paris, in France, who at the time was researching languages of Western Australia's Pilbara region.

Professor Robert Mailhammer (far right) and Charlie Mangulda, senior elder and songman (third from right), with Indigenous rangers on Croker Island in 2024.

Priyanka Kharbanda

"We were both fascinated by the nuances of Indigenous Australian languages," recalls Caudal. The pair began to research Iwaidja — one of the main languages on Croker Island — and had their first joint field trip in 2013.

"Iwaidja proved to be a perfect laboratory in which to make new discoveries. Together, we have created novel experimental tools for eliciting data in the field — in particular, building a substantial videoclip database, a method which has now been used for well over 15 under-studied languages," says Caudal.

Mailhammer also worked with the ARDS Aboriginal Corporation on the Iwaidja language documentation project, then-Language & Resources Manager, Emma Murphy, says their involvement began as part of a health promotion project, helping people create resources in their own languages.

She adds that towards the end of the project, families, school workers and others were keen to continue to strengthen local languages through resource development. "People want the next generations to be hearing, speaking, reading and writing their heritage languages, and they worry when this isn't happening," says Murphy.

"The project was a continuation of other great work by elders, linguists and ethnobotanists over many years," she adds. "Rob Mailhammer is one such linguist with a long history doing this work, and it was great to have the opportunity to partner with Western for this project."

CULTURAL CLUES

Over the years working on Iwaidja, Mailhammer became aware of the importance of the language to convey cultural information, such as kinship terms that can't be translated. An understanding of the culture and language has been important at Mamaruni, the school on Croker Island.

Under the culture of the island "people belong to different groups, which is something teachers need to understand. Brothers and sisters at a certain age are no longer allowed to talk to each other or be in close proximity'" he says. "Because the concept of kinship is much broader than it is in western societies, you might have 'brothers' and 'sisters' who aren't related by blood. If schoolteachers put them at the same desk, for example, it causes them huge discomfort."

To help address issues like this, Mailhammer ran workshops on the language and culture for new teachers with little background knowledge. "We have also involved the community, where elders explain the significance of kinship groups to the kids," he says.

> "SWITCHING TO LANGUAGES THAT SUPPORTED LEARNING WAS MORE FRIENDLY."

It has been a success, but continuity remains a problem — with teachers moving on every few years, there is no one to take on this training over the long term, and running it relies on the willingness of the principal and availability of elders.

Heleana Yarrngu, a former teacher and Indigenous woman from Croker Island, worked with Mailhammer on a project to use Kunwinjku, another of the island's Indigenous languages, to teach maths.

"Switching to languages that supported learning was more friendly and we could communicate a lot easier than by just using English," says Yarrngu.

"Using a mother-tongue at the beginning of lessons to explain what we are going to learn would support better outcomes in two-way learning. Having a relationship in our first language and then being able to communicate, supports both the Indigenous teacher and the students to learn better," she says.

In the future, Mailhammer would like to start a bilingual programme at the school with funding for a teacher in Indigenous language.

TRADITIONAL KNOWLEDGE

As well as documenting and recording the languages of Croker Island, Mailhammer and his team have become involved in wider projects focused on specialised terminology and usage, such as ecological and ethno-medicinal knowledge (bush medicine), poetry and music — types of knowledge which can be lost when key speakers pass away.

In partnership with the ARDS Aboriginal Corporation in Darwin and the University of Paris, Mailhammer is producing an ethno-medicinal dictionary written in Iwaidja.

"It will be valuable, not just for the island's health clinic, but also to document how Indigenous people on this island view health as a concept," he says.

For example, "the clinic measures weight and other indicators that western medicine regards as important," he says, "but if we can understand what factors are important as health indicators in the local culture, we can do a better job of rolling out health services here and in other Aboriginal communities".

The researchers have also been helping Croker Island's rangers to gain protection for many of the island's sacred sites through registration with the Aboriginal Protection Authority.

"Some sites have been identified but not registered, so people go fishing or walk in places they shouldn't," says Mailhammer. "These sacred sites need to be documented."

Over many years of working and visiting the island, Mailhammer has built tight connections with people in the community. "When you're not working, you might do a fishing trip together. Sometimes you work in people's homes," he says. "Some of those community members are much more than business partners or informants; they are close friends."

NEED TO KNOW

- Indigenous languages are crucial in passing along cultural, ecological and ethno-medicinal knowledge.
- But many are in danger of going extinct.
- Western's Robert Mailhammer, along with community experts, is working to document many of these languages.

Featuring the work of:

Prof. Robert Mailhammer

School of Humanities and Communication Arts

THE ENVIRONMENTAL DETECTIVES SOLVING ECOLOGICAL CRIMES

Environmental forensics researchers are developing rapid, on-site testing for urgent responses.

15 LIFE ON LAND

In August 2023 in the cold waters of Hazelbrook creek in the Blue Mountains of New South Wales, almost 1,000 crayfish were dying. Bifenthrin, an insecticide which is highly toxic to aquatic organisms, that was probably spilled on a suburban driveway had made its way through the stormwater system to the creek's previously pristine waters.

This tragedy was accidental. But such careless behaviour — which resulted in an $8,250 fine — amounts to 'abuse of the environment'. According to the United Nations' Environment Program (UNEP), environmental crime is one of the most common criminal activities in the world.

In 2017, the UNEP recognised 'environmental crime' as a component of 'transnational organised crime', noting that it posed a growing threat to peace, security, sustainable development and the environmental rule of law.

Investigation of such crime is done by environmental forensics scientists, like Associate Professor Val Spikmans at Western Sydney University.

"From a forensic science perspective, environmental crime is defined as illegal activity that involves the environment in a negative way, done in a way that is possibly not on purpose, but still negligent," Spikmans says. It covers everything from someone illegally dumping household waste to the large-scale release of chemicals from an industrial facility, and describes pollution of land, water or air.

While the definition of environmental crime hasn't changed much over time, the technology and scope have.

There is now an understanding that the impacts of an environmental crime can extend far beyond the present, to affect the environment and people tens, hundreds, or thousands of years into the future.

Having started his career working with the NSW Department of Environment and Conservation as a forensic scientist, Spikmans switched to conducting research at Western Sydney University in 2012 with the aim of developing better technology and techniques for environmental forensics.

Part of the challenge with field investigations is that the crime scene can change rapidly, sometimes even in a matter of minutes if the pollutant is waterborne or airborne. "It's all about getting a result quickly; even 10–15 minutes can be too long," Spikmans says.

In the field, forensic scientists need rapid data on the type and concentration of the pollutant over the affected area to be able to trace it back to its source.

Spikmans and colleagues from Fire & Rescue NSW, the NSW Department of Climate Change, Energy, Environment and Water, the NSW Environment Protection Authority (NSW EPA) and the Global Forensic and Justice Center at Florida International University have developed field-based screening methods, using scaled-down portable versions of benchtop laboratory equipment that can be tailored to each pollution scene. The idea is that the equipment will help rapidly identify the presence of any chemicals of concern, and indicate whether the concentration is high or low. That information is vital in working out what threat the contamination poses — and what protective measures might be needed.

It's also used to map out where the chemical has spread, and its source. "You determine the chemical profile, but then you physically trace that chemical profile back upstream, to see where it might have come from," Spikmans says.

As part of the development of field capabilities, Spikmans and colleagues designed and built a mobile forensic laboratory from the ground up to house all the equipment required and to provide a working space for sample analysis whilst in the field.

One of Spikmans' students, Denise Duff, has developed a comprehensive protocol for the lab, which includes what pieces of equipment will be needed, how the samples should be handled and stored, and how the data should be interpreted. "She demonstrated that on average for a case, it takes about 20 minutes to set up the mobile lab upon arrival and then within about three or four hours she processed all the results," Spikmans says.

"On-site laboratory technology provides information faster during pollution investigations than off-site testing can," says NSW EPA scientist, Dr Ian Holland.

Holland, as an example, points to the potential for contaminated water used to contain a factory fire to enter nearby waterways.

"The in-field testing can inform how that fire water is managed to minimise harm to the community and environment, and whether any messaging for downstream water users is required to keep them safe, such as no swimming or extraction," he says. "A swift response to not only contain the pollution but also identify its source is critical to minimising the amount of environmental harm caused."

NEED TO KNOW

- Environmental crime is a growing problem.
- Western's Val Spikmans is working in environmental forensics.
- With colleagues, he is developing a mobile laboratory for use in the field.

Featuring the work of:

A/Prof. Val Spikmans

School of Science

"IT'S ALL ABOUT GETTING A RESULT QUICKLY; EVEN 10–15 MINUTES CAN BE TOO LONG."

CasarsaGuru/iStock/Getty

Environmental crime is a growing global problem.

RAISING THE ALARM ON TOXIC METALS IN WATER AND SOILS

Affordable heavy metal sensors could enable clean water to be accessible to all, say Western scientists who are developing detectors using new materials.

6 CLEAN WATER AND SANITATION

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

When heavy metals from industrial activities leach into soil or water, they can cause serious health risks and environmental damage. Exposure to lead, for example, can lead to neurological disorders; while other heavy metals, such as cadmium, disrupt nutrient cycling by reducing the number and diversity of nitrogen-fixing bacteria in plants.

Current methods for detecting heavy metals — such as spectroscopy and chromatography — often require expensive equipment, skilled personnel, and time-consuming sample preparation. These methods may not be readily accessible in resource-limited settings or for individual users. Portable and cost-effective alternatives are urgently needed to make safe drinking water available for all, an aspiration inscribed in the United Nations Sustainable Development Goals.

To address the need for sensitive and accessible detection methods, a team of researchers led by Dr Feng Li, at Western Sydney University's School of Science, has developed a copper chemosensor based on what is known as a 'metallo-supramolecular material'. Copper is commonly found in the water from old buildings with copper pipes, and can cause liver and kidney disease when ingested at high doses over long periods of time.

The new sensor — 5-(diethylamino)-2-(2,3-dihydro-1H-perimidin-2-yl)phenol, or 'HL' — is not only remarkably sensitive but also produces an optical signal that can be seen with the naked eye.

"Our chemosensor, HL, has three key components: a receptor specific to copper ions, the optical component that produces a visible colour when activated, and an electron donor linking the two," Li explains.

The researchers have found using spectroscopy, that HL detects copper ions at concentrations as low as 0.235 parts per billion (ppb). However, even without equipment, it produces a visible colour change at 159 ppb, which is well below the World

NEED TO KNOW

- Copper can lead to liver and kidney problems when ingested at high levels.
- Western's Feng Li and team have developed a sensor that can detect low levels of copper ions in water.
- This test could make it possible for communities to cheaply test their own water supplies.

The copper sensor developed by Dr Feng Li and his team could make it possible for communities to cheaply test their own water quality.

Health Organization (WHO) recommended 'safe' human consumption limit of 2,000 ppb.

"Notably, our sensor is water soluble unlike many other chemosensors that rely on organic solvents," Li says. "This makes it more suitable for real-world applications."

For example, Li envisions that HL could be useful for individual households, particularly in rural areas reliant on rain or ground water. Unlike large corporations with access to expensive detection equipment, individual households lack the means to conduct comprehensive water testing. When embedded on a paper — similar to pH indicator strips — HL could enable residents to cheaply test their own water quality. This accessibility empowers communities to monitor their own water supply, promoting awareness and proactive measures to mitigate contamination risk.

Dr Feng Li (far right) and his research team including Dr Daniel Fanna (fourth from left).

Though it is yet to be fully commercialised, HL-based copper sensing proved to have a practical use for Dr Daniel Fanna, a former PhD student in Li's group. Knowing that his grandmother lived in a home with copper pipes, he tested the water after it had been sitting in the pipes for several weeks.

"Although the levels were below the WHO's recommended limits for drinking water, it nonetheless opened my eyes to why it is important to let the tap run for a while to help flush out contaminants, especially if the tap hasn't been used in a while," Fanna said.

In partnership with Western geoscientist Dr Jason Reynolds, the research team has further developed HL to detect copper ions in soil samples as well. Li is now working with Professor Andrew Shalliker, discipline lead of chemical and forensic sciences at Western, to develop and validate a calibrated device that can estimate copper concentration when used in conjunction with an app on a mobile phone.

In addition, Li has developed sensors for detecting other toxic heavy metals, including mercury.

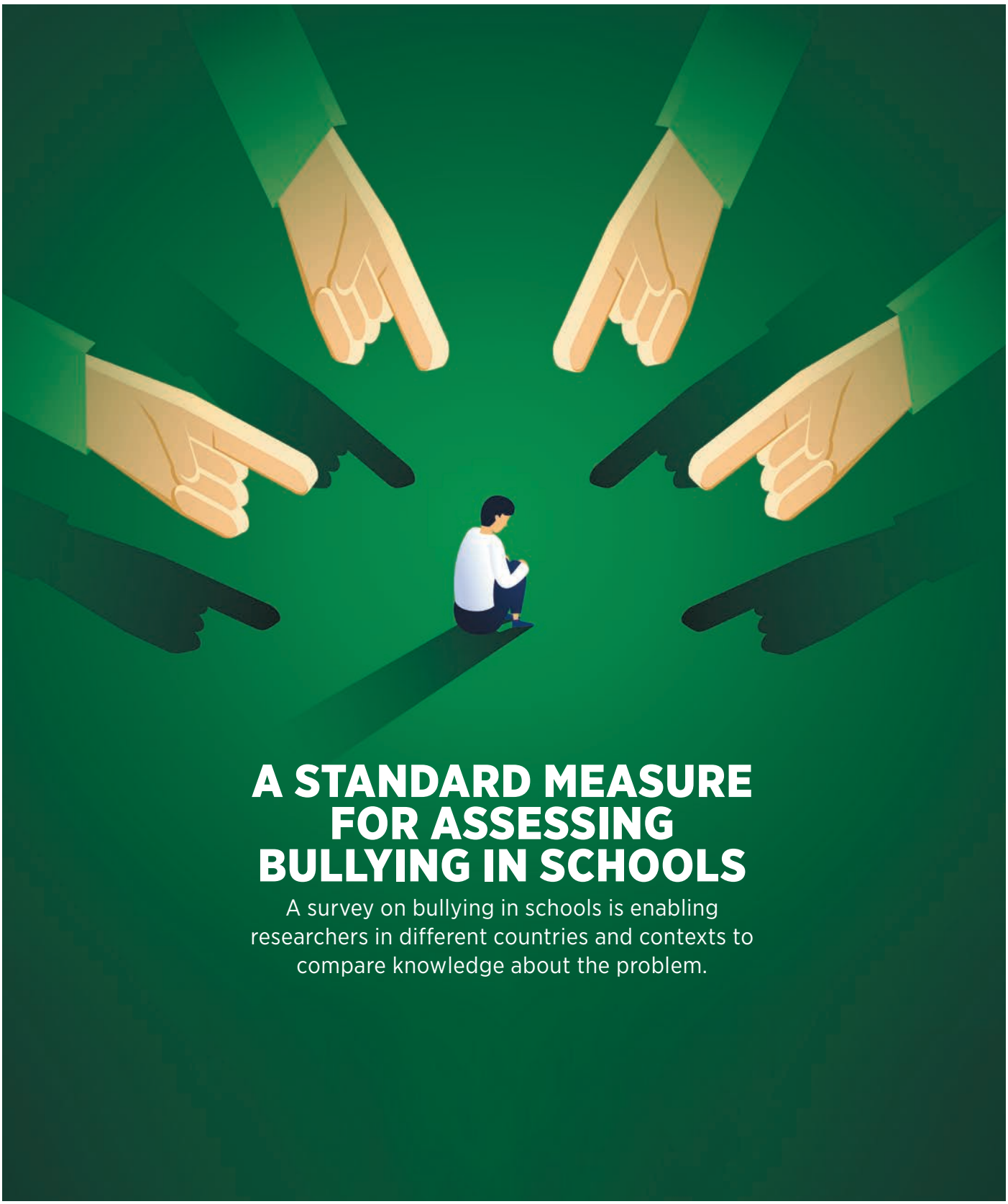
"Ultimately, our goal is to empower stakeholders with the technology to monitor water and soil quality cost-effectively and with immediate results," Li says. "As we build on our existing work on metallo-supramolecular materials, we also expect to develop sensors for pesticides and even new contaminants of concern."

Featuring the work of:

Dr Feng Li & Dr Daniel Fanna

↗ School of Science

Geneviève Vallée/Alamy



A STANDARD MEASURE FOR ASSESSING BULLYING IN SCHOOLS

A survey on bullying in schools is enabling researchers in different countries and contexts to compare knowledge about the problem.

Bullying is an extensive problem in schools.

"A conservative estimate is that about 80% of students have been bullied at some point during their school lives in Australia," says Western Sydney University's Associate Professor Roberto Parada, who has dedicated his career to exploring bullying in schools. He's found that "roughly one in six young people are bullied persistently — at least once or twice a week."

This can have both short-term and long-term impacts. "The immediate impact of bullying on kids can express itself as fear, anxiety, depression and low self-esteem," says Parada. "New research is showing that childhood bullying can have ongoing effects later in life."

But bullying is a highly complex social problem that defies simple analysis, and it requires more than simplistic measures to quantify. That is where Parada hit a problem when he first started to research bullying in the late 1990s for his PhD. "There was nothing that could measure it in a standardised way back then," recalls Parada. "And so, my supervisor challenged me, asking: 'What about creating your own measure?'"

Parada accepted the challenge, and more than 4,500 questionnaires later, he developed the Adolescent Peer Relations Instrument (APRI): a tool for measuring bullying in schools. It measures both the frequency and intensity of bullying, providing a more nuanced understanding of the issue.

The survey poses 18 questions about whether a student has been bullied in various forms (such as being teased, pushed, slapped, ignored or gossiped about) and, if so, how frequently. Questions are then reversed to ask whether the student did any of those actions to other students.

This is important since often the bullied are bullies themselves. "Previous measures used to classify kids as either a bully or a victim," says Parada. "But one study that I did using APRI found that students will sometimes switch between those two roles."

The power of APRI is that it allows the effectiveness of interventions to be assessed using a standard measure. "For the first time, we can compare the results of different types of interventions," says Parada. "The main thing I wanted to accomplish was to realise a standard measure of bullying. It wouldn't matter if you're in Albania, Pakistan or Australia, you can do an intervention and measure its effectiveness using the same standard."

The usefulness of APRI to do this is evidenced by the fact that it has been translated into 15 languages, including Mandarin, Indonesian and Spanish. Parada has made APRI freely available for anyone to use.

Evidence that it can be used effectively in different cultures has been found in Romania. "APRI is a versatile scale, providing information on the frequency of bullying and victimisation as well as on specific types of perpetration and victimisation," says Dr Raluca Balan, a professor in clinical psychology and psychotherapy at Babeș-Bolyai University in Cluj-Napoca, Romania. While APRI was developed and validated mainly on populations in individualistic cultures, Balan and her team were able to use it to study children and adolescents in Romania, which has a collectivist culture."

The tool has helped explode some other common myths about bullying. For example, girls are commonly thought to bully more than boys in relational ways, such as gossiping and excluding. But the data doesn't stack up. "We've just published a study where we looked at more than 400,000 adolescents in 75 countries and we found little to no difference in relational bullying between boys and girls," says Parada.

Parada suspects that such preconceptions have been hard to challenge because of the lack of objective measurements. "These myths perpetuate themselves because of poor measurement," he says.

Using APRI, Parada also found some interesting trends for bullying that are critical to consider when researching the issue. "We found that bullying fluctuated during the school year, with the most bullying occurring towards the end of the school year," says Parada. "This has massive implications. For example, if you do an intervention at the end of the school year and assess its effect at the middle of the next year, you will find a decline. But you'd find the same thing even if you had done nothing."

It also varies by year groups. "There's more bullying in the younger years in high school," says Parada. "It seems to peak around year nine and ten and then it goes down from there, but never to zero."

Surprisingly, APRI doesn't explicitly address the problem of cyberbullying. "What our research shows is that cyberbullying is really just a form of verbal bullying, which is included in APRI," explains Parada. He also believes that the impacts of cyberbullying may be exaggerated since kids can relatively easily ignore hurtful messages. One study of 17,000 students in Finland "found that cyberbullying alone produced no mental health or other effects in children," he adds.

But in general, bullying is a serious problem. "If your child is being bullied, you need to do something about it," says Parada. "You can't just sit on it and hope it will go away."

Thanks to APRI, it is now possible to explore the effectiveness of interventions in an evidence-based manner no matter where you are in the world.

NEED TO KNOW

- About 80% of students in Australia have been bullied.
- But it can be hard to quantify, which impedes analysis.
- Western's Roberto Parada has created a standardised measure for bullying.

Featuring the work of:

A/Prof. Roberto Parada

School of Education

Dr Michelle Ryan conducting field work at Penrith's Boundary Creek to observe platypuses.

WHY THE PLATYPUS FITS THE BILL

Getting more people engaged in platypus protection brings benefits to the wider western Sydney ecosystem, including freshwater habitats.

Matthew Abbott

6 CLEAN WATER AND SANITATION

14 LIFE BELOW WATER

When Dr Michelle Ryan began her career as an aquatic ecologist, freshwater turtles were her focus. But she quickly found her attention drawn to another riverine creature: the platypus.

"They're so quirky, there's no animal like them anywhere else in the world," says Ryan, now a senior lecturer in ecology and environmental science at Western Sydney University.

Endemic to eastern Australia the platypus, a monotreme, is a rarity among mammals, laying eggs rather than birthing live young. Males have sharp spurs on their hind limbs, with which they can inject venom.

The platypus's appearance — an odd assemblage of features approximating an otter's body and fur, a beaver's tail and a duck's webbed feet and bill — was thought so implausible that scientists in Europe who first observed specimens sent from Australia believed themselves to be the victims of a hoax.

"Platypuses are bizarre; every feature of them is weird and amazing," says Ryan.

They are celebrated as one of Australia's most recognisable faunal emblems, but unlike other native species, such as the koala and kangaroos, there is relatively little understood about them. That's because they're incredibly challenging to observe, explains Ryan, who is one of only a handful of researchers studying them in the field. "Platypuses are really elusive — they're out mainly during the night and they don't like being around people, so they're really hard to spot."

Studying them is very time-consuming and expensive, often involving nights wading out into muddy waters, setting nets, and waiting hours for a platypus to swim into them. As a result, there's a dearth of data on the platypus across the Sydney region, including information on population size, range and health, Ryan adds.

Gathering more data will not only help scientists better understand the species, it will also allow the platypus to be better protected against threats such as land clearing and pollution under the law. "I think one of the reasons why they haven't been listed as a threatened species in New South Wales is because we don't have that baseline data," says Ryan. "It's something we're working towards, because platypuses are here but they're under pressure."

NEED TO KNOW

- The platypus is iconic, yet relatively little is known about it.
- Michelle Ryan and her team are working in waterways throughout western Sydney to collect baseline data.
- This will help foster greater protection for platypus, as well as the freshwater habitat they live in.

A platypus, the faunal emblem of New South Wales.

photostrip/iStock/Getty

POSITIVE FOR PLATYPUS

Ryan and her team at Western have been sampling numerous freshwater rivers, creeks and streams in the Greater Sydney area since 2019, searching for signs of platypuses. "Many people don't even know there are platypus in their waterways," she says.

Lisa Harrold, president of the Mulgoa Valley Landcare Group in western Sydney, can attest to that. From historical anecdotes, she knew there probably would once have been platypus living in the 10 km stretch of creek she and her team of volunteers are working to restore. "But I have been all along Mulgoa Creek on many occasions over the past 30 years and I've never seen a platypus, nor have I heard of anyone seeing one."

So when Ryan and her team approached Harrold two years ago seeking permission to sample the water for environmental DNA — tiny traces of genetic material shed by living things into their surroundings — she was surprised that the results came back positive for platypus in two out of four locations tested.

"It was a reward from decades of restoration," reflects Harrold. "Michelle's work has energised me to work so much harder to raise awareness in the broader community about what is going on in the creek that may affect platypus populations."

Similarly, testing of more than 35 locations in the Cattai Creek catchment area northwest of Sydney revealed that platypuses were present in roughly half of the locations sampled. "Nobody in the scientific community had realised

we had platypus in our urban waterways, but Michelle came along and built up the scientific literature," says Sue Martin, chair of the Cattai Hills Environment Network (CHEN).

Following on from the environmental DNA testing, Ryan and her team are now studying platypuses at an individual level. Using nets, they briefly capture the animals from the water to record their sex, weight, length and body fat. They also microchip the animals for future identification and take fur samples to test for the presence of heavy metals.

While she admits much more work must be done to build a comprehensive picture, what her team has discovered so far has been encouraging. Platypus population density is low, comprising a small number spread over a relatively large area, but the "really good news is that we have juveniles, so we know that they are breeding," she says. "And all the platypuses we've captured have really good fat stores and seem to be relatively healthy."

Dr Michelle Ryan and colleagues looking for platypuses in Penrith's Boundary Creek (top, left); Ryan and a colleague taking measurements in the lab at Western's Hawkesbury campus.

(Top and bottom right) Matthew Abbott; (Bottom left) Nerida Taylor

CREATING RIPPLES

For Ryan, getting the local community involved is key to the work, and she holds frequent talks to raise public awareness on how people can help protect platypus. This includes offering tips, such as picking up dog poo — to prevent it from being washed into waterways and causing an excess of nutrients — and not tipping chemicals down the sink.

It's also why Ryan enlisted citizen scientists from Mulgoa Valley Landcare Network and CHEN to assist with eDNA sampling, and engaged volunteers from Greater Sydney Landcare's Streamwatch programme to help monitor water quality.

"When you do conservation monitoring and get to work alongside researchers like Michelle, it makes the work so much more meaningful when you see that your data is contributing to the bigger picture," says Streamwatch's project officer, Jessica Lumbroso.

"People really connect with the platypus," says Ryan who hopes this will encourage the public to take better care of waterways in their neighbourhoods.

"Hopefully it makes them think: 'Hey this is not just a stormwater drain or somewhere where we can dump rubbish, but a place that is home to an amazing creature that needs protecting,'" says Ryan.

In 2021 she was appointed the 'Waterkeeper', or voice of protection, for the Hawkesbury-Nepean River, as part of a global movement of community-based organisations that appoint on-the-river advocates.

The platypus can act as a flagship species — a symbol and rallying point for the conservation of freshwater habitats and their inhabitants in western Sydney. Protecting it, therefore confers benefits to the wider ecosystem.

"Until you have a really cute animal like the platypus, the broader community isn't that interested" in volunteering to help pull weeds along the riverbank to restore the habitat, or protecting less charismatic creatures such as a tiny mussel, says Harrold. "There are so many species that can benefit from that one flagship species."

Already, Ryan's work is creating ripples at the policy level. "The information her team provides for us as a community group allows us to go back to our decision makers and say that this is a really important habitat…we have platypus here, we need to protect them," notes Harrold.

Australia's federal government is taking greater interest as well. In November 2023, it pledged $1 million to establish three sanctuaries, or 'Platypus Parks,' along the Hawkesbury River, which Ryan will help develop. This is part of a wider effort to clean up and restore urban waterways.

She is proud of the work they have done so far. "We've added 66 new points where we've found platypus throughout western Sydney," Ryan says. "We're hoping that that information helps create healthier waterways."

Featuring the work of:

Dr Michelle Ryan

↗ School of Science

INCREASING THE REACH OF EVIDENCE-BASED HELP FOR PARENTS

Researchers call for policy change to improve access to parenting resources and interventions.

3 GOOD HEALTH AND WELL-BEING

Children raised in stressful or unsupportive family environments are more likely to develop emotional and behavioural problems, but with improvements to parenting practices, children's wellbeing and skills can improve too.

Australia is home to some of the world's best evidence-based parenting supports, in the form of information and programmes which are empirically shown to improve parenting and child outcomes. However, Dr Frances Doyle, a clinical child psychologist at Western Sydney University, is finding that these are often not accessible to those who would most benefit from them.

In a 2022 paper published in the journal *Child Psychiatry & Human Development*, Doyle and her coworkers highlighted the policy imperative for improved access to evidence-based parenting resources.

This kind of parenting support, provided by universities, not-for-profit organisations, and private companies, ranges from in-person interventions to websites offering advice. Research indicates use of such supports by parents and caregivers can result in mental health benefits and changed behaviours for children, as well as enhancing their social, emotional, and academic skills.

Parents can also benefit from improved wellbeing and mental health, setting more realistic, age-appropriate expectations for their kids and for themselves. Furthermore, parenting supports help to prevent child maltreatment and family violence.

Despite this, only 35% of Australian parents needing help for their children's emotional and behavioural problems said that their needs had been fully met.

"What stands out is the mismatch between the potential benefits of parenting supports and what is currently being done to support these resources," says Professor Daryl Higgins, an expert on preventing child abuse and neglect at the Australian Catholic University in Melbourne. "At this stage, we don't have a national strategy or a government department responsible for parenting support. Different departments are working in silos, so parenting support falls through the cracks."

The limited government funding, and limited eligibility for receiving parenting support has resulted in stigma around receiving support. And, often only those parents with considerable child behaviour problems get access. "But the same parenting resources could also help caregivers with more common challenges, such as setting limits for their children, or difficulties getting them to bed at night," says Doyle.

Change is on the horizon. In 2022, the federal government invested $40 million in funding to provide the Triple P — 'Positive Parenting Program' — a world-leading online resource, that is free to all families across Australia during the funding period. "Recent changes to funding have come about following Australia's first National Children's Mental Health Strategy," says Doyle. "It's a clear signal for us to embrace the use of evidence-based parenting supports for all families."

NEED TO KNOW

- Evidence-based parenting supports improve parenting and child outcomes.
- But only 35% of parents who need help say their needs are being met.
- Policies are needed to give more people access to parenting programmes.

Dr Frances Doyle.

Featuring the work of:

Dr Frances Doyle

- The MARCS Institute for Brain, Behaviour and Development, and School of Psychology

(Top) Ijubaphoto/E+/Getty

FINDING SYMMETRY IN UNUSUAL PLACES

Elucidating connections between forest fires, traffic jams and stock-market fluctuations using the power of pure mathematics.

"Many people think mathematics is just about computation and calculation," says pure mathematician, Professor Roozbeh Hazrat, from Western Sydney University. "But it's about looking at a problem and uncovering a pattern, which often comes with some symmetry."

An object has symmetry if it remains the same after you perform some transformation on it. For example, a circle doesn't change if you rotate it or reflect it in a mirror, hence mathematicians say it has both rotational and reflective symmetry.

Symmetry is a lynchpin of fields of research ranging from string theory through to financial security. Hazrat has been using algebra to express symmetry in mathematical language for more than two decades, and his research has attracted more than $1 million in funding from various funding agencies.

A UNIVERSAL LANGUAGE

"Mathematics has its own language, which transcends boundaries and cultures," says Hazrat, who is the director of Western's Centre for Research in Mathematics and Data Science (CRMDS). "It's very precise and compact, but at the same time, it tells you a lot."

Hazrat, along with his colleague Professor Gene Abrams from the University of Colorado in the United States, has been examining chip firing — a popular model of local symmetric behaviour that describes how objects can spread and move along a grid to form complex phenomena. To do this, they have been using mathematical objects known as groups, which are sets of elements that obey certain rules. They have also been employing certain algebras associated with graphs, known as Leavitt path algebras.

Chip-firing models have been used to describe phenomena as diverse as forest fires, traffic jams, and stock-market fluctuations. Using these tools, Hazrat and Abrams have developed a formula that relates chip-firing to Leavitt path algebras.

"This opens the door for understanding chip firing by associating it to a very rich structure of algebras," says Hazrat. "It demonstrates how different areas of mathematics can be related to each other and can ultimately shed light on real-life phenomena such as symmetry."

"Roozbeh's work has been concentrated on the classification of these algebras. This topic is an active area of maths research literally on all five continents," adds Abrams. "Roozbeh's formidable knowledge of various topics, together with his creativity and ingenuity, has enabled him to intuit and subsequently rigorously prove many important interdisciplinary results."

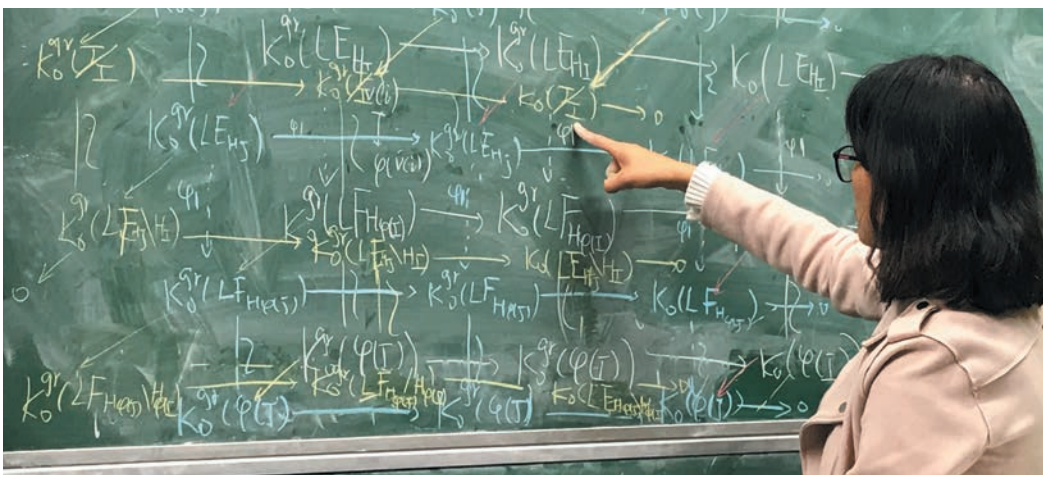
A LONG-TERM PERSPECTIVE

Because pure mathematics is so foundational and driven by curiosity rather than by finding solutions to immediate real-world problems, it is extremely difficult to assess its impact in the short term. Often its real impact becomes apparent much further down the track. "A famous example is prime numbers," says Hazrat. "A lot of people studied them out of curiosity, but now they underpin passwords and security."

This long-term perspective is embraced by researchers at the CRMDS, who are conducting research ranging from pure mathematics to data science. "At the CRMDS, we're training future mathematicians to strengthen science, technology, and mathematical discipline in Australia," says Hazrat. "These areas are highly needed for the future of the country."

NEED TO KNOW

- The impact of pure mathematics can be hard to quantify and is often only clear in the long term.
- Symmetry is an important component of many research fields.
- Western's Roozbeh Hazrat has been using pure mathematics to describe symmetry.



Dr Huanhuan Li, an ARC Research Fellow in Professor Hazrat's team, working on a three-dimensional diagram of the symmetry of Leavitt path algebras.

Featuring the work of:

Prof. Roozbeh Hazrat

School of Computer, Data and Mathematical Sciences

INCLUSIVITY IS THE KEY TO SUCCESS

A one-size-fits-all model doesn't work for social enterprise projects, says a Western researcher who has been studying and working in rural Cambodia.

3 GOOD HEALTH AND WELL-BEING

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Social enterprises are an important tool in humanitarian and development policy. However, western-centric thinking and an overemphasis on management tools and business strategies can hamper their effectiveness, warns Dr Isaac Lyne, a research fellow at Western Sydney University's Institute for Culture and Society.

Lyne has been studying rural community development and livelihoods in low-income countries. He has investigated the success and failure of several social enterprise projects in Cambodia, where he has conducted research over the past 17 years. Social enterprises use business models and entrepreneurial processes to solve problems such as social exclusion and environmental pollution, aiming to build capacity in communities and expand employment opportunities.

EMPOWERING LOCALS

Lyne first visited Cambodia in 2008 while he was based at the University of Bradford in the United Kingdom. In Phnom Penh, he encountered the award-winning social enterprise, Friends International, which reintegrates street children with their communities. Lyne forged a strong relationship with them and secured a British Council grant to incorporate social enterprise into the Master of Arts in Development Studies course at the Royal University of Phnom Penh. He also co-founded the National Social Enterprise Conference of Cambodia and remains a visiting lecturer at the university.

"I started off my research career with all these big picture concerns about globalisation and free trade," says Lyne. "But I'm not an economist, and so I quickly felt overwhelmed by these issues. I became more interested in participatory development approaches and action research at a grassroots level."

Lyne's PhD project at Western explored how local communities make sense of social enterprise in Cambodia. He spent time conducting action research in two neighbouring villages, engaging closely with the people there and gathering their opinions on social enterprise projects. The local people then worked with Lyne and a community development organisation called Buddhism for Social Development Action (BSDA) to establish a canteen in a local school.

"The aim was to provide healthy meals for the children, offer employment training for young people, and give local vegetable growers the chance to sell produce to the canteen, to supplement their earnings from the nearest market," he explains. "I view the project as a success; even though the selling side didn't work out in a co-operative way, it did benefit one particular woman who embraced the entire project and ended up being the sole supplier to the canteen, and who was able to take more of the villagers' produce to sell. When I visited the villages again three years later, she had switched to trading organic vegetables and her house was upgraded."

Local suppliers using reuseable bamboo baskets to bring produce to the Hanchey Bamboo Resort has helped to reduce waste.

Issac Lyne

In another project, again in close partnership with BSDA, Lyne collaborated on removing plastic from the supply chain of an eco-friendly resort providing vocational training to disadvantaged youth. Hanchey Bamboo Resort caters to the tourist market and has created training opportunities and income for the local community. Excessive plastic use is a major environmental issue across Cambodia – in the community where the retreat is situated, there is no refuse collection, and instead plastic waste was burnt in the open air.

"Isaac came to us with a clear plan for how to become plastic free," says Michèle Abouchar, former director of the Hanchey Bamboo Resort. "Alongside run-

Rice fields in Kampong Cham province in Cambodia.

jean-claude soboul/Moment/Getty

ning workshops with the staff, he also conducted workshops with our food suppliers. He involved everyone in the process and treated everyone as equals, so we all felt we were part of the change. It was hugely valuable to have him on board."

"We negotiated with local suppliers to bring their produce in large, reusable bamboo baskets," says Lyne. "This has reduced waste and pollution around the resort."

Lyne recently completed another piece of research on a social business in Cambodia that distributes clean drinking water in 20-litre plastic bottles. The business is based on building water kiosks in rural locations; they take water from a local source, clean it, and then bottle it. They then sell the bottled water to the surrounding villages.

Certain communities responded positively to the water project, but others did not. In one village, there was high community and political tension that pre-dated the project, and Lyne's research showed that these tensions partly explained why the project was failing in that particular village.

NEED TO KNOW

- Western's Isaac Lyne has been working on social enterprise projects in Cambodia for almost 20 years.
- He has found that action research and participatory development approaches are more effective than a focus on management tools and business strategies.

A TAILORED APPROACH

"My projects take a bottom-up approach, going directly to speak with the communities involved," says Lyne. "The problem I have with current social business models is the assumption that you can roll it out from one place to the next, without considering each specific community and their needs." His work has been cited by international development agencies, including USAID, as a demonstration of alternative ways to support social enterprise in communities, whereby communities are able to build upon their existing assets.

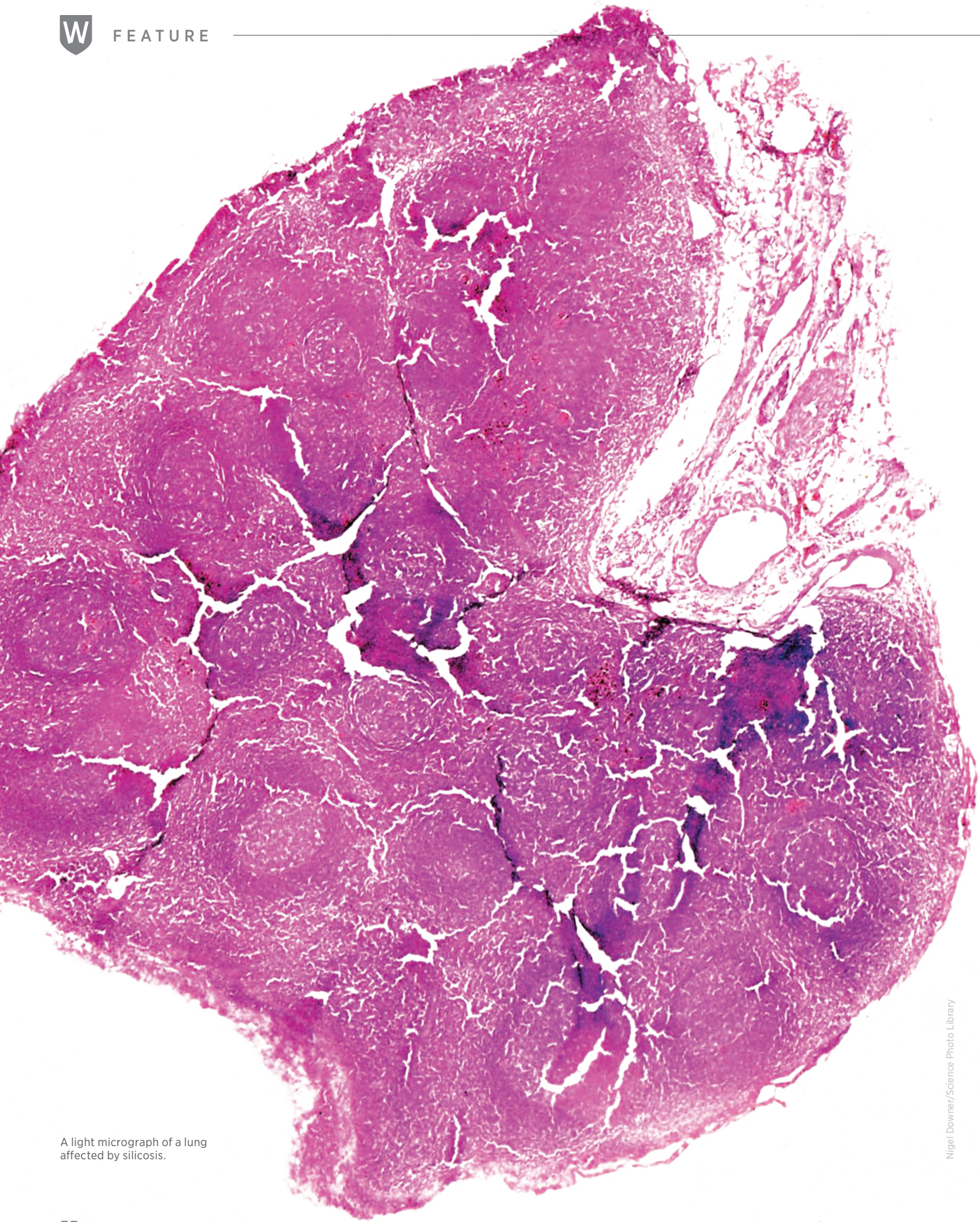
Lyne is currently examining digital finance initiatives for smallholder farmers in Laos and Cambodia. While certain areas in Laos have embraced digital life, Cambodia is lagging behind, and rural communities remain cash-based. This is partly due to the high debt burden of smallholders, who prefer cash to help them pay off debts and buy essentials.

"Interdisciplinary research and interaction with all relevant stakeholders are absolutely crucial to ensure the success of social enterprise projects in the world's poorest nations," says Lyne. "I hope my research helps to mitigate some of the mistakes that might otherwise be made."

Featuring the work of:

Dr Isaac Lyne

↗ Institute for Culture and Society



A light micrograph of a lung affected by silicosis.

Nigel Downer/Science Photo Library

FIGHTING A DEADLY DISEASE OF THE PAST

Australia's ban on the manufacture and use of artificial stone will save many lives, but for the hundreds of workers who have already been diagnosed with silicosis the journey is just beginning.

8 DECENT WORK AND ECONOMIC GROWTH

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

In 2018, when a student told Dr Maggie Davidson about a case of local stonemasons working with artificial stone who had been diagnosed with accelerated silicosis, alarm bells rang.

Davidson, a lecturer and researcher in occupational hygiene and environmental health at Western Sydney University, was aware of major concerns about respirable crystalline silica (RCS) and occupational lung diseases both locally and internationally, and it was immediately clear that the incurable lung disease was connected to the masons' workplace. What horrified her was the speed with which it was progressing. "These were young men, who were dying from very rapid onset silicosis," she said.

Having been investigating biological aerosols and biotoxins for more than 15 years, Davidson urgently wanted to understand what they were exposed to, and what could be done about it. She set about talking with workers and managers, and it was immediately apparent that they were dealing with both a complex dust mixture and multifaceted exposure to chemical (stone dust, solvents, adhesives and resins), biological (microorganisms, endotoxin), and physical (cold, heat, damp, vibration, noise) hazards.

NEED TO KNOW

- The use of engineered stone has led to a resurgence in silicosis among workers.
- Engineered stone was banned in Australia in 2024.
- The lessons learnt must be applied to other industries in Australia such as medicinal cannabis and industrial hemp.

That silicosis was being diagnosed at all was shocking to many. While known as a disease affecting construction, stonemasons, mine, and quarry workers who were exposed to RCS in the workplace, it was thought to have been largely eradicated in Australia thanks to the introduction of work health and safety regulations and more efficient controls and surveillance in the 20th century.

This changed with the popularity of inexpensive and accessible engineered stone — a composite material containing crushed stone, including crystalline silica, pigments and other recycled materials, bound together by a resin adhesive. Cutting it to size, grinding, and polishing for kitchen and bathroom benchtops releases fine toxic and carcinogenic RCS particles into the air which can be drawn deep into the air exchange regions of the lungs.

In 2015, a man whose job involved cutting and polishing engineered stone received a diagnosis of complicated silicosis in Australia. Soon after, stories about many silicosis-afflicted stone workers hit the news; and today hundreds of victims of what is now called artificial stone silicosis have been diagnosed. Some of the cases have been fatal.

THE BAN

Though the re-emergence of silicosis has been alarming, the response has been swift and powerful. Many respiratory physicians, occupational hygienists, and researchers, like Davidson, as well as workers, owners, unions, professional societies and government agencies, have focused attention on the crisis.

A 2020 position statement from The Thoracic Society of Australia and New Zealand (TSANZ), to which Davidson contributed, called out the failed enforcement of regulations for dust control and poor surveillance. That effort led to a 2023 report from Safe Work Australia, the Australian government's work health and safety agency, which advised that the use of engineered stone should be prohibited. A na-

tional ban on the use, supply and manufacture of engineered stone came into place on 1 July 2024. The ban is a world first.

The ban is a victory, but it doesn't end the story of silicosis and other occupational lung diseases in modern Australia, nor does it mean more workers won't be diagnosed, says Davidson. Through a recent study it is estimated that more than 500,000 Australians have been exposed to RCS, and it is predicted to cause in excess of 83,000 silicosis cases, and around 10,000 lung cancer cases.

The earliest stages of the disease typically have no symptoms, so it may be years before the full toll is understood. Workers may develop shortness of breath, a cough, fatigue, and chest pain. Over time, their lung tissue will become further inflamed and scarred. They may progress to a stage where a lung transplant is required, or the condition is fatal. They are also at greater risk of developing lung cancer, tuberculosis, autoimmune disorders, and other conditions. Currently there are no effective treatments for the disease.

ALL ASPECTS OF THE DISEASE

Understanding the nature of artificial stone silicosis is critical to workers' welfare. Davidson's initial intuition — that there was something unusual about how fast the men were getting sick — was validated by the Safe Work Australia report, which noted that the properties of the stone appeared to be contributing towards a "more rapid and severe disease".

When artificial stone is cut, Davidson said, the dust that is released into the air doesn't just have silica in it, it also contains additives such as glass, resin and pigments. "It's really complex," she says.

Dr Maggie Davidson running tests on a respirable crystalline silica sample.

To discover more about the impacts, Davidson and Western colleagues, including Associate Professor Gary Dennis, Associate Professor Sue Reed and Professor Deborah Yates, applied for a state government grant to examine the impact of these components on primary bronchial cells in a customised aerosol chamber designed to mimic real time exposure in the lungs. Whole-transcriptome RNA sequencing was used to examine cell response to the engineered and natural stone dusts.

Davidson had learnt about the technology and approach during her postdoctoral studies at Colorado State University in the United States where they were using it to identify the components in agricultural dusts that were causing lung diseases in agricultural workers. Now her team are the first researchers in Australia to use an aerosol chamber in this context to figure out the specific dust components that are most problematic, and develop targeted responses to manage exposures and reduce the risk of preventable occupational diseases.

She has now collected many samples of engineered stone dust from Australian workplaces and run numerous trials. Tissue culture supplies and data analysis were delayed by the COVID-19 pandemic, but Davidson and her colleagues have established a proof of concept: the exposed bronchial cells reacted differently to the engineered stone dust than to controls (water vapour).

The work promises to illuminate which dust constituents contribute to the rapid inflammation of the lungs, which could aid in identifying targets for treatment and generating lessons for risks to labourers working with similar products. They are also using the approach to study complex workplace dusts in other industries, and working to incorporate 3D models (organoids/spheroids) and other primary cells (alveolar, small airways, macrophage) to further refine the real-time exposure simulations and study response pathways and respiratory disease modelling.

LESSONS LEARNT

The lessons from the engineered stone industry, and the wave of silicosis, must not be wasted, say the researchers. Other instances of silicosis in the 20th century — caused by the manufacture of tatami mats in China, the sandblasting of denim in Turkey, and the creation of dental tools in the U.S. — are examples of hard-won knowledge and of the safeguards from one industry not being applied to all, says Davidson. The expanding market of recycled and composite engineered materials can help address environmental concerns. However, she adds that we must be cautious about the potential for these new products to generate toxic dusts that may harm workers during manufacture and installation, as well as in eventual demolition and recycling.

The good news, according to Davidson, is that "silicosis is now on the radar in many industries, and more funding has become available to carry out research before workers are affected."

To that end, Davidson has also begun to investigate potential risks in the medicinal cannabis and industrial hemp industries in Australia, where internationally there has also been a re-emergence of historical allergic and respiratory diseases in workers. She is currently collecting and characterising settled and airborne dust samples from hemp mills across the country to test in the aerosol chambers and identify potential hazards.

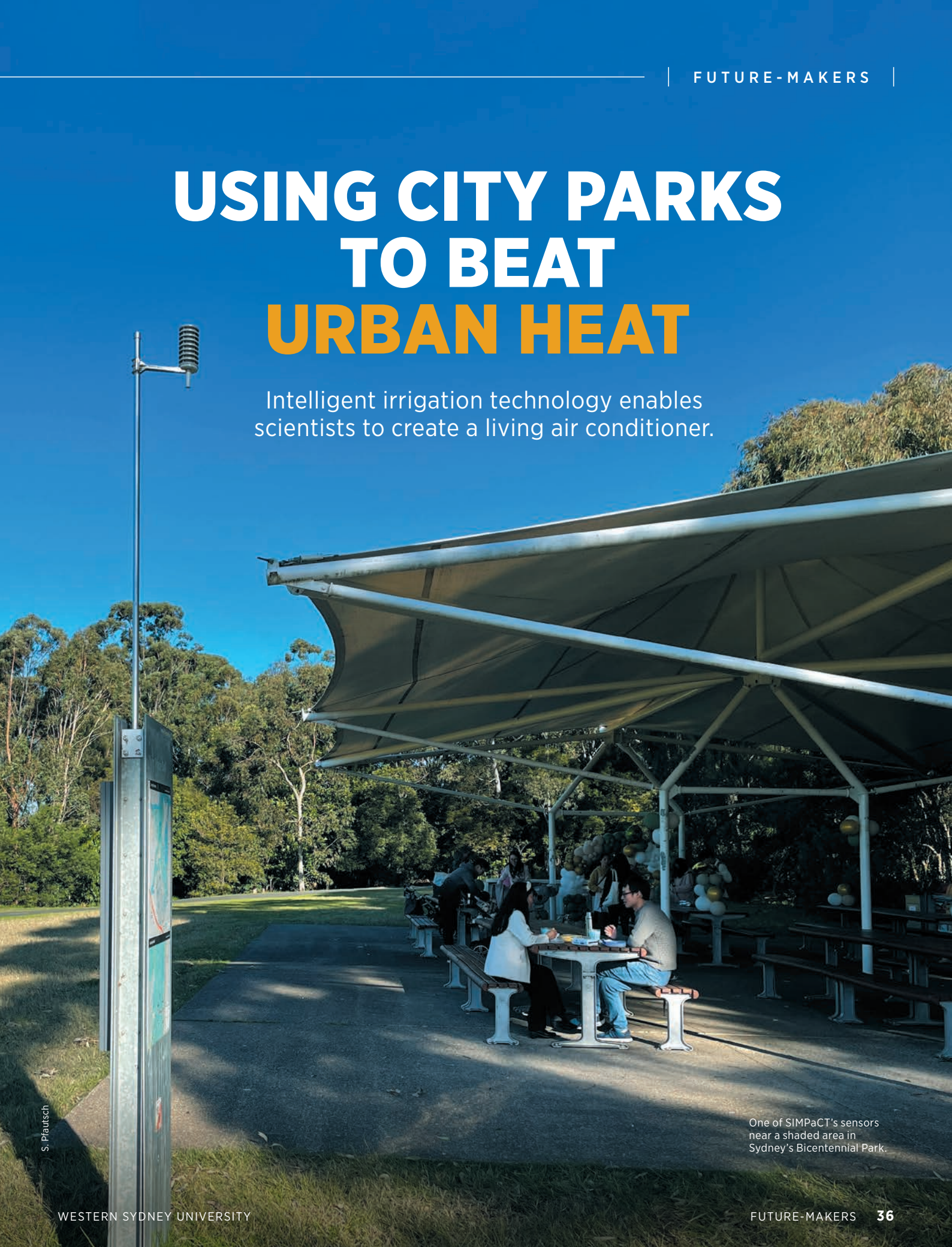
Featuring the work of:

Dr Maggie Davidson

↗ School of Science

USING CITY PARKS TO BEAT URBAN HEAT

Intelligent irrigation technology enables scientists to create a living air conditioner.



S. Pfautsch

One of SIMPaCT's sensors near a shaded area in Sydney's Bicentennial Park.

11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION

On a hot summer's day in western Sydney, partially shaded urban parkland can offer respite from the heat of the city streets. With the assistance of an AI-driven, ultra-smart, park irrigation system, this natural cooling effect can be enhanced, spilling cooled air into surrounding streets.

Professor Sebastian Pfautsch, an urban green infrastructure researcher at Western Sydney University, has led a world-first project to use the irrigation network of Bicentennial Park — within Sydney Olympic Park — to maximise the cooling benefits that the park provides.

"We have shown that you can turn a city parkland into an urban air-conditioning system," says Pfautsch, whose project has won a string of Australian awards, and was a finalist in the 2023 World Smart City Awards.

The major contributor to the cooling effect are parks' trees, says Pfautsch, who has a PhD in tree physiology and spent 15 years in fundamental plant research before moving into research on urban green spaces. As well as providing shade, trees act like giant natural evaporative coolers as they draw water up through their roots and then release it out of their leaves in a process called transpiration.

"A large tree can create 800 square metres of shade, while transpiring 400 to 600 litres of water each day to cool the air," Pfautsch says. When the trees of Bicentennial Park are transpiring at maximum rates, the team has measured air temperatures in the park to be several degrees cooler than at nearby carparks.

To maintain maximum transpiration rates, however, there must be sufficient moisture in the soil.

"Hidden under Olympic Park is one of the biggest urban irrigation systems in the world, incorporating 300 kilometres of irrigation pipes fed with recycled greywater," Pfautsch says. Bicentennial Park is so large, it can only be watered section by section to maintain the required water pressure. Its irrigation system features 200 separate sprinkler zones that can be independently switched on and off in a rolling sequence each night.

THE RESIDENTIAL POPULATION OF THE SYDNEY OLYMPIC PARK REGION
is expected to increase
FROM
8,000
TO
30,000
in 2036

The idea for the Bicentennial Park urban cooling project came when the park's irrigation system developed a fault during a heatwave in early 2020. Built on a former landfill site, without irrigation the park's relatively thin topsoil dries out rapidly in hot conditions.

For residents in the surrounding dense urban development, Bicentennial Park is an invaluable recreational space attracting more than 1 million visitors each year. "When the irrigation system broke down, everything crisped up, it looked absolutely shocking," says Pfautsch, who was contacted by park management asking for his advice on park recovery. "As we talked, the conversation quickly progressed from how to maintain a park under increasing pressure from the public and from climate change, to how could we maximise the cooling effect we can get from it."

A CHANGE IN FOCUS

Pfautsch switched his research focus from forestry to green urban infrastructure after seeing green sites around western Sydney stripped of all their trees to build new suburbs as the region grew. "I thought, nobody is doing any research into the impacts of that kind of development in western Sydney," Pfautsch says. As a major metropolitan centre that already regularly experiences temperatures more than 10°C higher than the eastern suburbs, western Sydney's trees were being completely undervalued, Pfautsch thought. "Western Sydney University has a long history of urban planning, and when I pitched them the idea of urban green infrastructure research, they loved it," he says.

NEED TO KNOW

- Urban parklands can help cool cities.
- The SIMPaCT project has used irrigation to maximise cooling in Sydney's Bicentennial Park.
- This has both public health and water savings benefits.

Sydney's Bicentennial Park.

(Top) Art-skvortsova/iStock/Getty; (infographic statistic) S. Pfautsch et al, SIMP@CT Smart Irrigation Management for Parks and Cool Towns, Aug 2023.; (Bottom) S. Pfautsch

After he moved to Western in 2017 to set up the programme, a series of hot summers produced record-breaking heatwaves across eastern Australia, with the highest temperatures recorded in western Sydney.

Penrith gained notoriety on 4 January 2020 as the hottest place on Earth, reaching 48.9°C. The region's concentration of unshaded roads, carparks, buildings and other hard infrastructure would soak up heat all day, and then radiate it after sundown, keeping air temperatures high all night. "That's particularly problematic for health, because your body doesn't have a chance to recover before the next hot day," Pfautsch says. Hospital admission spikes after a string of hot nights are well documented.

Under heatwave conditions — which are predicted to worsen due to climate change — the importance of urban green space becomes clear, Pfautsch says. "To counter the urban heat-island effect caused by all these hard surfaces, we can use what is called the 'park cool-island effect.'"

A snapshot of real-time measurements at Sydney's Bicentennial Park on the SIMPaCT website, freely available to the public.

A COOL APPROACH

As Pfautsch studied Bicentennial Park's irrigation system with a view to urban cooling, he quickly came to appreciate the system's complexity, and pulled together a multidisciplinary team to tackle the project. As well as Sydney Water and the Sydney Olympic Park Authority, Pfautsch worked with the Institute of Sustainable Futures at the University of Technology Sydney, to install wireless air temperature and soil moisture sensors throughout the park. He also brought in researchers from Western's School of Computer, Data and Mathematical Sciences, to write the AI algorithms and code to automate the system. Private industry assisted with the digital integration of the system.

"During normal operating conditions, we irrigate to maintain plant health," Pfautsch explains. "But when it gets really hot, we switch to irrigation for cooling. Before the heat arrives, we increase irrigation so that the plants — particularly the trees — can transpire at maximum rates, which give us the maximum cooling effect."

The team used machine learning to develop an AI solution, called SIMPaCT, that could automatically optimise Bicentennial Park's complex nightly irrigation schedule. The AI's decisions are based on data including the current humidity and soil moisture conditions in the park and the weather forecast from the Bureau of Meteorology. The AI also has a growing bank of irrigation experience from which to refine its decision making.

The first year of the project involved a lot of problem solving, Pfautsch says. "But since August 2023, we have completely let go, and the system is just doing what it's supposed to do." During the day, air temperatures in the park are typically several degrees lower compared to the nearby commercial and event precincts, but the biggest impact of the project can be measured at night. "You can get up to seven and a half degrees cooler air in the park," Pfautsch declares proudly.

The cooling that the park generates markedly reduces the energy needs of nearby buildings, says Lizzy Pattinson, director of strategic projects and innovation in the Cities and Active Transport Team of the New South Wales Government. "It also generates public health benefits by reducing harmful impacts related to heat stress, and by making outdoor recreation more appealing," she says.

Unlike most smart irrigation systems, saving water was not a project objective. But by switching from a human-operated system — where the tendency would be to err toward extra irrigation 'just in case' — to an automated data-driven system, water use in the park has fallen significantly. "We think water savings of 15–20% are possible, because of the precision application of water in the park," Pfautsch reveals.

The team is now looking for other parks and green spaces in which to replicate the project. "SIMPaCT was designed to easily scale up or down, and we want to trial it in irrigation projects that are far less complex than Bicentennial Park," Pfautsch says. Conversations ranging from implementation in nearby public parks and botanic gardens, to potential projects in the United Arab Emirates, are underway.

Featuring the work of:

Prof. Sebastian Pfautsch

↗ School of Social Sciences

(Computer) Kieran Stone/Moment/Getty; (Inside image) S. Pfautsch

CREATING RESILIENCE TO FUTURE FLOODS

Using the Hawkesbury-Nepean Valley as an example, geographers are teaching adolescents to recognise the danger of rising water and how to react.

4 QUALITY EDUCATION

A major flood in the Hawkesbury-Nepean River Valley, northwest of Sydney, represents Australia's highest flood threat and could be catastrophic in terms of loss of life, property and livelihoods. Studies conducted about community attitudes and flood awareness within this area indicate that people are remotely conscious of flood risk but do not perceive it as a significant risk to their life or property. Dr Kay Carroll, deputy dean at Western Sydney University's School of Education, is working with Western colleagues and government partners including the New South Wales State Emergency Service (NSW SES), Infrastructure NSW and the Australian Bureau of Meteorology to create programmes that teach adolescents about the risk of floods and how to respond.

For example, 'Water in the World' is an online Geography programme, available on the NSW SES website for students in years 7 to 8. It explores the history of flooding in the Hawkesbury-Nepean Valley, real-world impacts of natural hazards such as flooding, and how a community can develop resilience and responsive approaches in these contexts.

Another programme, 'Water in the Valley,' is aimed at students in primary years 1–6. As Nicole Hogan, the assistant commissioner in emergency management at NSW SES, says, "School students learning about flooding is highly beneficial as this assists in raising awareness of the impacts of floods, as well as the best actions to take should flooding occur, ultimately building resilience within communities."

Carroll, who has a background in teaching and researching history and geography, says she finds her team's work around natural hazards and community engagement and resilience important. As she points out, if parents and their children don't understand the history of flooding and the ongoing danger, they might ignore rising-water warnings and when that happens, they can be trapped. "We know internationally that child and adolescent engagement with disaster awareness and preparedness enables student action, voice and helping parents and the community. This delivers significant reductions in mortality rates and recovery post-event," she adds

Based on a survey of 332 students who completed one of the online programmes, Carroll and her research colleagues found that children had 50% more conversations with their parents about flood risks. The team found that after completing the learning activities from 'Water in the World' more students realised that flooding could occur in their local community, and that they were more aware of the role that NSW SES plays in responding to severe storm and flood events.

Although it takes a widespread team to create, distribute, and use these programmes, Carroll says it has been important focusing on the Hawkesbury-Nepean Valley: "If you can make curriculum and learning relevant to the local context, students get engaged."

NEED TO KNOW

- The Hawkesbury-Nepean Valley is Australia's highest flood threat.
- Increasing awareness of what to do in case of flooding can save lives.
- A team of researchers from Western, along with government partners, have developed an online resource that teaches adolescents about flood risk.

Dr Kay Carroll.

Featuring the work of:

Dr Kay Carroll

School of Education

(Top) JayKayl/iStock/Getty

PUSHING FOR RESPECTFUL MATERNITY CARE

Australia's first study on 'obstetric violence' offers a glimpse into the prevalence of traumatic experiences suffered before or after birth.

3 GOOD HEALTH AND WELL-BEING

5 GENDER EQUALITY

The right of women to respectful maternity care is at the centre of an initiative of the Parliament of New South Wales. The Birth Trauma Inquiry formally asks women for their accounts of obstetric violence — instances of abuse and mistreatment by healthcare providers during pregnancy and labour, and following birth.

Between July and August in 2023, women submitted more than 4,000 accounts detailing their childbirth experiences to the Inquiry.

Also contributing was a 2022 study led by Dr Hazel Keedle, a senior lecturer of midwifery at Western Sydney University, which revealed that one in ten Australian women experienced obstetric violence.

The study, published in *Violence Against Women*, was the first to examine this in Australia. Forms of mistreatment ranged from abusive words, rough vaginal procedures, being forcibly restrained during birth, and surgical procedures such as episiotomies being performed without consent.

Vuk Saric/E+/Getty

Obstetric violence can affect how women are able to function as parents.

NEED TO KNOW

- A study revealed that one in ten women in Australia has experienced obstetric violence.
- Trauma during the perinatal period can affect how women function as parents.
- The Birth Trauma Inquiry in New South Wales, which looks into this, has spurred similar international initiatives.

Alongside obstetric violence, the study found 28% of women reported their birthing experience as traumatic and 35% experienced at least one form of mistreatment. "Healthcare professionals do not intend to cause harm, but there is a disconnect with what women are experiencing," says Keedle.

Experiencing trauma during the perinatal period can lead to higher rates of postnatal depression and post-traumatic stress disorder, she adds. Ongoing mental health issues can also affect how women are able to function as parents.

Obstetric violence can occur gradually, often starting when women feel dehumanised. Keedle and her coworkers found that obstetric violence was more prominent in standard maternity care in public hospitals. These healthcare systems are fragmented, with women consulting different midwives and doctors at each appointment.

"In such a busy, short-staffed environment, no one is listening to the woman's thoughts and wishes. Strangers are performing tests and surgical procedures on her body without explanation. That breeds an environment that leads to violation," says Keedle.

In contrast, continuity-of-care models — where women see the same professionals throughout pregnancy, have a better record of establishing rapport with carers, she says. "Women understand that things don't always go according to plan. They are usually okay with that as long as they are treated with respect and kindness and kept informed."

The increased awareness of obstetric violence in Australia has spurred similar initiatives in other countries. The Birth Trauma Inquiry in New South Wales inspired a similar inquiry in the UK; furthermore, the survey is now an international collaboration, led by Keedle, with 10 research groups across the world applying it in their own countries.

Dr Bashi Kumar-Hazard, a human-rights lawyer and a collaborator on the survey, hopes that the surveys reveal internationally recognisable patterns. "We can expect to obtain sound data on the consistent complaints that are being made regardless of country, culture, or jurisdiction," she says. "While the abuse may look diverse because of resource and cultural differences, the incentives to abuse are underpinned by the same attitudes towards women."

Featuring the work of:

Dr Hazel Keedle

↗ School of Nursing and Midwifery

SEEING INSIDE TUMOURS DURING CANCER TREATMENTS

In future, surgeons will be able to target regions inside tumours by using AI-enhanced magnetic resonance imaging to guide radiation treatment.

Conceptual image of cancer radiotherapy.

Kateryna Kon/Science Photo Library
This research was funded by the Cancer Council NSW Project Grant RG 22-02.

3 GOOD HEALTH AND WELL-BEING

By combining artificial intelligence with state-of-the-art radiation therapy for cancer, Western Sydney University researchers hope to be able to image the internal structures of tumours, which will enable clinicians to tailor cancer treatment.

The conventional way to treat tumours is to excise them surgically, but this generally requires a major operation, and some tumours are surgically inaccessible.

By replacing the scalpel blade with focused beams of X-rays, electrons or other subatomic particles, radiation therapy can treat tumours without cutting patients open. However, breathing and other bodily movements can cause tumours to move during treatment, and so surgeons must target a considerably larger region than the tumour. This can result in collateral damage to surrounding healthy tissue.

An exciting new treatment that promises to overcome this problem is MRI–LINAC. It integrates two key technologies that have been used separately for treating cancer into a single system. A linear accelerator (LINAC) delivers high-dose radiation, while magnetic resonance imaging (MRI) provides real-time imaging of the tumour. This allows clinicians to pinpoint tumours during treatment, drastically reducing the damage to nearby, healthy tissue.

Bringing these two technologies together was quite a feat of engineering since MRI requires very high magnetic fields, which can cause the radiation beam to veer off course. "They're challenging technologies to combine in one machine, and so MRI–LINAC is a very recent development," notes Professor Bill Price, from Western's School of Science. As a result, there are only a handful of such machines in the world today.

Having devoted his professional life to researching MRI, Price is now working on the MRI side of MRI–LINAC. While MRI is a mature technology, he is convinced that it has a lot more to offer. "It's come such an enormous way in the last three decades, but it still has so much untapped potential," he says.

In particular, MRI can do more than just locate the positions of tumours — it can also reveal their internal structures. As part of a project funded by the Cancer Council NSW, Price and his team at Western are now exploring how to exploit this ability of MRI to precisely treat tumours using MRI–LINAC.

"For example, if part of the tumour is more resistant to radiation than the rest, then you can increase the dosage in that area," explains Price. "If you can do that, you're much more likely to have successful treatment and hopefully lower rates of recurrence."

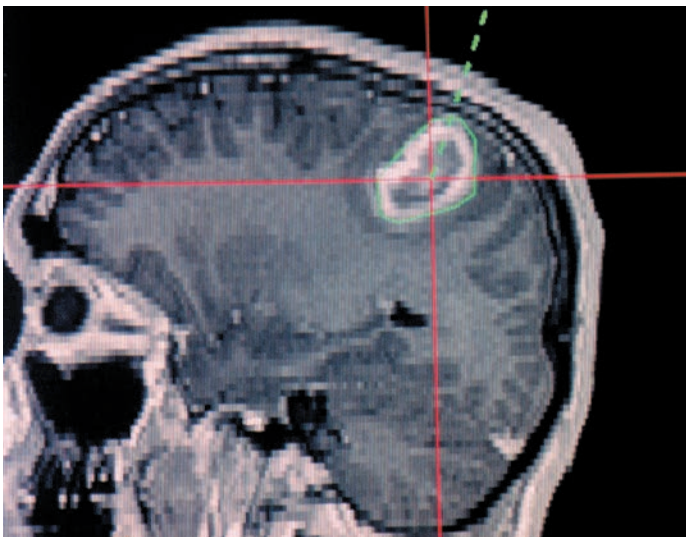
Price's team is obtaining images on tissue samples that contain pancreatic, oesophageal, liver, and rectal tumours in the lab using ultrahigh-resolution MRI systems that use extremely high magnetic fields to image samples that are up to 3 cm in size. "Our lab MRIs have very high magnetic fields, and so they can give resolutions that greatly surpass what you can get on a clinical machine," explains Dr Timothy Stait-Gardner, the National Imaging Facility Fellow in Western's School of Science.

They then plan to use AI to apply the results to the lower resolution images obtained using (clinical) MRI systems in MRI–LINAC machines, which are designed to scan the whole body.

By comparing images taken on the same sample on a very-high-field MRI machine and a clinical MRI machine, the team intends to use AI to create algorithms that can greatly improve images taken on clinical MRI systems.

Price is excited about the project's potential. "Feeding our results into MRI–LINAC promises to be fantastic. Instead of: 'Oh, there's a tumour, blast away,' suddenly you can devise a treatment much more carefully," says Price. "There should be better treatment, fewer side effects, less cancer recurrence and less damage to tissue that didn't need to be irradiated."

The ability to see inside tumours makes treatment tailored to individual patients much easier and quicker. "I hope that in the future we won't need so many physical biopsies because treatment decisions could be made much faster and with less trouble for the patient using MRI," says Price. "We could find out the extent of a tumour, what type it is, how heterogeneous it is, and if there are changes in pH or oxygenation, because all of these things affect treatment protocol."



A magnetic resonance imaging (MRI) scan showing a brain tumour.

Philippe Plailly/Science Photo Library

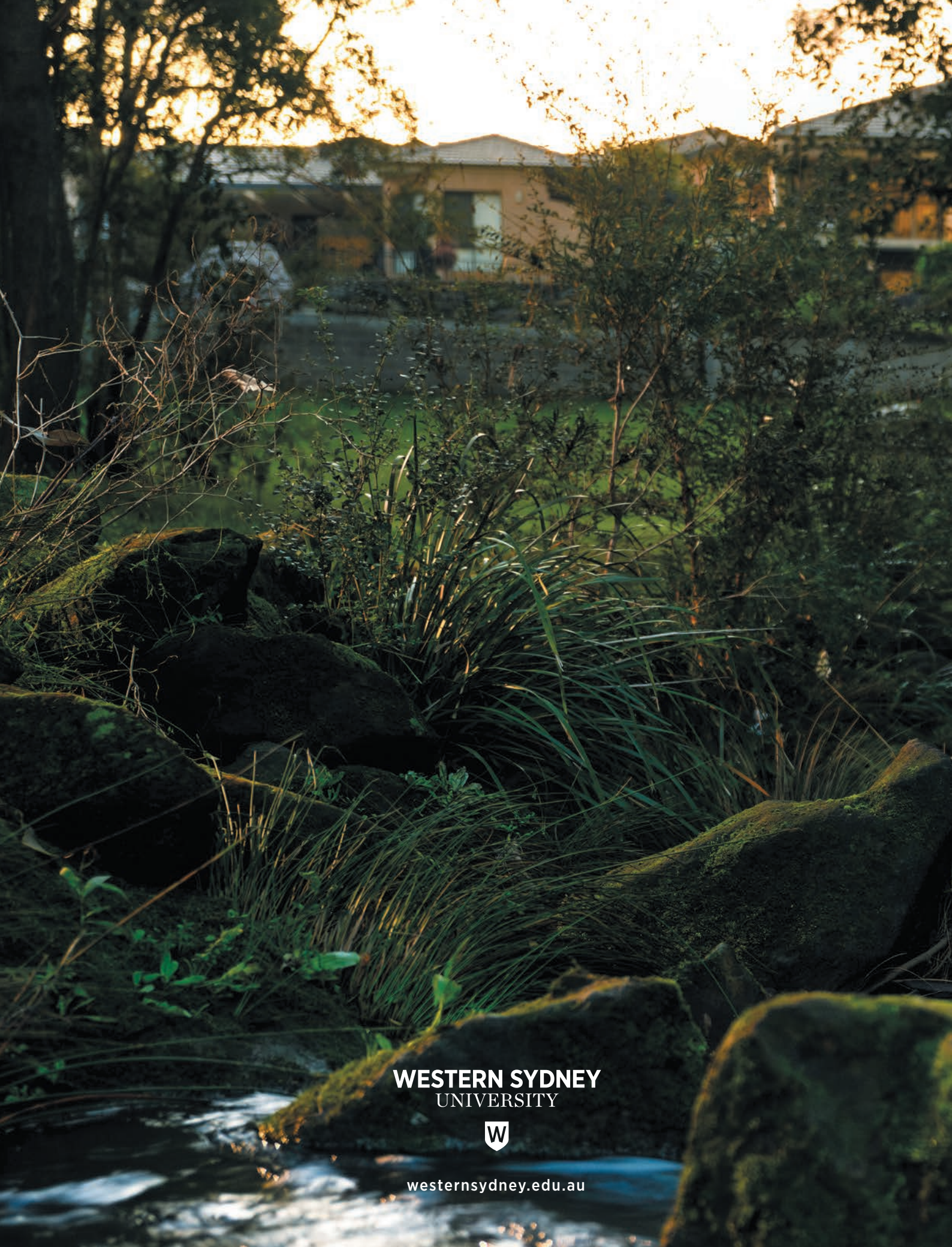
NEED TO KNOW

- Radiation therapy is a popular way to treat tumours.
- But the movement of patients during a procedure can lead to damage to the surrounding tissue.
- A new system called an MRI–LINAC could make it possible to pinpoint tumours during treatment.

Featuring the work of:

Prof. Bill Price and Dr Timothy Stait-Gardner

School of Science



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