THE UNIVERSITY of ADELAIDE

Annual Report 2019

ENVIRONMENT INSTITUTE

adelaide.edu.au/environment

"THE ENVIRONMENT INSTITUTE HAS BEEN TRADITIONALLY PERCEIVED AS A SCIENCE-HEAVY DOMAIN. THIS ANNUAL REPORT HIGHLIGHTS A STRONG MULTI-DISCIPLINARY RESEARCH APPROACH DELIVERING REAL POSITIVE IMPACTS ON OUR ENVIRONMENT."

Professor Anton PJ Middelberg
Deputy Vice-Chancellor (Research)

Photo: Hannah Tanz
Cover image: Luke Casey

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ABOUT THE INSTITUTE

The *Environment Institute* is committed to environmental excellence.

Mission

The *Environment Institute*'s mission is delivering relevant, innovative and actionable outcomes to complex global environmental challenges, to ensure sustainable goals benefit the health of our environment, our wellbeing and support the economy.

Vision

To develop strong local and international collaborations and engagement to address complex future environmental problems while exporting innovation around the world.

There are many complex, global environmental challenges that threaten the health and wellbeing of our delicate ecosystems, communities and economies. Environment Institute researchers engage in a diverse range of cross-disciplinary research to gain an understanding of our environmental past and plan for a sustainable future. We play a vital role in translating research into management, policy and technology. With over 70 research members and significant input from all five Faculties within the University, our membership continues to broaden. The diversity of our membership and our access to outstanding research facilities is a great strength to deliver a holistic approach the global issues.

Here at the *Environment Institute*, we're proud to provide on-going mentoring and leadership development of our early and mid-career researchers. We recognise the importance of providing our less experienced staff every opportunity to succeed in what is an ever more competitive environment. We have witnessed impressive outcomes from this high-quality program including outstanding success in securing competitive funding.

Connecting knowledge to lead change

The institute has significant experience in delivering outcomes of importance to our environmental wellbeing, industry and government agencies. We provide new knowledge and develop novel tools to better monitor climate change impacts, biodiversity, invasive species and ecosystem health; while our palaeontologists and evolutionary biologists learn from the past to better understand the future world.

We have experts in:

- Climate change: variation through time, resilience, adaption, mitigation and legal compliance.
- Conservation biology
- Environmental economics
- Evolutionary biology
- Genetics, ancient DNA and DNA barcoding
- Human health, behaviour and mobility
- Landscape transformation and restoration
- Low energy technologies
- Marine and freshwater ecosystems
- Natural hazard risk reduction
- Palaeontology
- Safeguarding biodiversity
- Water quality and supply

The *Environment Institute* is affiliated with the following programs, centre and facilities:

- Adelaide Exposure Science and Health
- Australian Bioactive Compounds Centre
- Australian Centre for Ancient DNA
- Australian Centre for Evolutionary Biology and Biodiversity
- Centre for Applied Conservation Science
- Marine Biology Program
- Spatial Science Research Group
- Sprigg Geobiology Centre
- Unmanned Research Aircraft Facility
- Water Research Centre

Photo: Bob Hill

AT A GLANCE

33 PROFESSORIAL RESEARCHER LEADERS

71 MEMBERS

AUSTRALIAN RESEARCH COUNCIL FUNDING OUTCOMES

6	1	1	2
Discovery Project	Future Fellowship	Industrial Transformation Training Centres	Linkage Project

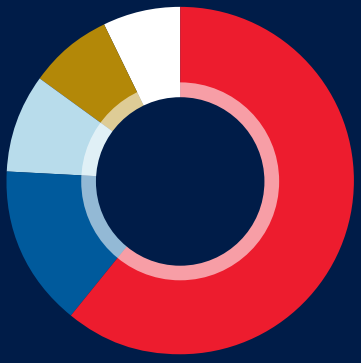
PUBLICATIONS

Our 71 research leaders have produced the following publications in 2019:

469	4	25	7
Journal Articles	Books	Conference items and papers	Expert reports to external bodies

ARTICLES IN HIGH IMPACT FACTOR JOURNALS

6	14	43
15+ JIF* Publications	10–14 JIF* Publications	6–9 JIF* Publications



MEMBERSHIP BREAKDOWN BY FACULTY**

61%	Sciences
15%	Health and Medical Sciences
9%	Professions
8%	Arts
7%	Engineering, Computer and Mathematical Sciences

*Journal impact factor
**As at December 2019

HIGHLIGHTS

- Research tracing one billion years of plant life by Professor Andy Lowe and a team of international colleagues culminated in a paper in *Nature* titled 'One thousand plant transcriptomes and the phylogenomics of green plants'.
- Professor Sean Connell's opinion piece 'How can we boost the impact of publications? Try better writing' in *Proceedings of the National Academy of Sciences of the United States of America* generated a lot of attention across Twitter.
- 'The global distribution of avian eggshell colours suggest a thermoregulatory benefit of darker pigmentation' was published in *Nature Ecology & Evolution* by a team including Associate Professor Phill Cassey. The study found that darker the eggs lost their heat more slowly keeping the embryo warmer, and advantage for birds in cooler climates.
- Hosted 2019 Australian of the Year dual recipient Dr Richard 'Harry' Harris SC OAM for an intimate breakfast presentation and a student Q&A session.
- Australian Research Council (ARC) awarded Environment Institute members 2 Linkage projects, 1 Future fellowship, 1 Industrial Transformation Training Centre and 6 Discovery Projects.
- Supported and hosted a wide variety of events including Heat and Habitat Symposium, Private Land Conservation Conference and Wilkins Oration.
- Professor Nigel Spooner and colleagues were awarded a $1.3M Linkage Project to provide a framework for the sustainable management of Aboriginal rock art and cultural heritage management in Cape York Peninsula.
- Professor Volker Hessel was part of a team of international researchers who have won a $16 million ERC Synergy Grant to investigate the use of new kinds of plasma energy to revolutionize fertilizer production.
- The successful Windara Reef native oyster restoration experiment is entered its second major funding phase.
- The Water Research Centre began its revitalisation.

Photo: Michelle Lim

OVERVIEWS

Deputy Vice-Chancellor (Research)

Environment Institute members are tackling important research challenges around water, climate change resilience, adaptation and mitigation, biodiversity, conservation, marine biology, palaeontology and genetics. The Institute is supporting the University's mission to conduct world-class research and innovation, engage globally and partner with industry, government and community to create high-value economic and social dividends.

The *Environment Institute* has been traditionally perceived as a science-heavy domain. This annual report highlights a strong multi-disciplinary research approach delivering real positive impacts on our environment. For example, the report contains items on ways in which protecting the health of our population from an extreme weather event can be achieved by empowering the community through targeted communications and using smart technologies in our urban landscapes; the importance of futureproofing our biodiversity laws in protecting our most vulnerable species; and using novel material chemistry solutions for biosystem banking. The report also sheds light on the psychological perspectives of our global challenges and understanding hazardous material exposures and controlling risks; as well as delving into environmental impacts on food security, ecological rehabilitation and social aspects including the birth intentions of migrants within China.

I am pleased to note that 2019 was a strong year for the *Environment Institute* members in the Australian Research Council grant schemes, with the award of six Discovery Projects, two Linkage Projects, an Industrial Transformation Training Centre and a Future Fellowship. Outstanding contributions by members to their fields were also recognised by appointments to major decision-making bodies: Associate Professor Patrick O'Connor was elected the new Chair of the National Landcare Network, and Professor Bob Hill joined the Native Vegetation Council. In addition, Associate Professor Phill Cassey was the Lead Author for a chapter of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) thematic assessment, and Dr Michelle Lim an author of the IPBES Global Assessment Report.

Professor Anton PJ Middelberg
Deputy Vice-Chancellor (Research)

Advisory Board Chair

I invite you to celebrate the achievements of the *Environment Institute* in 2019.

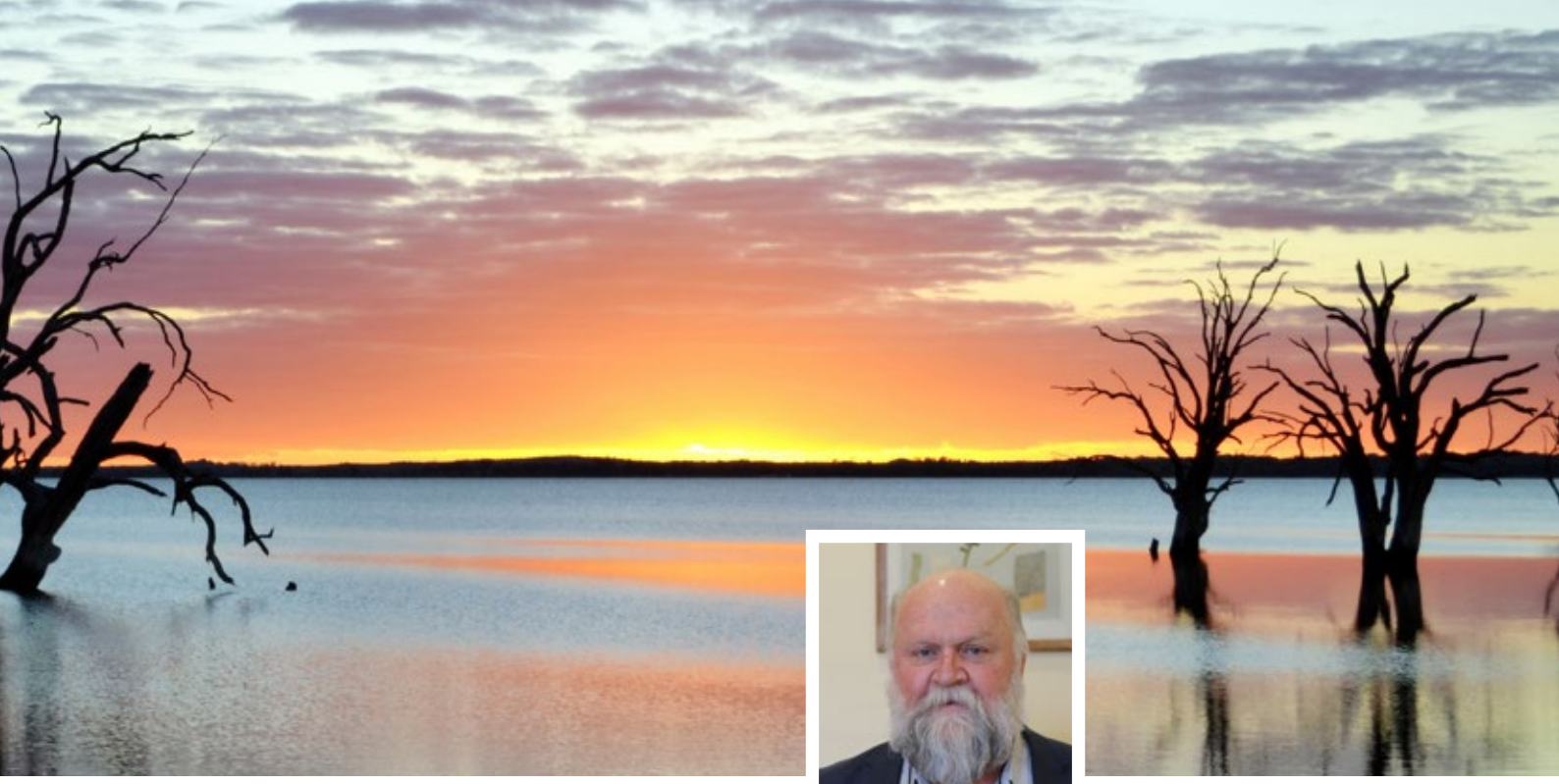
The *Environment Institute* plays an important role within the University of Adelaide, ensuring researchers from diverse disciplines come together to produce impactful research. Collaboration and research excellence are central elements in the collective impact of the Institute.

The strength and success of the *Environment Institute* rests with on the shoulders of the members, who bring together a unique range of perspectives to the research effort. It is from this diversity of experience that the collaborations continue to build a strong foundation for innovation and impactful research that has a broad reach into our community.

Boasting an expanding membership of 71 members in 2019, the Institute works to develop and implement solutions to improve the health of the environment, the wellbeing of our community and to sustain our economy.

This report is my final message as Chair of the *Environment Institute*'s Advisory Board. It is with much regret that I have needed to step down from this role due to a move to Victoria. I am grateful for the opportunity to Chair the Institute and for the privilege of working with the dedicated and passionate staff and members. I would also like to take this opportunity to welcome Professor Hugh Possingham as the new Chair of the *Environment Institute* Board. I look forward to the future directions of the *Environment Institute* under the wise guidance of Professor Possingham.

As I sign off, I would also like to acknowledge the dedication, hard work and commitment of the staff in the Institute. The *Environment Institute* maintains its enduring research impact within the University of Adelaide and the broader community, and we are all the better for the work of the members and the commitment of its staff. To this end, I would like to pay particular credit to Professor Bob Hill, who I very much enjoyed working with. Professor Hill's leadership, commitment and passion drive and sustain the strength and performance of the *Environment Institute*. Thank you for all that you do, Bob.



The Advisory Board is made up of a committed group of professionals, who come together to provide leadership to the *Environment Institute*. I would like to pay tribute to all of the Advisory Board members who have served as members during my time as chair, and thank them for their commitment to the Institute.

I look forward to seeing the *Environment Institute* excel at the challenges and opportunities that present in the years ahead. The work of the *Environment Institute*'s is compelling and urgent – it is the future of our planet.

Sandy Pitcher
Advisory Board Chair

Director

Our annual report is a true reflection of the diversity of the *Environment Institute*'s membership, featuring members from public health, psychology, law, population and environmental studies, architecture and chemistry. The blend of contributions is evidence of our major recruiting drive to strengthen ourselves for an even more relevant future.

2019 was a year of considerable consolidation for the Institute, as we sought greater involvement in government and industry projects with environmental relevance. A major initiative for us that occupied much of our thinking in 2019 was the development of "Planetary Health" as a major research theme. We held successful workshops where we sought to understand the expertise that we have to offer for the future health of the environment and its impact on the people who will live in it. At the very end of 2019 two events occurred that focused our thinking even more and delayed our launch of this initiative. During December, we had a series of extremely hot days that came on top of a prolonged drought and we saw clear evidence that if we do not react strongly to this, then Adelaide will become a city that is extremely difficult to live in over the coming years.

In June 2019 a series of uncontrolled fires began on Australia's east coast and fire remained a major concern, culminating in a stunningly intense and damaging 2019-2020 fire season in Australia. In 2019 we were already planning our response to this and it was clear that we were entering a new era of extreme events that will have impacts for decades to come. The challenge for the *Environment Institute*, the University of Adelaide, and people everywhere, is to respond to such changes before it is too late. We have reached the point where we have a stark choice about the legacy we leave future generations. We can continue to be suspicious of one another and take the egotistical view that human interaction is the most important thing for us to consider in the future, or we can acknowledge that if we do not work together to repair our environment quickly, we will have little left to argue about.

Professor Bob Hill
Director

MAINTAINING FUTURE BIODIVERSITY WITH PALEO-ARCHIVES

Safeguarding species and ecosystems against future climate changes requires reliable predictions and effective solutions.

Researchers at the *Environment Institute's* Climate, Ecology and Evolutionary Dynamics group are 'putting the dead to work', using fossils, ancient DNA, paleoclimate reconstructions, and ecological and climate models, to better anticipate and manage biodiversity responses to future climate change.

By pinpointing, in space and time, where past climate warming events occurred that are similar to potential warming scenarios at local and regional scales, researchers are able to locate potentially vital natural, unplanned experiments. These reference points in Earth's history are being used to establish the likely consequences of future global warming for biodiversity loss and ecosystem change.

Approximately 40% of terrestrial ecosystems are projected to have experienced shifts in temperature during the past 21,000 years that are similar in pace and magnitude to regional-scale future forecasts. Lead researcher, Associate Professor Damien Fordham says that the type of data they can collect from these sites has the potential to help inform numerous international conservation plans for species and ecosystems around the world.

"Using fossil and molecular data from these sites, together with advanced computational approaches, we are able to unveil ecological and evolutionary responses to these rapid warming events of the past. Importantly, we do this using measures of biotic change that are identical to those used for estimating and discussing future biodiversity change among the scientific and policy communities" said Associate Professor Fordham.

"Collectively, these paleo-archives help us to better predict and understand the consequences of future global warming on rates of terrestrial biodiversity loss and their effects on ecosystem properties, including the goods and services they provide to humanity."

"Furthermore, the research findings allow us to identify what causes some species to be more prone to climate-driven extinction than others, and how to improve early-warning systems that signal impending population collapse, extinction or ecosystem shifts as a result of climate change" said Associate Professor Fordham.

This research is part of a global exercise, involving a large number of academic and conservation institutions, covering a wide range of species, ecosystems and regions, producing novel and interesting results. Research has already identified regions of the world with some of the largest overlap between past and future warming events and these are located in the Artic, Eurasia, Amazon and New Zealand. These climatically and biologically diverse areas provide us with important natural laboratories for better understanding biotic responses to trajectories of future climate change and equipping decision-makers with improved strategies for mitigating biodiversity loss from climate change.

This integrative research agenda focused on using paleo-archives to maintain future biodiversity will be featured in an article in *Science* in coming months. The article is the result of a scientific meeting in 2018 held at the Royal Danish Academy of Sciences, which was funded in part by the *Environment Institute* and sponsored by the International Union for the Conservation of Nature.

Further reading

Brown, S. C., Wigley, T. M. L., Otto-Bliesner, B. L. Rahbek, C., & Fordham, D. A. (2020). Persistent Quaternary climate refugia are hospices for biodiversity in the Anthropocene. *Nature Climate Change*, 10, 244–248. doi: 10.1038/s41558-019-0682-7

Fordham, D. A., Saltré, F., Haythorne, S., Wigley, T. M. L., Otto-Bliesner, B. L., Chan, K., Brook B. W. (2017). PaleoView: A tool for generating continuous climate projections spanning the last 21,000 years at regional and global scales. *Ecography*, 40, 1348-1358. doi: 10.1111/ecog.0303

PALEOVIEW

THE CLIMATE, ECOLOGY AND EVOLUTIONARY DYNAMICS GROUP HAS DEVELOPED A FREEWARE SOFTWARE FOR GENERATING AND VIEWING PALEOCLIMATE DATA FOR DETECTING BIOTIC RESPONSES TO MAJOR CLIMATE SHIFTS SINCE THE LAST GLACIAL MAXIMUM. FIND OUT MORE HERE: FORDHAMLAB.COM/CLIMATE-GEOGRAPHY

Clockwise from top left:

Ancient DNA extracted from fossils provides paleo logbooks of climate-driven biodiversity dynamics. Photo: Australian Centre for Ancient DNA, The University of Adelaide

Fossils from caves are enabling researchers to more effectively manage threatened mammals in Australia. Photo: Liz Reed

Paleo-archives can inform the future conservation management of the critically endangered saiga tatarica antelope which once inhabited vast areas of Eurasian steppe.

TOWARDS FUTURE-READY BIODIVERSITY LAWS

Australia has one of the world's highest extinction rates. Existing laws have been ineffective in stemming biodiversity loss and are ill-prepared for the uncertainty and surprise of global change.

Photo: Michelle Lim

Australia is one of the most biodiverse places on Earth. Devastatingly, it also has one of the world's worst extinction rates and the highest modern record of mammalian extinctions. Traditional efforts to effectively manage biodiversity through existing regulatory frameworks, while important, have been unable to stem the losses of critical national assets. In South Australia, while the area of land under formal conservation protection has increased progressively across the state, biodiversity continues to experience significant decline. This is due to widespread historic clearance, agricultural intensification, changed fire regimes, resource extraction (particularly in marine habitats), climate change and introduced invasive species.

Though we live in extraordinary times, responses to unprecedented biodiversity loss in Australia continue to reflect outdated understanding of novel challenges (e.g. clearing of native vegetation in response to bushfire threats; expansion of protected areas without tackling drivers of biodiversity loss such as climate change or unsustainable production and consumption). If we do not transform our biodiversity laws, current extinction rates will accelerate particularly under conditions of global environmental change.

The *Environment Institute's* Dr Michelle Lim, Lecturer in the Adelaide Law School, was awarded a 2019 University of Adelaide Barbara Kidman Fellowship to identify opportunities to reform South Australian law so that South Australia's natural heritage may thrive under conditions of unprecedented change. The 2017 South Australian Biodiversity Parliamentary Inquiry found that existing threats to biodiversity in South Australia will be exacerbated by global environmental change. The Inquiry also found that current biodiversity laws are outdated and out of step with national and international laws and best practice. Lack of cohesion across fragmented legal instruments and inadequate enforcement provisions and compliance action were identified as key shortcomings of the current South Australian legislative framework for biodiversity.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is the global body on biodiversity science and knowledge. IPBES was established by countries

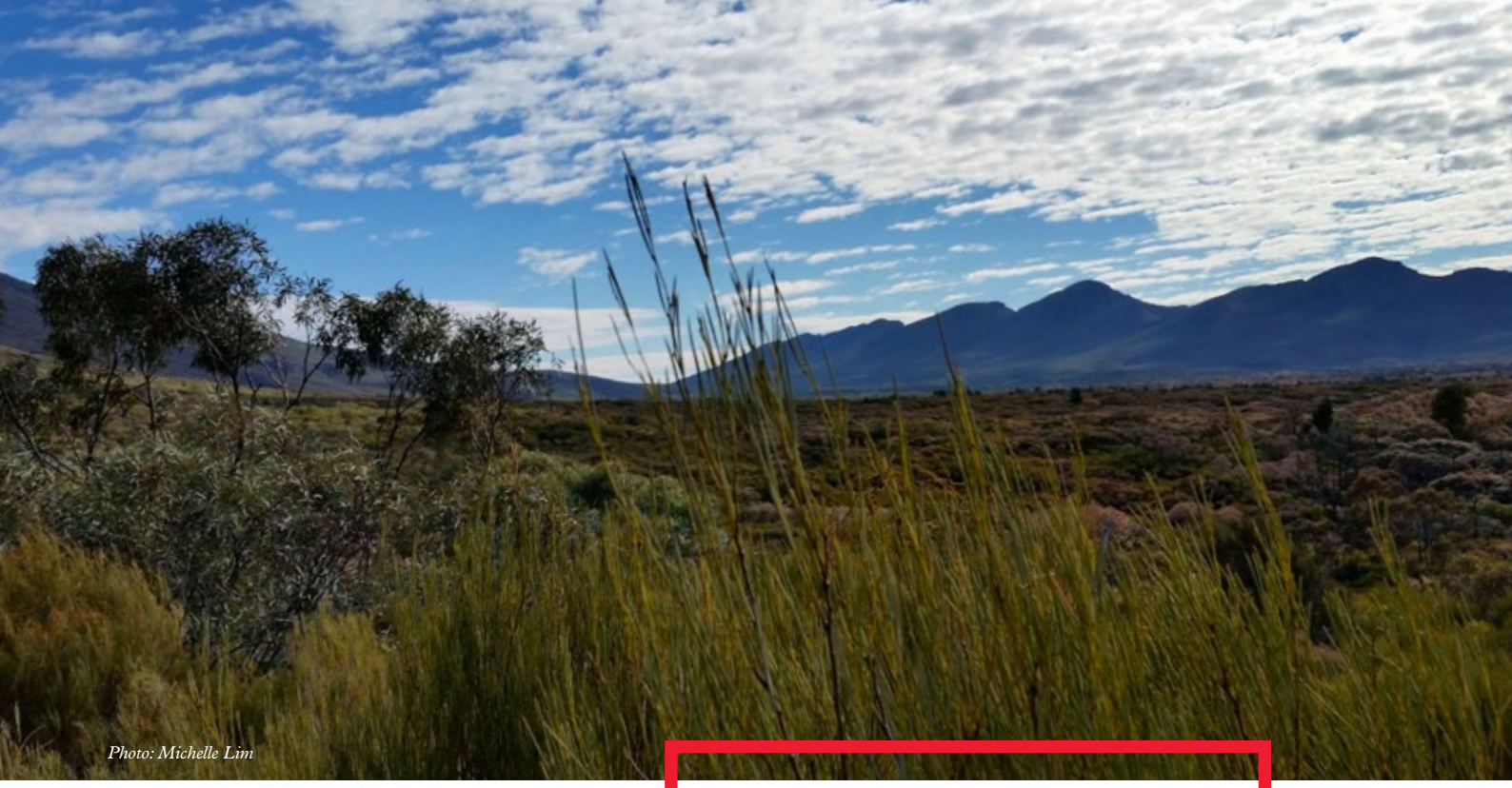


Photo: Michelle Lim

"THE GLOBAL ASSESSMENT FOUND THAT IT REMAINS POSSIBLE TO SHIFT THE CURRENT TRAJECTORY AWAY FROM THE 6TH MASS EXTINCTION."

to provide governments with cutting-edge understanding on biodiversity and the contributions it makes to human well-being. Dr Lim was an author of the IPBES Global Assessment Report– the world's largest stocktake of the state of biodiversity. The Global Assessment found that it remains possible to shift the current trajectory away from the 6th mass extinction. However, to do so, transformative change is required across our economic, social and governance systems. Of particular note, the Assessment highlighted that enhancing environmental law and its implementation is fundamental to achieve transformative change. Similarly, ensuring greater justice and inclusion in conservation and decision-making more broadly were also identified as being critical to reversing the current state of biodiversity.

The Barbara Kidman Fellowship enabled Dr Lim to examine how the findings of the IPBES Global Assessment could be incorporated into South Australian biodiversity law and policy to address some of the key shortcomings in existing law identified by the Biodiversity Parliamentary Inquiry. The findings of the Fellowship research emphasise the importance of redesigning legal frameworks with the future in mind. To do so futures thinking and greater interdisciplinarity is essential to facilitate incorporation of the avant-garde of knowledge into legislative reform processes. Fellowship findings were included in the Adelaide Law School's Environmental and Natural Resources Law (ENREL) Research Unit's submission to the 10-year review of the Commonwealth's Environment Protection and Biodiversity Conservation 1999 (Cth) Act. The findings of the Fellowship are also being extended in the context of the Convention on Biological Diversity's post-2020 Framework.

Further reading

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Lim, M. 2019. 'How do we address unprecedented biodiversity decline? — the IPBES Global Assessment and the opportunities for Australian law and policy'. *Australian Environment Review*, 34, 103-109.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services . (2019). Global Assessment Report on Biodiversity and Ecosystem Services. https://ipbes.net/global-assessment

Dr Michelle Lim (middle) with colleagues at the IPBES7 Plenary.

PROTECTING POPULATION HEALTH IN OUR CHANGING CLIMATE

Variations in temperature and season, have mostly beneficial effects on the natural world as species adapt to recurrent hot, cold, dry and wet meteorological conditions. Extremes are often less well tolerated if adaptive capacity is exceeded.

The state of the environment can affect all within an ecosystem - including humans, who can suffer adverse health effects associated with a changing climate and more extreme weather events. Knowledge about what these health effects are, and who is most vulnerable, is essential to inform adaptation and prevention strategies to protect population health in a changing climate.

Professor Peng Bi, *Environment Institute* researcher in the School of Public Health, has been investigating the health impacts of climate change for well over a decade. Professor Bi is part of an Australia-wide consortium of authors that contribute yearly to the Medical Journal of Australia-Lancet 'countdown on health and climate change'. The research undertaken by his team has led to a greater understanding of how human health and disease is affected by variations in weather, and the associated health and economic implications for a warmer future.

In 2019 the team's climate change and heat-related research was diverse and wide-spread. This included a focus not only on diseases in South Australia (for example heat-induced urinary diseases undertaken by Dr Matthew Borg) but as far abroad as Nepal, where climate factors were shown to affect childhood diarrhoea taken on by PhD student Dinesh Bhandari), and in China where the climate-sensitive disease dengue fever is of significant public health concern, managed by Dr Jianjun Xiang, Dr Michael Tong, Dr Alana Hansen and Professor Phil Weinstein.

Epidemiology has taught us much about how high ambient temperatures and heatwaves adversely affect the health of the aged and sick in our society, less is known about other vulnerable groups and how they are affected.

One such group is workers. In collaboration with fellow *Environment Institute* member Professor Dino Pisaniello from Adelaide Exposure Science and Health, Dr Blesson Varghese and Dr Alana Hansen, together with colleagues across the nation, Professor Bi undertook occupational and environmental health research in four cities of Australia. Their findings showed that people were at higher risks of suffering occupational injuries during heat waves and in hot working conditions affecting workers not only from outdoor occupations but also indoor industries, with some sub-groups particularly at risk.

How can society prevent poor health outcomes with changing climate? Building resilience and adapting to lower our risk of illness and injury are key. This can be maximised by effective and targeted risk communication to vulnerable groups, raising awareness to empower appropriate planning and adaptation responses. Heat health warnings, which have been informed by Professor Bi's previous work, alert the public to the health hazards when heat waves are extreme.

Through her research, Dr Susan Williams worked with industry and health partners to investigate the public perceptions of and responses to these warnings in regional areas of Australia; and social psychologist Dr Scott Hanson-Easey provided new evidence on how best to tailor these heat-health warnings to the public.

The multidisciplinary environmental health research undertaken by Professor Bi and his team continues to provide evidence for policymakers and stakeholders on ways humans can build adaptive capacity and prepare for climate change; thereby minimising the adverse health effects, related healthcare costs and productivity loss that a warmer future may bring.

Prof Peng Bi (centre front) with the research team (from left): Prof Dino Pisaniello, Dr Michael Xiaoliang Tong, Dr Rezanur Rahaman, Dr Olga Anikeeva, Dr Alana Hansen, Prof Phil Weinstein, Assoc Prof Paul Rothmore, Dr Adriana Milazzo, Dr Scott Hanson-Easey, Dr Blesson Varghese, Syeda Hira Fatima, Dr Matthew Borg, Jingwen Liu, Dr Susan Williams, Berhanu Wondmagegn, Dr Lingsheng Yang, Dr Jianjun Xiang (absent: Dinesh Bhandari).

Further reading

Beggs, P., Zhang, Y., Bambrick, H., Berry, H., Linnenluecke, M., Trueck, S., Bi, P., Boylan, S., Green, D., Guo, Y., Hanigan, I., Johnston, F., Madden, L., Hankinson, A., Malik, A., Morgan, G., Kirkpatrick, A., Rychetnik, L., Stevenson, M., Watts, N., & Capon, A. (2019). The 2019 report of the MJA-Lancet countdown on health and climate change: a turbulent year with mixed progress. *Medical Journal of Australia*, 211(11). doi: 10.5694/mja2.50405.

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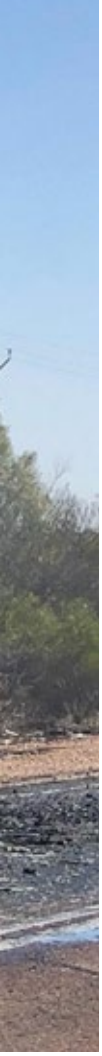
Williams, S., Nitschke, M., Howell, S., Nairn, J., Beattie, C., Wynwood, G., & B,i P. Heat-health warnings in regional Australia: examining public perceptions and responses. *Environmental Hazards*, 18(4), 287-310. doi: 10.1080/17477891.2018.1538867

Wondmagegn, B., Xiang, J., Williams, S., Pisaniello, D., & Bi, P. (2019). What do we know about the healthcare costs of extreme heat exposure? A comprehensive literature review. *Science of the Total Environment*, 657, 608-618. doi: 10.1016/jscitotenv.2018.11.479

Photos: courtesy of SA Country Fire Service and SA Metropolitan Fire Service

"A KEY RESEARCH STRENGTH IS IN UNDERSTANDING SKIN ABSORPTION OF CHEMICALS AND THE PERFORMANCE OF PROTECTIVE CLOTHING, WHICH IS ESPECIALLY IMPORTANT FOR FIREFIGHTERS AND OTHER FIRST RESPONDERS, AND THOSE CLEANING SMOKE OR HAZARDOUS CHEMICAL-IMPACTED AREAS."



EXPOSURE SCIENCE AND PROTECTION OF PEOPLE AND THE ENVIRONMENT

Hazardous materials of various types can have adverse impacts on people, plants and animals.

Environmentally persistent chemicals are often implicated in ecosystem damage, as vividly described by Rachel Carson in her book *Silent Spring* in the 1960s. Even common substances, released in large enough quantity, e.g. milk, can cause environmental damage.

In 2019 the *Environment Institute* welcomed researchers at Adelaide Exposure Science and Health (AESH) as members. AESH, in the School of Public Health, is a multidisciplinary group of chemists, toxicologists, occupational and environment exposure scientists. Their research is aimed at understanding hazardous material (HAZMAT) exposures and providing evidence-based practical advice on ways of controlling risks. Working at the intersection of emergency services, occupational and environmental health, they collaborate with a range of organisations including government, industry and professional bodies. Since 1997, a team of AESH scientists have been providing 24/7 HAZMAT advice to fire, health and environmental service agencies. They are well integrated into emergency management systems in South Australia, providing advice on chemical containment, decontamination and clean-up, as well as assisting agencies in dealing with unknown chemicals and complex mixtures. They are often engaged in the prevention of chemical contamination of waterways and agricultural land from fires and transport incidents. Notably in 2019, AESH initiated a Memorandum of Understanding between the University of Adelaide and four government agencies including the Environment Protection Authority.

Beyond service provision, their research is supported by defence and emergency service agencies, as well as occupational health organisations and industry. A key research strength is in understanding skin absorption of chemicals and the performance of protective clothing, which is especially important for firefighters and other first responders, and those cleaning smoke or hazardous chemical-impacted areas. As an example, their work with the Bushfire and Natural Hazards CRC addresses skin uptake of combustion products under hot conditions. Since 2008, they have been working with the US and Australian governments on chemicals of security concern. Their primary data feeds into international guidance and databases for first responders.

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IMPACT OF ENVIRONMENTAL STRESSES ON HUMAN–ENVIRONMENT INTERACTIONS

Ecological and food security, ecological rehabilitation of the Three Gorges Dam since the implementation of large-scale ecological programs, and the effects of air pollution on the intentions of China's internal migrants to have a second child (second birth intentions) are an ever-present concern for the Chinese government.

Environment Institute researcher Associate Professor Yan Tan from the Department of Geography, Environment and Population is addressing issues surrounding these environmental stresses and human-environment interactions in close collaboration with researchers from the Nanjing Institute of Geography and Limnology at the Chinese Academy of Sciences and Nanjing University (China). Their research has resulted in four articles in high-ranked journals summarised below.

'Ecological red lines' (ERL) are currently used as a Chinese national policy for protecting ecological systems for sustainable development and safeguarding ecological security. Although unique to China, ERL's are comparable to natural protected areas and strategic environmental assessments in Australia and in other countries. In a recent study to establish a coherent framework and criteria for classifying ERL at a regional scale, Associate Professor Tan and colleagues constructed five key indicators that measure ecosystem services (annual available recharge, soil retention capacity, net primary productivity, protected areas, lakes and flood storage and retention areas) and two ecological vulnerability indicators (susceptibility of geological hazards, rocky desertification). The results show that the total area of ERL in China's Yangtze River Economic Belt amounts to 1.13 million km², accounting for 55.5% of the total land area within the Belt.

Severe food shortages have greatly affected communities in the Yangtze River Basin. Another study quantified the change in spatial-temporal patterns of crop production in the area since 1990. Panel models were constructed to examine how climate variation, sown area, fertilizer use intensity, and population size influence the capacity for crop production in the region. They found that the total crop production increased by 15.2% over the 1990–2015 period, while there exist significant differences in crop output across the upper, middle, and lower sections of the Basin. These finding are important to the food security policies for the community.

China's Three Gorges Dam project, spanning the Yangtze River, is one of the world's most controversial infrastructure projects due to substantial ecological and social issues. The effects of three major ecological programs – terrestrial ecosystems, water pollution prevention, and ecological operation – on ecological rehabilitation of the affected areas, have been evaluated by researchers. Extensive observed data on soil erosion, forest cover, water quality, sediment, spawning size of four domestic fish species, other fish species, and endemic fish species are used for the analysis. The results show that these programs significantly improved ecological functions in the Three Gorges reservoir area. China's practice suggests that mitigation policies can rehabilitate ecosystems and reverse some negative effects of large dams.

The fertility rates of the Chinese population have been declining. By investigating the impact of particulate matter (PM) on the birth intentions or fertility behaviour of the childbearing population, research has identified a negative association between $PM_{2.5}$ concentration and the second birth intentions of Chinese migrants. The impact exhibits marked regional differences, with greater second birth intentions in areas with less air pollution. The results have direct implications for the Chinese government to play a role in making and implementing environmental policies on the mitigation of smog to effectively safeguard the health of individuals and communities and potentially raise China's fertility rate.

"RESEARCH HAS IDENTIFIED A NEGATIVE ASSOCIATION BETWEEN $PM_{2.5}$ CONCENTRATION AND THE SECOND BIRTH INTENTIONS OF CHINESE MIGRANTS"

Further reading

Xu, X., Yang, G., Tan, Y., Liu, J., Zhang, S., & Bryan, B. (2020). Unravelling the effects of large-scale ecological programs on ecological rehabilitation of China's Three Gorges Dam. *Journal of Cleaner Production*, 256, 120446. doi: 10.1016/j.jclepro.2020.120446

Xu, X., Yang, G., & Tan, Y. (2019). Identifying ecological red lines in China's Yangtze River Economic Belt: A regional approach. *Ecological Indicators*, 96, 635-646. doi: 10.1016/j.ecolind.2018.09.052

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Guo W, Tan Y, Yin X, Sun Z. (2019). Impact of $PM_{2.5}$ on second birth intentions of China's floating population in a low fertility context. *International Journal of Environmental Research and Public Health*, 16(21), 4293. doi: 10.3390/ijerph16214293

MATERIALS CHEMISTRY SOLUTIONS FOR BIOMOLECULE AND BIOSYSTEM BANKING AND PROTECTION

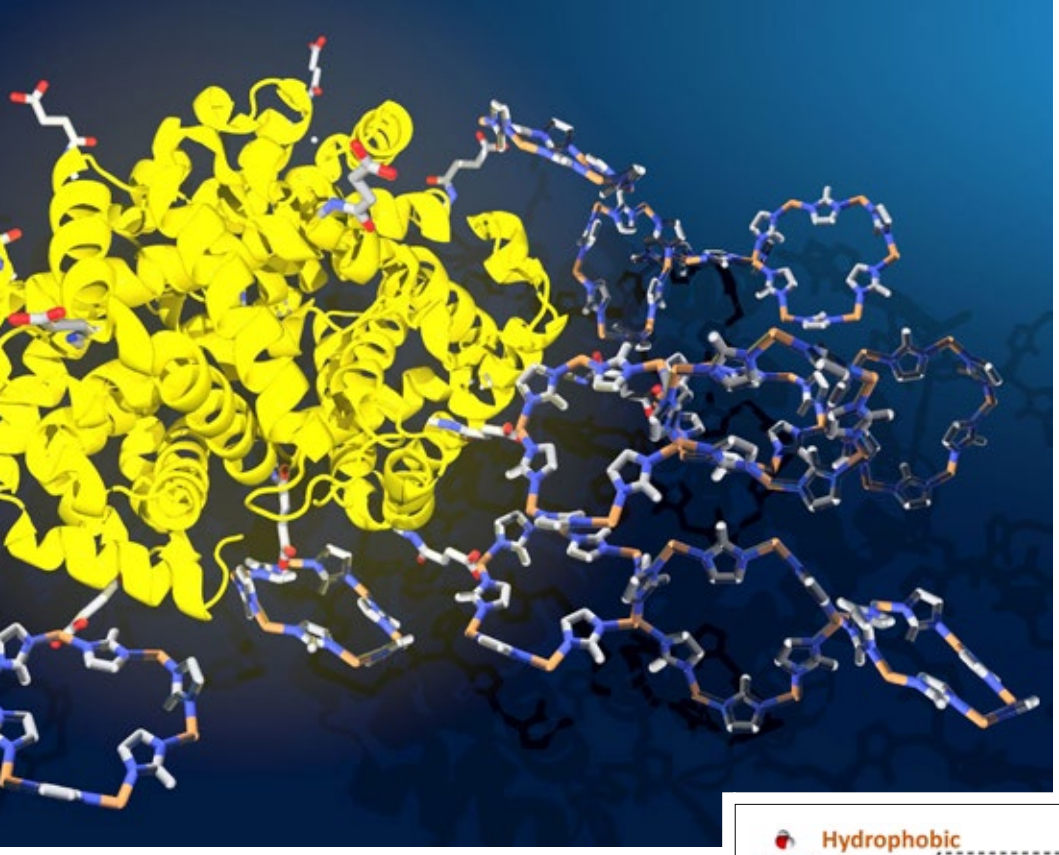
Biomacromolecules are a range of bio-derived molecules (biomolecules), including proteins, nucleic acids, and carbohydrates. Biomacromolecules are increasingly finding applications as therapeutics, as markers for disease prognosis and for monitoring ongoing treatment, in molecular sensing arrays, or as biocatalysts for selective and energy-efficient chemical transformations.

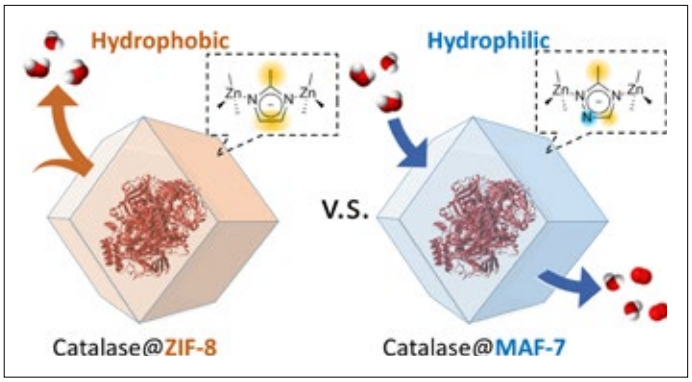
As Nature's catalysts, enzymes can convert reactants into products at room temperature in high yield, thereby allowing them to be used for large scale synthesis of important chemicals in an energy-efficient manner. A significant obstacle to effective use of biomacromolecules is their known instabilities when removed from a controlled biological environment. Many biomolecules lose their functionality when exposed to harsh environments, for example elevated temperatures, non-aqueous media, or when exposed to strongly acidic or alkaline conditions. In more complex biological assemblies, such as virus particles and cells, their susceptibility to degradation limits applications in vaccine development, gene therapy and cell culture. While researchers have proposed solutions for protecting biomolecules, such as infiltrating them into porous materials via pore infiltration, there is still a need for better, more adaptable protective coating methodologies.

In collaboration with researchers from the Technical University of Graz, *Environment Institute* researchers Professor Christian Doonan and Professor Chris Sumby, from the Centre of Advanced Nanomaterials, have been working on an encapsulation strategy for protection of biomacromolecules and biosystems.

The strategy, termed *biomimetic mineralisation*, works by initiating the growth of a porous chemical coating around the "soft" biomacromolecule. The methodology was called biomimetic mineralisation due to the similarities to Nature's biomineralisation processes whereby hard mineral structures are induced to grow to protect the soft tissues of many organisms. The porous material used for biomimetic mineralisation provides a hard, mineral-like coating around the biomolecule that protects it from elevated temperatures, organic solvents, and acids and bases that could cause its destruction. Moreover, the porous structure of the coating allows controlled access to the biomolecule and can even be programmed to dissolve in response to certain stimuli and release an intact biomacromolecule.

In 2019 the research collaboration reported two significant advances on the methodology. The first advance demonstrated that the ability of the coating to attract water, or other polar substances (hydrophilicity), was critical to efficient functioning of encapsulated enzymes, while the second contribution demonstrated at another class of porous coating could be used for protection. Excitingly, this second advance led to an Australian provisional patent being filed to protect this invention.





Above:

Artistic representation of the initial stages of biomimetic mineralisation occurring on the surface of a biomacromolecule. The yellow ribbon structure is the biomacromoleule and the rod components are a small amount of the porous coating.

Right:

Encapsulation of biomacromolecules can preserve biological functionality in harsh environments, a process termed biomimetic mineralization. Catalase (a type of enzyme) encapsulated within hydrophilic MAF-7 coating retained activity upon encapsulation (right), whereas a hydrophobic ZIF-8 coating inactivates the enzyme and provided negligible protection (left).

The porous coating commonly used in the field actually presents a hydrophobic (water or polar substance repellent) surface to the biomolecule. In a recent publication in the prestigious Journal of the American Chemical Society, the joint Australian-Austrian research team demonstrated for the first time that more hydrophilic structural analogues of the protective coating could be induced to coat biomacromolecules. These new materials allowed enzymes, that were inactive in the previously used coating, to be made into biocomposites where the biological activity could be retained. This breakthrough will allow a wider variety of enzymes to encapsulated to produce functional biocomposites, broadening the scope for developing biocatalysts for fine chemical synthesis and sensing applications.

The second contribution, which was published in the same journal, reported that an emerging class of porous materials called hydrogen-bonded organic frameworks (HOFs), could also be used for biomolecule protection. These materials rapidly encapsulated biomacromolecules under biologically relevant conditions and notably provide a number of other advantages. These included being a metal-free solution for protection (previous porous coatings contained metal ions) and conferring stability to a wider range of acidic conditions.

While much of the research has focussed on applications in biocatalysis, the use of these biocomposites to store (biobanking), transport biomacromolecules (bioprotection) and improve detection (biosensing) are starting to be more widely considered. In collaboration with virologists in the School of Biological Sciences the research team is now planning to examine how these materials might be applied to vaccine delivery.

Further reading

Liang, W., Xu, H., Carraro, F., Maddigan, N., Li, Q., Bell, S., Huang, D.M., Tarzia, A., Solomon, M. B., Amenitsch, H., Vaccari, L., Sumby, C. J., Falcaro, P.,Doonan, C. J. (2019). Enhanced activity of enzymes encapsulated in hydrophilic metal-organic frameworks. *Journal of the American Chemical Society*, 141(6), 2348-2355.

Liang, W., Carraro, F., Solomon, M. B., Bell, S.G., Amenitsch, H., Sumby, C. J., White, N. G., Falcaro, P., Doonan, C.J. (2019). Enzyme encapsulation in a porous hydrogen-bonded organic framework. *Journal of the American Chemical Society*, 141(36), 14298-14305.

THE BIG PICTURE: GLOBAL CHALLENGES, PSYCHOLOGICAL PERSPECTIVES

Environment Institute members in the School of Psychology are engaged in multiple research projects to better understand human health and well-being across the lifespan in the context of environmental challenges. Arguably, the challenges we face on the planet today can be understood in the context of psychology - the study of human behaviour.

Nature and its impacts on children's wellbeing

Responding to increasing urbanization, increasing technology use, reductions in mental health and school performance and limited exposure and engagement of the natural environment, Dr Mark Kohler is investigating the benefits of nature-based learning at school for child wellbeing, school performance and attitudes towards nature. In a project funded by the Australasian Wildlife Management Society, South Australian parents and teachers rate primary school children's academic performance, learning environment and opportunity for outdoor learning and play. Preliminary analyses suggest that nature-based learning positively impacts on both child school performance and wellbeing and resilience.

Dr Kohler is also leading a large national program in partnership with the Jane Goodall Institute Australia and funded by the Philips Foundation. This project, called the Roots and Shoots Resource Box for schools program, aims to deliver a free resource kit to promote and facilitate nature-based learning activities in up to 4,000 schools nationally, all tied to the Australian school curriculum in each state. The research involves children completing an online survey before and after the program to assess changes in wellbeing, and attitudes toward school and nature. Registration of schools is open, and the free resource boxes will be available for delivery from late 2020.

Development of psychological interventions for responding to crises

The biopsychosocial impact of bushfires is a focus of research in the School of Psychology, shaping a holistic understanding of health and care delivery. Professor Deborah Turnbull, Professor Anna Chur-Hansen and Associate Professor Rachel Roberts are part of a multidisciplinary team from the Schools of Psychology and Public Health working in collaboration with the community to study the psychological impact of bushfires. The study seeks to understand the range of responses from the community as well as provide an in-depth examination of experiences. This research will ultimately inform the development of co-designed psychological interventions as well as curricula for health professional students who will have future roles in responding to such crises.

Dr Amanda Taylor, Professor Paul Delfabbro and Associate Professor Rachel Roberts have received funding from the Bushfire and National Hazards Cooperative Research Centre (BNHCRC) and the Hospital Research Foundation for a project on investigating ways to maintain and promote positive mental health and wellbeing in young adult emergency services volunteers under the age of 25. The services will include parks and wildlife services and firefighters, who are exposed to potentially traumatising events.

Understanding behaviour to improve environmental health

Extending research into human-animal bond, Associate Professor Carolyn Semmler and Professor Anna Chur-Hansen's research examines the psychological factors around meat consumption.

In collaboration with Honours students and colleagues from the Faculty of Arts, they focused on the psychological mechanisms and factors that drive meat consumption when consumers clearly expressed pro-animal attitudes, a form of cognitive dissonance termed the 'meat-paradox'. Furthering the understanding of how consumers might use various cognitive strategies to avoid changing their meat consumption behaviour, techniques could be developed for modifying consumption behaviour, to improve environmental and population health as well as the health of individuals.

Further reading

Dowsett, C., Semmler, C., Bray, H., Ankeny, R.A., & Chur-Hansen, A. 2018. Neutralising the meat paradox: Cognitive dissonance, gender, and eating animals. *Appetite*. 123, pp 280-288. https://doi.org/10.1016/j.appet.2018.01.005

"ROOTS AND SHOOTS RESOURCE BOX FOR SCHOOLS PROGRAM, AIMS TO DELIVER A FREE RESOURCE KIT TO PROMOTE AND FACILITATE NATURE-BASED LEARNING ACTIVITIES. GET INVOLVED AT ROOTSANDSHOOTS.ORG.AU/RESOURCEBOX"

OVERCOMING URBAN HEAT

Adelaide and cities around the world are facing similar challenges: increasing population density, reduced open spaces, increasing urban heat and increasing need for cooling to combat heat. With warming climates and increasingly unpredictable weather patterns, dealing with these challenges correctly has become even more critical.

Cities need to be better managed and new developments need to be planned more thoughtfully, whilst implementing designs which will be more resilient to future changes.

The *Environment Institute* was a sponsor of the *Heat and Habitat in Cities Symposium*, organised by researchers at the School of Architecture and Built Environment on December 9th and 10th, 2019. Opened by the Minister for Environment and Water, Honourable David Speirs MP, the Symposium brought together international and national experts in:

- urban microclimate
- urban greening
- building energy use
- human thermal comfort
- innovative systems and building technologies
- policy makers and design practitioners

According to the Bureau of Meteorology, summer this year was Australia's second hottest on record, with temperature 1.88C above average. It has been predicted that unless appropriate measures are taken, the average temperature in Australia can be close to 4C higher than the global average temperature by 2100. Nevertheless, there are ways to help mitigate urban heating, such as urban greening, better building design (to reduce radiant heat on building surfaces and minimize cooling energy), applying 'smart' building facades and environmental control systems, and using cool materials for exterior surfaces. Whilst improving our cities and built environment generally, it is also important that special attention is given to those who are most vulnerable to heat, such as people with low socio-economic background and those who are older and frail.

Symposium outcomes are currently being prepared into both an online publication which will be available for general public, and a Special Issue for Energy and Buildings journal (Elsevier) on Advances in Research for Resilient Cities and Building Energy Use Minimisation.

Further reading

Bartesaghi-Koc, C., Osmond, P., & Peters, A. (2019). Mapping and classifying green infrastructure typologies for climate-related studies based on remote sensing data. *Urban Forestry and Urban Greening*, 37, 154-167.

Sharifi, E., Larbi, M., Omrany, H., & Boland, J. (2020). Climate change adaptation and carbon emissions in green urban spaces: Case study of Adelaide. *Journal of Cleaner Production*, 254, May.

The University of Adelaide. (n.d). Heat and Habitat in Cities Symposium. Retrieved from https://ecms.adelaide.edu.au/architecture/h2csymposium

Slessor, C. (2019, December 9). Australia's capital cities are getting hotter — but there are ways to cool them down. *ABC News*. Retrieved from www.abc.net.au/news/2019-12-09/how-to-cool-down-your-capital-city-amid-rising-temperatures/11779722

The Heat and Habitat in Cities Symposium

"IT HAS BEEN PREDICTED THAT UNLESS APPROPRIATE MEASURES ARE TAKEN, THE AVERAGE TEMPERATURE IN AUSTRALIA CAN BE CLOSE TO 4°C HIGHER THAN THE GLOBAL AVERAGE TEMPERATURE BY 2100."

ENVIRONMENT INSTITUTE ENGAGEMENT

It was a busy year for the *Environment Institute* and its members. There was a pleasing mix of sponsored events and public engagement opportunities to showcase our enlightening research.

Climate Change Update 2019 Adelaide

In conjunction with the Australian National University (ANU), the *Environment Institute* hosted a very successful Climate Change Update 2019 Adelaide at the beginning of March. The evening included guest presenter Hon Mark Butler, MP, Shadow Minister for Climate Change & Energy to open the event. The following speakers were:

- Professor Mark Howden, Director, ANU Climate Change Institute, ANU
- Professor Seth Westra, University of Adelaide
- Professor Tom Kompas, Crawford School of Public Policy, ANU and University of Melbourne
- Cathie Armour, ASIC Australian Securities and Investments Commission

Decision making in the dark

The *Environment Institute* proudly hosted 2019 Australian of the Year dual recipient Dr Richard 'Harry' Harris SC OAM for an intimate breakfast presentation. This was followed by a student presentation with extensive Q&A. Richard shared his fascination of deep-cave exploration which has incidentally led to many underwater, cave discoveries and a magnificent contribution to citizen science.

Dr Richard 'Harry' Harris SC OAM

Jane Goodall Luncheon

The celebration of the 10th anniversary of the chimpanzee enclosure at Monarto Zoo, happily coincided with a visit to Adelaide by world-renowned primatologist Dr Jane Goodall, who opened the enclosure. This recent visit was the last stop in the Australian leg of her global Rewind the Future 2019 tour. During the visit to Monarto, Dr Goodall spoke to a gathering of sponsors, volunteers, researchers and zoo staff at the chimpanzee enclosure, and then again over a vegetarian lunch catered by The Adelaide Oval, proudly sponsored by the *Environment Institute*.

Dr Jane Goodall at Monarto Zoo.
Photo: Mark Tipple Photography

Speakers at 'Meeting Australia's Climate Change Targets' forum. Left to right: Professor Bassam Dally, Professor Nick Falkner, Professor Sarah Wheeler, Professor Gus Nathan, Professor Bronwyn Gillanders, Professor Mike Young, Professor Bob Hill (Director, Environment Institute), Mrs Susan Jeanes (Facilitator)

Meeting Australia's Climate Change Targets: Price, Opportunity and Pathways

The *Environment Institute* and the Centre for Energy Technology were excited to host the joint forum 'Meeting Australia's Climate Change Targets: Price, Opportunity and Pathways' on the 29th of April 2019. The forum brought together scientific experts who presented their perspectives of different options to meet our emissions targets by 2050 and answered key questions about policy, technology and pathways. It was well attended informative night which explored Australian climate change beliefs and behaviour, measurement and feedback, natural carbon sink - the ocean, sharing access to and permitting use of our climate, CO_2 mitigation and the transport sector. The presenters were

- Professor Sarah Wheeler, Associate Director of Research, Centre for Global Food and Resources
- Associate Professor Nick Falkner, Director of the Australian Smart Cities Consortium
- Professor Bronwyn Gillanders, Deputy Director, Environment Institute
- Professor Mike Young, Centre for Global Food and Resources
- Professor Gus Nathan, Director, Centre for Energy Technology
- Professor Bassam Dally, Deputy Director, Centre for Energy Technology

Research Tuesday

Mission Mammal

August's 'Mission Mammal' Research Tuesday focussed on the many species that now require urgent conservation and our critical role to play. From understanding species distribution through time, fighting disease and understanding urban adaptions, Professor Kris Helgen, Dr Liz Reed, Dr Wayne Boardman and Chelsea Graham provided their insights.

Climate Changed

Experts from the *Environment Institute* presented at the November's Research Tuesday titled 'Climate Changed'. Discussion surrounded climate change issues, including why we must integrate understanding of climate change impacts into our every thought and action. The expert panel on this successful night consisted of Professor Seth Westra, Dr Cesca McInerney, Associate Professor Patrick O'Connor and Dr Doug Bardsley.

Scope TV

Professor Bob Hill appeared on ScopeTV episode airing 12 May 2019. ScopeTV is a fun children's show that encourages a love of science. In the episode he explained how plant fossil records can inform us on the evolution of the planet.

Wilkins Oration

The Wilkins Oration was co-hosted by the *Environment Institute* and the Wilkins Foundation. The night paid homage to the adventurous life of Sir Hubert Wilkins and his scientific, geographic explorations and cinematic contributions.

PUBLIC ENGAGEMENT

The *Environment Institute* members were active in participating in public engagement opportunities in 2019:

DATE	SPEAKER	DESCRIPTION
4 March	Professor Seth Westra	Climate Change Update 2019
29 April	Professor Bronwyn Gillanders & Professor Sarah Wheeler	Meeting Australia's climate change targets: Price, opportunity and pathways
12 May	Professor Bob Hill	ScopeTV
8 July	Dr Michelle Lim	Unprecedented global biodiversity decline – What does this mean for the economy, agriculture and human well-being? (Centre for Global Food and Resources and the SA branch of the Australasian Agricultural Resource Economics Society)
9 July	Australian Centre for Ancient DNA Researchers	Identifying the millions of species yet to be classified (ABC Science Show)
13 August	Professor Kris Helgen, Dr Liz Reed & Dr Wayne Boardman	Mission Mammal (Research Tuesday)
16 August	Professor Bob Hill & Professor Michelle Waycott	How plants shaped the past present and future (Science in The Pub Adelaide)
5 November	Professor Bob Hill	Evolution of the southern Australian vegetation – the world's biggest climate change experiment (Butterfly Conservation SA)
12 November	Professor Bob Hill	Australia's tempestuous relationship with wildfire – past, present and future (Sprigg Lecture Series)
13 November	Professor Seth Westra, Dr Cesca McInerney, Associate Professor Patrick O'Connor & Dr Douglas Bardsley.	Climate Changed (Research Tuesday)
14 November	Professor Kris Helgen	New mammals in a changing world (School of Biological Science Research Symposium)
14 November	Dr Jasmin Packer	Engagement and conservation (School of Biological Science Research Symposium)
14 November	Ms Tahlia Perry	EchidnaCSI: Using citizen science for research, outreach and conservation (School of Biological Science Research Symposium)
14 November	Dr Erinn Fagan-Jeffries	Outreach and community involvement in taxonomy (School of Biological Science Research Symposium)
14 November	Dr Alice Jones	Blue Carbon - how coastal vegetation can help combat climate change (School of Biological Science Research Symposium)
14 November	Professor Bob Hill	Environment Institute research strategies for 2020 and beyond (School of Biological Science Research Symposium)
23 November	Dr Liz Reed	Mega night of science (Megafest: Naracoorte World Heritage Festival)
29 November	Dr Michelle Lim	Making South Australian biodiversity law fit for purpose in the Anthropocene: Challenges and opportunities
6 December	Dr Myall Tarran	The great evolutionary transitions in animals and plants (Science in The Pub Adelaide)
13 December	Dr Nengye Liu	China's future role in managing the increasingly precarious Antarctic ecosystem (podcast)

LOCAL AND INTERNATIONAL SPEAKERS

The *Environment Institute* was host to local and international speakers in 2019:

DATE	SPEAKER	DESCRIPTION
30 April	Professor Tianbao Qin, Wuhan University, China	China and the convention on biological diversity
1 May	Professor Hugh Possingham, The Nature Conservancy	Innovative conservation science & economics at The Nature Conservancy
1 August	Associate Professor David Nogués-Bravo, University of Copenhagen	Macrogenetics: amplifying the phylogeography of genes in a changing world
30 August	Professor Richard Parncutt, University of Graz	The human cost of climate change
14 November	Professor Margaret Byrnes, Department of Biodiversity, Conservation, Western Australia	Genomics for plant conservation and restoration (School of Biological Science Research Symposium)
27 November	Professor Josh Cinner, James Cook University	Locating and learning from bright spots among the world's coral reefs
29 November	Dr Seraina Klopfstein, Universität Bern	Parasitic wasps

CONFERENCES AND WORKSHOPS

The *Environment Institute* supported the following conferences, workshops and events in 2019:

DATE	EVENT
4 March	Climate Update 2019
29 April	Meeting Australia's climate change targets: Price, opportunity and pathways
3 May	Threatened Plant Translocation Workshops, Australian Network for Plant Conservation workshop
14 May	Dr Jane Goodall, Luncheon for chimpanzee enclosure anniversary at the Monarto Zoo
16 September	Decision making in the dark (Australian of the Year breakfast) with Dr Richard Harris
8-10 October	Private Land Conference
31 October	Wilkins Oration
7-8 November	South Australian Coastal Conference
11 December	South Australian Seagrass Symposium
9-10 December	Heat & Habitat in Cities Symposium

AWARDS AND ACHIEVEMENTS

Congratulations to *Environment Institute* members on their outstanding awards and achievement

ARC Future Fellowship

Dr Emma Sherratt was awarded a prestigious ARC Future Fellowship, Dr Sherratt will receive up to $100,000 of non-salary funding over four years, which may be used for personnel, equipment, travel and field research costs directly related to the Future Fellow's research.

Dr Emma Sherratt

Australasian Quaternary Association (AQUA) biennial conference 2019

Students from the Sprigg Geobiology Centre were successful at the 2019 Australasian Quaternary Association (AQUA) biennial conference held in Canberra. Best student poster joint winner Charles Maxson (supervisors: Associate Professor John Tibby, Dr Jonathan Tyler and Dr Cameron Barr), Best student talk winner Sarah McDonald (supervisor: Dr Jonathan Tyler) and Best PhD student talk winner Haidee Cadd (supervisors: Associate Professor John Tibby and Dr Jonathan Tyler).

2017 Bradshaw Medal

We were pleased to announce a team of leading researchers at the *Environment Institute* were awarded the honour of the 2017 Bradshaw Medal for their paper which was published in Restoration Ecology titled: 'Urban habitat restoration provides a human health benefit through microbiome rewilding'. Congratulations to the team involved: Professor Philip Weinstein, Professor Andrew Lowe, Dr Laura Weyrich, Dr Martin Breed, Jacob Mills and Nicholas Gellie.

Dragon's Den

For a number of years, the *Environment Institute* has invested in a leadership program for early career researchers. This program has been a great success and many of the participants of the program in the past are now in leadership positions within the University or externally. This year's participants were Dr Stuart Brown, Dr Eleanor Dormont, Dr Raphael Eisenhofer. Dr Errin Fagan-Jeffries, Dr Nicole Foster, Dr Daniel Gregg, Dr Dominic McAfee, Dr Emma Sherratt, Dr Myall Tarran, Dr Andrew Thornhill and Dr Alexandra Peralta.

European Union's Horizon 2020

Professor Hessel was a part of a team of international researchers which won a $16 million ERC Synergy Grant in the European Union's research and innovation programme, Horizon 2020. The grant will enable the team to investigate the use of new kinds of plasma energy to revolutionize fertilizer production. Congratulations!

Faculty of Sciences Awards

Congratulations to Dr Alice Jones for receiving the Sciences Partnership Development Award. This award recognises efforts by a researcher in establishing mutually-beneficial research partnerships with organisations outside of academia for longer-term advancement of knowledge and societal impact.

Congratulations also to Dr Erinn Fagan-Jeffries for receiving the Harold Woolhouse prize. This prize is for the best PhD thesis produced in the Faculty of Sciences.

Participants in the Environment Institute's Dragon's Den Leadership Program along with the Dragon's.

Back row L to R: Dr Dominic McAfee, Dr Andrew Thornhill, Dr Stuart Brown, Dr Daniel Gregg, Dr Emma Sherratt, Dr Paul Dalby (Facilitator), Dr Kane Aldridge (Director, Goyder Institute and Dragon's Den coach). Front row L to R: Ms Rachel Barratt, Associate Director, Aither and Dragon's Den Coach), Dr Errin Fagan-Jeffries, Dr Alexandra Peralta, Dr Nicole Foster, Dr Eleanor Dormont, Dr Raphael Eisenhofer.

Dr Dominic McAfee at a Fresh Science Competition

Native Vegetation Council L to R : Natalie Sommerville, Ross Sawers, Professor Bob Hill, Emily Jenke (Presiding Member), John Neal, Catherine Hollingsworth, Maurice Roche.

Fresh Science Competition

Ten Fresh Scientists revealed their scientific discoveries using in the time it took for a sparkler to burn. We are pleased to announce that Dr Dominic McAfee was voted best speaker.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) selected Associate Professor Phill Cassey as Lead Author for Chapter 4 of the IPBES thematic assessment named "the assessment of invasive alien species".

International Building Performance Simulation Association Fellowship

Congratulations to Professor Veronica Soebarto who was awarded the title of Fellow by the International Building Performance Simulation Association (IBPSA) for her distinction in and substantial contribution to the field of building performance simulation.

Associate Professor Phill Cassey

Professor Veronica Soebarto

Max Day Award

Congratulations to PhD student Ms Nicole Foster from the Marine Biology Program who was one of two, 2019 recipients of the Australian Academy of Science Max Day Environmental Science Fellowship Award. The award recognises early-career researchers working on the conservation of Australia's flora and fauna, the ecologically sustainable use of resources and the protection of the environment and ecosystem services.

New Chair of the National Landcare Network

We're delighted to announce that Associate Professor Patrick O'Connor was selected the new Chair of the National Landcare Network and aims to support the movement of people who are working in Australia towards the UN Sustainable Development Goals.

Native Vegetation Council

Professor Bob Hill was elected as the Minister for Environment and Water's nominee on the Native Vegetation Council. In this role he gives expert advice on applications received for removal of native vegetation. He will also assist in re-establishing native vegetation.

Associate Professor Patrick O'Connor

Society of Australian Systematic Biologists Early Career Research Excellence Award

Dr Erinn Fagan-Jeffries, from Professor Andy Austin's research team, was awarded the Society of Australian Systematic Biologists Early Career Research Excellence Award at the conference in Brisbane. She received the award from the SASB President Dr Michael Rix.

University of Adelaide Stem Young Achievers Award

We were delighted to hear that PhD student Tahlia Perry, from Professor Frank Gruntzner's research team, has won the renown Young Achievers: University of Adelaide STEM Award. Tahlia is a passionate science communicator and women in STEM ambassador.
We congratulate her on the award.

Tahlia Perry (left) and Professor Rachel Burton. Photo: Awards Australia

ENVIRONMENT INSTITUTE ADVISORY BOARD MEMBERS

Ms Sandy Pitcher (Chair)

Chair, Environment Institute Advisory Board

Sandy is an experienced executive and has worked in senior levels of the public sector in South Australia, the Australian government and the United Kingdom. She has recently taken up a role leading the Victorian government skills, training and higher education portfolios. Sandy's private sector experience includes an executive consultant role at ASX 100 company OZ Minerals. She has a strong background in climate change, renewable energy and a range of boards, including Save the Children Australia, the South Australian Minerals and Energy Council and Solar Citizens. Sandy is a graduate of the University of Adelaide, a Fellow of the Institute of Public Administration Australia, Graduate of the Australian Institute of Company Directors and was the national Telstra Businesswoman of the Year, Community and Government in 2012.

Professor Richard Hillis

Pro Vice-Chancellor (Research Performance), University of Adelaide

Richard is the Pro Vice-Chancellor (Research Performance), providing leadership in achieving the University's strategic goals in relation to research quality, revenue, productivity and international standing. Richard spent 18 years at the University of Adelaide (1992-2010) where he was Mawson Professor of Geology, State of South Australia Chair of Petroleum Geology and Head of the Australian School of Petroleum. From 2010-2018 Richard was CEO of the Deep Exploration Technologies Cooperative Research Centre (DET CRC) which developed transformational technologies for mineral exploration. Richard is a Fellow of ATSE (Australian Academy of Technology and Engineering) and of the Geological Society of Australia. He was awarded the Geological Society of Australia's Webb Medal for leadership in the earth sciences (2014) and South Australian Scientist of the Year (2018).

Ms Sandy Carruthers

Director of Science, Department of Environment and Water

Sandy is the Director of Science for the Department of Environment and Water (DEW). Through her role, Sandy is accountable for the coordination and delivery of DEW's core science capability to support NRM in South Australia. She plays a key role in the interface between NRM science, policy and delivery in South Australia, and recently led the development of a Research Partnership Strategy for DEW, to support the critical relationships between DEW and the South Australian research sector.

Dr Susannah Eliott

Chief Executive Officer, Australian Science Media Centre

Susannah has more than 20 years of practical experience in science communication. Susannah is currently CEO of the Australian Science Media Centre, an independent not for profit organisation that works with the news media to highlight the scientific evidence behind the story. Previously appointed to the national Climate Commission and Chair for the Expert Working Group on Science and the Media for the Federal Government. She currently sits on the Federal Government's Science Sector Working Group and the *Environment Institute* Board.

Facing page: Associate Professor Diego Garcia-Bellido with a large specimen of the newly described trilobite Redlicha rex *from the Emu Bay Shale, Kangaroo Island.*

Ms Elaine Bensted

Chief Executive, Zoos South Australia

Elaine is the Chief Executive of Zoos South Australia. Since being in the role she has led an improvement in the financial position of this conservation charity and an increase in Zoos SA membership base from 26,000 to over 40,000. Elaine has previously held senior positions in State and Local Government, and the private sector in the finance industry.

Professor Chris Daniels

Director of Cleland Wildlife Park, Department for Environment and Water

Chris is the Director of Cleland Wildlife Park (Department for Environment and Water, SA Government). He is also involved in many other environmental leadership activities focused on conserving wildlife and connecting people with nature. Chris has published 9 books, 1 DVD and over 250 scientific and community publications. He received a Doctor of Science (DSc) from the University of Adelaide in 2018.

ARC FUNDING OUTCOMES

TYPE	ANNOUNCED	EI INVESTIGATOR(S)	AIM OF PROJECT	AMOUNT
Linkage Project	2	Associate Professor Phillip Cassey & Dr Thomas Prowse	Development of genetic technology for rodent population suppression.	$492,000
		Professor Nigel Spooner	Aboriginal rock art and cultural heritage management in Cape York Peninsula.^	$1,342,000
Future Fellowship	1	Dr Emma Sherratt	Adaptive morphology and evolution of invasive rabbits and hares.	$681,697
Industrial Transformation Training Centres	1	Professor Nigel Spooner	ARC Training Centre for Integrated Operations for Complex Resources.	$3,703,664
Discovery Project	6	Dr Emma Sherratt	Snake fangs: insights into evolution, palaeoclimate and biodesign. *	$681,697
		Dr Jonathan Tyler & Associate Professor John Tibby	East Asian Monsoon response to periods of abrupt global change.	$464,000
		Professor Peng Bi	Climate Change and Burden of Disease: Current Risk and Future Burden.	$488,456
		Professor Christian Doonan & Professor Christopher Sumby	Advancing the Chemistry of Metal-organic Frameworks for Biotechnology.	$550,000
		Professor Sarah Wheeler	Consequences of water reform and changing farm adaptation in the Murray-Darling Basin.	$157,699
		Professor Steven Cooper	Can parasites cause host population divergence? *	$401,030

**Lead institution Flinders University*
^Lead institution Notre Dame

Ancient rock art painting at the Quinkan rock art site, Cape York Queensland, Australia

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Global Food and Resources

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Chief Botanist, State Herbarium of SA

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Director, Australian Bioactive Compounds Centre

Professor Tom Wigley (Adjunct)

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Director, Centre for Applied Conservation Science

Associate Professor Bertram Ostendorf
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Dr Kate Sanders
Dr Emma Sherratt
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Professor Steven Cooper
Principal Researcher, SA Museum

Professor Stephen Donnellan
Genetics and Evolution, SA Museum

2019 CITATION STATISTICS

Listed alphabetically below are the 2019 citation statistics of *Environment Institute* researchers. These statistics offer insights into the impact of researchers in their chosen field.

RESEARCHER	NUMBER OF CITATIONS IN 2019 Number of times an article has been cited by another article	H-INDEX Number of publications with a citation number greater than or equal to h	i10-INDEX Number of publications with at least 10 citations.
Dr Lee ARNOLD	616	30	48
Professor Andrew AUSTIN	600	51	163
Associate Professor Jeremy AUSTIN	572	42	86
Dr Doug BARDSLEY	202	22	33
Dr Simon BAXTER	616	35	46
Professor Peng BI	1002	46	113
Dr Wayne BROADMAN	152	16	31
Professor Justin BROOKES	894	46	89
Associate Professor Peter BURDON	109	10	11
Associate Professor Phill CASSEY	1364	47	172
Professor Anna CHUR-HANSEN	437	30	69
Professor Alan COLLINS	1518	53	133
Professor Sean CONNELL	1487	65	156
Professor Alan COOPER	2912	83	199
Professor Steven COOPER	452	43	110
Professor Stephen DONNELLAN	619	45	129
Professor Christian DOONAN	1735	44	88
Dr Georgina DREW	49	9	8
Dr Juraj FARKAS	165	14	19
Professor Robert FITZPATRICK	395	39	154
Dr Damien FORDHAM	517	30	68
Dr Diego GARCIA-BELLIDO	297	24	44
Dr Sharyn GASKIN	58	9	9
Professor Bronwyn GILLANDERS	1201	57	148
Professor Michael GOODSITE	326	28	48
Professor Frank GRUTZNER	534	35	60
Professor Kristofer HELGEN	1221	41	120
Professor Volker HESSEL	2105	72	306

RESEARCHER	NUMBER OF CITATIONS IN 2019	H-INDEX	i10-INDEX
Professor Bob HILL	461	57	176
Dr Mark KOHLER	211	22	32
Dr Bastien LLAMAS	985	27	45
Professor Megan LEWIS	259	24	42
Dr Michelle LIM	35	7	3
Dr Nengye LIU	26	6	4
Professor Andy LOWE	1469	60	163
Professor Holger MAIER	1907	60	201
Dr Francesca MCINERNEY	528	18	26
Professor Ivan NAGELKERKEN	1416	61	141
Associate Professor Melissa NURSEY-BRAY	237	19	31
Associate Professor Patrick O'CONNOR	164	12	16
Associate Professor Bertram OSTENDORF	294	27	56
Dr Jasmin PACKER	42	8	7
Professor Dino PISANIELLO	420	32	62
Dr Thomas PROWSE	225	17	29
Dr Liz REED	28	10	12
Dr Frank REITH	500	25	55
Dr Kate SANDERS	402	22	32
Associate Professor Carolyn SEMMLER	122	14	16
Dr Emma SHERATT	383	19	25
Professor Veronica SOEBARTO	382	25	49
Professor Nigel SPOONER	373	35	74
Professor Christopher SUMBY	558	34	75
Associate Professor Yan TAN	240	20	35
Dr Vicki THOMSON	63	8	7
Dr Leigh THREDGOLD	8	4	1
Dr John TIBBY	235	30	60
Dr Jonathan TYLER	162	15	19
Professor Michelle WAYCOTT	1193	44	93
Professor Philip WEINSTEIN	841	47	175
Associate Professor Seth WESTRA	1056	33	58
Dr Laura WEYRICH	498	20	30
Professor Sarah WHEELER	437	29	55
Dr Fiona WHELAN	38	10	10
Professor Tom WIGLEY	1807	111	287
Professor Mike YOUNG	93	23	47

SELECTED PUBLICATIONS

The following list comprises our top publications that have attracted online attention and around the world. *Environment Institute* researchers are shown in bold type and articles are listed alphabetically by journal name.

Crowe-Riddell, J., D'Anastasi, B., Nankivell, J., Rasmussen, A., & **Sanders, K.** (2019). First records of sea snakes (Elapidae: Hydrophiinae) diving to the mesopelagic zone (>200 m). *Austral Ecology*, 44(4), 752-754. doi:10.1111/aec.12717

Murphy, B., Woolley, L., Geyle, H., Legge, S., Palmer, R., Dickman, C., Augusteyn, J., Brown, S. C., Commer, S., Doherty, T. S., Eager, C., Edwards, G., **Fordham, D. A.**,. . . Woinarski, J. (2019). Introduced cats (Felis catus) eating a continental fauna: the number of mammals killed in Australia. *Biological Conservation*, 237, 28-40. doi:10.1016/j.biocon.2019.06.013

Lockwood, J., Welbourne, D., Romagosa, C., **Cassey, P.**, Mandrak, N., Strecker, A., . . . Keller, R. (2019). When pets become pests: the role of the exotic pet trade in producing invasive vertebrate animals. *Frontiers in Ecology and the Environment*, 17(6), 323-330. doi:10.1002/fee.2059

Mills, J., Brookes, J., Gellie, N., Liddicoat, C., **Lowe, A.**, Sydnor, H., . . . Breed, M. (2019). Relating urban biodiversity to human health with the 'holobiont' concept. *Frontiers in Microbiology*, 10(MAR). doi:10.3389/fmicb.2019.00550

Yun, H., Brock, G., Zhang, X., Li, L., **Garcia-Bellido, D.**, & Paterson, J. (2019). A new chancelloriid from the Emu Bay Shale (Cambrian Stage 4) of South Australia. *Journal of Systematic Palaeontology*, 17(13), 857-867. doi:10.1080/14772019.2018.1496952

Beggs, P. J., Zhang, Y., Bambrick, H., Berry, H. L., Linnenluecke, M. K., Trueck, S., **Peng, B.**,. . . Capon, A. G. (2019). The 2019 report of the MJA-Lancet Countdown on health and climate change: a turbulent year with mixed progress. *Medical Journal of Australia*, 211(11), 490-491, 491.e491-491.e421. doi:10.5694/mja2.50405

Cole, T. L., Ksepka, D. T., Mitchell, K. J., Tennyson, A. J., Thomas, D. B., Pan, H., Zhang, G., Rawlence, N. J., Wood, J. R., Bover, P., Bouzat, J. L., **Cooper, A.**, . . . Waters, J. M. (2019). Mitogenomes uncover extinct penguin taxa and reveal island formation as a key driver of speciation. *Molecular Biology and Evolution*, 36(4), 784-797. doi:10.1093/molbev/msz017

Cooper, N., Bond, A. L., Davis, J. L., Portela Miguez, R., Tomsett, L., & **Helgen, K. M.** (2019). Sex biases in bird and mammal natural history collections. *Proceedings. Biological sciences*, 286(1913), 20192025-20192025. doi:10.1098/rspb.2019.2025

Leebens-Mack, J., Barker, M., Carpenter, E., Deyholos, M., Gitzendanner, M., Graham, S., . . . McNeal, J. (2019). One thousand plant transcriptomes and the phylogenomics of green plants. *Nature*, 574(7780), 679-685. doi:10.1038/s41586-019-1693-2

Bradshaw, C., Ulm, S., Williams, A., Bird, M., Roberts, R., Jacobs, Z., Laviano, F., **Weyrich, L. S.**,. . . Saltré, F. (2019). Minimum founding populations for the first peopling of Sahul. *Nature Ecology and Evolution*, 3(7), 1057-1063. doi:10.1038/s41559-019-0902-6

Wisocki, P.A., Kennelly, P., Rojas Rivera, I., **Cassey, P.**, Burkey, M. L., & Hanley, D. (2019). The global distribution of avian eggshell colours suggest a thermoregulatory benefit of darker pigmentation. *Nature Ecology and Evolution*, 4, 148–155 (2020). https://doi.org/10.1038/s41559-019-1003-2

Breed, M., Harrison, P., Blyth, C., Byrne, M., Gaget, V., Gellie, N., Groom. S. V. C., Hodgson, R., Mills, J. G., **Prowse, T. A. A.**, . . Mohr, J. (2019). The potential of genomics for restoring ecosystems and biodiversity. *Nature Reviews Genetics*, 20(10), 615-628. doi:10.1038/s41576-019-0152-0

Freeling, B., Doubleday, Z., & **Connell, S.** (2019). How can we boost the impact of publications? Try better writing. *Proceedings of the National Academy of Sciences of the United States of America*, 116(2), 341-343. doi:10.1073/pnas.1819937116

Gower, G., Fenderson, L. E., Salis, A. T., **Helgen, K. M.**, van Loenen, A. L., Heiniger, H., . . . Cooper, A. (2019). Widespread male sex bias in mammal fossil and museum collections. *Proceedings of the National Academy of Sciences of the United States of America*, 116(38), 19019-19024. doi:10.1073/pnas.1903275116

Teixeira, J., & **Cooper, A.** (2019). Using hominin introgression to trace modern human dispersals. *Proceedings of the National Academy of Sciences of the United States of America*, 116(31), 15327-15332. doi:10.1073/pnas.1904824116

Palci, A., Seymour, R. S., Nguyen, C. V., Hutchinson, M. N., Lee, M. S., & **Sanders, K.** (2019). Novel vascular plexus in the head of a sea snake (Elapidae, Hydrophiinae) revealed by high-resolution computed tomography and histology. *Royal Society Open Science*, 6(9), 191099-191091-191099-191096. doi:10.1098/rsos.191099

Bastin, J., Finegold, Y., Garcia, C., Gellie, N., **Lowe, A.**, Mollicone, D., . . . Crowther, T. (2019). Response to Comments on "The global tree restoration potential". *Science*, 366(6463). doi:10.1126/science.aay8108

Hirose, K., Payumo, A., Cutie, S., Hoang, A., Zhang, H., Guyot, R., Lunn, D., Bigley, R. B., Yu, H., Wang, J., Smith, M., Gillet, E., Muroy, S. E., Schmid, T., Wilson, E., Field, K. A., Reeder, D. M., Maden, M., Yartsev, M. M., Wolfgang, M. J., **Grützner, F.**, . . . Huang, G. (2019). Evidence for hormonal control of heart regenerative capacity during endothermy acquisition. *Science*, 364(6436), 184-188. doi:10.1126/science.aar2038

Fabijan, J., Caraguel, C., Jelocnik, M., Polkinghorne, A., **Boardman, W.**, Nishimoto, E., . . . Speight, N. (2019). Chlamydia pecorum prevalence in South Australian koala (Phascolarctos cinereus) populations: identification and modelling of a population free from infection. *Scientific Reports*, 9(1), 6261-6261-6261-6211. doi:10.1038/s41598-019-42702-z

Facing page: Crowd of all ages at Tarntanyangga (Victoria Square) for Schools for Climate Strike.

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