THE UNIVERSITY of ADELAIDE

Annual Report 2017

ENVIRONMENT INSTITUTE

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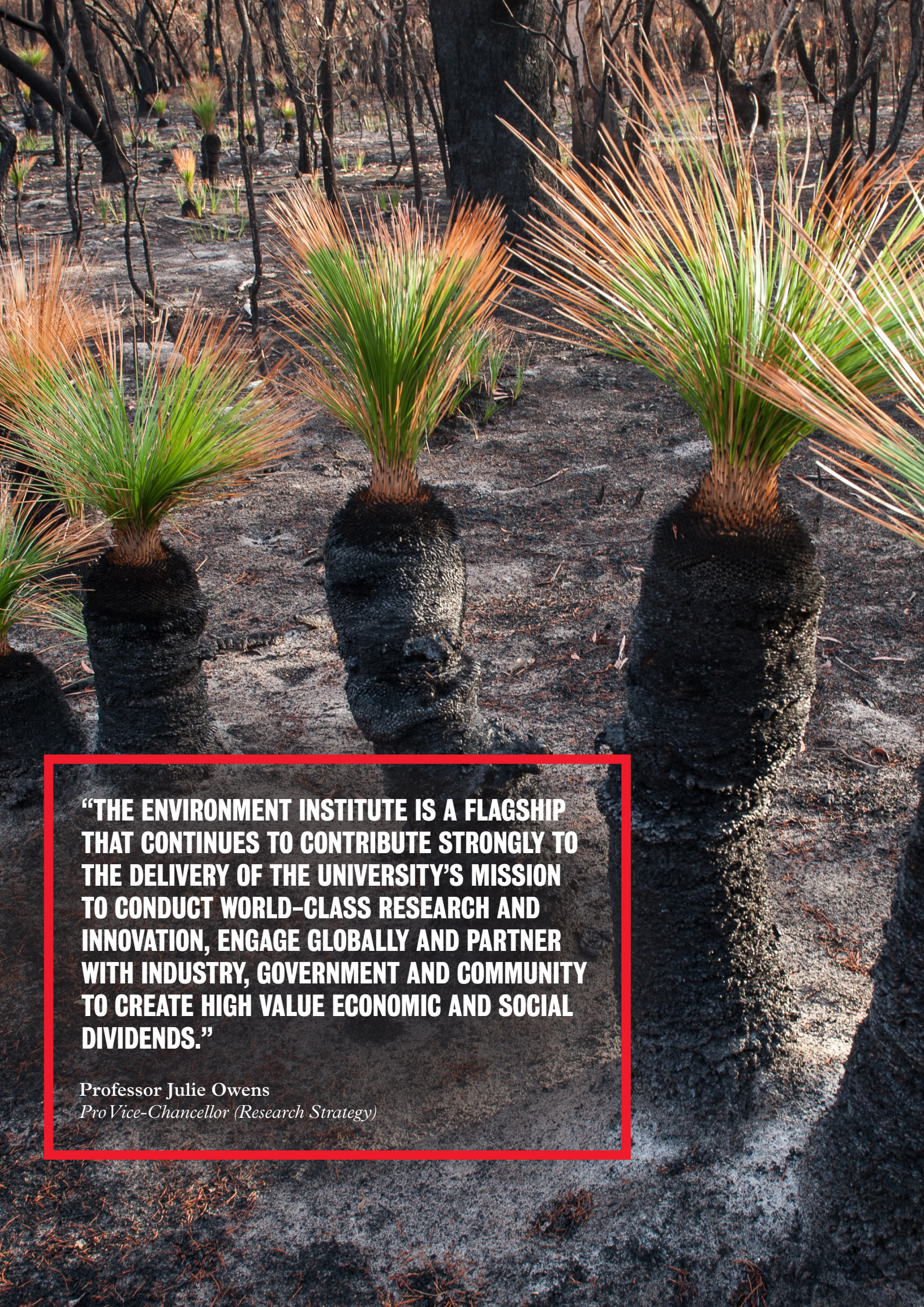


“THE ENVIRONMENT INSTITUTE IS A FLAGSHIP THAT CONTINUES TO CONTRIBUTE STRONGLY TO THE DELIVERY OF THE UNIVERSITY’S MISSION TO CONDUCT WORLD-CLASS RESEARCH AND INNOVATION, ENGAGE GLOBALLY AND PARTNER WITH INDUSTRY, GOVERNMENT AND COMMUNITY TO CREATE HIGH VALUE ECONOMIC AND SOCIAL DIVIDENDS.”

Professor Julie Owens
Pro Vice-Chancellor (Research Strategy)

CONTENTS

VISION

The Environment Institute facilitates outstanding research across environmental sciences. To enable this, it brings together leading water and climate scientists and researchers in fields including conservation biology, climate adaptation and mitigation, biodiversity, marine biology, landscapes, palaeontology and genetics.

By developing strong international collaboration and external engagement we can address complex environmental problems and export innovation to the world

Connecting knowledge to lead change

Our environmental specialists work together on projects to deliver relevant, innovative and actionable outcomes in areas of importance to the Australian community including:

- Water
- Biodiversity
- Conservation biology
- Landscape transformation and restoration
- Oceans and marine biology
- Climate change, resilience, adaption and mitigation
- Genetics, ancient DNA and DNA barcoding
- Palaeontology
- Evolutionary biology

The Environment Institute is affiliated with the following programs:

- Australian Bioactive Compounds Centre (ABCC)
- Australian Centre for Ancient DNA (ACAD)
- Australian Centre for Evolutionary Biology and Biodiversity (ACEBB)
- Applied Conservation Science Centre
- Global Ecology Laboratory (GEL)
- Marine Biology Program (MBP)
- Spatial Science Research Group
- Sprigg Geobiology Centre (SGC)
- Water Research Centre (WRC)

2017 AT A GLANCE

AUSTRALIAN RESEARCH COUNCIL FUNDING OUTCOMES

- 5 Discovery Projects
- 1 Discovery Indigenous
- 2 Discovery Early Career Research Award (DECRA)
- 1 Future Fellowship
- 1 Linkage Infrastructure, Equipment and Facilities
- 1 Linkage Grant

PUBLICATIONS

Our 42 research leaders have produced the following publications in 2017:

- 244 Journal articles
- 5 Books
- 12 Conference papers
- 6 Expert reports to external bodies
- 4 Nature
- 2 Nature Communications
- 1 Science
- 2 PLoS Biology
- 2 Proceedings of the National Academy of Sciences of the United States of America
- 2 Ecological Monographs
- 1 Global Change Biology
- 1 Frontiers in Ecology and the Environment

HIGHLIGHTS

Institute focus:

Develop and implement solutions to improve the health of the environment, our wellbeing and to sustain our economy. Key areas include:

- uncovering how life has evolved on the Australian landmass,
- explaining the history of indigenous people in Australia and globally, and their interaction with the environment,
- confronting environmental issues around sourcing and supply of clean fresh water,
- working to restore health to coastal marine environments,
- restoring the positive interactions between agriculture and the environment, and
- working to ensure the environment not only co-exists with modern development, but thrives amongst the pressures of society.

Some of these themes interconnect in ways that provide a unique focus to the Environment Institute. For example, our research on the Australian fossil record from close to the dawn of life through to subfossil remains of organisms that have dies since Europeans arrived in Australia are now being linked in an innovative way to provide data towards the conservation of species at risk and also to inform re-vegetation projects, especially in light of likely climate change over the next 2-300 years.

The Environment Institute played a major role in the following 2017 highlights

- $2 million ARC Linkage Grant announced, led by Dr Lee Arnold, Prof Bob Hill and Dr Liz Reed to investigate the Naracoorte caves.
- Prof Kristofer Helgen arrived at the University from the Smithsonian Institution.
- Australian Centre for Ancient DNA and SA Museum win a Eureka Prize for their Aboriginal Hair Project, which was published in *Nature* in March this year.
- Dr Zoe Doubleday was awarded a SA Tall Poppy Award, and Dr Laura Weyrich awarded SA Tall Poppy of the Year Award.
- Prof Bronwyn Gillanders was nominated for SA Scientist of the year and is awarded Goyder Water grant for Coastal Carbon .
- Sandy Pitcher the CE of DEWNR appointed as Chair of the Environment Institute Advisory Board.
- Prof Andy Lowe and Assoc Prof Ben Sparrow have featured as cover story in Science for article discovering new dryland forest equivalent to 60% of the landmass of Australia.
- University of Adelaide received a license to train drone pilots through the Centre of Applied Science, and has run courses in five countries.
- Environment Institute researchers were awarded 1 Future Fellowship, 2 DECRA, 1 Discovery Indigenous, 5 Discoveries, 1 Linkage Grant, 1 Linkage Infrastructure Equipment and Facilities Grant.

STRATEGIC ALIGNMENT ACROSS SOUTH AUSTRALIA

The Environment Institute actively seeks to partner in projects for the direct benefit of South Australia and we are seeking to increase this engagement in the future. Examples include:

Resources, energy and renewable assets

The marine investigations as part of the Spencer Gulf Ecosystem Development Initiative provides industry with credible evidence-based development options, while the restoration of Australia's native oyster reefs seek to reinstate one of the most widespread habitats for fisheries catch, biodiversity and filtration for water quality. Both of these initiatives aim to protect the quality of our seafood exports.

We undertake critical research in marine environments, including the ground-breaking research on the Spencer Gulf cuttlefish population, and the plan to reverse the wholesale loss of oyster reefs, which once sustained fisheries catch, water quality and surrounding habitats. Furthermore, research on the use of native plants by Australia's indigenous people has the potential to unlock new and valuable resources that will provide a unique market for novel plant products.

Food and wine production

Our major focus here is to ensure that agricultural production in our State is optimized while taking full advantage of the options to maximize the environmental health of both land under cultivation and adjoining native vegetation. We have an increasing interest in the re-vegetation of damaged lands, especially in response to changing climates, so that re-vegetated areas thrive into the long term.

Attracting a diverse student body

The world-class research carried out by staff within the Environment Institute is a strong attractor of international students and staff to Adelaide, to work in both the long and short term on cutting edge research.

Ecotourism

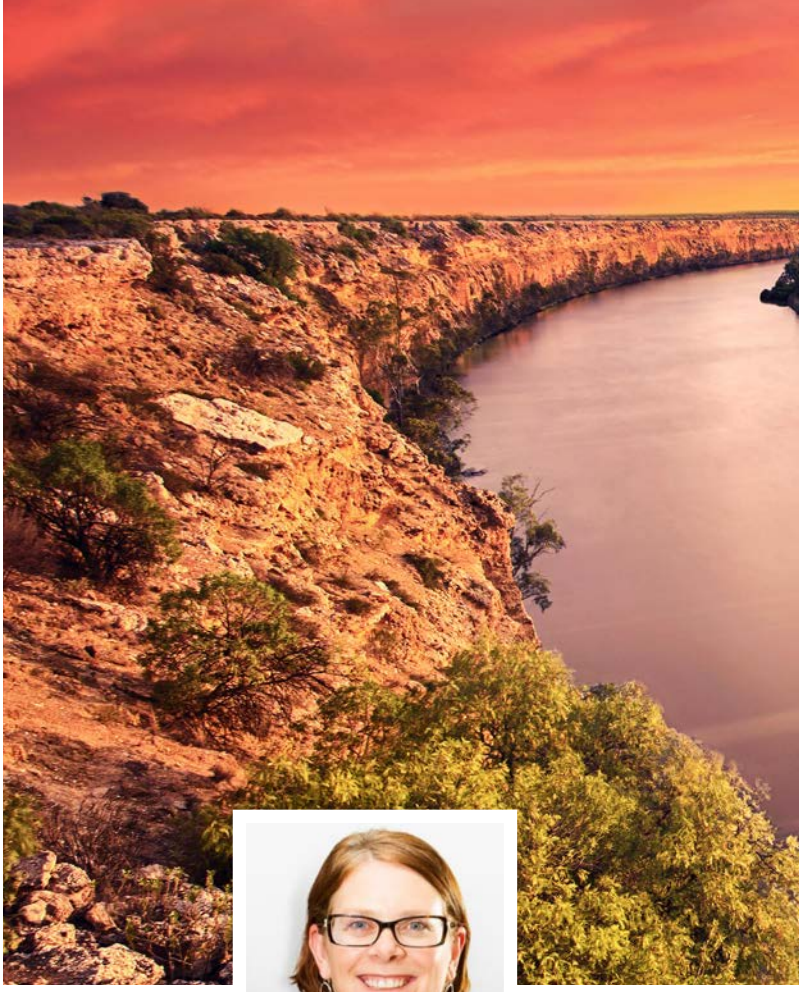
Much of our research is focused on areas of great interest to the tourism market. We work in close partnership with the Department for the Environment, Water and Natural Resources, the South Australia Museum and the Botanical Gardens and State Herbarium in order to develop sites with international ecotourism potential. These include the cuttlefish in the Upper Spencer Gulf, the world famous Warratyi rock shelter fossil site in the Flinders Ranges, the Kangaroo Island Cambrian fossil site and the UNESCO World Heritage listed Naracoorte Caves. Our research has highlighted the long connection Indigenous Australians have with the land though a study of Ancient DNA contained in ancient hair samples. We are strong supporters of the new Ecotourism degrees that have commenced at the University of Tasmania and provide many great research opportunities for domestic and international students.

Innovative research

The Environment Institute works to commercialise research and give Australian businesses an edge. Research and commercialisation partners are working with governments worldwide to develop DNA tools to support new legislation. We are in the early stages of large scale industry-led projects in Biosecurity and Coastal marine systems. These may result in CRC applications over the next 2-3 years.

We are at the forefront of international connections, both in research partnerships and in research student training. Our staff partner into dozens of countries internationally and they are regular international visitors, as well as hosts to some of the great international scientists of our time.

OVERVIEWS



Pro Vice-Chancellor
(Research Strategy)

Members of the Environment Institute have had another strong year, generating valuable research and innovation outcomes, across a broad range of fields related to the environment and its impact from ancient times to the present. Their contributions address areas such as adapting to a changing environment, sound management of our landscape and biosphere, the provision of abundant clean water and the promotion of population health and wellbeing.

The University is particularly pleased to see numerous world-class research successes by Institute members throughout the year. A few of the particular highlights were:

- A $2M ARC Linkage Grant, led by Dr Lee Arnold, Prof Bob Hill and Dr Liz Reed, to investigate the animal and plant fossils in the World Heritage-listed Naracoorte caves, and determine the conditions under which these fossils were deposited and when it all occurred;
- The Australian Museum Eureka Prize for Excellence in Interdisciplinary Scientific Research was won by the Australian Centre for Ancient DNA (ACAD) and the SA Museum for their Aboriginal Hair Project;
- Dr Laura Weyrich, also from ACAD, was awarded the SA Tall Poppy Award;
- Critical support from the Environment Institute allowing the University to receive a license to train drone pilots through the Centre of Applied Conservation Science, which has now run courses in five countries; and
- Continuing grant success in key Australian Research Council Schemes, all of which are increasingly competitive.

The Environment Institute is a flagship that continues to contribute strongly to the delivery of 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

Professor Julie Owens
Pro Vice-Chancellor
(Research Strategy)

Advisory Board Chair

As the incoming Chair, I welcome you to celebrate the achievements of the Environment Institute over the past year. The Environment Institute has an important goal: to deliver outstanding research across a broad environmental range by bringing together leading researchers in a variety of relevant fields, including water, biodiversity, marine biology, landscapes and genetics. Collaboration and research excellence are central to our achievements.

The Institute's work is as broad in scope as it is deep in discovery. Our focus areas include

- uncovering how life has involved on the Australian landmass
- confronting environmental issues around sourcing and supply of clean water
- working to ensure the environment can thrive amongst the pressures of society.

The Environment Institute works to develop and implement solutions to improve the health of the environment, the wellbeing of our community and to sustain our economy. The collective impact of our research and collaboration is both central and essential.

Reflecting on the highlights and the achievements of the Environment Institute over the past year affirms the important role the work plays within our community.

The Environment Institute continues to enjoy research success, with many of the highlights of 2017 centring around the research efforts. The highlights and recognition within our Annual Report reflects the breadth and deep of the research endeavour.

This annual report marks my first year as Chair of the Environment Institute. It is an honour to be involved with such a committed group of researchers, who are working on some of the biggest questions and challenges facing our environment and our community. I wish to thank Dr Steve Morton, the outgoing chair, and ongoing supporter of the work of the Institute.

I would also like to acknowledge the dedication, hard work and commitment of the staff in the Institute. I particularly note my personal thanks and admiration for the Director, Professor Bob Hill, who leads the Institute with his unique combination of intellect, grace and determination. I look forward to the challenges and opportunities the Environment Institute will approach in the year ahead, and I particularly look forward to the continuing impact of the Institute.

Sandy Pitcher
Advisory Board Chair

Director

2017 has been a very good year for the Environment Institute. Our major partnerships within State Government continued to grow and have now begun to show very significant outputs. Some of the projects that have either commenced or have consolidated during this year include the long-running stygofauna project, which is a major collaboration between EI members and the Western Australian and South Australian Museums; the Aboriginal Hair Project, which is a stunning collaboration between Alan Cooper and the Australian Centre for Ancient DNA and the South Australian Museum, and the Naracoorte Caves Linkage project, which is a new and globally significant collaboration between the EI and the South Australian Department for the Environment, Water and Natural Resources and the Naracoorte Council. There are several other important partners in this project.

I remain very proud of our early and mid career mentoring programs, which I believe lead the way, not just at the University of Adelaide, but across Australia. It is now evident that several of the recipients of this training have gone on to major career successes and we will continue to support this program as strongly as we can.

In the second half of 2017 I concluded 11 years as Executive Dean of the Faculty of Sciences, and became full-time Director of the Environment Institute. This is a very exciting transition for me, since it offers the opportunity for me to utilise the experience I gained as Executive Dean and apply it in a concentrated fashion to the Environment Institute. Before the end of 2017, we had plans in place to lead an Expression of Interest for an ARC Centre of Excellence, and preliminary plans for somewhere between one and three CRC bids. We go in to 2018 with significant plans for major research initiatives.

Professor Bob Hill
Director

‘LOST’ FORESTS HIDING IN PLAIN SIGHT

A new global analysis surveying the distribution of forests and woodlands has ‘found’ 467 million hectares of previously unreported forest in dryland ecosystems – a land area equivalent to 60% of Australia.

The research was conducted by an international team of scientists and students from the Food and Agriculture Organization of the United Nations (FAO) and 15 organisations, including the Environment Institute’s Professor Andy Lowe. Their findings, published in Science, have increased the current estimates of global forest cover by 10%. This is a very significant finding with broad consequences for global carbon budgeting and dryland restoration and management.

These discoveries were made possible by overcoming previous limitations of forest assessment, due to low tree density and lack of ground validation, through a new photo-interpretation tool called Collect Earth. This new reassessment accessed higher resolution satellite imagery, through Google Earth Engine as well as the incorporation of ground validated information from ecological plots established in Australia.

While the forest assessments increased the area of dryland forest across all inhabited continents, the study concentrated around rainforest, desert and tundra biomes, to the south of the Sahara desert, around the Mediterranean, southern Africa, central India, coastal Australia, western South America, north-east Brazil, northern Colombia and Venezuela, and northern parts of the boreal forests in Canada and Russia. The differences in coverage estimates are most significant in Africa where drylands forest estimates have doubled.

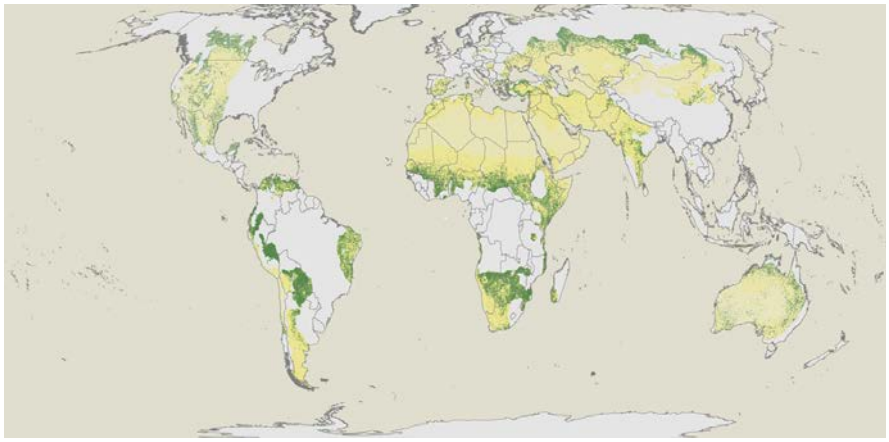
Dryland ecosystems contain some of the most threatened, yet disregarded, ecosystems, while facing pressure from climate change and human activity.
Climate change will lead to extended droughts, regional warming, and, combined with a growing human population, an increased risk of land degradation and desertification in dryland biomes. This new analysis increases the area of dryland forest by 45%. By revealing that drylands—which make up about 40% of Earth’s land surface—have a greater capacity to support trees and forest than previously perceived, a unique chance is presented to mitigate climate change impacts through large-scale dryland conservation and afforestation actions. Highlighting the potential for improved livelihoods of the people in these ‘new forest’ areas. Large scale reforestation programs in China (The Great Green Wall) and Africa are currently under construction to plant trees across vast areas to the South of major deserts (Gobi and Sahara) in an attempt to halt the southern advance of desert. These forest mapping results confirm the excellent potential of such initiatives to establish new forests in dryland regions.

The results also increase our estimates of global forest carbon stocks by 15 to 150 gigatonnes carbon or by 2 to 20% (depending on the density of trees). That’s a lot of carbon, especially when you consider that the global emissions of carbon dioxide are approximately 30 gigatonnes.

THESE FINDINGS WILL HELP IMPROVE THE ACCURACY OF GLOBAL MODELS OF TERRESTRIAL CARBON SINKS AND IMPROVE OUR ACCOUNTING OF THE GLOBAL CARBON BUDGET AND CARBON INVENTORIES.

We can't assume that the discovery of this 'missing sink' has solved climate change problems. However, these findings will help improve the accuracy of global models of terrestrial carbon sinks and improve our accounting of the global carbon budget and carbon inventories, which are required to be submitted under international climate conventions including the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Identifying these significant carbon sinks in dryland areas, some of the poorest regions on earth, could also help support initiatives to return carbon offset benefits to these countries.

It is indisputable that dryland forests will play an important role in preventing desertification, maintaining livelihoods and mitigating the impacts of climate change at regional and global scales. It is vital that research continues to monitor the long-term trends in dryland forest cover and quality.



Above

New forest areas neighbouring rainforest, desert and tundra biomes; mainly to the south of the Sahara desert, around the Mediterranean, southern Africa, central India, coastal Australia, western South America, north-east Brazil, northern Colombia and Venezuela, and northern parts of the boreal forests in Canada and Russia

Photo credit: sciencemag.org

Further Reading

Bastin, JF, Berrahmouni, N, Grainger, A, Maniatis, D, Mollicone, D, Moore, R, Patriarca, C, Picard, N, Sparrow, B, Abraham, EM, Aloui, K, Atesoglu, A, Attore, F, Bassullu, C, Bey, A, Garzuglia, Garcia-Montero, LG, Groot, N, Guerin, G, Laestadius, L, Lowe, AJ et al. 2017, 'The extent of forest in dryland biomes', *Science*, vol. 356, no. 6338, pp. 635-638.

DO WE ACTUALLY NEED MALES AT ALL? SOME SNAKES THINK NOT

"Two species of Australian snakes have decided that when times are tough, we females will just reproduce independently, and do away with males altogether," says Dr Vicki Thomson, ARC DECRA (Discovery Early Career Researcher Award) Fellow and member of the Environment Institute.

A new study by Dr Thomson and her collaborators, published in the *Royal Society of Open Science,* has shown that two species of Austro-Papuan elapid snakes, the coastal/Papuan taipan *(Oxyuranus scutellatus)* and southern death adder *(Acanthophis antarcticus),* can reproduce asexually if required. Until now these species were known to only reproduce sexually and to either lay eggs that then hatch into neonates, or baby snakes (termed 'oviparous') or give birth to live neonates (termed 'viviparous'). In captivity, females from each species have, for the first time, generated male offspring that genetically resemble only their mothers and not the males housed with them.

"We still need to figure out whether the females always need a male close by to trigger, possibly via hormones or behavioural cues, this asexual reproductive mode even though they did not mate with them," says Dr Thomson.

Typical of facultative parthenogenesis events, many of the eggs did not develop fully into neonates, and of those that did, one neonate had malformed scales and another had a deformed eye. This might not matter in the wild though, as the benefits of being able to switch between sexual and asexual reproduction include allowing a single or few female(s) to colonise a new environmental niche and produce offspring. As long as some neonates survive to adulthood, a new parthenogenic population can be generated from one or a handful of female snakes. In contrast, species that only ever reproduce sexually are dependent on both sexes colonising a new environment and require them to come into contact with each other for mating to occur, which may be difficult in new populations where population density is low.

Dr Thomson continues, "having this alternate reproductive mode may help ensure their survival during hard times, such as those they might experience with a rapidly changing climate, by allowing them to follow their prey species or a preferred environmental envelope across the landscape."

Dr Thomson, who started her DECRA project investigating 'The role of epigenetic modifications in tiger snake adaptation', has also found this alternate reproductive mode in tiger snakes.

"It appears to be more widespread than initially thought, although we still need to observe it in the wild to infer a true adaptive advantage to this behaviour", Dr Thomson says. Detecting it in the wild may not be far off as Dr Thomson is currently mounting expeditions to remote offshore islands across southern Australia in search of exciting tiger snake populations.

Further Reading

Allen, L, Sanders, KL & Thomson, VA, 2018, 'Molecular evidence for the first records of facultative parthenogenesis in elapid snakes', *Royal Society of Open Science*, vol. 5, 171901.

THIS ALTERNATE REPRODUCTIVE MODE MAY HELP ENSURE THEIR SURVIVAL DURING HARD TIMES, SUCH AS THOSE THEY MIGHT EXPERIENCE WITH A RAPIDLY CHANGING CLIMATE.

Top
Southern death adder
(Acanthophis antarcticus)

Above
Coastal/Papuan taipan
(Oxyuranus scutellatus)
Photo credit: Luke Allen

AN AUSTRALIAN ORIGIN FOR A PACIFIC WANDERER?

Near the northern-most tip of Aotearoa (New Zealand), an 800-year-old Pōhutukawa tree clings almost impossibly to the cliff-face above the rocks and the sea, in a place known to the Māori as Te Rerenga Wairua, the leaping off place of the spirits.

This tree is one of the most sacred and significant in Aeotearoa, as it is the place where the spirits of the dead enter the afterlife, traveling through the tree, down into the sea through Te Aka, the root of the tree, through to the spirit world.

This Pōhutukawa tree, and other closely related species in Aeotearoa are often collectively known by their Māori name as Rātā, and belong to a genus known as *Metrosideros* in Linnean taxonomy, with about 60 recognized species. These trees are significant in many ways and represent one of the most widely distributed flowering plant genera in the Pacific. Sole species are found in South Africa and South America, and others found from the sub-Antarctic islands of New Zealand, all the way to the Bonin Islands near Japan, Papua New Guinea and occupied West Papua, and many islands in between like Tahiti and Rarotonga. *Metrosideros* is found even in Hawaii, where it is an early colonizer of barren lava flows and is known by the kānaka maoli (Indigenous Hawaiians) as the ōhi'a lehua.

Metrosideros achieved this incredible distribution because many species have lightweight seeds that are dispersed via wind, and carried into the air where they can survive freezing atmospheric temperatures, and if they are blown into the sea, survive up to 30 days in salt water and still germinate. They are supreme dispersers, and so the great mystery has always been; they are found on every vegetated landmass in the Pacific – but why are they are not found in Australia?

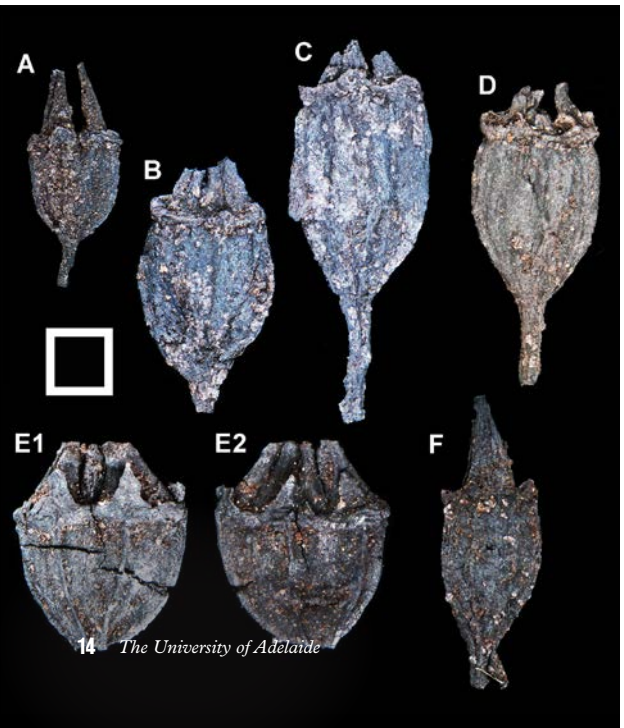
Previously researchers had hypothesised that *Metrosideros* must have evolved in New Zealand, and subsequently dispersed throughout the Pacific from there, as the only fossil record of the group was found there.

Below - L to R
Fossil fruits of the newly discovered Metrosideros species *from the Oligo-Miocene of Tasmania. Tarran et al. (2017)*

Flowering Pōhutukawa Tree taken at Cornwallis Beach, West Auckland.

Opposite - L to R
Fossil flowers and fruits from the Oligocene aged Little Rapid River deposit in Tasmania. Tarran et al. (2016)

Oceanside Pōhutukawa around Mt. Maunganui, New Zealand.



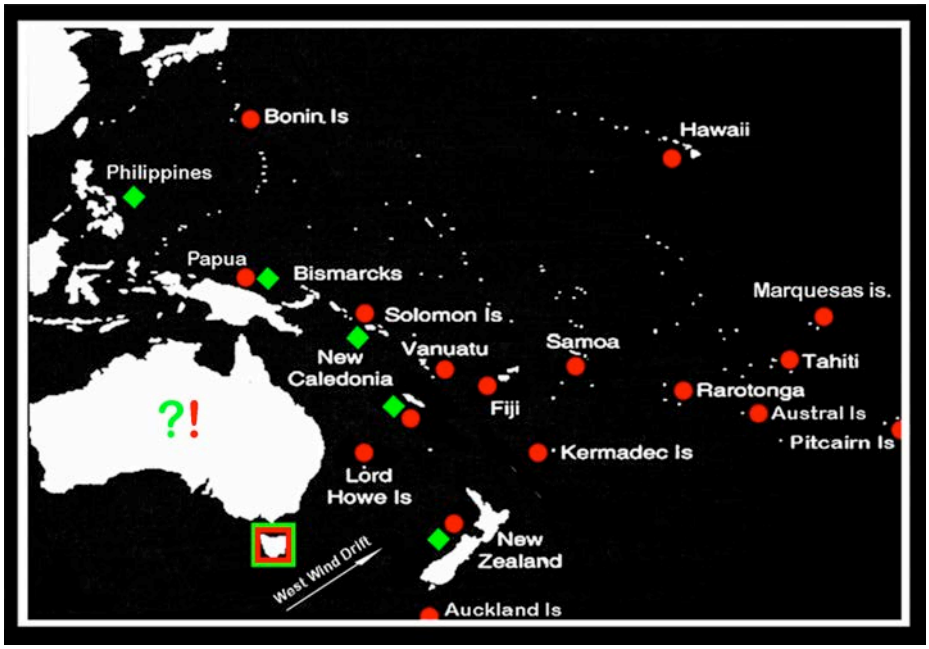
Environment Institute research, however, is starting to tell a different story, that the long roots of these special trees may stretch back through time all the way back to Australia.

Palaeobotany PhD student Myall Tarran discovered the oldest described fossil flowers, fruits and leaves of *Metrosideros* subgenus *Metrosideros* from the Eocene-Oligocene (Around 40-30 million years ago) of Tasmania, proving that *Metrosideros* did once occur in Australia, but has subsequently become extinct. But these fossils didn't necessarily prove an Australian origin for the genus, despite being the oldest described. They belonged to the same subgenus that is most widely distributed, and so there is no way of knowing that they didn't evolve elsewhere, and disperse from some other landmass such as New Zealand.

Recently published in the American Journal of Botany, Mr Tarran's research on fossil fruits, from the Oligo-Miocene of Tasmania (between 33 and 16 million years), provide stronger evidence for the Australian origin hypothesis, belonging to a different subgenus (Subgenus *Mearnsia*), with species which are less widely distributed – occurring mainly on the Gondwanic landmasses surrounding Australia, New Zealand, New Caledonia, Papua as well as the Solomon Islands and the Philippines. These fossils help to tell a different story, that while naturally extinct in Australia today, a diversity of *Metrosideros* species once occurred in the continent, and there is a good chance that the subgeneric diversity may have diverged here.

So perhaps once upon a time, tens of millions of years ago, gnarled ancestors of the Pōhutukawa and Rātā also clung to coastal cliffs in Australia, like they do in Aotearoa today, and westerly winds blew their seeds across the ditch, and elsewhere throughout the Pacific? Or, perhaps, their distant ancestors evolved before New Zealand had broken off from Australia and begun its tectonic drift eastward.

The mystery now is why and when *Metrosideros* became extinct in Australia, yet survived on every other major vegetated landmass in the Southern Hemisphere? These are questions that further research into the fossil record might help to answer.

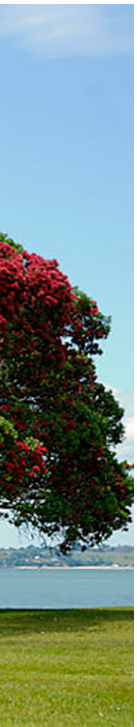


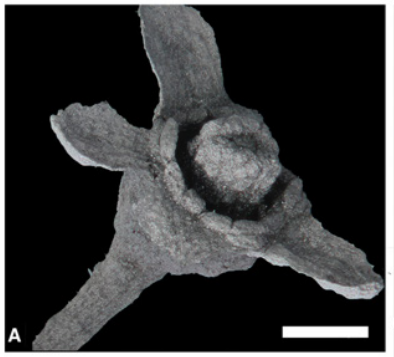
Above
Distribution of Metrosideros subgenus Metrosideros *(red circles) and* subgenus Mearnsia *(Green diamonds) around the Pacific (not including South Africa and South America), with a question mark indicating it's absence from Australia, and exclamation mark indicating the discovery of fossils here" Modified from Tarran et al. (2016, 2017)*

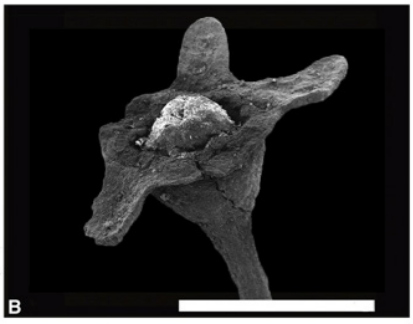
Further Reading

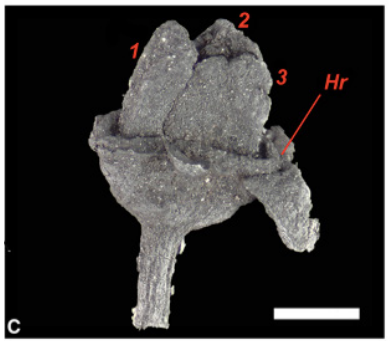
Tarran, M, Wilson, PG, Macphail, MK, Jordan, GJ & Hill, RS, 2017, 'Two fossil species of *Metrosideros* (Myrtaceae) from the Oligo-Miocene Golden Fleece locality in Tasmania', Australia, *American Journal of Botany*, vol. 104, no. 6, pp. 891- 904.

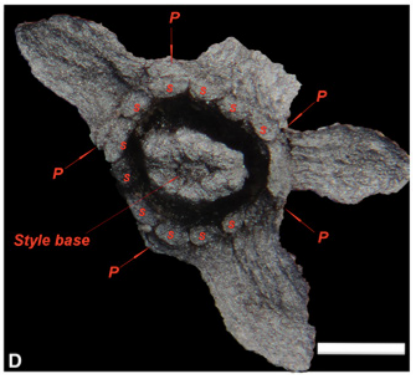
Tarran, M, Wilson, PG & Hill, RS, 2017, 'Oldest record of *Metrosideros* (Myrtaceae): Fossil flowers, fruits, and leaves from Australia', *American Journal of Botany*, vol. 103 no. 4, pp. 754-768.











Research Stories

ANCIENT WETLANDS IN AN UNLIKELY SETTING

Islands made of sand may seem like transitory features in the landscape, however, Environment Institute researchers have made an intriguing discovery on Queensland's North Stradbroke Island (traditionally known as *Minjerribah*).

The second largest sand island in the world, North Stradbroke Island has a "treasure trove" of ancient wetlands, some more than 200,000 years old. In fact it has more wetlands that have existed since the last ice age (~20,000 years ago) than any other Australian region. This unique feature may provide valuable insights to past local and regional climate variations.

A team lead by Environment Institute's Associate Professor John Tibby, alongside the University of Queensland and the Queensland Government, undertook sedimentary coring and dating of 16 wetlands on the island. The results, now published in the Journal of Quaternary Science, has ascertained that 6 of these date to the height of the ice age (known as the last glacial maximum, or LGM) or earlier.

Climates in Australia were much drier and colder during the LGM than today. Sea levels were up to 130 m lower than today, with much of that water locked up in massive ice sheets in the Northern Hemisphere. Across Australia there were few wetlands during this time, which raises the question: where and how did plants and animals that need permanent water survive?

The persistence of North Stradbroke Island wetlands itself suggests that for much of the past 40,000 years, and for perhaps much longer, the local environment has remained relatively moist.

This may partly be due to links between these wetlands and the island's groundwater systems, which act as water reservoirs during periods of rainfall deficit and suggests the island and the wider region may have been a refuge for plants and animals from dry climates.

"Analysis of the sediments laid down on North Stradbroke Island wetland will provide a better understanding of natural environmental variation and the potential impact of humans on the region." says Associate Professor Tibby. Using this information, it is possible to gain insights into climate variation at the time the Australian megafauna went extinct. The lack of such information is one reason why the debate between human and climate causation of megafauna extinction continues.

Research on North Stradbroke Island has practical applications too. Sedimentary information can identify the importance of sites, and the risks to its stability, to inform appropriate management strategies. Recent concerns over increased groundwater extraction from the island during the Millennium Drought (2001-2009) prompted analysis of the history of Blue Lake – a beautiful and iconic lake on the island. Research showed that Blue Lake has been unchanged for 7,500 years – a unique occurrence for Australian lakes – but that increased water abstraction could fundamentally alter its ecology for the first time.

Environment Institute research into the wetlands of the island is ongoing. Four PhD students from the University of Adelaide are working on various aspects of the island's history, from projects focussed on the climate of the last thousand years to those inferring environmental change through the whole of the last glacial cycle (the last 125,000 years) and beyond. With its long uninterrupted record of past climate conditions North Stradbroke Island still has more to reveal.

This research has been funded by the Australian Research Council, the Queensland Government, and the Jani Haenke Charitable Trust. It involved the support of the Quandamooka Yoolooburrabee Aboriginal Corporation and Minjerribah Moorgumpin elders.

Further reading

Barr, C, Tibby, J, Marshall, JC, McGregor, GB, Moss, PT, Halverson, GP, & Fluin, J, 2013, 'Combining monitoring, models and palaeolimnology to assess ecosystem response to environmental change at monthly to millennial timescales: The stability of Blue Lake, North Stradbroke Island, Australia', *Freshwater Biology*, vol. 58 no. 8, pp. 1614-1630.

Barr, C, Tibby, J, Moss, PT, Halverson, GP, Marshall, JC, McGregor, GB, & Stirling, E, 2017, 'A 25,000-year record of environmental change from Welsby Lagoon, North Stradbroke Island, in the Australian subtropics', *Quaternary International*, vol. 449, pp. 106-118.

Moss, PT, Tibby, J, Petherick, L, McGowan, H, & Barr, C, '2013', Late Quaternary vegetation history of North Stradbroke Island, Queensland, eastern Australia', *Quaternary Science Reviews*, vol. 74, pp. 257-272.

Tibby J, Barr , C, Marshall, JC, Mcgregor, GB, Moss, PT, Arnold, LJ, Page, TJ, Questiaux, D, Olley, J, Kemp, J, Spooner, N, Petherick, L, Penny, D, Mooney, S & Moss, E, 2017, 'Persistence of wetlands on North Stradbroke Island (south-east Queensland, Australia) during the last glacial cycle: implications for Quaternary science and biogeography', *Journal of Quaternary Science*, vol. 32, pp. 770-781.


5 mm

Research Stories

NARACOORTE CAVE FOSSIL FLORA

The World Heritage listed Naracoorte Caves National Park has long been known for its impressive animal fossil records. Lesser known is the exciting discovery of plant remains alongside these animal fossils in at least two caves within the system, most notably Robertson Cave.

Some of these plant remains are so well preserved that they look as though they have just fallen from the tree. This is an intriguing find, as the physical conditions that allow for good preservation of bone are not usually favourable for plant preservation, which has resulted in sparse records of plant life where animal fossils are common. Finding both together allows researchers to begin to piece together the vegetation in which the animals lived and hence the impressive possibility of reconstructing the entire ecosystem, and to model past climate.

Postdoctoral Fellow, Dr Kathryn Hill, along with the Environment Institute Director, Professor Bob Hill, and several students, have examined the fossil plants from within Robertson Cave and identified 20 species, many of which can still be found in South Australia. The Robertson Cave sediments investigated are ~13 000 years old. Using this information, researchers assembled a picture of the vegetation habitat and concluded that the Robertson Cave area was once home to a permanent creek bed.

The sandy loam and clay soils within the cave would have accommodated plants such as *Mentha diemenica*; a perennial, insect pollinated plant requiring moist, sunny conditions.

This species is now rare in South Australia. The erect annual herb Senecio glomeratus with wind dispersed seeds, that today requires wet conditions, is also present. It is the presence of plants that grow in wet clay soils that lead us to the hypothesis that there was a water body present.

Also present were the low shrub Flame and Cranberry Heath (*Astroloma conostephioides* and *A. humifusum*), at least six Eucalyptus tree species and two Allocasuarina tree species, which prefer dry open forest and sandy soils, and would have grown furthest from the creek edge.

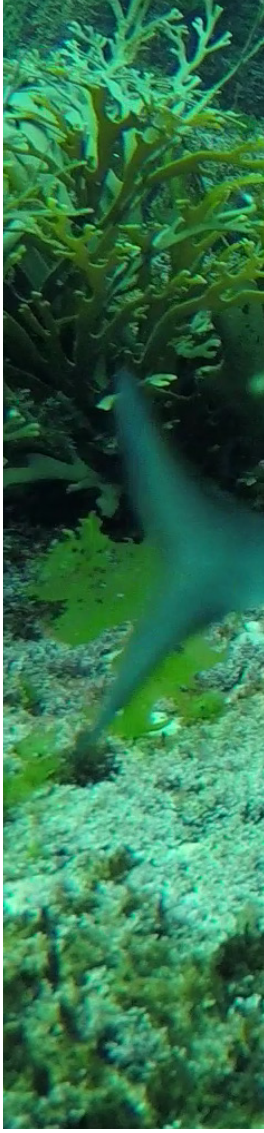
This research has concluded that the vegetative habitat present at this site 13 000 years ago was a forest dominated by *Eucalyptus* trees with the presence of a least one creek and open areas with small shrubs and groundcovers present surrounding creek area. Once this baseline vegetation has been fully documented and described our researchers will use it as the basis for identifying and interpreting less well preserved plant fossils from other locations within the cave complex. This will enable a more complete picture of the South Eastern South Australia vegetation history to be reconstructed.

Opposite Left
Dr Kathryn Hill (centre), next to Professor Bob Hill, Environment Institute Director, and a student group on a botanical trip to Naracoorte Cave National Park.

Left
13 000 year old Allocasuarina *(Sheoak) cone from Robertson Cave, Naracoorte Caves National Park, South Australia.*

Above
Allocasuarina verticillata *cone from Jannali, NSW, Australia; photo by John Tann, 2008.*

VOLCANIC CO_2 VENTS SHOW THE IMPACTS OF CLIMATE CHANGE ON BIODIVERSITY



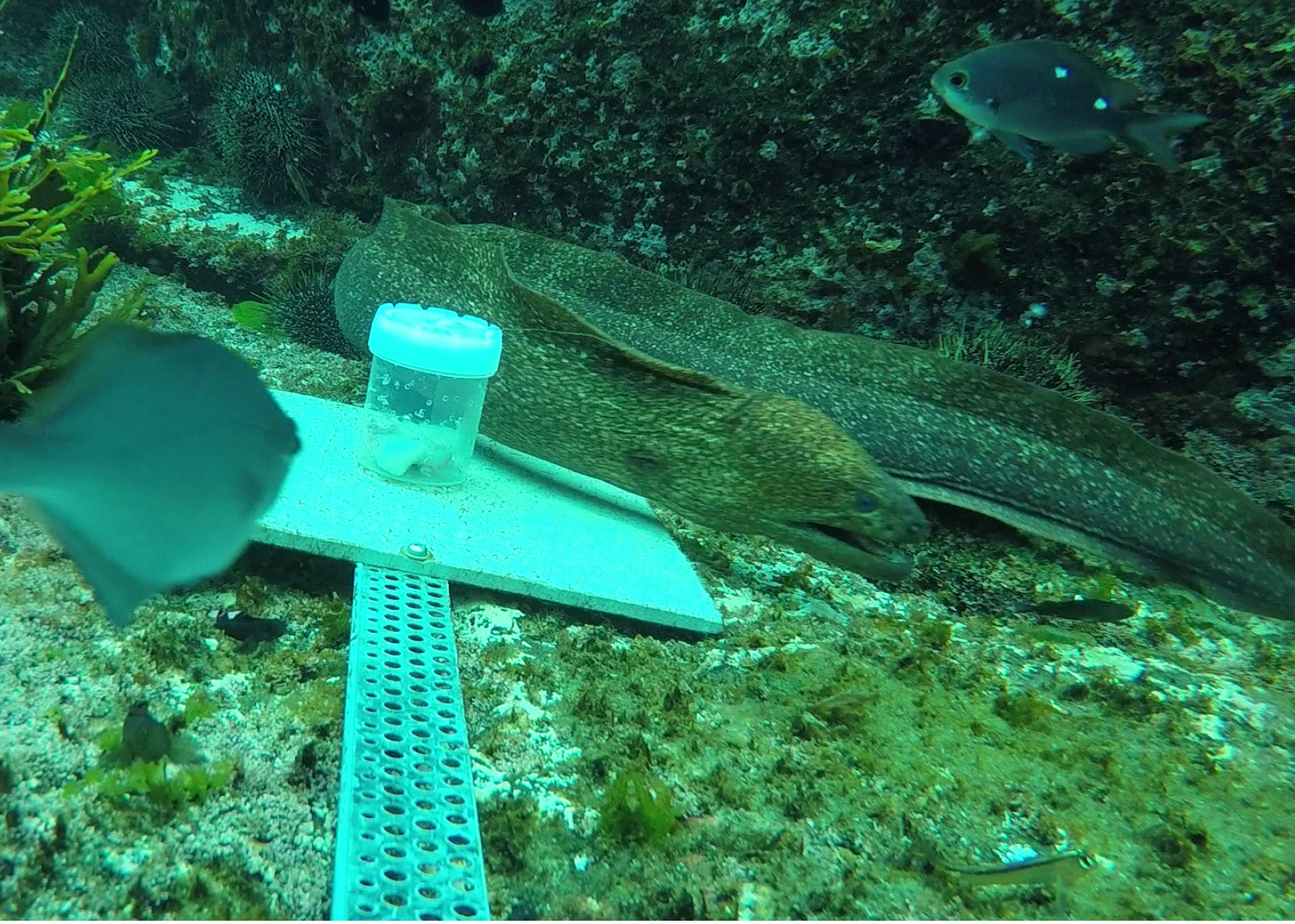
Climate change is predicted to have a major impact on species populations and biodiversity, but our ability to forecast such change in detail is still hampered. Natural laboratories can help us better understand the impacts of climate change on species communities and ecosystems.

People depend heavily on the services that oceans provide. These not only include sources of protein, income, and new medicines, but also indirect services such as cultural values, recreational benefits and mitigation of natural disasters. Healthy ecosystems provide better services and this is directly related to species biodiversity. Hence, it is critical to understand how species diversity is being altered due to increasing human impacts on our oceans.

Humans have long exploited the rich resources of the ocean free of charge, but with the increasing impacts on the oceans (e.g. overfishing, pollution, habitat destruction) this provisioning is no longer guaranteed. Ocean warming and acidification, resulting from rapidly increasing human greenhouse gas emissions into the atmosphere, are exacerbating other human impacts.

To better forecast future changes in biodiversity and ecosystem services there is an urgent need to upscale from simple laboratory experiments to large-scale experiments that incorporate the complexity of natural systems. A Future Fellowship from the Australian Research Council to Environment Institute's Professor Ivan Nagelkerken has facilitated such an approach, revealing unexpected results that would not have been predicted based on simple lab experiments.

Prof. Nagelkerken and his research team, in collaboration with Professor Sean Connell, has used submarine volcanic vents where carbon dioxide is naturally released from the seabed to study what a future ocean might look like. Unexpectedly, total fish abundances on the seabed were found to be higher under



elevated CO_2 levels. This is because CO_2 enhances growth of seaweeds, providing more food and shelter for small invertebrates which act as a food source for fishes.

However, these positive effects of ocean acidification are dampened because of a concurrent decrease in the biodiversity of fish species and marine habitats. Weedy species that have a 'generalist' life style fare well under elevated CO_2 but outcompete less common and more sensitive species. As a result, ecosystems and species communities are being homogenised with lower diversity as a consequence. Ultimately, this will have repercussions for the services that these ecosystems provide to humans.

Working in natural environments has shown that ecological complexity can dampen the negative effects of climate change. Simplified laboratory studies have shown detrimental effects of elevated CO_2 on animal behaviours. For example, fishes are attracted to their predators or deterred to their natural prey or habitats. Nevertheless, in nature these species can still survive because of compensatory mechanisms, e.g. reliance on other senses to find their prey and habitats. A critical element to consider is the interactive effect of ocean warming and acidification on species communities, as one will not occur without the other. Using large aquaria (mesocosm) simulating a temperate coastal ecosystem, Professor Nagelkerken's lab found that any positive effects of ocean acidification, e.g. resource enrichment, can be nullified by elevated ocean temperatures, through reduced energy flow from the bottom of food webs to higher trophic levels, such as predatory fishes.

This research demonstrates the delicate balance of the ocean ecosystems and how future climate changes might impact this invaluable resource. Ultimately, it is critical to work towards reducing global ocean temperatures and to accomplish reduced CO_2 emission targets as set out under the recent the Paris Agreement.

Further Reading

Nagelkerken, I, Goldenberg, S, Ferreira, CM, Russell, BD & Connell, SD, 2017, 'Species interactions drive fish biodiversity loss in a high-CO2 world', *Current Biology*, vol. 27, pp. 2177–2184.

Goldenberg, SU, Nagelkerken, I, Ferreira, CM, Ullah, H & Connell, SD, 2017, 'Boosted food web productivity through ocean acidification collapses under warming', *Global Change Biology*, vol. 23, pp. 4177-4184.

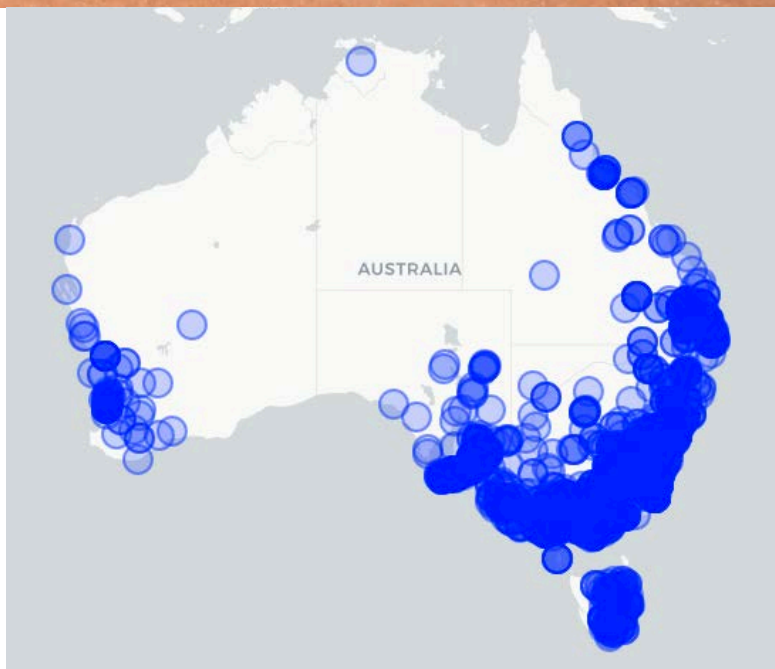
Goldenberg, SU, Nagelkerken, I, Marangon, E, Bonnet, A, Ferreira, CM, Connell, SD, 2018, 'Ecological complexity buffers the impacts of future climate on marine animals', *Nature Climate Change*, vol. 8, pp. 229-233.

Ullah, H, Nagelkerken, I, Goldenberg, SU & Fordham, DA, 2018, 'Climate change could drive marine food web collapse through altered trophic flows and cyanobacterial proliferation', *PLoS Biology*, vol. 16, no. 1, 2003446.

Above
Moray eel (Gymnothorax spp.) *captured through baited remote underwater video used to determine attraction to food and predator abundance at submarine volcanic vents.*

Above
PhD student Tahlia Perry analysing Echidna scat.

Right
Echidna sighting recorded through the EchidnaCSI app.



ECHIDNA CSI: A FORENSIC APPROACH TO ECHIDNA CONSERVATION

Echidnas are an iconic Australian species and together with the platypus form the extraordinary group of egg-laying mammals, the monotremes.

Echidnas are the most widespread native mammal in Australia, can occupy habitats from the desert to snow covered mountains and are important cultivators of the land. However, there are still major knowledge gaps in terms of the distribution, biology and ecology of these fascinating animals. It is crucial we gain a better understanding of echidnas across the whole of Australia in order to better protect them. A new citizen science project, the Echidna Conservation Science Initiative – EchidnaCSI – is using an innovative approach of combining public engagement with molecular biology to better understand wild echidna populations and to help their conservation.

EchidnaCSI is led by PhD student Tahlia Perry and the Environment Institute's Professor Frank Grützner, with strong collaboration from echidna expert Dr Peggy Rismiller. The project asks the public to log sightings of echidnas across Australia and to collect their scats for molecular analysis. The data is collected through a phone app, developed by PhD student Alan Stenhouse, that allows the public to record sightings of echidnas in the wild and automatically registers the day, time and location along with a photo. The app also allows the public to log echidna scats that they collect to again allow easy collection and submission of necessary data, prior to sending the scats to the University of Adelaide.

The EchidnaCSI app has been downloaded more than 5000 times, with 3000 echidna sightings submitted and 200 echidna scats collected across Australia. The data has revealed that echidnas are inhabiting more urbanised areas, appearing even in the centre of Adelaide and highly abundant in surrounding suburbs with similar trends for every major city in Australia, which is a concern for their overall well-being.

Also of particular note is the number of echidnas killed by cars, approximately 80% of deaths recorded have been a result of roadkill, highlighting the need to make our roads safer for native wildlife.

Tahlia Perry is developing techniques to analyse the echidna scats to investigate many aspects of their biology that observations alone cannot answer. There is DNA in echidna scats from the echidnas themselves, their environment and their food. This allows the investigation of their genetic health and gut health along with their diet. The scats also contain stress hormones and reproductive hormones that can be analysed to further investigate their health and breeding.

The advantage of these molecular approaches is that they allow researchers to gain insights into species' biology and ecology in a non-invasive way.

EchidnaCSI has received excellent publicity since its launch, attracting TV shows 'The Project', 'Totally Wild' and 'Scope'. The media presence of EchidnaCSI has continued, with more than 60 radio interviews, news articles, media reports and blog posts across Australia which has raised the profile of EchidnaCSI significantly.

The team also held a 'Citizen Science Day' in conjunction with WWF's Earth Hour, funded by the Environment Institute. The event promoted the importance of citizen science and how to be involved in projects running out of the University of Adelaide.

Professor Grützner's research group has led efforts to increase molecular studies on monotremes, which provide powerful insights into mammalian evolution. Through EchidnaCSI, the team are now developing applications for field ecology, conservation, captive breeding and importantly, science outreach and learning.

GET INVOLVED!

www.facebook.com/EchidnaCSI

Help us find where they are, what they are doing and if they are healthy - so we can work towards their conservation. Download the EchidnaCSI app from the App Store and Google Play now.

EchidnaCSI
Echidna Conservation Science Initiative

INSTITUTE ENGAGEMENT

DATE	MEDIA RELEASE
17-Jan	Fossils found reveal unseen 'footprint' maker
22-Feb	Risk of Ross River Virus global epidemic
9-Mar	Dental plaque DNA shows Neandertals used 'aspirin'
9-Mar	Aboriginal hair shows 50,000 years connection to country
14-Mar	Microbes measure ecological restoration success
24-Mar	Planting native vegetation for productive crops
19-Apr	Megafaunal extinctions driven by too much moisture
27-Apr	Ocean warming to cancel increased CO2-driven productivity
28-Apr	Bacteria with Midas touch for efficient gold processing
12-May	'Lost' forests may help balance global carbon budget
15-May	Food sector to benefit from innovation push
31-May	Naracoorte Caves to be focus of $2m research project
21-Jun	New catalyst paves way for carbon neutral fuel
22-Jun	Australian origin likely for iconic New Zealand tree
28-Jun	Bringing SA's oysters back from the brink
30-Jun	Building a native food industry in Australia
7-Jul	'Weedy' fish species to take over our future oceans
10-Jul	Uni of Adelaide accredited to train drone pilots
20-Jul	Kakadu site shows 65,000 years of human occupation
25-Jul	University of Adelaide researchers win Tall Poppy awards
31-Jul	Renowned zoologist reveals the life of mammals
3-Aug	Trapdoor spiders crossed Indian Ocean to get to Australia
31-Aug	Eureka Prize win for Aboriginal Heritage Project
4-Sep	Citizen Scientists wanted to solve echidna mysteries
11-Sep	Ancient wetlands offer window into climate change
28-Sep	Mapping the thylacine's mysterious loss from mainland
13-Oct	Pacific Island Leader launches Centre for Applied Conservation Science
21-Nov	Climate change models of bird impacts pass the test
7-Dec	Southern Ocean's health affected by River Murray's ebb and flow
21-Dec	Paris Climate Agreement targets challenged

"THE ENVIRONMENT INSTITUTE HAS AN IMPORTANT GOAL: TO DELIVER OUTSTANDING RESEARCH ACROSS A BROAD ENVIRONMENTAL RANGE BY BRINGING TOGETHER LEADING RESEARCHERS IN A VARIETY OF RELEVANT FIELDS, INCLUDING WATER, BIODIVERSITY, MARINE BIOLOGY, LANDSCAPES AND GENETICS. COLLABORATION AND RESEARCH EXCELLENCE ARE CENTRAL TO OUR ACHIEVEMENTS."

Ms Sandy Pitcher
Chair, Advisory Board

FUNDING OUTCOMES

Type	Announced	Lead EI Researcher	Aim of Project
Linkage Project	1	Dr Lee Arnold; Professor Robert Hill; Dr Elizabeth Reed; Professor Alan Cooper; Associate Professor Jeremy Austin; Dr John Tibby; Adjunct Professor Nigel Spooner	This project will provide a unique window into a key period of global climate change, animal extinctions and evolution of the modern Australian environment at the World Heritage-listed Naracoorte Caves.
Linkage Infrastructure, Equipment and Facilities	1	Dr Jonathan Tyler; Professor Bronwyn Gillanders; Dr John Tibby	This project aims to establish a facility for mass spectrometry and sample preparation to enhance Australian capacity to analyse the stable isotope composition of silicate minerals.
Discovery	5	Professor Steven Cooper; Professor Andrew Austin	Adaptation to life in the dark: genomic analyses of blind beetles.
		Dr Damien Fordham; Associate Professor Jeremy Austin	The project aims to reconstruct mechanisms of range contraction to avert species extinctions and provide a framework for better allocating resources for endangered species in Australia and beyond.
		Dr Kate Sanders	This project will investigate how visual gene pathways lost and restored during reptile evolution.
		Dr Martin Breed	This project will advance our understanding of seagrass adaptation and acclimation responses to extreme climatic events.
		Dr Lee Arnold	This project aims to determine the nature, timing and causes of megafaunal extinction in arid Australia using an extensive fossil necropolis at Lake Callabonna.
Discovery Early Career Researcher	2	Dr Christian Huber	This project will build the first detailed portrait of human genetic adaptation through time and reveal the genetic and environmental drivers that have shaped modern human genetic diversity and pathology.
		Dr Vicki Thomson	This project aims to investigate the role of epigenetic modifications in tiger snake adaptation.
Discovery Indigenous	1	Dr Raymond Tobler	To reconstruct the genetic history of the peopling of Sahul - the landmass connecting Australia with New Guinea at the time of colonisation.
Future Fellowship	1	Dr Bastien Llamas	To create the first ultra high quality Aboriginal Australian reference genome to explore human adaption to diverse environments.

AWARDS AND ACHIEVEMENTS

Congratulations to Environment Institute members

ARC Future Fellowship

Congratulations to Dr Bastian Llamas on receiving an Australian Research Council Future Fellowship. Dr Bastian is part of the Australian Centre for Ancient DNA. He was awarded $684K to create the first ultra high-quality Aboriginal Australian reference genome to explore human adaption to diverse environments.

Barbara Kidman Women's Fellowship

Congratulations to Dr Zoe Doubleday on receiving the University of Adelaide's Barbara Kidman Women's Fellowship. The fellowship supports female academics to enhance and promote their career.

Eureka Prize for Excellence in Interdisciplinary Scientific Research

Congratulations to the Aboriginal Heritage Project, on being awarded the Eureka Prize for Excellence in Interdisciplinary Scientific Research. This prize recognises the ground-breaking research of a partnership between Prof Alan Cooper, the Australian Centre for Ancient DNA, the local members of the Aboriginal community, the South Australian Museum and the University of New South Wales. Their work assembled a timeline for Aboriginal Australian's arrival and settlement in Australia through mitochondrial DNA gained from hair samples collected during a series of remarkable anthropological expeditions across Australia from 1928 to the 1970s and are part of the South Australian Museum's unparalleled collection.

Fresh Scientist

Congratulations to Dr Jenna Crowe-Riddell on being awarded a Fresh Science award. Fresh Science is a national competition that supports early-career researchers to become spokespeople for science. Dr Crowe-Riddell studies the evolutionary biology of vertebrate sensory systems, with a focus in particular on sea snakes.

Goyder Institute Board

Congratulations to Professor Megan Lewis who was appointed as the Goyder Institute's newest Board member. The Goyder Institute Board sets the strategic vision for the Goyder Institute and brings together South Australia's leading water research capabilities.

SA Scientist of the Year Finalist

Congratulations to Prof Bronwyn Gillanders who was recognised as a finalist in the category of SA Scientist of the Year at the SA Excellence Awards. Prof Gillanders researches population structure and connectivity, Cephalopod biology, ecology and fisheries, coastal carbon opportunities, ecological and environmental change and integrated marine management.

Unsung Heroes of South Australian Science Finalist

Congratulations to Dr Francesca McInerney who was recognised as a finalist in the category of Unsung Heroes of South Australian Science. The award recognises significant contributions to South Australian science by individuals who have not yet received formal public recognition. Dr McInerney measures the isotopic composition of fossil plants to learn about past climates, and their effects on ancient ecosystems.

Tall Poppies

Congratulations to Dr Laura Weyrich and Dr Zoe Doubleday on being awarded the Tall Poppy Award. The Tall Poppy Awards, an initiative of the Australian Institute of Policy and Science, recognise young Australians producing world-class scientific research and also demonstrate great leadership potential. Dr Laura Weyrich was further honoured with the Tall Poppy of the Year Award at the SA Excellence Awards.

Opposite Page Top
Dr Jenna Crowe-Riddell at Fresh Science 2017.

Opposite Page Left
Prof Alan Cooper at the Australian Museum Eureka Prize Awards night.

Above
Dr Susan Close MP and Prof Bronwyn at the SA Excellence Awards.

Right
Dr Laura Weyrich accepting her Tall Poppy of the Year Award.

CITATION STATISTICS

Researcher	Number of citations in 2017	h-index	i10-index
ARNOLD, Lee	421	26	41
AUSTIN, Andrew D	423	49	148
AUSTIN, Jeremy J	550	36	70
BAXTER, Simon W	593	33	45
BREED, Martin	248	15	19
BROOKES, Justin D	626	38	75
CASSEY, Phill	1135	42	139
CONNELL, Sean D	1368	56	135
COOPER, Alan	2521	76	185
COOPER, Steve J	468	38	95
DONNELLAN, Stephen C	644	42	113
DOONAN, Christian	1295	35	70
FARKAS, Juraj	132	10	10
FORDHAM, Damien A	328	25	48
GARCIA-BELLIDO, Diego	190	21	36
GILLANDERS, Bronwyn M	1102	53	131
GRUTZNER, Frank	509	32	50
HELGEN, Kristofer	759	35	93
HILL, Robert	386	52	161

Researcher	Number of citations in 2017	h-index	i10-index
KOH, Lian Pin	1638	50	105
LEWIS, Megan M	227	22	32
LOWE, Andrew J	1157	51	131
MAIER, Holger R	1506	53	170
MCINERNEY, Francesca	417	17	20
NAGELKERKEN, Ivan A	1191	55	119
OSTENDORF, Bertram	261	25	44
REED, Liz	25	9	7
REITH, Frank	293	24	38
SANDERS, Kate L	338	20	27
SPOONER, Nigel	326	31	67
SUMBY, Christopher	467	28	57
TIBBY, John C	220	27	51
TYLER, Jonathan	75	14	15
WAYCOTT, Michelle	1226	42	77
WHEELER, Sarah	269	22	38
WEINSTEIN, Philip	664	44	149
WESTRA, Seth P	538	25	40
WEYRICH, Laura	270	15	18

ENVIRONMENT INSTITUTE ADVISORY BOARD MEMBERS

Ms Sandy Pitcher (Chair)
Former Chief Executive of the Department of Environment, Water and Natural Resources

Sandy has worked at senior levels of the public sector in South Australia, the Australian government and the United Kingdom. She recently ended a three-year term as the Chief Executive of the Department of Environment, Water and Natural Resources in the South Australian government. Sandy has a strong background in climate change, renewable energy and is consulting with Deloitte, and serving on a range of boards, including Solar Citizens and Climate Knowledge Innovation Community – Australia. 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 Bob Hill (Director)
Director, Environment Institute

Bob is the Director of the Environment Institute. He is best known for his research on the fossil history of Nothofagus and southern conifers, and has won awards for his research on the impact of climate-change on Australian vegetation. He has published more than 125 refereed journal papers, 35 book chapters, several symposium papers and has edited or co-edited four books.

Professor Bronwyn Gillanders
Deputy Director, Environment Institute

Bronwyn is the Deputy Director of the Environment Institute. She is a prominent marine scientist with a strong focus on fish and cephalopods and environmental issues. She has more than 150 publications which have been cited over 11,000 times. She regularly interacts with government and industry for research. She is the current President of the World Council of Fisheries Societies and a past President of the Australian Society for Fish Biology.

Professor Julie Owens
Pro Vice Chancellor (Research Strategy), University of Adelaide

Julie is the Pro Vice-Chancellor (Research Strategy). She is internationally eminent in the research areas of pregnancy, regulation of placental and foetal growth and the developmental origins of health and disease. She has a deep understanding of research strategy, with considerable experience in managing major research collaborations, generating prestigious outputs, and attracting research funding. She has also had valuable involvement in national and international competitive research peer review, with the ARC College of Experts, the NHMRC Academy and various grant and fellowship panels.

Ms Sandy Carruthers
Director of Science, Department of Environment, Water and Natural Resources

Sandy is the Director of Science for the Department of Environment, Water and Natural Resources (DEWNR). Through her role, Sandy is accountable for the coordination and delivery of DEWNR'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 DEWNR, to support the critical relationships between DEWNR and the South Australian research sector.

Dr Susannah Eliott
Chief Executive Officer, Australian Science Media Centre

Susannah Eliott 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.

OUR LEADING MEMBERS

Professor Bob Hill
Director, Environment Institute

Professor Bronwyn Gillanders
Deputy Director, Environment Institute
Director of Marine Biology Program

RESEARCH CENTRE & PROGRAM LEADERS

Professor Andrew Austin
Director, Australian Centre for Evolutionary Biology and Biodiversity

Associate Professor Jeremy Austin
Deputy Director, Australian Centre for Ancient DNA

Professor Justin Brookes
Director, Water Research Centre

Associate Professor Phill Cassey
Director, Applied Conservation Science Centre

Professor Kristofer Helgen
Deputy Director, Applied Conservation Science Centre

Professor Sean Connell
Marine Biology Research Group

Professor Alan Cooper
Director, Australian Centre for Ancient DNA

Professor Megan Lewis
Spatial Science Research Group

Professor Andy Lowe
Director of the Centre for Conservation Science and Technology

Professor Philip Weinstein
Director, Australian Bioactive Compounds Centre

Associate Professor John Tibby
Director, Sprigg Geobiology Centre

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Chief Botanist, State Herbarium of SA

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Professor Frank Grutzner

Civil, Environmental & Mining Engineering
Professor Holger Maier
Associate Professor Seth Westra

Global Food and Resources
Professor Sarah Wheeler

Physical Sciences
Professor Christian Doonan
Professor Christopher Sumby
Professor Nigel Spooner

Public Health
Professor Peng Bi

INDEPENDENTLY FUNDED RESEARCH FELLOWS

ARC Future Fellows
Professor Ivan Nagelkerken
Dr Lee Arnold
Dr Simon Baxter
Dr Damien Fordham
Dr Diego Garcia-Bellido
Professor Lian Pin Koh
Dr Frank Reith
Dr Kate Sanders
Dr Francesca McInerney

Research Fellow
Dr Liz Reed

ASSOCIATE MEMBERS

Dr Martin Breed
Dr Juraj Farkas
Dr Manuel Solis
Dr Vicki Thomson
Dr Jonathan Tyler
Dr Laura Weyrich

PARTNER MEMBERS

Professor Steven Cooper (Adjunct)
Principal Researcher, SA Museum

Professor Stephen Donnellan
Genetics and Evolution, SA Museum

Dr Giles Hamm
Honorary Fellow, SA Museum

SELECTED PUBLICATIONS

The following list comprises a selection of the Environment Institute's publications from 2017. Environment Institute researchers are shown in bold type and the journals are listed alphabetically by journal type.

Weijola, V, Kraus, F, Vahtera, V, Lindqvist, C & **Donnellan**, SC 2017, 'Reinstatement of Varanus douarrha Lesson, 1830 as a valid species with comments on the zoogeography of monitor lizards (Squamata: Varanidae) in the Bismarck Archipelago, Papua New Guinea', *Australian Journal of Zoology*, vol. 64, no. 6, pp. 434-451.

Fan, PF, He, K, Chen, X, Ortiz, A, Zhang, B, Zhao, C, Li, YQ, Zhang, HB, Kimock, C, Wang, WZ, **Helgen**, K & Groves, C 2017, 'Description of a new species of Hoolock gibbon (Primates: Hylobatidae) based on integrative taxonomy', *American Journal of Primatology*, vol. 79, no. 5, 22631.

Fordham, DA, Saltré, F, Haythorne, S, Wigley, TM, Otto-Bliesner, BL, Chan, KC & Brook, BW 2017, 'PaleoView: a tool for generating continuous climate projections spanning the last 21 000 years at regional and global scales', *Ecography*, vol. 40, no. 11, pp. 1348-1358.

Goldenberg, SU, ***Nagelkerken***, *I*, Ferreira, CM, Ullah, H & **Connell, SD** 2017, 'Boosted food web productivity through ocean acidification collapses under warming', *Global Change Biology*, vol. 23, no. 10, pp. 4177-4184.

Janecka JE, Zhang, Y, Munkhtsog, B, Bayaraa, M, Galsandorj, N, Wangchuk, TR, Karmacharya, D, Li, J, Lu, Zhi, Uulu, SZ, Gaur, A, Kumar, S, Kumar, K, Hussain, S, Muhammad, G, Jevit, M, Hacker, C, Burger, P, Wultsch, C, Janecka, MJ, **Helgen K**, William J Murphy, Rodney Jackson; Range-Wide Snow Leopard Phylogeography Supports Three Subspecies, *Journal of Heredity*, vol. 108, no. 6, pp. 597-607

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