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Environment Institute

2015 Annual Report

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Environment Institute

2015 Annual Report

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Vision

The Environment Institute exists to deliver outstanding research across environmental sciences. To enable this, it brings together leading water and climate scientists and researchers in fields including biodiversity, marine biology, landscapes and genetics.

By developing strong international collaboration and external engagement we can address complex future 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 research outcomes in areas of importance to the Australian community including:

- > water
- > biodiversity
- > conservation
- > landscape transformation and restoration
- > oceans and marine biology
- > climate change, resilience and adaptation
- > genetics, ancient DNA and DNA barcoding
- > evolutionary biology

The Environment Institute is affiliated with 9 main programs and centres:

- > The Australian Bioactive Compounds Centre (ABCC)
- > The Australian Centre for Ancient DNA (ACAD)
- > Australian Centre for Evolutionary Biology and Biodiversity (ACEBB)
- > Conservation Science and Technology Program (CCoST)
- > Global Ecology Lab (GEL)
- > Landscape Futures Program (LFP)
- > Marine Biology Program (MBP)
- > Sprigg Geobiology Centre (SGC)
- > Water Research Centre (WRC)

2015 at a glance

Australian Research Council Funding Outcomes

- 1 Linkage
- 2 DECRA
- 5 Discovery
- 1 Future Fellowship

Grant Income

Category 1	\$6,631,150
Category 2	\$3,170,432
Category 3	\$2,803,589
Category 4	\$ 433,524
Total grant income for 2015	\$13,038,695

*Includes grant income awarded in 2015 from multi-year grants.

Publications

Our core group of 29 research leaders have produced the following publications in 2015:

- 262 Journal articles
- 5 Books
- 24 Conference papers
- 2 Science
- 2 Nature
- 2 Nature climate change

Highlights

Institute focus: Developing strong international collaboration and external engagement to address future environmental problems and export innovation to the world.

- > **Professor Sean Connell** and **Associate Professor Ivan Nagelkerken's** research into ocean acidification and warmer sea levels resulted in papers published in *Scientific Reports*, *Proceedings of the National Academy of Science* and *Nature Climate Change*.
- > **Professor Andy Lowe** is involved in University of Adelaide and SA Government \$600,000 pilot program to build SA's bee population to help protect native plants and production from orchards and crops that rely on bee pollination.
- > Through an Australian Research Council Linkage Project ACAD's **Associate Professor Jeremy Austin** was involved in a collaboration study with the University of Canberra to develop a new better method for DNA profiling of human hairs—published in *Forensic Science, Medicine and Pathology*.

- > **Professor Justin Brookes** has been a part of a collaborative study involving 64 scientists collecting data from 6 continents that revealed that Earth's lakes are warming faster than its air. The research was published in *Geophysical Research Letters* and attracted considerable media attention worldwide including commentaries in *Science* and *Nature*.
- > **Associate Professor Seth Westra** and his team were awarded funding under the ARC's Linkage Projects scheme to develop a unified approach to quantifying flood risk. Associate Professor Westra's study highlighting differences in flood risk was published in *Nature Climate Change*.

Aligning with South Australia's economic priorities

The State Government has developed ten economic priorities for South Australia's future. These priorities are areas where the State Government believes that it can make the most difference to the lives of everyday working people and to the future prosperity of our State.

The Environment Institute is engaged in several of these and will work to increase engagement in the future. We can demonstrate strong engagement in:

Unlocking the full potential of South Australia's resources, energy and renewable assets

The Environment Institute has a strong positive role to play in assisting our State in this priority. The creation of an energy industry in the Bight Basin would be an enormous boost to the economy of South Australia and Eyre Peninsula.

The Environment Institute can play a key supporting role in environmental assessment and monitoring to help mitigate risk associated with environmental impact.

Premium food and wine produced in our clean environment and exported to the world

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.

Projects involving local revegetation strategies that enhance the presence of useful orchard pollinators will optimise and enhance South Australia's \$54 million dollar apple and pear industry.

The Knowledge State—attracting a diverse student body and commercialising our research

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.

South Australia—a growing destination choice for domestic and international travellers

Much of our research is focused on areas of great interest to the tourism market. For example, we work very closely with the South Australia Museum on the world famous Ediacaran fossil site in the Flinders Ranges, the Kangaroo Island Cambrian fossil site and the UNESCO World Heritage listed Naracoorte Caves.

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.

Growth through innovation

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.

Promoting South Australia's international connections and engagement

The Environment Institute is 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

“It has been a year of new partnerships and initiatives for the Environment Institute in 2015.”

Professor Bob Hill

Deputy Vice-Chancellor (Research)



The Environment Institute continues to deliver outstanding results in line with the University of Adelaide's research strategy, and is well positioned to respond to the National Innovation and Science Agenda. Institute researchers are producing tremendous outcomes in areas of critical societal benefit including climate change, conservation technology and biodiversity.

The Institute was again well represented in the 2015 Australian

Research Council funding rounds, and the calibre of world-class research being conducted is exemplified by a host of publications in internationally acclaimed journals, including *Science*, *Nature* and *Nature Climate Change*. The ability of the Environment Institute to attract and retain top talent, and fast-track research career development, is evident.

While the success of university research can be assessed using measures of excellence, it can also be found in its economic, social, and environmental impacts. As you read through the stories within this report you will appreciate the innovative and creative ways researchers at the Environment Institute are working towards new solutions to some of Australia's and the world's "grand challenges".

Through forging fruitful relationships with industry, government and the community, and responding to areas of immediate and critical importance to Australia and its place in the world, Environment Institute researchers are key contributors to the University's commitment to deliver research of the highest impact.

Professor Mike Brooks

Deputy Vice-Chancellor (Research)

Advisory Board Chair



It is a pleasure once more to help introduce the Annual Report from the Environment Institute. The Environment Institute continues to develop a record of leading-edge research, innovation and collaboration, and the Advisory Board throughout 2015 has sustained with enthusiasm its input to these important initiatives.

The Environment Institute continues to shine as a centre for research

excellence. In 2015, again, it was well represented in the 2015 Australian Research Council funding rounds. Institute researchers continued to publish their work in the very top international journals, such as *Science* and *Nature*. Finally, the ability of the Institute to attract exciting new researchers is evidence of its growing status.

Research excellence is vital to the success of the Environment Institute, yet in the eyes of the Advisory Board it is a beginning to the creation of benefit. The Board brings expectations from the world outside academia to discussion about research, and so Board members are most excited by research aimed at helping solve the complex environmental issues that confront us as a society. It so happens that Board members end up learning more than they impart because of the quality and breadth of the Institute's researchers, and feel privileged to be associated with such fine scientists.

With these themes in mind, the Board is especially stimulated by research which creates solutions of benefit to the surrounding society. The Board celebrates the growing focus of researchers in the Environment Institute on provision of solutions. Prominent among such efforts over the past year have been work on enhancing bee populations to help pollination of native plants, orchards and crops, on unified approaches to quantifying flood risk for better water management, and on the restoration of South Australia's oyster reefs.

Through such combined excellence in research and its application, the Advisory Board believes that the Environment Institute adds lustre to the University's reputation as a leader in environmental science in Australia. I commend its Annual Report to you.

Dr Steve Morton

Chair, Environment Institute Advisory Board

Director



It has been a year of new partnerships and initiatives for the Environment Institute in 2015. When research is interdisciplinary, with strong external engagement and judicious co-investment it paves the way for successful outcomes that make measurable improvements to people's lives.

In an increasingly competitive environment, I am pleased to see Environment Institute researchers continue to take on the challenge of

initiating collaborative research projects with a visionary outlook.

The Environment Institute continues to provide avenues to foster cross-disciplinary collaboration, and harness expertise from throughout the university. From the School of School of Civil, Environmental and Mining Engineering, researchers were awarded funding under the ARC's Linkage Projects scheme to develop a unified approach to quantifying flood risk. A study highlighting differences in flood risk was published in *Nature Climate Change*. This research is pivotal to our water management decision-making process in a changing climate.

Research by the Marine Biology group into ocean acidification and warmer sea levels has contributed significantly to the international dialogue. This research has local as well as global importance—the impact of climate change must not be ignored if we are to make effective policy decisions to safeguard our multi-billion dollar fishing industry. Publications as a result of this research have featured in many high impact journals in 2015.

Local stories such the plan to restore South Australia's Oyster reefs with a 20-hectare restoration development, and investigation of megafaunal remains at the UNESCO World heritage listed Naracoorte Caves, are exciting prospects. These are examples of projects that build relationships with government, community groups and cross-disciplinary researchers to deliver local outcomes with global impact.

In 2015, our ARC funding success were comprised of one Linkage grant, two Discovery Early Career Researcher Awards, five Discovery Awards, and one Future Fellowship. Early and mid-researchers who are achieving research excellence and are leaders in their fields dominated these successes.

It has been exciting to watch these talented people build successful careers and deliver on the University's research strategy: research excellence, pursuing the big research questions, and aligning with state and national priorities. I look forward to seeing innovative research from Environment Institute leaders continue to flourish on both a local and international stage.

Professor Bob Hill

Director

Border Security: protecting Australia from invasive threats

Invasive species (animal pests, weeds and diseases) cause immense damage to our environment, native plants and animals, and annual production losses worth millions of dollars. Alien vertebrate pest animals alone cost Australia in excess of \$720 million per year.

The indirect environmental cost, as a result of the extinction of species, loss in biodiversity, and damage to ecosystem functioning, is immeasurable. Changes in the structure and functioning of ecosystems has the potential to impact the environmental systems that underpin our livelihoods, such as the availability of water and food, the regulation of nutrient cycling and the climate. The Invasion Ecology Group, led by Assoc. Prof. Phill Cassey, works across the biosecurity continuum to help ensure that the Australian economy, society and environment are protected from a variety of biological threats, including pests and diseases, and illegal wildlife trade.

Australia is a world leader in biosecurity and biosurveillance efforts. Despite this, new post-border invasions have continued to increase over the last decade, and alien species remain one of the leading threats to our environment and economy. There is therefore a need for both risk preparedness and more effective control of established pests.

Risk assessment and management

Regional economies depend heavily on tourism and trade, which carry unavoidable risks for the introduction of new pests and diseases. The Invasion Ecology group has constructed innovative new pathway tools and surveillance techniques for

estimating the risk of future incursions across a broad range of emerging invasive pests and diseases. For example, a baseline model for the transport of individuals and commodities was developed through the analysis of physical transport methods into Australia. An overall risk ranking was calculated by taking into account both seaborne and air traffic. This analysis will continue to provide a valuable tool in the development of future biosecurity policy.

Established pests

Invasive pests and diseases are among the greatest threats to global biodiversity and constitute an unprecedented form of human-induced global change. Once established, invasive alien species are exceedingly difficult to get rid of. No widespread mainland invasive vertebrate pest has yet been eradicated in Australia. The Invasion Ecology group is working to promote evidence-based solutions to the management of invasive species, and provide new state-of-the-art technological solutions to their surveillance and control. One such method, with the potential for extremely effective but humane and ethical control invasive pest species, harnesses recent advances in gene drive technology in order to render affected individuals infertile and propagate this gene throughout the population.

Wildlife trade

Wildlife trade is a multi-billion-dollar business, with hundreds of millions of live specimens and commodities being traded every year. The Invasion Ecology group are applying novel statistical and mathematical approaches to evaluate the legal and illegal trade in species, and working with enforcement agencies to assist in combatting illicit transnational wildlife crime. Recent work on the illegal trade in alien reptile species has shown that vigilant and ongoing biosecurity is desperately required to prevent the future establishment of venomous and highly aggressive species already present in private captivity within Australia.

Further reading

Bellard C, Cassey P, Blackburn TM. (2016) Alien species as a driver of recent extinctions. *Biol. Lett.* 12: 20150623.

Cope RC, Ross JV, Wittmann TA, Prowse TAA, Cassey P (2016) Integrative Analysis of the Physical Transport Network into Australia. *PLoS ONE* 11(2): e0148831



Asian black-spined toad

The Asian black-spined toad is alien (not native) to Australia. The toad is widespread in Asia, and an increasing number are being intercepted at Australian airports and sea ports from flights and ships arriving from Asia.

If the Asian black-spined toad was to establish in Australia, it could compete with native frogs and toads for food and habitat. It also has the potential to carry exotic parasites and diseases. Like the cane toad, the black-spined toad is noxious to native wildlife.

Image credit: Brian Gratwicke

“No widespread mainland vertebrate pest has yet been eradicated from Australia. We need new, innovative tools to make it happen.”

Associate Professor Phill Cassey

Restoring Australia’s native oyster reefs

The coordination of a \$3-5 million business plan to restore damaged and lost coastal habitat is centred on The Environment Institute, University of Adelaide. With the support of The Department of Water and Natural Resources, Department of Primary Industries and Regions South Australia, Ian Potter Foundation and Australian Research Council we have started on an ambitious plan to reverse the wholesale loss of oyster reef with a 20-hectare restoration development in South Australia.

The germ of this plan was initiated when a PhD student and staff member, Dr Heidi Alleway and Prof. Sean Connell, discovered one of Australia’s most significant losses of productive habitat. Native oyster reefs once characterised Australian’s sheltered coasts, forming one of the most widespread habitats for protein production, fisheries catch, biodiversity and filtration for water quality that sustain surrounding habitats. Yet, this extraordinary loss was completely eradicated from human memory until the publication of Alleway and Connell (2015) in *Conservation Biology*.

Over 150 years ago, our pioneers trawled and hacked oysters from the reefs they formed so they could survive on a cheap and readily accessible source of energy rich protein and construct roads and buildings with lime of their shells. The tonnage involved in moving oysters from place to place was so great that it occupied the minds and journals of railway managers. Over 1500 km of South Australian coast was once oyster reef in which the current turbid water was once crystal clear and teeming with fish.

Fast-forward to today, and Heidi Alleway (Director of Fisheries, PIRSA) and Sean Connell (Professor of Ecology, University of Adelaide) have spent many hundreds of hours meeting with community groups, government departments and ministers to not only realise the this loss, but to see the economic, social and environmental benefits of restoring our reefs. After two years of consultation with regional and coastal communities, coastal planners and policy makers, and officials from transport and navigational sectors we have an approved design for reefs to be constructed pending final government approvals.

The work required for restoration and benefits are going to be intergenerational. By ensuring that local communities have ownership over restoration and their benefits will ensure that such a long-term vision is indeed intergenerational. The influence on local tourism, fishing and education offers economic opportunities that will facilitate the ongoing custodianship of one of Australia’s greatest assets.

After all, Australia is a coastal culture where we flock to the sea to live, relax and seek inspiration. Where we create an intersection between economic opportunity and healthy lifestyles, we also create vibrant cultures whose sea change may inspire others to follow.

The global water challenges are great: we need to ensure potable water supply and service irrigation industries to grow food; we need to improve the plight of the billion people without access to clean drinking water; we need to adapt to climate change and the new risks that this presents and we need to ensure water for the environment.

Common to all these challenges is a need to translate the science into management, policy and technology. The Water Research Centre’s partnerships with industry enables rapid uptake of the science and adoption into management.

This science translation is core to our activities and allows us to blend fundamental and applied science, boosting the impact of our work to influence both local and global water quality improvement.

Further reading

Heidi K Alleway, Sean D Connell, Loss of an ecological baseline through the eradication of oyster reefs from coastal ecosystems and human memory, *Conservation Biology*, (2015) 29 (795-804)

Image credit: jmettraux



Image credit: Andrew Malone

“Where we create an intersection between economic opportunity and healthy lifestyles, we also create vibrant cultures whose sea change may inspire others to follow.”

Professor Sean Connell

Fossils reveal ancient shrublands in fiery landscape

New fossil evidence shows that Australia's fire-prone shrubland open vegetation originated at least 70 million years ago—40 to 50 million years earlier than previously thought.

The findings, published in the *American Journal of Botany*, reject prevailing wisdom that Australia was covered with rainforest until 40 million years ago, and that currently dominant native vegetation types mostly developed over the last 25 million years on a drying continent with increasing fire.

Recent molecular phylogenetic studies have suggested much older origins for some plant groups that are now prominent in open and fire-prone habitats, and there is an increasing realisation that fire was an important evolutionary force long before the modern vegetation began to evolve.

"I grew up and started working believing that this iconic Australian sclerophyll shrub vegetation evolved under the influence of fires as the rainforests dried out, largely over the last 25 million years or so. But it now looks like our fire-prone vegetation has much more ancient origins," says co-author Professor Bob Hill. "This dryland, fire-prone vegetation precedes the mega-rainforests by a long period of time, and it somehow managed to survive through the wetter times."

Understanding the evolutionary origins of open vegetation types, including grasslands, savannas and sclerophyll shrublands, is a central theme in ecology, since these vegetation types now dominate much of the world's ice-free terrestrial landscape.

The breakthrough comes out of a long-term research partnership of about 30 years

between Professor Hill and colleagues Dr Ray Carpenter (Research Fellow at University of Tasmania and University of Adelaide), Associate Professor Greg Jordan (University of Tasmania) and Dr Mike Macphail (Australian National University).

The researchers studied sediment, dated from the Late Cretaceous period by Dr Macphail, from core drilled in the Bundeys Basin of central Australia, northeast of Alice Springs, by the Northern Territory Geological Survey. Dr Carpenter detected numerous tiny leaf fragments from the family Proteaceae, which now includes well-known native plants such as *Banksia*, *Macadamia* and *Grevillea*. It was also evident that fire had been part of the landscape from the preserved charcoal material.

They concluded that part of the ancient vegetation they were studying was similar to what you can now see in south-western Australia, and there were even a couple of leaf fragments that look just like living *Banksia*. *Banksia* is one of Australia's most iconic native plants and is very often associated with fire. Somehow this family of plants has shown extraordinary persistence over an incredibly long period of time, through extremely variable climatic conditions.

The widespread burning of the Late Cretaceous is likely to have reduced the amount of phosphorus in the soils, and so wildfires would have promoted the spread of plants like Proteaceae, that are able to thrive

on these marginal soils and giving them a competitive advantage. We are still a long way from properly understanding how to manage fire in our landscape today, and to do that we need to understand how fire and vegetation co-evolved. This research is a significant step towards that understanding.

Further reading

Carpenter RJ, Macphail MK, Jordan GJ, Hill RS. Fossil evidence for open, proteaceae-dominated heathlands and fire in the late cretaceous of Australia. *American Journal of Botany* 2015, 102(12): 2092-2107.



“We’re a long way from properly understanding how to manage fire in our landscape. This research is a significant step towards that understanding.”

Professor Bob Hill

How will climate change affect our marine resources?

Over 80% of Australians live within 50 km of the coast, and coasts form an essential component of our daily lives. However, climate change is jeopardising the important ecosystem services that oceans provide. Associate Professor Ivan Nagelkerken studies what the potential impacts might be for fisheries species and coastal ecosystems.

Coastlines and wetlands provide many services and goods, estimated to be worth more than \$52.5 trillion per year. People depend on the oceans for food, employment, recreation, protection from storms and tsunamis, and various other ecosystem services. Along coastal shorelines, fisheries production relies heavily on inshore habitats like mangroves, saltmarshes, estuaries, and seagrasses. Yet these are among the most severely impacted systems globally due to human pressures, exacerbated by climate change. While we understand how direct human impacts lead to loss of fisheries productivity and ecosystem health, we still have little understanding of the indirect human effects such as climate change and ocean acidification.

Associate Professor Ivan Nagelkerken has been awarded a Future Fellowship from the Australian Research Council to study how climate change is affecting our fisheries species and coastal ecosystems in South Australia. Using a combination of large mesocosm experiments, smaller laboratory experiments, meta-analyses of the published literature, and field studies in natural laboratories (e.g. warming hotspots and natural CO₂ vents) has provided insights into what the future might behold.

Results from laboratory studies have shown, for example, that a variety of species such as mullet, Port Jackson shark, leather jackets, zebrafish, and barramundi change their behaviours due to the effects of ocean acidification. For example, fishes have difficulty finding their food, are no longer scared by predators, alter their interactions with other species, or prefer different habitats. Ocean acidification appears to impact a range of senses, such as hearing, vision, and olfaction, that are critical for growth and survival of species populations. Ocean warming has large effects on metabolic processes, and particularly in fish leading to an increased need for food. Combined with the negative effects of acidification on hunting behaviour, this can lead to reduced fish growth and body size, however. It is the effect of combined multiple global change stressors that we need to understand, as their effects usually act in synergism. A mesocosm experiment, for example, showed that temperature had a larger effect on species than ocean acidification, but when combined their synergistic effects lead to almost complete collapse of species and habitats.

Ocean acidification and global warming will lead to species loss, and have a bottom-up effect on food webs which will impact species at higher trophic levels most (i.e. those species that are important for fisheries). Another finding was that very generalist species at the bottom of food webs can increase in abundance, but this effect is not translated to other important species leading to a simplification of marine ecosystems.

Not only fisheries species are affected but also the habitats on which they depend. Warming and acidification not only alter the health and abundance of coastal habitats in their current ranges, but also drive range extension to higher latitudes. For example, mangroves in Australia are slowly extending their ranges southwards, to the detriment of salt marshes.

The ~3.4 million Australians that engage in inshore recreational fishing each year, directly contribute ~ \$2.5 billion per year to the economy, while the commercial seafood industry is the sixth-most valuable of Australia's food-based primary industries, with a gross value of \$2.3 billion. Hence, safeguarding the sustainability of wild-caught fisheries species is one of the big challenges in a rapidly changing world.

Further reading

Nagelkerken I, Connell SD (2015) Global alteration of ocean ecosystem functioning due to increasing human CO₂ emissions. *Proceedings of the National Academy of Sciences USA* 112: 13272-13277

Nagelkerken I, Russel BD, Gillanders BM, Connell SD (2016) Ocean acidification alters fish populations through habitat modification. *Nature Climate Change* 6: 89-93



“Safeguarding the sustainability of wild-caught fisheries species is one of the big challenges in a rapidly changing world”

Associate Professor Ivan Nagelkerken

Naracoorte's fossil caves: an extraordinary window into the past

South Australia has a remarkable variety of fossil localities, representing much of the history of life on Earth. From Ediacaran life forms in the Flinders Ranges, to Cambrian assemblages on Kangaroo Island and skeletons of gigantic marsupials at Lake Callabonna, there is much to celebrate about our state's fossil heritage.

One locality, the Naracoorte Caves National Park, achieved the ultimate level of heritage recognition in 1994 when it was listed as a UNESCO World Heritage site; a serial nomination with Riversleigh in Queensland. These sites form the Australian Fossil Mammal Sites (Riversleigh/Naracoorte) and represent outstanding examples of key periods and processes in earth's evolutionary history.

Located in the Limestone Coast region, the vertebrate fossil deposits of Naracoorte are relatively young geologically, covering the latter part of the Quaternary Period (2.6 Ma to present). They are unrivalled among comparable sites for their excellence of preservation, diversity of fossil faunas, number of deposits and time span represented.

The caves have accumulated a nearly continuous record of biodiversity and past environments spanning at least the past 500,000 years. Vast assemblages of small vertebrates were accumulated by roosting owls and other predators. Many caves acted as pitfall traps for unwary animals, collecting enormous deposits of large mammal bones. To date, around 135 vertebrate species have been identified from the Naracoorte deposits.

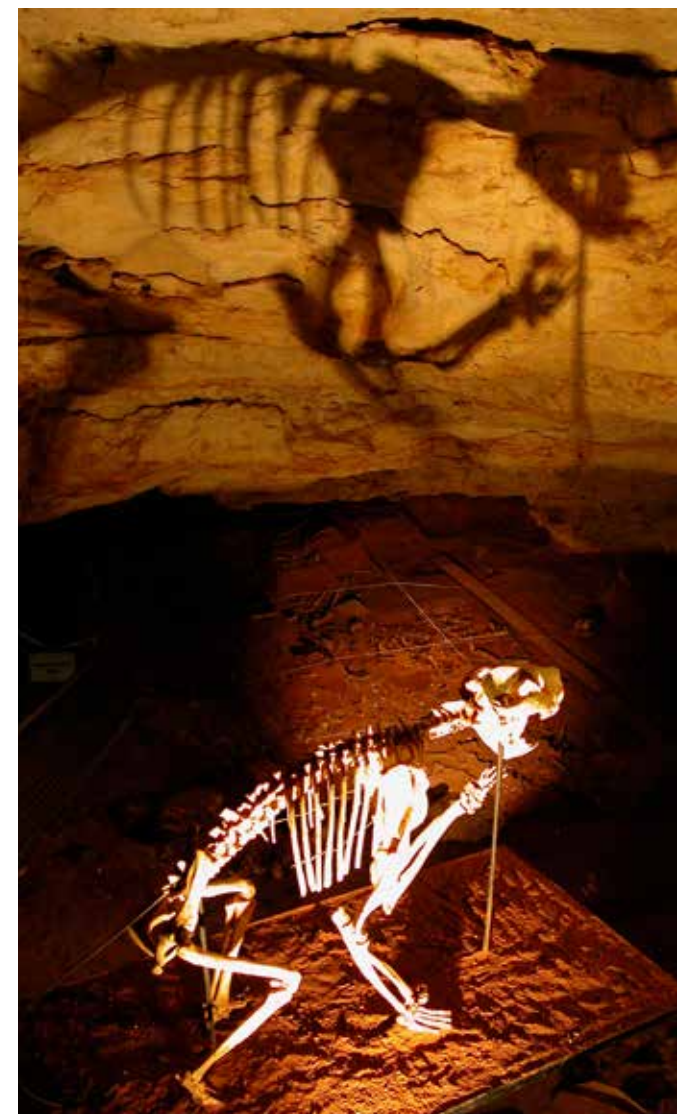
The most spectacular remains belong to the giant megafauna species that became extinct around 45,000 years ago. The cause and timing of these extinctions is one of the 'hottest' topics in vertebrate palaeontology and has been the subject of vigorous debate. Preserving much more than vertebrate fossils, the caves also hold a wealth of palaeoenvironmental information contained in speleothems, sediments, microfossils, plant remains and charcoal. Associated directly with the fossils, this provides a rare opportunity to place the preserved faunas within a local environmental context allowing detection of long-term patterns of biodiversity response to climate. Multiple contemporaneous sites at Naracoorte provide the opportunity to test observed patterns and correlate records across time and space. Deciphering Naracoorte's complex record is a multi-disciplinary endeavour. Vertebrate palaeontologist Dr Liz Reed joined Adelaide University in 2015 and has spent many years immersed in the fossil story of Naracoorte. Building on recent research directions, new collaborative work utilises a range of expertise within the Environment Institute, South Australian Museum and institutions across Australia and overseas.

A current Environment Institute project centres on refining the age and environmental context of two key megafauna sites at Naracoorte. Critical to this is developing robust chronologies, and Dr Lee Arnold and Professor Nigel Spooner are working on new approaches to OSL (optically stimulated luminescence) dating and developing age models against which to assess biodiversity and environmental patterns.

Various palaeoenvironmental proxies are being investigated by Drs John Tibby, Francesca McInerney, Jonathan Tyler and Juraj Farkas. Future work will include testing new approaches for utilising aDNA at Naracoorte in collaboration with researchers from the Australian Centre for Ancient DNA, palaeoclimate studies from speleothems and in-depth investigation of palaeovegetation and faunal records from Naracoorte. Innovative use of new technologies such as 3D laser scanning of cave sites will provide an unprecedented view of this remarkable fossil locality.

“The vertebrate fossil deposits of Naracoorte are unrivalled among comparable sites for their excellence of preservation, diversity of fossil faunas, number of deposits and time span represented.”

Dr Liz Reed



Thylacoleo skeleton reconstruction casting a shadow over the fossil bed, Victoria Fossil Cave



Above top: Sand cones in sand cave



Above bottom: Procoptodon browneorum

Risky business: the future of floods in a changing climate

Floods account for 43% of natural disasters worldwide in the last 20 years. Climate change is causing extreme rainfall intensity to increase globally. Scientists expect the rainfall intensity from storms to increase by as much as 14% for every degree of global temperature increase, depending on the season, location and a variety of other factors. The greatest increases occur for short-duration storms lasting up to several hours, bringing a heightened risk of flash-floods that are often extremely hazardous due to their rapid onset.

Associate Professor Seth Westra and his research team provide a unified approach to quantifying flood risk. They are developing the tools, technology and insights through a new spatial extreme value framework that is being used to predict extreme rainfall patterns, and that is based on insights on future changes to rainfall triggering mechanisms (e.g. whether the rainfall is caused by summer thunder storms or larger frontal rainfall systems). Projections can then be made available in a form that can be used by engineers and planners to design infrastructure and urban planning policies to adapt to future flood risk.

This research group is at the forefront of research looking at the impact of short-duration rainfall, and how that may be affected by climate change. Each region will have its own unique features that determine the flood risk from both short and long-term

rainfall events, and only through continued research will we be able to completely understand the likely future flood risks expected in a warmer future climate.

In addition to the development of policies to mitigate the consequences of floods, research on climate extremes (including both floods and droughts) can inform decisions surrounding:

- > management of water distribution networks of a city,
- > planning new developments while minimising potential impacts on water quality,
- > allocation of finite water resources between agriculture, industry and the environment,
- > implementation of our national water trading system,
- > the design of a water treatment device.

These decisions are complex and multifaceted. They require understanding a range of disciplines, including basic water science, engineering technology, ecology, policy and economics. Researchers have an important role to play in making sense of the data available to decision-makers. The problem is no longer about getting access to data, but how to manage having too much data! Petabytes of data now stream from real-time monitoring of pipeline systems, measurements of our water resources, the outputs from the latest weather and climate models, and many other places. Our challenge is to turn this data into valuable information that supports great decisions.

Making good decisions about water is critical to Australia's continued economic growth. Our sustainable development depends on the quality of our decisions. Associate Professor Seth Westra and his research team are developing the tools, technology and insights that will help others make great decisions to manage humanity's most precious resource—water.

Further reading

Zheng F, Westra S, Leonard M, 2015, Opposing local precipitation extremes, *Nature Climate Change*, 5, 5, 389-390



“Our challenge is to turn the ever increasing available data into valuable information that supports great decisions.”

Associate Professor Seth Westra

Food for Thought: Safeguarding our pollination services

“Pollination services to apple and pears alone contribute \$54 million per year to South Australia’s economy.”

Dr Katja Hogendoorn

South Australian crops, such as lucerne, almonds, apples and cherries are 80% to 100% dependent on insect pollinators to pollinate their flowers to produce seeds, nuts or fruit. Canola yield and quality can be improved with appropriate pollination services. Most pollinator services are delivered by feral honey bees, with the balance delivered by commercial honeybees and native pollinators. Pollination services to apple and pears alone contribute \$54 million per year to South Australia’s economy.

A heavy reliance on honey bees for pollination is risk prone, because it makes the productivity vulnerable to pests and diseases of honey bees. Varroa mite is present everywhere else in the world but Australia. Scientific consensus is that Varroa will reach Australia at some stage in the future, despite our best quarantine measures. It will decimate feral honey bees, but will not affect the 2500 native bee species or other pollinating insects.

Varroa mite is very invasive, and is present on our doorstep in Papua New Guinea and in New Zealand. It is expected that the demise of feral honey bees, caused by Varroa, will drive up the demand for hived bees and will result in a pollinator deficit in the horticultural industry. To reduce this predicted deficit, landscapes around crops can be improved to support the health of both native pollinators and managed honey bee hives.



However, irrespective of a Varroa mite incursion, smart improvement of nutrition for pollinators around crops will enhance free pollination services, as the density of native bees and feral honey bees in crops is influenced by the proximity of ‘pollinator habitat’ that contains food plants and nesting opportunities. The Pollination Reserves project has been co-developed between University of Adelaide, PIRSA and DEWNR. It is a program designed to investigate the actions that South Australian growers can undertake to locally support the pollination services to their pollinator dependent crops. The outcome will be increased crop productivity in the short to medium term and greater security of pollination services in the longer term.

Interested industry and community groups include Lucerne Australia, Apple and Pear Growers of SA, Almond Board of Australia, RIRDC, Wheen Bee Foundation, NRM Boards, Native Vegetation Council and Not-for-profit native vegetation restoration organisations. In the forthcoming flowering season, researchers from the University of Adelaide will map the activity of honeybees and native pollinators in areas of revegetation and native vegetation around apple and pear orchards in the Adelaide Hills. In addition, they will create a short-list of the most useful pollinating species and identify the plants used by the pollinators as sources of pollen and nectar. This will allow strategic choices in revegetation with a selection of the plants that benefit crop pollinators. Dr Katja Hogendoorn, a bee specialist at the School of Agriculture, Food and Wine and Professor Andy Lowe, Environment Institute, University of Adelaide, lead this project.

The intention of the Pollination Reserves Program is to:

- > Research and identify the locally important pollinators in crops which are highly pollinator dependent;
- > Identify the natural resources that support the presence of these important pollinators in the cropping environment, before, during and after crop flowering.
- > Establish pollinator habitat around pollinator dependent crops and monitor its potential to support the health, diversity and density of different types of pollinators.

Some of the key outcomes sought from this program are to:

- > Enable increased crop production and improved quality from enhanced pollination in the short term and greater resilience against the threat of Varroa mite incursion and other threats to feral honeybees.
- > Inspire local community understanding of how premium foods are linked to a clean and green environment;
- > Create incentives for community and farmers to maintain and enhance sustainable landscapes;
- > Increase and enhance native habitat in SA.



Next generation DNA technology solves mysteries old and new

“Identifying the remains of Australia’s missing war dead is a national issue with ongoing social, legal and cultural impacts.”

Associate Professor Jeremy Austin

As the large-scale analysis of DNA gets cheaper and easier, we are witnessing a revolution in our abilities to forensically investigate human and biodiversity issues.

The Australian Centre for Ancient DNA is one of the leading ancient DNA centres in the world. The centre has an international reputation for highly innovative research and is developing new platform technologies and collaborative programs with international research leaders.

Expertise includes the following areas:

- > Forensics
- > Impacts of Climate Change
- > Bioinformatics
- > Megafaunal Extinction
- > Microbiomes
- > Human Evolution

Data bank launched for global access to ancient DNA

In 2015, the Online Ancient Genome Repository (OAGR) was established. OAGR is a worldwide data bank that catalogues a significant collection of DNA data from ancient human skeletons and microbes found in their dental plaque.

The project is a collaboration between The Australian Centre for Ancient DNA, University Libraries and eResearch SA to make ancient genomics and microbiome data freely available to other researchers around the world. The data includes bioinformatics pipelines and metadata in an organised and searchable fashion to enable multidisciplinary access and reuse.

By combining genomic variant analysis with microbiome data obtained from sequencing ancient dental calculus, OAGR will enable researchers to investigate key genetic and

microbial changes over human evolution and the potential relationships to modern health.

Digital object identifiers (DOIs) are minted to facilitate persistent identification and citation. Data presented in the recent publication, Haak et al. (2015) Massive migration from the steppe was a source for Indo-European languages in Europe, Nature can be found in OAGR.

The initial data is sourced from ACAD and Harvard Medical School's Department of Genetics, the Wellcome Trust Sanger Institute and the Institut de Biologia Evolutiva in Barcelona, Spain.

“It’s no longer good enough to just have a publication that talks about data,” says Dr Breen. “This will enable underlying files to be made available to facilitate other research. This database puts ACAD at the head of the ancient DNA field in terms of displaying publicly available data.”

OAGR is built on the MyTardis research data management with the assistance of eResearch South Australia, and funded by the Australian National Data Service (ANDS).

ANDS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy program (NCRIS). Data published in OAGR is licenced under the Creative Commons Attribution 4.0 International License.



Advanced DNA Forensics Facility

Identifying the remains of missing persons, either natural mortalities or victims of murder, natural disaster, terrorism, wars and/or humanitarian violations, is a growing global issue with significant social, legal and cultural impacts.

The Australian Centre for Ancient DNA's Advanced DNA Forensic research is a leading international facility for cutting-edge forensic service delivery, and provides an ongoing specialised service to Police agencies and state coroners, defence and humanitarian organisations.

New ‘next generation DNA technologies’ combined with our existing ancient DNA expertise delivers reliable and comprehensive forensic identification and intelligence information from highly degraded remains, trace evidence and ‘cold-cases’. The Facility has ongoing contracts with the Australian Defence Force's Unrecovered War Casualties (Army unit), identifying the remains of Australian II World War dead.

“Identifying the remains of Australia’s missing war dead is a national issue with ongoing social, legal and cultural impacts”, says Associate Professor Jeremy Austin, Deputy Director of the Australian Centre for Ancient DNA.

One such case Associate Professor Austin is working on is the identification of the missing sailor from the Navy Ship HMAS Sydney. In November 1941, after a battle with a German raider, The Kormoran, the HMAS Sydney was lost. 645 men aboard Sydney were never found, save for one body which washed up in a life raft on Christmas Island in February 1942. Ten years ago, DNA recovered from that body was sent to the ancient DNA lab at Adelaide University to try find a match with a living relative.

The reason it is taking so long is all in the DNA. Mitochondrial DNA survives much longer in degraded remains, but it is passed down the maternal line, from mother to child. Whoever the sailor is, his direct descendants do not share his DNA. This makes for a complex family tree, and locating a suitable relative to test for DNA is the hardest part.

Unidentified natural mortalities and murder victims represent a “silent mass disaster” (~40,000 sets of unidentified human remains in the USA). Similarly, forced disappearances (civilians kidnapped and murdered by their own governments) and armed conflicts have resulted in the disappearance of hundreds of thousands of people over the last century and future demand for the genetic analysis of mass graves is predicted to grow dramatically.

Dr Denise Higgins is a member of the Forensics team and was awarded an “Overseas Humanitarian Service Medal” by the Australian Federal Police for her work in the Netherlands on the shot-down Malaysia Airlines MH17 plane.

The team has also provided critical identifications for a number of state Police agencies in missing persons’ cases. Associate Professor Austin was awarded the Commissioner’s Certificate of Appreciation for his work on the Daniel Morcombe case. Associate Professor Austin provided DNA testing to confirm the identity of Daniel Morcombe’s skeletal remains. This critical piece of evidence helped return Daniel’s remains to his family and led to a successful conviction for Daniel’s murder. This award was presented by Queensland Police Commissioner, Ian Stewart.

Above left: Ancient DNA lab
Below left: Some of the 160 soldiers massacred at Tol were buried in a nearby cemetery, while others remained in mass graves (Photo: AWM 094652)



Institute engagement

2015 snapshot

- 10 Public events
- 24 Media releases
- 19 Awards and achievements

Researcher Engagement

Environment Institute researchers contributed to the community dialogue through involvement in public events.

Public event	Date	Researchers	Event details
Science in the Pub	19 May	Andrew Lowe Lian Pin Koh Phill Cassey	Practical solutions to the biodiversity crisis
Pint of Science	20 May	Andrew Lowe	WOMADelaide Planet Talks Collaboration—Sustaining Life: Can food security and biodiversity coexist?
Pint of Science	20 May	Corey Bradshaw	The bees knees: the importance of pollinators and their recent decline
Science in the Pub	12 Jun	Phil Weinstein	Infection Dissection: where do emerging infectious diseases come from?
Royal Society of South Australia	27 Jul	Bronwyn Gillanders	Giant Australian Cuttlefish
Research Tuesdays	25 Aug	Bronwyn Gillanders	Hard data
Science in the Pub	4 Sep	Bronwyn Gillanders Ivan Nagelkerken	Marine ecology: sea-ing the future?
Science Nation	5 Nov	Alan Cooper	Science Says: Taking a lighter look at the top science stories of 2015
Research Tuesdays	10 Nov	Seth Westra	Water Risk
Science in the Pub	13 Dec	Anna Rigosi	Water; where does it come from, where does it go?

Date	Media release	Researchers
15 Jan	Out of the pouch: ancient DNA from extinct giant roos	Bastien Llamas, Alan Cooper
27 Jan	Urban sprawl promotes worm exchange across species	Konstans Wells
3 Feb	Prevention is better than cure for water ecology	Giulia Ghedini
19 Feb	Oyster ecosystems a huge loss for South Australia	Bronwyn Gillanders
3 Mar	Research challenges popular theory on origin of languages	Alan Cooper
26 Mar	Coorong fish hedge their bets for survival	Bronwyn Gillanders
28 Apr	Flood disaster risk is more complex than expected	Seth Westra
11 May	Volunteers help monitor River Torrens ducks	Phill Cassey
11 Jun	SA needs to look beyond wind for its clean energy	Corey Bradshaw
17 Jun	Databank launched for global access to ancient DNA	Jimmy Breen, Alan Cooper
16 Jul	Better DNA hair analysis for catching criminals	Jeremy Austin
24 Jul	Mammoths killed by abrupt climate change	Alan Cooper, Corey Bradshaw
24 Jul	Genomics research to benefit wine and biodiversity	Alan Cooper
11 Aug	Volcanic vents preview future ocean habitats	Ivan Nagelkerken, Sean Connell
25 Aug	Fire damage to soils sets back bushfire recovery	Wayne Meyer
31 Aug	Three year research project described in just 3 minutes	Andrew Farrer
5 Sep	Ensuring healthy bees for farms and trees	Andrew Lowe
13 Oct	Global marine analysis suggests food chain collapse	Ivan Nagelkerken, Sean Connell
12 Nov	Sharks' hunting ability destroyed under climate change	Ivan Nagelkerken, Sean Connell, Jennifer Pistevos
24 Nov	Seeing natural selection at work in ancient human DNA	Wolfgang Haak, Alan Cooper
10 Dec	Fossils reveal ancient shrublands in fiery landscape	Bob Hill
15 Dec	Headbanging Aussie bee takes a heavy metal approach to pollination	Katja Hogendoorn, Andy Lowe
16 Dec	Baby fish will be lost at sea in acidified oceans	Ivan Nagelkerken, Sean Connell, Tullio Rossi



Environment Institute Activities

Featured Speakers

The Environment Institute was host to the following local and international speakers in 2015:

Date	Speaker	Description
23 Jan	Dr Anna Szecsenyi-Nagy, University of Mainz, GER	Molecular genetic investigation of the Neolithic population history in the western Carpathian Basin (ACAD)
17 Mar	Dr Emma Sherratt, University of New England, AUS	ACAD Shape Analysis Workshop (ACAD)
27 Mar	Dr Tim Cohen, University of Wollongong, AUS	Australia's past climate: revisiting the dominant paradigm using mega-lakes of central Australia (SPRIGG Seminar Series)
14 Apr	Dr Karen Meusemann, Schlinger Postdoctoral Fellow, Australian National Insect Collection, CSIRO National Research Collections AUS	Phylogenomics and the evolution of the insects (ACEBB Seminar)
8 May	Dr Robert Gaines, Pomona College, USA	Chemical weathering, seawater chemistry and the Cambrian explosion: evidence from the ocean and from palaeosols (SPRIGG Seminar Series)
19 May	Dr Lee Ann Rollins, Deakin University, AUS	Invasive species as a model for the study of rapid evolution; (School Seminar Series)
29 May	Assoc Prof Galen Halverson, McGill University, CAN	A Continental Flood Basalt Driver for Neoproterozoic Oxygenation and Snowball Glaciation (SPRIGG Seminar Series)
12 Jun	Prof Phil Weinstein, University of Adelaide, AUS	Infection Dissection: Where do emerging infectious diseases come from? (Science in the Pub)
18 Jun	Ben Heard, University of Adelaide, AUS	Should Australia embrace a nuclear future? (Debate)
27 Jul	Prof Bronwyn Gillanders, University of Adelaide, AUS	Giant Australian Cuttlefish Seminar (Royal Society of South Australia)
7 Aug	Dr Liz Reed, University of Adelaide, AUS	Naracoorte's fossil caves: life, the megafauna and everything (SPRIGG Seminar Series)
20 Aug	Prof Tim Flannery	Climate Crisis: Emergency Actions to Protect Human Health (Public Lecture)
21 Aug	Dr Katrin Meissner, Uni of New South Wales, AUS	Modelling the dynamics of past climate change events (SPRIGG Seminar Series)

18 Sep	Dr Axel Suckow, CSIRO	Environmental Tracers and the Age of Groundwater. Definitions, Principles and Applications (SPRIGG Seminar Series)
15 Oct	Dr Christopher Fogwill, Future Fellow, University of New South Wales, AUS	Antarctica, a remote continent? Past and future contributions to global sea level rise (SPRIGG Seminar Series)
30 Oct	Prof Michael Bird, ARC Laureate Fellow, James Cook University, AUS	What stable-isotopes can say about humans, climate, vegetation and megafauna in tropical Australia (SPRIGG Seminar Series)
3 Nov	Dr Katharine Grant, Australian National Uni, AUS	Reconstructing sea level changes over 500,000 years: The 'basin isolation' approach, chronology, & implications (SPRIGG Seminar Series)

Conferences and Workshops

The Environment Institute supported the following conferences and workshops in 2015:

Date	Description
5-8 Jul	AAS Boden Research Conference: Comparative Genomics Animals Down Under (Genetics Society of AustralAsia Inc. Conference)
4 Aug	Impacts of prescribed burning on orchids and their pollinators (Orchid Conservation Workshop)
9-13 Nov	Bioinformatics 15: Advanced Bioinformatics workshop for early career researchers (Bioinformatics Workshop ACAD)
25 May	Workshop on the Climatic Change Special Issue: "Historical and possible future changes to the frequency and severity of Australian climatic natural hazards" (Ozewex Workshop)



Awards and achievements

Congratulations to Environment Institute members

Award	Recipient	Description
Lecturer of the Year Award	Dr John Conran	John is Senior Lecturer within the area of Ecology and Environmental Science and was awarded Lecturer of the year by the Adelaide University Science Association.
Future Fellowship Award	Dr Frank Reith	Dr Reith intends to use the fellowship to research new tools for gold exploration and processing.
Commissioner's Certificate of Appreciation	Assoc Prof Jeremy Austin	Associate Professor Austin provided DNA testing to confirm the identity of Daniel Morcombe's skeletal remains. This critical piece of evidence helped return Daniel's remains to his family and led to a successful conviction for Daniel's murder. This award was presented by Queensland Police Commissioner, Ian Stewart.
Women's Research Excellence Award	Dr Laura Weyrich	Established to celebrate International Women's Day, the awards recognise, celebrate and promote academic women's research excellence at the University of Adelaide. Dr Laura Weyrich received the award for her research in ancient dental calculus and its use as a means of understanding how the human microbiome responds, adapts, and changes in a natural model system.
Core Values Award	Prof Andrew Lowe, Dr Anita Smyth, Dr Steve Morton, along with a team of 15 others	As part of the Ecosystem Council and Ecosystem Science Long Term Plan, the Steering Committee were runners up and received a Highly Commended award at the International Association for Public Participation (IAP2) Australasia's Core Values Awards. The award recognises outstanding projects at the forefront of public participation and community engagement. The group has been helping to establish a basis, scope and future direction for ecosystem science for Australia and has produced a directions document after consultation with several hundred ecosystem scientists across the country.
Three Minute Thesis Competition	Andrew Farrer	A research thesis explained in only three minutes, using only one powerpoint slide was the task set. Andrew's presentation, "Ancient DNA and the life on us," was one of ten presentations judged by a panel of experts in research and communication skills.
Inspire Australia Research Competition	Tullio Rossi	Received 3rd prize for his video, "Lost at sea" Tullio's video was derived from his PhD research, which studied the effects of ocean acidification on fish behaviour, with particular focus on sound-driven orientation.

Award	Recipient	Description
Tony McMichael Public Health Ecology and Environment Award	Prof Philip Weinstein	Phil Received this year's award for his significant and discernible contribution in the combined domains of public health, ecology and environmental health. The Public Health association has named the award after Professor Tony McMichael, who was a world leader in research and advocacy for incorporating ecological and environmental factors into the field of public health (including climate change)
Tall Poppy Awards	Dr Martin Breed	The award recognises individuals who combine world-class research with a passionate commitment to communicating science and who demonstrate great leadership potential. Dr Breed is doing fantastic work developing conservation and restoration solutions from studying plant adaptation and community ecology.
Student Prize	Pablo Garcia Diaz	Pablo won the Student Prize for his presentation at the Statistics in Ecology and Environmental Monitoring (SEEM) 2015 conference in Queenstown, New Zealand. Pablo won over the judges with his 5-minute 'speed talk' presentation about his research into the preparedness of Australian border and post-border biosecurity in detecting new incursions of exotic amphibians into the country.
Best student presentation	Thomas Barnes	Best student presentation at the 2015 Aus Marine Sciences Assoc–SA, symposium
ARC College of Experts	Prof Megan Lewis	Appointed to the Australian Research Council College of Experts Biological Sciences Panel in November 2015.
Fellow of Surveying and Spatial Sciences Institute	Prof Megan Lewis	Elected as a Fellow of the SSSI for 'conspicuous service to the spatial sciences profession' in August 2015
Surveying and Spatial Sciences Institute SA Environment and Sustainability Award 2015	Dr Dorothy Turner, Dr Ken Clarke, Assoc Prof Bertram Ostendorf and Prof Megan Lewis	Won the award for their project Remote sensing and spatial analysis enhancing ecological understanding of wetlands in South-Eastern South Australia, part of a Goyder Institute project in collaboration with SARDI and DEWNR.
Surveying and Spatial Sciences Institute SA Educational Development Award 2015	Assoc Prof Bertram Ostendorf	An award for teachers, facilitators or academics who have substantially contributed through teaching, research, publication or professional activities.
Surveying and Spatial Sciences Institute SA Undergraduate Project Award 2015	Brooke Schofield	For 2014 School of Biological Sciences Honours project Identifying Acid Sulphate Soils using Hyperspectral Signatures and Imagery, supervised by Megan Lewis and Davina White.
Westpac Innovation Challenge for Agribusiness	Assoc Prof Bertram Ostendorf	The 'Drones for Grapevines' project team led by Assoc Prof Bertram Ostendorf and including Prof Megan Lewis, Assoc Prof Lian Pin Koh and Dr Vinay Pagay was one of five finalists in the 2015 Westpac Innovation Challenge for Agribusiness, and won the People's Choice Award.
Overseas Humanitarian Service Medal	Dr Denice Higgins	Awarded by the Australian Federal Police for her work in the Netherlands on the shot-down Malaysia Airlines MH17 plane.
Inaugural Australian Science Media Centre's award for 'most engaged UoA researcher with the media'.	Assoc Prof Jeremy Austin	Jeremy's media engagement on his forensic case work assisting police was cited for this award.



Left: PhD student Andrew Farrer receiving his cheque from Vice Chancellor Warren Bebbington after taking out the Adelaide University Three Minute Thesis competition.

Citation statistics

Researcher	Number of citations in 2015	h-index	i10-index
ARNOLD, Lee	400	19	30
AUSTIN, Andrew D	453	46	124
AUSTIN, Jeremy J	479	29	57
BAXTER, Simon W	555	27	39
BRADSHAW, Corey J	1893	54	189
BROOKES, Justin D	457	29	55
CASSEY, Phillip B (Phill)	888	33	102
CONNELL, Sean D	809	45	109
COOPER, Alan	2073	68	151
COOPER, Steven J	363	34	82
DONNELLAN, Stephen C	622	38	96
FORDHAM, Damien A	330	19	33
GARCIA-BELLIDO, Diego	145	17	24
GILLANDERS, Bronwyn M	1039	47	107
GRUTZNER, Frank	515	30	49
HILL, Bob	317	48	148
KOH, Lian Pin	1553	41	80
LAMBERT, Martin F	386	29	71
LEWIS, Megan M	144	18	26
LOWE, Andrew J	1073	43	101
MAIER, Holger R	1334	46	127
MCINERNEY, Francesca A (Cesca)	315	14	16
MEYER, Wayne S	188	28	73
NAGELKERKEN, Ivan A	926	45	95
REED, Liz	25	8	6
REITH, Frank	191	18	30
RUSSELL, Bayden D	505	26	46
SANDERS, Kate L	291	17	19
TIBBY, John C	201	25	44
WAYCOTT, Michelle	864	32	60
WEINSTEIN, Philip	581	34	119
WESTRA, Seth P	327	18	29
WIGLEY, Tom M	1942	98	249

ARC funding outcomes

Type	Announced	Lead EI Researcher	Aim of project
Linkage	1	Seth Westra	To develop a unified approach to flood risk.
DECRA	2	Martin Breed	To address a key debate on the relative roles of dispersal and selection on adaptation, testing how life history traits determine the magnitude of adaption.
		Laura Weyrich	To examine the evolutionary history of the human microbiome by exploring ancient bacterial communities preserved in calcified dental plaque over the past 10 000 years.
Discovery	5	Seth Westra	To develop a new spatial extreme value framework to predict extreme rainfall patterns, using insights on future changes to rainfall triggering mechanisms.
		Jeremy Austin	To develop and apply a novel targeted sequence capture and high throughput DNA sequencing approach to simultaneously type thousands of informative identity, ancestry and phonotype markers in a single assay to facilitate identification of unknown suspects and missing persons.
		Andrew Lowe	Using Australian flora as the model, tackle a central issue of evolution and conservation—what drives species adaption?
		Bayden Russell	To bridge the gap between physiology and ecology in kelp forest species by developing mechanistic models to predict change and, in unprecedented step, test them in long-term experiments at naturally acidified sites to understand the consequences of ocean acidification and warming for kelp forests.
		John Tibby	High resolution analyses of two continuous 140 000 year old sediment deposits will be used to answer fundamental questions about how current Australian environments came to be.
Future Fellowship	1	Frank Reith	To develop a new geobiological tools for gold exploration and processing that are rooted in a fundamental understanding of geobiological gold cycling.

Table left: Statistics were harvested from Google Scholar and were correct at the time of publication.

Board members

Professor Bob Hill

Director, Environment Institute

Bob is the Executive Dean, Faculty of Sciences at the University of Adelaide. Professor Hill 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.

Dr Steve Morton

**Advisory Board Chair,
Environment Institute**

**Honorary Fellow,
CSIRO Ecosystems Sciences**

Dr Steve Morton is an Honorary Fellow with the CSIRO Sustainable Ecosystems in Alice Springs in the Northern Territory. As well as being chair of the Advisory Board for the Environment Institute, he is also Director of Bush Heritage Australia, a Board Member of Desert Knowledge Australia, Director on the Board of Territory Natural Resource Management and Chair of the Seven Member Lake Eyre Basin Scientific Advisory Panel. He is interested in the ecology of Australian deserts, science of Indigenous advancement, and the use of R&D for natural resource management.

Professor Mike Brooks

**Deputy Vice Chancellor
and Vice-President (Research),
University of Adelaide**

Professor Mike Brooks is the Deputy Vice-Chancellor and Vice-President (Research) at the University of Adelaide. Professor Brooks is a leading international researcher in computer vision and image analysis. His work has seen wide commercial use in the security and defence industries and has resulted in international awards. Professor Brooks has published many influential papers in the areas of auto-calibration, structure from motion and video surveillance. He is a Fellow of the Australian Computer Society, a Fellow of the Australian Academy of Technological Sciences and Engineering, Associate Editor of the International Journal of Computer Vision, and serves as a non-executive director on several boards.

Ms Sandy Carruthers

**Director, 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 Elliott

**Chief Executive Officer, Australian
Science Media Centre**

Susannah Elliott 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.

Mr Allan Holmes

Allan Holmes has been a career public servant with more than 35 years of service in Victoria and South Australia. He recently left government after 15 years as chief executive of the South Australian Department of Environment, Water and Natural Resources. He has worked in biochemistry, agriculture, environment protection, forestry, park management and nature conservation. He currently chairs Nature Play SA, is a board member of the SA EPA as well as Arid Recovery Inc. and consults intermittently. Allan is an active contributor to public discussion of environmental matters.

Ms Pauline Gregg

General Manager (Environment) Telstra

Pauline is General Manager–Environment for Telstra and is responsible for their environmental strategy. She has over 20 years experience in environmental sustainability in both the public and private sectors. Pauline is passionate about educating companies on the importance of the environment in their operations. Pauline's interest in the environment has seen her take on an advisory role to the Board of the Environment Institute.

Professor Bob Hill

Director, Environment Institute

Professor Bronwyn Gillanders

Deputy Director, Environment Institute
Director, Marine Biology Program

Professor Andrew Austin

Associate Head of School, Biological Sciences Research
Director, Australian Centre for Evolutionary Biology and Biodiversity

Associate Professor Jeremy Austin

Deputy Director, Australian Centre for Ancient DNA

Professor Corey Bradshaw

Sir Hubert Wilkins Chair of Climate Change

Professor Justin Brookes

Director, Water Research Centre

Associate Professor Phill Cassey

Director, Centre for Conservation Science and Technology

Professor Sean Connell

Marine Biology Research Leader

Professor Alan Cooper

Director, Australian Centre for Ancient DNA

Professor Steven Cooper (Affiliate)

Principal Researcher, SA Museum

Professor Stephen Donnellan (Affiliate)

Professor, Genetics and Evolution

Professor Frank Grutzner

Genetics Lecturer

Associate Professor Lian Pin Koh

Director, Centre for Conservation Science and Technology
ARC Future Fellow

Professor Martin Lambert

Head of School, Civil, Environmental and Mining Engineering

Associate Professor David Lewis

Chemical Engineering

Professor Megan Lewis

Associate Head, Research Education
Associate Dean, Future Students Sciences

Professor Andy Lowe

Chair, Plant Conservation Biology
Director, Centre for Conservation Science and Technology

Professor Holger Maier

Civil, Environmental and Mining Engineering

Professor Wayne Myer

Director, Landscape Futures Program

Dr Liz Reed

Research Fellow

Dr John Tibby

Director, Sprigg Geobiology Centre

Professor Michelle Waycott

HBS Womersley Chair, Systematic Botany

Professor Philip Weinstein

Head of School, Biological Sciences

Associate Professor Seth Westra

Civil and Environmental Engineering

Independently funded research fellows

Dr Lee Arnold

ARC Future Fellow

Dr Simon Baxter

ARC Future Fellow

Dr Damien Fordham

ARC Future Fellow

Dr Diego Garcia-Bellido

ARC Future Fellow

Dr Cesca McInerney

ARC Future Fellow

Associate Professor Ivan Nagelkerken

ARC Future Fellow

Dr Frank Reith

ARC Future Fellow

Dr Kate Sanders

ARC Future Fellow

Professor Tom Wigley

DORA Fellow

Selected Publications

The following list comprises a selection of the Environment Institute's publications from 2015. The leading researcher from the Environment Institute is shown in bold type and the journals are listed alphabetically by journal title:

- > Carpenter RJ, Macphail MK, Jordan GJ, **Hill RS**. Fossil evidence for open, proteaceae-dominated heathlands and fire in the late cretaceous of Australia. *American Journal of Botany* 2015, **102**(12): 2092-2107.
- > **Bradshaw, C. J. A.**, Craigie, I., & Laurance, W. F. National emphasis on high-level protection reduces risk of biodiversity decline in tropical forest reserves. *Biological Conservation*, 2015, 190(C), 115-122.
- > **Gillanders BM**, C Izzo, ZA Doubleday, Q. Ye. Partial migration: Growth varies between resident and migratory fish. *Biology Letters* 2015, 11: 20145080.
- > Brook, BW, and **Bradshaw, CJA**. Key role for nuclear energy in global biodiversity conservation. *Conservation Biology*, 2015, 29(3), 702-712.
- > Grammer GL, SJ Fallon, C Izzo, R Wood, **BM Gillanders**. Investigating bomb radiocarbon transport in the southern Pacific Ocean with otolith radiocarbon. *Earth and Planetary Science Letters* 2015, 424: 59-68.
- > Ghedini G, **Russell BD, Connell SD**. Trophic compensation reinforces resistance: Herbivory absorbs the increasing effects of multiple disturbances. *Ecology Letters* 2015, **18**(2): 182-187.
- > **Nagelkerken I**, Sheaves M, Baker R, Connolly RM. The seascape nursery: a novel spatial approach to identify and manage nurseries for coastal marine fauna. *Fish and Fisheries* 2015, **16**(2): 362-371.
- > O'Reilly CM, Sharma S, Gray DK, Hampton SE, Read JS, Rowley RJ, Schneider P, Lenters JD, McIntyre PB, and 53 other authors, including **Justin D. Brookes**. *Geophysical Research Letters* 2015, **42**(24):10773-10781
- > García-Díaz P, Ross JV, Ayres C, **Cassey P**. Understanding the biological invasion risk posed by the global wildlife trade: propagule pressure drives the introduction and establishment of Nearctic turtles. *Global Change Biology* 2015, **21**(3): 1078-1091.
- > Blackburn TM, Delean S, Pyšek P, **Cassey P**. On the island biogeography of aliens: A global analysis of the richness of plant and bird species on oceanic islands. *Global Ecology and Biogeography* 2015.
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