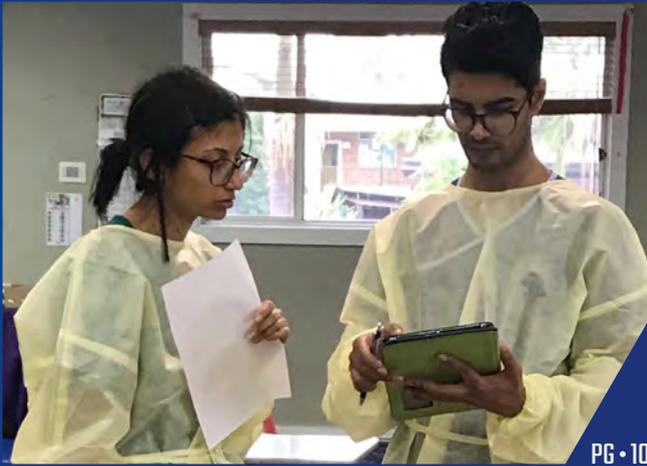


RESEARCH IMPACT SHOWCASE

Parliament of NSW

28 March 2022





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The Waratah Research Network and the Research Impact Showcase

The Waratah Research Network was established in October 2018 to “provide a mechanism for government, universities and the broader research community to work together more strategically on NSW priorities and emerging issues”.

Under its mandate, the Network discussed conducting an annual Research Impact Showcase in NSW. The Showcase is intended to assist the Waratah Research Network in understanding and promoting the impact of research in NSW and its translation into economic, social, cultural and environmental outcomes.

The Showcase highlights successful examples of high-impact engagement and collaboration between NSW Government agencies and universities and encourages further cooperation to achieve real end-user benefits and prosperous outcomes for NSW across various sectors.

Judges

We extend our appreciation to the following people who had the difficult task of assessing the 39 applications received and choosing which projects to showcase in this booklet:

Stephanie Blows

NSW Ministry of Health
Principal Policy Officer, Mental Health Branch

Tori Hocking

Macquarie University
Executive Manager, Research

Professor Dane McCamey

UNSW Sydney
Associate Dean Enterprise and Engagement,
Faculty of Science

Patricia Morton

NSW Ministry of Health
Principal Policy Officer, Office for Health and
Medical Research

Dr Fiona Yardley

NSW Department of Education
Director, Higher Education

Dr Claudine Moutou

NSW Department of Planning
and Environment (DPE)
Team Leader, Social Research

Dr Suzanne Pierce

Office of the NSW Chief Scientist & Engineer
Director, Policy Science & Research

Scientia Professor Sven Rogge

UNSW Sydney
Pro Vice-Chancellor (Research)

Wicky West

The University of Sydney
Manager, Business and Research Development

Order of Proceedings

Acknowledgement of Country and Introduction to the Waratah Research Network

Professor Hugh Durrant-Whyte, NSW Chief Scientist & Engineer

Inaugural Research Impact Showcase Address

The Hon. Alister Henskens SC MP, Minister for Science, Innovation and Technology

Showcase 1 Keeping education safe during the pandemic

National Centre for Immunisation Research and Surveillance, Sydney Children’s Hospital Network, the University of Sydney, NSW Health, Department of Education

Showcase 2 (video) Measuring the effect of rodent eradication on Lord Howe Island’s threatened bird life

Charles Sturt University, Department of Planning, Industry and Environment (DPIE, now DPE) Science, Economics and Insights Division

Showcase 3 Understanding bushfires and developing strategies to minimise their impact

University of Wollongong (UOW), UNSW Sydney, Western Sydney University, DPIE, National Parks Wildlife Service

Showcase 4 (video) Translating research into defence industries, products and jobs

University of Technology Sydney (UTS)/NSW Defence Innovation Network, Defence NSW, Office of the NSW Chief Scientist & Engineer

Morning Tea

Panel Discussion

Moderator: Professor Jennifer Martin, Deputy Vice-Chancellor, UOW, Chair, Deputy Vice-Chancellors Committee

Showcase 5 Identifying the success and sustainability of NSW seafood industries

UTS, UOW, Southern Cross University, Department of Primary Industries (DPI)

Showcase 6 (video) Growing community languages in NSW

The University of Sydney/Sydney Institute for Community Language Education, Department of Education

Showcase 7 Improving outcomes for Aboriginal and Torres Strait Islander children

UTS Jumbunna Institute for Indigenous Education and Research, Department of Communities and Justice

Showcase 8 (video) Improving the management of NSW rivers

Macquarie University, DPIE

Closing Remarks

Professor Hugh Durrant-Whyte, NSW Chief Scientist & Engineer

Networking Lunch



Message from the Minister

NSW has proven it can rival anywhere in the world when it comes to our research and development capabilities.

The NSW Government is committed to attracting and collaborating with our finest minds and research institutions on critical projects that will deliver improved social, economic, educational and environmental outcomes right across the state.

It is through harnessing the power of collaboration that NSW achieves a thriving high-quality and high-impact research and innovation ecosystem.

The Waratah Research Network has made great strides since it was first established in 2018. The Network has helped to break down communication barriers between NSW Government, universities and the research community and has seen increased engagement between partners.

We are committed to supporting industries to generate high-impact delivery against NSW's great challenges including better coordination of strategic investment against the Premier's Priorities, state outcomes, and metropolitan and regional precinct initiatives.

This inaugural Research Impact Showcase represents just some of the successful collaborative projects undertaken between NSW State Government agencies and universities.

I commend the exceptional research projects highlighted in this booklet, as well as the hundreds more being supported across NSW and congratulate the Waratah Research Network in its mission to maximise the exceptional research capabilities in NSW through working together on a shared purpose.

The Hon Alister Henskens SC MP
Minister for Science, Innovation and Technology
Minister for Skills and Training



Message from the Chief Scientist & Engineer

Welcome to the inaugural Research Impact Showcase, which celebrates outstanding collaborative research undertaken by NSW universities and government agencies

Firstly, I would like to thank the Hon. Alister Henskens SC MP, our new Minister for Science, Innovation and Technology, for attending today's showcase. The creation of this new portfolio demonstrates the NSW Government's ongoing strong commitment to supporting R&D in NSW.

I would also like to thank the previous Chair of the Deputy Vice-Chancellors Committee, Professor Mary Spongberg, for her contributions, and welcome the new Chair, Professor Jennifer Martin.

The Waratah Research Network was established in 2018 to facilitate partnerships between researchers across government and universities and amplify the impact of research in strategic areas for NSW. Today's showcase provides just a snapshot of the depth and breadth of collaborative research being undertaken in NSW as a result of this initiative.

The projects showcased today are wide-ranging in their focus. In our schools, projects supported the safe return to schools during COVID-19 and improved the way we teach diverse languages. In our vulnerable communities, projects improved outcomes for Aboriginal and Torres Strait Islander families at risk of statutory child protection intervention, and increased access to mental health support in rural areas.

To tackle environmental challenges, projects developed strategies to minimise bushfire impacts, protected and monitored native bird life during the rodent eradication program on Lord Howe Island, saved an endangered turtle from extinction and improved the management of our rivers. Many partnerships focused on boosting economic outcomes, from a network that increases the translation of defence research into products and services, to a tech platform that ensures markets are fair and efficient, to projects that protect and support our seafood industries.

Each project demonstrates how collaborative research translates to real economic, social, cultural and environmental outcomes. The success of these projects, even in the face of ongoing disruptions from COVID-19, is testament to the hard work and dedication of all partners involved.

I congratulate the research teams showcased today on your contributions, noting they are just a small sample of NSW's incredible research prowess. I look forward to seeing more successes as the Waratah Research Network continues to champion engagement and collaboration in research in our state.

Professor Hugh Durrant-Whyte
NSW Chief Scientist & Engineer
Chair, Waratah Research Network

Keeping education safe during the pandemic



Research Partners

NSW Health Dr Kerry Chant, Dr Victor Carey, Dr Jeremy McAulty, Dr Andrew Milat, Sally Ellis, Dr Caroline Sharpe

NSW Department of Education Marnie O'Brien, Trish van Tussenbroek

National Centre for Immunisation Research and Surveillance (NCIRS)/Sydney Children's Hospital Network/University of Sydney

Professor Kristine Macartney, Associate Professor Nicholas Wood, Dr Archana Koirala

The Challenge

Since the COVID-19 pandemic began, government officials around the world have had to determine if schools and early childhood education and care services could safely deliver on-campus learning, and assess the contribution of schools to transmission of infection. This has been an ongoing significant issue, not only from a public health perspective but also due to the disruptive effect of remote learning on parents with work responsibilities and the impacts on education and wellbeing for children. To make evidence-based decisions, an understanding of the transmission of the virus and emerging variants in education settings was required.



The Project

The project investigated SARS-CoV-2 cases and exposures in NSW educational settings in 2020 and 2021. This included undertaking contact tracing, enhanced follow-up surveillance and opt-in swab and serology testing of greater than 30,000 close contacts over both years.

The project continues to monitor risks in key education settings in 2022 to inform COVID prevention policies for children and teachers as they return to classrooms.

The Outcome

The project was conducted, reported, and disseminated as planned to very tightly scheduled time frames. The close working relationship between researchers and government departments enabled rapid commissioning of research, the development of collaborative research protocols that met public health, education and government decision-makers' needs, and rapid research execution.

The project rapidly produced high-quality, comprehensive findings on transmission rates and risks in education settings that contributed to public health advice and government decisions in NSW, Australia and globally. Strategies to reduce transmission risks were then developed and implemented, particularly to manage higher-risk activities. The study confirmed low rates of transmission in educational settings in 2020 and again with the emergence of new variants in 2021. This evidence supported decisions to resume on-campus learning in both 2020 and 2021.

The Impact

The project supported positive social, educational and economic outcomes, including that parents and carers could return to work, educational organisations could resume onsite services, and children and young people could resume face-to-face learning sooner, benefiting their education and social wellbeing.

Public confidence in the evidence-based decision to return to on-campus learning can be seen in the figures. During stay-at-home restrictions during March–May 2020, around 90 per cent of students were learning remotely in NSW, with similar reduction in early childhood education settings. By early May 2020, early childhood centres across Australia reported attendance was up to around 65 per cent of pre-COVID levels. By 25 May 2020, all NSW school students were back to face-to-face learning.

The study continued during the 2021 Delta outbreak, finding that transmission in schools was still low, despite being higher than the ancestral strain. The study also reported higher rates of transmission in staff and supported prioritising teachers and early childhood educators for vaccination and a return to face-to-face learning.

The study has continued to provide current, quality data to public health authorities, government and parents during the recent Omicron outbreak, allowing on-campus learning to be maintained.



Improving outcomes for Aboriginal and Torres Strait Islander children



Research Partners

UTS Jumbunna Institute for Indigenous Education and Research

Distinguished Professor Larissa Behrendt, Paddy Gibson, Craig Longman, Alison Whittaker, Associate Professor Paul Gray

NSW Department of Communities and Justice Aboriginal communities and their organisations

Non-government organisations and practitioners in the child protection sector

The Challenge

The NSW statutory child protection system continues to intervene disproportionately in the lives of Aboriginal children and their families. This increases as intervention becomes more intrusive, with Aboriginal children being 10 times more likely to be removed from their families and placed into out-of-home care.

An independent review of the NSW child protection system, commissioned by the NSW Government in 2015 and conducted by David Tune AO PSM, found it to be “ineffective and unsustainable”. The review found that outcomes for Aboriginal and Torres Strait Islander children were particularly poor, with considerable immediate and long-term human and economic costs to Aboriginal children and young people, their families and communities. This includes poorer educational attainment, and physical and mental health outcomes, and greater risk of unemployment, homelessness and contact with justice system.



The Project

Commencing in 2012, UTS’s Jumbunna Institute for Indigenous Education and Research has focused on Aboriginal communities and organisations to transform statutory child protection systems and practices to meet the needs of Aboriginal and Torres Strait Islander families at risk of intervention by statutory child protection authorities.

This includes providing advocacy and direct support for Aboriginal families negotiating the involvement of child protection authorities in their lives towards achieving family goals, while providing researchers an opportunity to understand the systemic and practice issues affecting these families.

A second objective has been to raise awareness about ongoing issues within the child protection system and its harmful impacts on many Aboriginal children, families and communities. The broader community is not well informed about the removal of Aboriginal children from their families. The feature documentaries *Utopia* and *After the Apology* sought to remedy this, and media coverage was garnered in both print and radio.

A third objective was to provide logistical, financial and other support to affected communities to strategically advocate for change. Jumbunna co-hosted forums and supported Aboriginal communities and organisation by providing expert consultation on key issues, supporting their advocacy and system design.

The Outcome

- A child protection legal clinic was developed, operating from the Redfern Community Centre, which provided direct support and advocacy to numerous families. This included research assistance to lawyers representing families, as well as direct advocacy with NSW and Northern Territory child protection case workers and managers. Experience gained on effective child protection advocacy was also shared with other communities and across jurisdictions. Jumbunna continues to provide advocacy and support to a limited number of families involved in the child protection system.
- Support was provided to Grandmothers Against Removals (GMAR), a network of families directly affected by the child removal crisis.
- Two feature-length documentaries were produced and released – *Utopia* and *After the Apology*. *Utopia* had a cinematic release in Australia and has twice been broadcast by SBS. *After the Apology*, which documented the work of GMAR, was released to critical acclaim at the Adelaide Film Festival and received special screenings for both federal and state parliamentarians. The work also led to the development of a training film for the Family Law Court.
- Jumbunna has consolidated this work with the establishment of the Indigenous Child Protection Hub, which has been successful in attracting research and other funding to work with communities on system and practice reform. The Hub, led by Associate Professor Paul Gray, who is also co-chair of the Family Matters Leadership Group, works to critique existing approaches and reimagine child protection systems from a First Nations perspective, elevating Aboriginal voices and building the evidence base for community-led initiatives, as well as providing direct advocacy and support for families and across systems. This includes leadership of the national Family Matters campaign, and involvement in the development of the successor plan to the National Framework for Protecting Australia’s Children, and submissions to state, national and international processes exploring child protection and the rights of indigenous children.

The Impact

This work focused on driving transformational change in statutory child protection systems for Aboriginal and Torres Strait Islander families. Support was provided to GMAR and advocacy alongside this family network led to the NSW Government commissioning a major review, ‘Family is Culture’, that recommended widespread reform to the sector. In addition, the project’s advocacy and support resulted in at least 15 Aboriginal children being successfully restored to their families.



Addressing mental health issues in rural and remote NSW



Research Partners

University of Newcastle Professor David Perkins, Dr Hazel Dalton, Dr Tonelle Handley, Dr Scott Fitzpatrick, Nic Powell

NSW Health David Pearce, Amy Wyndham, Becky Walker

The Challenge

People living in rural and remote communities experience consistently poorer mental health outcomes than those who live in cities. Rural mental health services are not working, despite increases in government funding.

Rural people face a series of challenges not being addressed by the current service mix, as well as unique stresses such as droughts, floods and bushfires, which can lead to a lack of control over their own economic security.

Those who do reach out for professional help often find it isn't easy to come by, with waiting lists for many services. Communities outside large regional centres often face a shortage of resident medical and allied health specialists such as psychiatrists, psychologists and mental health nurses.

Suicide rates outside of capital cities are consistently higher – by 67 per cent in 2019, according to ABS data – and remote communities have higher suicide rates on aggregate. Suicide among young Australian men in rural and remote areas is estimated to occur at almost twice the rate as metropolitan areas.

For young Indigenous males and females in remote communities, suicide rates may be up to six times higher compared to other Australians.



The Project

The Centre for Rural and Remote Mental Health (CRRMH) was established to create healthy rural communities. The CRRMH has many key objectives, one of which is to coordinate and manage the Rural Adversity Mental Health Program (RAMHP), which it developed and runs in partnership with rural local health districts and the NSW Ministry of Health. RAMHP aims to promote the mental wellbeing of people in rural and remote NSW and connect those who experience mental health concerns with appropriate services and resources. These were delivered through training, community events, tailored mental health support conversations and extensive material available on the CRRMH website (crrmh.com.au), including *The Glove Box Guide to Mental Health* and the online magazine *Take Time*.

The Outcome

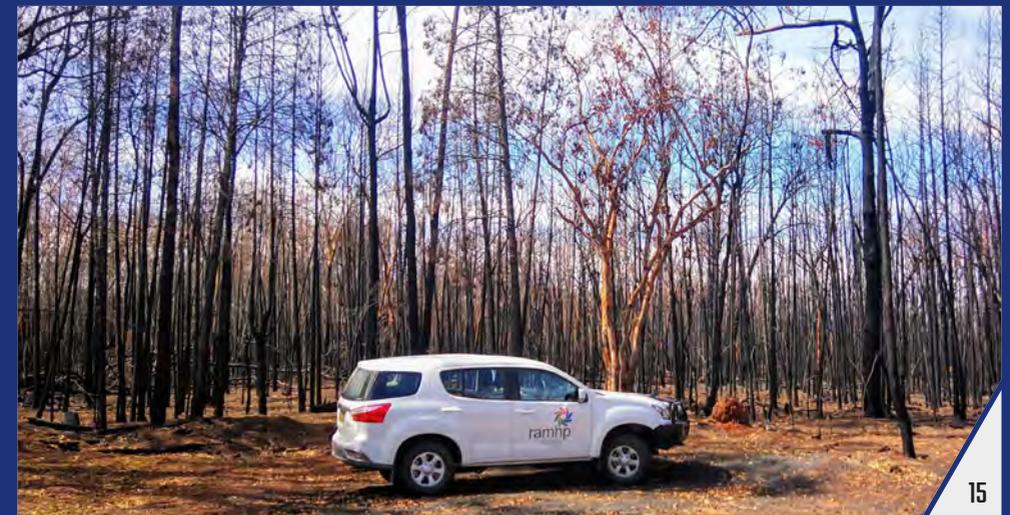
The RAMHP was successful in achieving four of its five key objectives¹:

- Communities and organisations had increased awareness of mental health services and resources.
- RAMHP training participants increased their knowledge on mental health.
- Communities and organisations (e.g. NSW Farmers, CWA) had better ability and capacity to recognise instances of mental ill health and could effectively link people to services and resources.
- Key agencies coordinated and collaborated to develop networks and resources that built an integrated and proactive response to community mental health needs.

1. Maddox S (2021) Rural Adversity Mental Health Program Outcome Evaluation Report. Centre for Rural and Remote Mental Health, University of Newcastle, Orange NSW Australia. Web: www.crrmh.com.au/content/uploads/sites/3/RAMHP-Outcome-Report-2016-2020_FINAL.pdf

The Impact

CRRMH promotes mental health literacy, links rural people to services and responds to drought, fire and floods. In the last five years it has linked 11,499 NSW people to mental health support and services, trained 41,991 participants through 1,967 courses and taken part in 2,200 community events attended by over 33,000 people.



Understanding bushfires and developing strategies to minimise their impact



Research Partners

NSW DPIE Dr Greg Summerell, Laura Babian, Matthew Adams

NSW National Parks Wildlife Service Carl Hollis

NSW Rural Fire Service Laurence McCoy, Melissa O'Halloran

Independent health, fire and Aboriginal cultural leaders Dr Richard Broome, Emeritus Professor Robert Whelan, Dr Richard Williams, Mr Shaun Hooper

UOW Associate Professor Owen Price, Vanessa Cavanagh, Dr Hamish Clarke, Dr Katharine Haynes, Emeritus Professor Ross Bradstock

UNSW Sydney Professor David Keith, Dr Mark Ooi

Western Sydney University Associate Professor Matthias Boer, Dr Rachael Nolan

University of Tasmania Nicolas Borchers Arriagada, Professor David Bowman, Dr Grant Williamson

University of Melbourne Dr Brett Cirulis, Professor Trent Penman

The Challenge

Fire risk and damage can be extreme in parts of NSW, particularly when combined with drought, vegetation change and climate change impacts. The 2019-20 Black Summer bushfires devastated NSW, with 5.5 million hectares burnt, 2,448 homes destroyed, an additional 1,013 homes damaged, and most tragically, the deaths of 26 people. More than one billion animals in NSW were estimated to have been killed or displaced in the fires, with the complete loss of some species believed to be permanent.

Planned burning is a long-standing bushfire risk mitigation strategy, but urban growth and a drying climate create a challenging operational environment for emergency services and land management agencies.

Planned burning is becoming more holistic with new understanding of the impacts of fire on the environment, and Aboriginal cultural heritage and associated values for caring for Country. Research is often required to develop better ways to balance these objectives. This is the purpose of a risk-based approach to fire management as recommended by the NSW Bushfire Inquiry in 2020.

The Project

The NSW Bushfire Management Research Hub was established in 2017 to understand how to use prescribed burning to meet the multiple objectives of protecting life and property, and the environment, as well as minimising smoke and greenhouse gas emissions and supporting the wellbeing of Indigenous communities.

The Research Hub targets work that improves fire management strategies and reduces risk to people, property and the environment. The Hub enables policy makers, planners and managers to work alongside academics, sharing findings and applying significant outcomes without delay.

The Outcome

Three key achievements of the Hub:

- Developing the FireTools Cloud, a novel platform incorporating geographical, biophysical and climate data to inform real-time, predictive fire-behaviour modelling. The platform is modular, user-friendly and portable, providing timely information. The Hub is working to further improve climate change and fire history information.
- Improving the Prescribed Burning Atlas, which helps fire managers tailor decisions about burning programmes to optimise risk reduction. This includes expanding spatial coverage to better represent NSW's diverse landscape, population and demographics and improve local decision-making.
- Providing research and reports to assist the NSW Bushfire Inquiry.

The Impact

The 2019-20 bushfires had unprecedented impacts on life, property and the environment, highlighting the need to invest in effective, research-supported bushfire management. The Hub provided the evidence base for the NSW Bushfire Inquiry's recommendations and the direction for future fire management and associated research needs. The Hub's research helps fire management agencies make decisions using risk assessment approaches to achieve strategic, social and environmental benefits.

The Hub's tools are being integrated into fire management decision-making and operations. FireTools provides data layers for National Parks and Wildlife Service's fire management plans. Data and methods from the Prescribed Burning Atlas provide foundational information for the Rural Fire Service Risk Evaluation Framework, which provides long-term strategic planning advice.



Improving the management of NSW rivers



Research Partners

Macquarie University Professor Kirstie Fryirs
NSW DPIE Fergus Hancock, Dr Simon Mould

University of Auckland Professor Gary Brierley

The Challenge

Millions of people in NSW rely on the health of their rivers and catchments for recreation, resources, agriculture, drinking water, tourism and environmental services. NSW has over 225,000 kilometres of rivers and major streams, a significant proportion of which has been modified by human activity over the last 230 years. As such there is a need to effectively analyse river condition and recommend strategies for recovery, restoration and sustainable management. Currently, over 60 per cent of NSW rivers are in moderate or poor geomorphic condition, with inland rivers in the Murray-Darling Basin generally worse-off than those on the coast.



The Project

The River Styles project set out to develop procedures and tools to understand river forms, processes and responses to human disturbance, and interpret river evolution, condition and recovery potential. The River Styles Framework provides a sophisticated and innovative approach to geomorphic analysis that can be used in any landscape, with findings deployed through policy, monitoring and on-ground rehabilitation.

State and local governments, land management groups and local communities use River Styles outputs to prioritise and manage their rivers and catchments for current and future needs. The project has found that there are 47 different types of river in NSW, some of which are rare and not previously identified. It has also found that around 40 per cent of rivers have moderate or good recovery potential that could be enhanced via targeted rehabilitation.

The Outcome

Use of the River Styles Framework has challenged and changed the way river management decisions take place and the level of intervention and resources required to meet environmental health targets. This has been achieved through development of catchment-scale and regional-level geomorphic templates for monitoring and assessment of rivers. The project continues to be informed by on-the-ground research undertaken across NSW.

Over 20 years of research, collaboration and applications underpinned the release of the state-wide River Styles database in 2020. This OpenAccess, web-based product can be used by river and water resource managers in any agency.

The Impact

The River Styles Framework is an international best practice approach to analysis of geomorphic river types, their evolution, condition and recovery potential. The Framework assists the NSW Government to manage the environmental state of rivers and catchments. It informs environmental policy and strategic planning, and is taught as a set of professional courses, creating stronger employment outcomes.

The River Styles Framework and its principles have been applied on six continents, including in America's iconic Colombia River catchment, and in the Ganga Basin in India, which is home to more than 45 million people. Over 500 people worldwide have received professional River Styles training so far.



Measuring the effect of rodent eradication on Lord Howe Island's threatened bird life



Research Partners

Charles Sturt University Associate Professor Melanie Massaro, Associate Professor Rachel Whitesed
NSW DPIE Science, Economics and Insights Division Nicholas Carlile, Dr Terry O'Dwyer

Taronga Zoo Michael Shiels
Lord Howe Island Board Peter Adams (CEO), Hank Bower

The Challenge

The majority of bird extinctions over the past 500 years have occurred on islands, with the main cause being the introduction of exotic predators. Lord Howe Island is a typical example of the problems arising from the introduction of exotic rodents. The arrival of ship rats in 1918 caused a wave of extinctions, including at least five terrestrial bird species, 13 invertebrates and two plants, and their presence continued to threaten the survival of native biota.

By 2019, Lord Howe Island had one of the highest densities of exotic rodents recorded anywhere in the world, with population estimates of up to 150,000 ship rats and 210,000 house mice. The main objective of the ambitious rodent eradication program undertaken was to remove those rodents from the island to protect and conserve many of the unique plants and animals endemic to Lord Howe Island.



The Project

Prior to the rodent eradication project commencing, DPIE and the Lord Howe Island Board approached Associate Professor Melanie Massaro of Charles Sturt University to quantify the positive and negative effects of the rodent eradication on threatened island birds. Melanie and her team started to study the Lord Howe currawong in 2017, two years before the rodent eradication.

There were fears that native terrestrial birds would be at risk of eating brodifacoum poison baits, especially the threatened Lord Howe currawong and the critically endangered Lord Howe woodhen. As such, in April and May 2019 over 95 per cent of the woodhen population and 30-40 per cent of the currawong population were captured and placed into captivity on the island, cared for by Taronga Zoo staff during baiting.

Baiting started in 2019, with poison placed in 19,000 baiting stations on a 10 by 10 metre grid around agricultural and inhabited areas, while brodifacoum pellets were distributed by helicopter in inaccessible areas. Regular island-wide searches were conducted to find and collect any native birds that may have ingested poison.

The currawongs and woodhens immediately began to nest when released after the baiting was completed.

The Outcome

The program set a new world standard for eradicating rodents on inhabited islands, with Lord Howe Island being the largest inhabited island to undertake an island-wide rodent eradication. The island was entirely rodent-free for over 17 months until April 2021, when a few rats arrived by ship from the NSW mainland and re-invaded the island. A second concerted effort was successful in eradicating these rats on Lord Howe Island. Biosecurity standards have been raised to avoid future invasions of rodents from the mainland.

The mitigation program has been highly successful in minimising the negative effects of the baiting on the two species of native birds, as more than 95 per cent of the pre-eradication woodhen population and over 50 per cent of the currawong population survived. The woodhen population has since increased to record numbers, doubling in 12 months, and the currawong population is increasing rapidly and is projected to reach pre-eradication numbers by 2022. Black winged-petrels, emerald doves, native snails and cricket populations are all recovering, while for the first time in a long time, fruit and seeds can ripen on plants, and seedlings are being seen.

The Impact

The long-term impact of the eradication program is the preservation of Lord Howe Island's unique biodiversity for future generations. Since the removal of rodents, many native plants and wildlife, including the woodhen and currawong, are flourishing. These environmental outcomes are expected to increase revenue through tourism by an estimated \$79.8 million over 20 years.

Communication of Charles Sturt University's research results will encourage and inform future large-scale rodent eradications on inhabited islands around the globe.



Saving endangered Australian turtle species from extinction



Research Partners

Western Sydney University Dr Ricky Spencer

NSW DPIE (formerly Office of Environment and Heritage) Gerry McGilvray, Shane Ruming

The Challenge

Turtles are one of the most vulnerable vertebrate animal groups on earth, with an estimated 40 per cent of species currently threatened with extinction. Australian freshwater turtles are at high risk of extinction due to the impact of foxes, urban population sprawl and wildlife disease. The demise of these turtle species would have wider ramifications given the significant role they play in maintaining environmental ecosystems.



The Project

The Western Sydney University Turtle Team (WSUTT) identified the imminent risks of turtle extinction in south-eastern Australia in 2002 and has since aimed to redefine broad-scale conservation biology and management of long-lived species. The university and NSW DPIE established a world-leading quarantine and breeding facility at the university's Hawkesbury campus.

The research team also developed and commercialised predator toxins to manage fox populations through the Invasive Animals CRC and other non-lethal fox management techniques including testing anti-predator lights, developing taste aversion techniques and implementing olfactory camouflage methods.

The team engaged with local communities to collect data and launched the TurtleSAT app in 2014 to help with Australian freshwater turtle conservation.

The Outcome

The project found that the Bellinger River snapping turtle, a species of turtles that was undergoing a rapid extinction event in 2015 due to the spread of 'subcutaneous ulcerative disease', had a 100 per cent mortality rate. The research team rescued healthy turtles and relocated them to the university's quarantine and breeding facility during the disease outbreak.

Once the rescued turtles were disease-free, they were relocated to several zoos around the country and were subject to an international breeding program with a 70 per cent reduction in the risk of extinction. Sixteen Bellinger River snapping turtles (the only adult turtles in the world) were saved and have been breeding successfully since 2016, resulting in 72 snapping turtle hatchlings at Taronga Zoo.

The Impact

This research collaboration between Western Sydney University and NSW Government agencies prevented rapid extinction of the endangered Bellinger River snapping turtle species, which was subject to an unprecedented risk of a novel disease. Healthy turtles were rescued and relocated to the Western Sydney University during the disease outbreak. This enabled re-classification of the species as critically endangered, securing federal funding of over \$2 million to on-ground conservation programs and citizen science projects to ensure their survival.



Improving water quality in NSW rivers



Research Partners

UTS Professor Simon Mitrovic, Associate Professor Richard Lim, Dr Jordan Facey, Dr Matthew Balzer

DPI Water Doug Westhorpe, Dr Lee Bowling, Dr James Hitchcock, Dr Andrew Brooks

WaterNSW Dr Ann-Marie Rohlf, Dr Alec Davie

The Challenge

Ensuring we can sustain and protect water, one of our most precious resources, is vital. The removal of water from NSW rivers has resulted in many environmental issues, including increased algal blooms, which can render drinking water unsafe for rural communities and affect the tourism sector by closing rivers and lakes to recreational use. These problems culminated in the mass fish kills in the Lower Darling River at Menindee in 2019.



The Project

The objectives for this project were to determine the important critical flow targets for rivers to reduce toxic algal blooms, thus reducing the risk of future fish kills and improving the quality of water for NSW. These findings would then be embedded in flow rules in legislative water sharing plans.

The research is founded on experimental field research to understand how ecosystems work. It involves field monitoring of how flows and nutrients change ecosystems. These field observations are verified or better understood using UTS facilities or river-based mesocosms in which the researchers can, for example, add nutrients and see how the ecosystem responds. Combining field measurements with lab and field experimental data helps to develop better flow rules for river management and understanding of how our rivers function. This research is still underway.

The Outcome

UTS research into the management of Australia's rivers has identified the volume, velocity and timing of environmental water flows required to stop or reduce some toxic algal blooms and improve overall river health.

The research has helped to develop environmental flows policy for the NSW Government, which has been used by the Murray-Darling Basin Authority for the Barwon-Darling rivers and the Commonwealth Environmental Water Holder for the Border rivers, to improve the ongoing health and ensure sustainable use of these river systems.

The Impact

Freshwater algal blooms cost the Australian economy over \$200 million per year. This research has determined effective flow targets to reduce algal blooms, benefitting communities across NSW and Australian rivers. The research has been used to test environmental flow rules in NSW legislative water sharing plans to determine if the flows supplied are having an environmental benefit, as well as giving a better understanding of how to manage fish kills.



Growing community languages in NSW



Research Partners

The University of Sydney/Sydney Institute for Community Languages Education (SICLE)
 Professor Ken Cruickshank, Merryl Wahlin, Dr Emily Bai

NSW Department of Education
 Georgina Harrisson, Dr. Sylvia Corish, Hilary Hughes, Lyndall Franks, Dr Paul Wood

The Challenge

NSW is one of the most multilingual regions in the world, with one quarter of the population speaking languages in addition to English at home. Over 200 languages are represented in the population. We have a vibrant Community Languages (CL) Schools sector, staffed by volunteer teachers, where over 40,000 students are learning one of 62 languages on weekends or weeknights. However, these resources are being ignored. Australia ranks lowest of all OECD countries in the provision and study of languages in mainstream education. Despite the more than 70 reports, policies and programs in the past 50 years, languages study continues to decline.



The Project

SICLE has aimed to research the provision of languages education, and to look at ways NSW's CL Schools sector can be strengthened and developed, as well as how this can impact on languages education in mainstream schools. The institute has three goals: to provide an evidence-base for languages education policy and initiatives; to provide pathways to teacher accreditation for the overseas-trained professionals who volunteer in the schools; and to improve teaching and curriculum in the CL schools.

The Outcome

The project has achieved its aims despite the setback of COVID-19. The three studies on the strengths and needs of the volunteer teachers, the pathways for overseas-trained professionals to gain Australian accreditation, and the organisation and capacity of the schools are international benchmarks in the study of languages education. The professional training for teachers and the 'Open Language' resource portal (openlanguage.org.au) enabled the shift to online teaching during COVID-19 and created an international audience for the Australian programs. The first cohorts of overseas-trained professionals who are volunteer teachers in the CL schools are now graduating as mathematics, science and languages teachers in Australia.

The Impact

SICLE research supports 40,000 students learning 62 languages in over 590 NSW schools, taught by 3200 volunteer teachers. The key benefits have been:

- **Improved student engagement and learning through blended learning, the online resources portal and a range of student film and digital initiatives.**
- **Addressing teacher shortages through professional learning pathways.** Collaboration with Western Sydney University and Australian Catholic University has established pathways for the estimated 4,000 overseas-trained professionals to gain accreditation and thus increase diversity in the NSW teaching force.
- **Improved quality of teaching and learning.** Over 3,300 volunteer teachers have completed our accredited professional learning programs. The project officer team has also established continuing support networks for 13 key languages.
- **A strong evidence base for community languages education.** The group has developed national and international partnerships and networks of teachers and researchers through online workshops, international conferences and research collaborations.



Protecting the NSW oyster industry



MACQUARIE
University
SYDNEY · AUSTRALIA

Research Partners

Macquarie University Associate Professor Melanie Bishop, Professor David Raftos, Professor Paul Haynes, Associate Professor Adam Stow

NSW DPI Dr Wayne O'Connor, Dr Michael Dove

The Challenge

The oyster industry is the oldest and largest aquaculture industry in NSW. In 2019/20 it was worth \$58 million, with approximately 258 oyster farming businesses spread across 32 coastal estuaries. In 2004 Queensland Unknown (QX) disease threatened to cripple the third largest oyster growing estuary in NSW, the Hawkesbury, with fears that the Sydney rock oyster industry might be entirely wiped out by the disease. QX disease is caused by a single-celled parasite initially identified in Southern Queensland and Northern NSW.



The Project

Macquarie University collaborated with oyster farmers and NSW DPI to discover how QX disease causes mass collapse and how selective breeding could be used to develop disease resistance. The project accessed state-of-the-art molecular biology laboratories and research aquaria at the Sydney Institute in Marine Science (SIMS) and the Port Stephens Fisheries Institute to characterise QX disease and its genetic markers in Sydney rock oysters.

A commercial company has been spun out from DPI to continue this work sustainably. The role of this company is to protect, develop and perpetuate selected lines of Sydney rock oysters to ensure that heritable, competitive and sustainable traits are available to protect the industry and drive its growth.

The Outcome

By identifying that environmental stressors including low salinity, high temperatures and chemical contamination made Sydney rock oysters vulnerable to the QX disease, the program discovered around 30 genes that contribute to disease resistance. These genes have been incorporated into the selective breeding program adopted by the NSW oyster industry to mitigate the threat of QX disease.

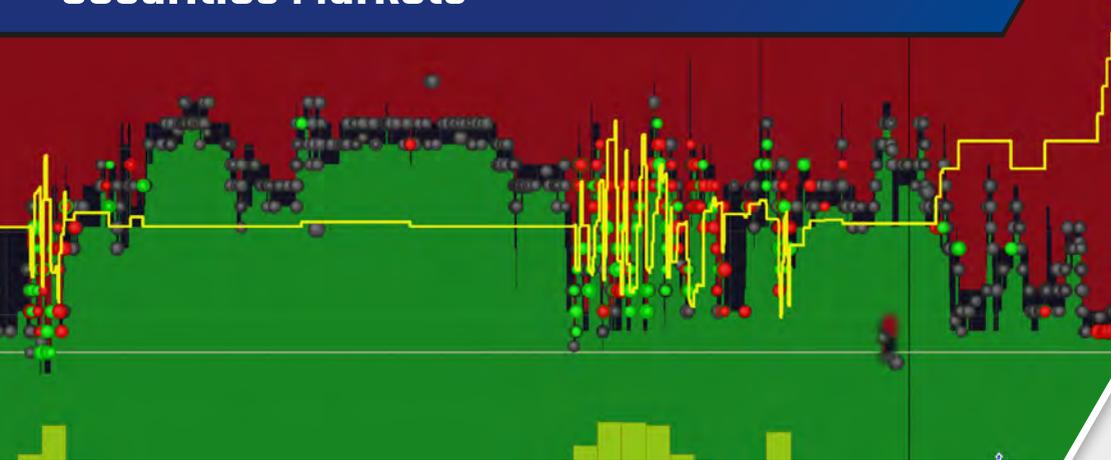
The project further supported the diversification of the industry to allow more widespread aquaculture of the non-native Pacific oyster, as the research indicated Pacific oyster aquaculture did not accelerate proliferation in the wild.

The Impact

Macquarie University's research is protecting the NSW oyster industry from collapse. In collaboration with DPI, Macquarie uncovered how QX disease causes the death of cultivated oysters and then improved selective breeding practices for disease resistance. Simultaneously, the university completed essential research underpinning the NSW aquaculture industry's diversification into Pacific oyster cultivation. Through protection and diversification the industry has increased by over 30 per cent in value since 2011 and DPI predicts NSW oyster industry production will double again by 2030.



Improving trading behaviour in Securities Markets

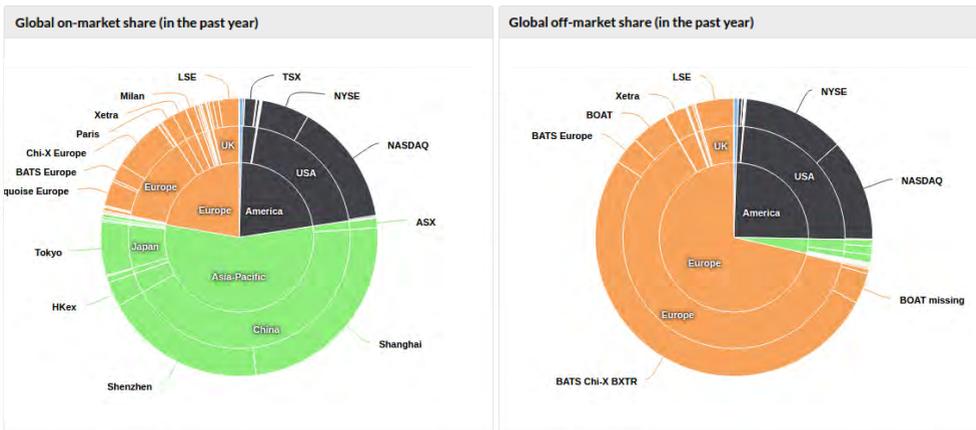


Research Partners

Macquarie University Professor Michael Aitken AM, Office of the NSW Chief Scientist & Engineer
 Professor Andrew Lepone, Professor Vito Mollica

The Challenge

The trading behaviour of thousands of market operators is monitored and policed by regulators, who generally employ only a small number of people. It is therefore difficult to keep securities markets fair, which requires identifying prohibited trading behaviour, such as insider trading and market manipulation.



The Project

SMARTS Broker, a commercial spinout from the Capital Markets Co-operative Research Centre (CMCRC), now known as the RoZetta Institute, was developed and commercialised to provide real-time surveillance services to corporate compliance officers. SMARTS Broker has the ability to replay market operations for a specific event, which allows for the identification of prohibited trading behaviour linked to that event.

SMARTS Broker was able to be developed due to a unique program run by RoZetta where PhD students, along with their industry sponsors, work with commercially confidential data onsite. Based on the results of their research, digitally enabled commercial solutions were created. Sustainable commercial enterprises based on these solutions were then developed by RoZetta, with the PhD students becoming employees and owners in the business.

The Outcome

The project found that markets can be made fairer and more efficient. SMARTS Broker allows for individuals and groups to easily participate in the surveillance process, supporting regulators in keeping markets fair. The markets also became more efficient as SMARTS Broker allowed for the market to police itself.

The Impact

RoZetta Institute's original technology is now used in 50 international exchanges and by regulators and more than 200 of the world's largest brokers across 50 countries, ensuring that financial markets are fair and efficient. The know-how has been transferred to health markets (Lorica Health). It underlies more than 500 new jobs and 190 PhD graduates. The net benefit to the government and industry partners is estimated at \$1.8 billion and \$2.4 billion respectively. Social dividends are in the \$100s of billions based on research that shows that enhancing market fairness reduces the cost of trading by as much as 10 per cent. SMARTS Broker was sold to Nasdaq in 2010 and has funded five commercial spinoffs estimated to be worth \$50 million, which will continue to support RoZetta well beyond its government funding.



Translating research into defence industries, products and jobs



Research Partners

NSW Defence Innovation Network (hosted by UTS)
Professor Bradley Williams, Lucia Kralova, Marc West, Lincoln Parker

Office of the NSW Chief Scientist & Engineer
Defence NSW Mike Gallagher, Joshua Sherman, Mai Li

The Challenge

Although NSW has strong research capabilities, the process of translating research into industry investment, new products and more jobs could be improved. There is a need and opportunity in NSW to increase research translation and commercialisation of innovative technologies and services. Defence was an area identified by the Office of the Chief Scientist & Engineer that could benefit from a network model, given existing capabilities and increasing federal government investment in defence capabilities.



The Project

The NSW Defence Innovation Network (DIN) was established to enhance NSW defence industry capability by improving the translation of research into defence products and services developed in NSW. This involved improving technology for defence end-users, attracting defence R&D and commercialisation investment to NSW small to medium-sized enterprises (SMEs) and universities, and boosting NSW SMEs' interests in the Australian defence market as well as the global defence market. The DIN is a university-led initiative with the NSW Government and the Defence Science and Technology Group. It collaborates widely with both industry and university-sector partners.

The Outcome

The DIN achieved its aims to increase NSW capacity for defence R&D, foster collaboration between NSW industry and universities, increase NSW defence science investment through national and international defence R&D programs, as well as support Australian STEM capacity and pathways to STEM careers in defence.

The project has been well received by the NSW defence industry and universities. There has been strong engagement in the DIN, as evident by the increasing attendance at DIN events and an established profile amongst defence businesses operating in NSW.

The Impact

Since its establishment in 2017, the NSW DIN has attracted over 100 projects representing more than \$90 million in cutting-edge, defence-related R&D investment to NSW, leading to already commercialised new capabilities and near-to-market next generation innovations. This investment continues to grow as the DIN expands its national and international reputation and relationships. The DIN is creating new opportunities for NSW defence businesses and researchers, and building their connections to major defence primes, the Australian Defence Force and defence organisations in allied nations including the US and UK. The DIN's recent successes include the \$1.5 million Defence Industry Quantum Research Consortium to develop world-first quantum sensing prototypes, the \$1.5 million Strategic Investment Initiative to deliver breakthrough technology in cyber, remote undersea surveillance and space, and several large projects with primes such as Thales, and leading NSW SMEs such as Dronesield and Ocius Technology.



Identifying the success and sustainability of NSW seafood industries



Research Partners

UTS Professor Kate Barclay, Dr Federico Davila, Dr Yohan Kim, Dr Nicholas McClean, Dr Ann Maree Payne, Dr Shashi Sharma, Dr Nicole Mazur

UOW Professor Alistair McIlgorm, Dr Michelle Voyer

Southern Cross University Associate Professor Stephen Schmierer

NSW DPI Fisheries and Aquaculture

The Challenge

Over the last three decades, tremendous technological progress has been made in fisheries management and production. This includes developing systems to prevent overfishing, and mechanisms to reduce bycatch in fishing gear. Perceptions of the fishing industry are strongly linked to tourism and local seafood production, so it is important to accurately understand the social and economic impacts of the industry in regional communities, to be able to improve those outcomes for communities, as well as for the industry's economic success.

A lack of current information and understanding of modern fisheries management in NSW meant that public perception was based on global media about overfishing, which applied to Australia in the 1980s, but is no longer true. Policymakers and lawmakers were more likely to favour calls for reduced access to NSW fishing grounds and this was having negative effects on coastal communities and businesses in the seafood production supply chain.



The Project

The project sought to develop a program of research to support the development of holistic, evidence-based development and review of policy. Three projects were conducted between 2014 and 2020 covering the following:

- Contributions of professional fishing to NSW
- Contributions of aquaculture to NSW
- Evaluation of a fisheries management policy change (Business Adjustment Program [BAP] report).

The Outcome

The first study found the economic value of NSW commercial fisheries had been greatly underestimated at around \$80 million in gross value of product, when in fact the industry was contributing more than \$436 million of economic outputs annually to NSW (in 2012/13). The study found the industry also generates 3,290 full-time jobs in fishing operations, service industries, sales and marketing, as well as making other social contributions to communities, such as search-and-rescue participation.

The second study on the impacts of the aquaculture industry estimated 1,758 full-time jobs and a contribution of more than \$226 million in economic outputs annually to NSW (in 2013/14) along with complementary and interdependent economic and social relationships with other industries including regional tourism.

In 2020, this program of evidence-based discussions and research delivered the NSW Government's BAP report for the industry, providing a snapshot of the industry in 2019 that will act as a benchmark and help to frame ongoing monitoring of the industry.

The Impact

This research has improved understanding of the social and economic value of seafood production in NSW. Industry advocates are now able to present evidence about the benefits of seafood production to coastal communities as part of policy processes affecting their access to resources – evidence that was previously unavailable. In 2020 the NSW Government instituted ongoing monitoring of social and economic fisheries indicators to be able to track changes over time and have a better evidence base for future policy changes.



