2018 NRM Science Conference

Abstract Book

Contents

Plenary Speakers

How little we know of nature: the thrill of scientific discovery in an uncertain world

Presenter: Professor Kristofer Helgen

Professor of Biological Sciences, Deputy Director of the Centre for Applied Conservation Science at the University of Adelaide

Twitter: @khelgen

Studies of biological diversity provide a framework for classification and identification of all life on earth, and are thus fundamental to all of the biological sciences and their applications, including conservation. The fact that much of the world's biodiversity remains scientifically undocumented constrains our current understanding of much of biology, and poses a challenge to effective conservation and management of the natural world. Despite centuries of research, previously overlooked species continue to be discovered and classified for the first time by scientists, even in the best known groups of organisms. Here I discuss mammals documented as new to science in the first two decades of this century based on my fieldwork in tropical regions and detective work in natural history museums. I discuss how these discoveries impact conservation and management decisions in a human-dominated world, in which natural landscapes are rapidly changing and species extinctions are increasing.

Conservation in the Anthropocene: the need for a less conservative perspective

Presenter: Professor Lesley Hughes

Professor, Department of Biological Sciences, Macquarie University

Macquarie University Twitter: @Macquarie_Uni

The rapidly changing climate has profound implications for biodiversity and is expected to result in greatly accelerating rates of species extinction. The need for new approaches to conservation in light of this threat has been recognised in the scientific literature for well over three decades. But there remains a huge gulf between recognition of the need for more interventionist action and actual implementation. This talk will address potential ways to bridge this gulf and canvas some new approaches to meeting the conservation challenge in the 21st century.

Describing current and future climate risk: an operational perspective

Presenter: Dr Karl Braganza

Head of Climate Monitoring, Bureau of Meteorology

Bureau of Meteorology Twitter: @BOM_au

A greater appreciation of the immediate need to address current and future climate risk has resulted in a change in the questions posed to science. There is now a recognition that the management of natural resources, and the management of built assets and operational systems, needs to encompass adaptation to future climate, and mitigation of the impacts of associated natural disasters. To address these needs, the science will increasingly look to characterise future climate change with respect to specific vulnerabilities, and include elements such as worse case scenarios and compound extreme events. This talk will present the challenges associated with fast-tracking the provision of relevant science for climate risk planning and implementation

Understanding climate change risks and opportunities: a financial institution's perspective

Presenter: Rosemary Bissett

Head of Sustainability Governance & Risk at the National Australia Bank

National Australia Bank Twitter: @NAB

The financial sector has been building its understanding of climate change related risks and opportunities for a number of years, with many institutions now incorporating climate change into their strategy, governance and risk management processes and disclosures. Regulators have also highlighted the financial nature of some climate risks, with APRA signalling that "many of these risks are foreseeable, material and actionable now". The Taskforce on Climate-Related Financial Disclosures' recommendations report has now triggered interest in financial institutions being able to use climate change scenarios and data for risk management and stress testing of credit portfolios. This presentation will cover NAB's response to climate change and early work by a 16 bank global pilot (including NAB) for the United Nations Environment Program Finance Initiative, which aims to implement key recommendations of the TCFD and use climate change scenarios to stress test participating bank loan portfolios.

The critical role of 'everyday nature' for the future of cities

Presenter: Professor Sarah Bekessy

Professor of Sustainability and Urban Planning, RMIT University

Twitter: @sbekessy

A perfect storm of ideas is generating unprecedented enthusiasm for embracing nature in cities. Re-enchanting urban residents with nature can deliver a remarkable range of health benefits, while creating cities that are more resilient to climate change. Creating 'every day nature' in cities presents opportunities to reverse the fate of many threatened species and connect people with Indigenous history and culture. But it's more than just urban greening; it's generating daily doses of biodiversity. The future of liveable cities may well depend on this new conceptualization, but a major shift in the way nature is conceived of and planned for is required.

What is sustainable agriculture? Complex interactions & communication challenges

Presenter: Dr Manu Saunders

Ecologist, Ecosystem services, University of New England

Twitter: @ManuSaunders

Sustainable agriculture depends on us building a better relationship with nature

Humanity's demand for food and fibre production is increasing and it is critical we manage agricultural landscapes sustainably to ensure production security. But 'sustainable' is an ambiguous term that is used in a variety of contexts with sometimes conflicting meanings. Agriculture is a social-ecological system, based on a mutual relationship between nature and humans. Ecologically sustainable management relies on integrating natural and human systems, and moving away from quantifying and managing individual components in isolation from the rest of the system. In particular, wild animals that interact with farms are often labelled simplistically as 'good' vs. 'bad', and managed in isolation, an approach that overlooks the complex ecological interactions across space and time that sustain ecosystem services on farms. Published evidence shows how agricultural landscapes can be managed to enhance ecosystem services (e.g. food production) and reduce environmental degradation, although there are still many knowledge gaps to fill. Despite existing knowledge, broader understanding and adoption of agroecological management practices is limited, partly because of disciplinary silos and communication challenges between researchers, political bodies and farmers. A landscape-scale systems approach to agricultural management, across land uses and industries, is essential to support an ecologically sustainable production system.

20 years of threatened species conservation

Presenter: Dr Katherine Tuft

General Manager at Arid Recovery

Twitter: @KatherineTuft

Arid Recovery is a not-for-profit conservation organisation that has been researching arid ecosystems in outback South Australia for over 20 years (since 1997). The reserve is one of Australia's largest feral free fenced reserves and landscape scale laboratory for conservation research, a "living laboratory". We have successfully excluded feral cats, foxes and rabbits from 60 square km and reintroduced four locally extinct species. A fifth threatened species, the Plains Mouse, reintroduced itself in 2006 and is now thriving. Science underpins the management of the reserve. We test, measure and adapt our techniques to do conservation as effectively and efficiently as we can in the dynamic arid zone. We are working with our collaborators to develop a sustainable, long-term reintroduction solution for our threatened species. Humanity's demand for food and fibre production is increasing and it is critical we manage agricultural

Climate Change

The Economics of Water Recovery in the Murray-Darling Basin

Wheeler S.A., Grafton Q.

1) University of Adelaide

Presenter: Sarah Wheeler

Water recovery expenditure in the MDB has been wasteful, has negative environmental externality and long-term community impacts

We review recent water reforms and the consequences of water recovery intended to increase stream flows in the Murray-Darling Basin (MDB), Australia. The MDB provides a natural experiment of water recovery for the environment that includes (a) the voluntary buy-back of water rights from willing sellers and (b) the subsidization of irrigation infrastructure. We find that (a) the actual increase in the volumes of water in terms of stream flows is much less than claimed by the Australian government; (b) subsidies to increase irrigation efficiency have reduced stream and groundwater return flows; (c) buy-backs are much more cost effective than subsidies; (d) many of the gains from water recovery have accrued as private benefits to irrigators; and (e) more than a decade after water recovery began, there is no observable basin-wide relationship between volumes of water recovered and flows at the mouth of the River Murray.

How and why are fire seasons changing in South Australia

Ray, D

Bureau of Meteorology

Presenter: Mr Darren Ray

Longer and more extreme South Australian fire seasons

Managing both wildfire and prescribed burning is an ongoing part of managing the natural landscape in Australia. Climate change is leading to warmer fire seasons, and weather patterns vary on a year to year and longer term basis. Anecdotally, changes are being reported in fire season length. The challenges in assembling data on fire weather are examined, and available evidence of the shifts in start and end of the fire season in South Australia, fire season length, and occurrence of severe, extreme and catastrophic fire days through the season. This will highlight the significant lengthening of the fire season, and impacts of year to year climate influences such as El Niño Southern Oscillation. Also explored is the contribution of changes in temperature, wind and humidity to the observed changes in fire weather, and implications of this for fire and environmental management under projected climate change in South Australia.

Managing and predicting extreme weather events in the SA grains and wine grape industries

Hayman, P.T. (1), Thomas D.S. (1), Ray, D. (2).

(1) South Australian Research and Development Institute ,(2) Australian Bureau of Meteorology

Presenter: Dr Peter Hayman

How can climate science help SA growers manage extreme events?

Extreme climate and weather events are low frequency but high consequence risks that have a disproportionate impact on crops, farm businesses, agricultural supply chains and regional economies.
Examples of precipitation related climate risks are the droughts (for example Millennium drought 2002 – 2009, 2015) or very wet seasons (2010/11). Temperature climate extremes include very hot summer of 2015/16 and hotter than normal springs. Extreme weather events include spring frosts (eg October 15, 16 and November 4th 2017) and spring heat events (eg 2015) or summer heat waves. Although South Australia has low rainfall intensity compared to eastern and northern Australia, intense rainfall can be very damaging especially when crops are mature and ready for harvest.
In this paper we outline the impacts of these risks and summarise management options. In some cases there are interesting tradeoffs for managers. For example, managing grapevines for heatwaves with a full canopy will increase the vulnerability to a wet summer and disease. In the grains industry a farmer that seeks to avoid frost damage by planting later or using a longer season variety will increase the heat and water stress.
The purpose of this work is to better understand the timing and nature of the climate and weather risks and the key management decisions that are being made. This will feed information into a project supported by funding from the Australian Government Department of Agriculture and Water Resources as part of their Rural R&D for Profit program titled "Forewarned is forearmed: managing the impacts of extreme climate events".

An ecological climate change classification for South Australia

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Presenter: Dr Patrick O'Connor

An ecological climate change classification for South Australia

Temperatures in South Australia have risen 0.5-1.5°C post-1950, a trend forecast to continue over coming decades. Although climate change is emerging as a significant driver of vegetation communities, its importance and resulting management priorities are expected to vary by region. We aimed to update ecological climate sensitivity mapping for South Australia and place this information into a framework for classifying climate change impacts on the biodiversity of landscapes based on the sensitivity of plant communities and their general resilience through the proxy of vegetation remnancy.

Using data from the Biological Survey of South Australia and TERN and a set of environmental and spatial predictors, we trained models of plant species composition across South Australia. When we projected these models onto future climate scenarios to predict the resulting amount of change to species composition, The Wheat Belt, mallee and northern Flinders Ranges were shown to have the highest sensitivity and appear to represent an ecological transitional zone between mesic and arid ecosystems.

Under the classification the far northern arid sub-regions, the southern tip of the Eyre Peninsula and western Kangaroo Island are classified as Resilient. The Mount Lofty Ranges and southern Flinders Ranges plus eastern Kangaroo Island are Resistant. Northern Eyre Peninsula and northern Flinders Ranges are Sensitive. The Wheat Belt across South Australia is Susceptible, the most vulnerable category.

The outputs of this study can be used to prioritise areas in South Australia where risks from climate change might be mitigated through management.

Using the past to save the future: the role of the 'recent' fossil record in biodiversity conservation

Reed, Elizabeth.

Environment Institute and School of Physical Sciences, University of Adelaide

Presenter: Dr Elizabeth Reed

No bones about it: fossils hold the key to conserving our future

Australia today is a mere shadow of its biologically diverse glory days. Over the last two centuries, its natural habitats and faunal communities have been irreversibly altered. None have been harder hit than our native mammals, with around 30 species extinct since European settlement. Impacts from invasive species, habitat destruction and climate change continue to push some species towards extinction. Now more than ever, natural resource managers and decision makers need to engage with all available data to inform conservation strategies.

In recent decades, palaeoecologists have advocated the use of fossil data from the recent past as a tool for conservation. Palaeontological data provides a model for understanding community dynamics and responses to climate change over ecologically meaningful timeframes. It also allows us to assess past distributions and habitat tolerances of species.

Critics of 'palaeo-conservation', cite issues related to the fossil record's lack of chronological and geographic resolution and often assume that fossils merely provide a 'checklist' of past species. Equally, modern ecological data could suffer similar criticism, particularly as the core source of data comes from a vastly disrupted environment where the original baseline has long gone.

In this paper, I will present palaeo-conservation case studies from late Quaternary cave sites, including the World Heritage listed Naracoorte Caves. At Naracoorte, analysis of fossil bats has revealed long-term resilience of the critically endangered Southern Bent-wing Bat. Notably, the fossil data have provided insights into bat behaviour and use of cave habitat, providing vital information for future conservation priorities.

Small mammals from the Naracoorte Cave fossils: how to use their past for their future

Treloar, J (1), Reed, E (1), Hutchinson, M (1,2), Arnold, L (1).

(1) The University of Adelaide, (2) South Australian Museum

Presenter: Ms Jessie-Briar Treloar

Using the past to conserve small mammal species into the future: the benefits of the Naracoorte Caves fossil record

Australian small mammal diversity has declined significantly since European settlement and species continue to struggle with the changes humans have made. So how do we safeguard small mammal species and populations into the future, given the increasing threat of climate change? By investigating how they responded to climate change in the past, we can predict and plan their conservation for the future. Examination of continuous time sequences of fossil remains of small mammal species, paired with accurate dates and climate proxies, will reveal how they responded in the past. The fossil record of the Naracoorte Caves provides this opportunity with an abundance of well-preserved small mammal fossils that span a continuous high-resolution record from 500,000 years ago up to immediately pre-European settlement. Most of the small mammal species are still extant, with at least fourteen currently listed as Near Threatened, Vulnerable, Endangered, or Critically Endangered making them prime candidates for future conservation planning. Information on past patterns of small mammal responses to late Quaternary climate change can then be used to determine which species are at risk and how to plan for their future.

Tomorrow's forecast: Still Farming

Conesa, D (1), Telfer, W (1), Boomsma, A (1).

(1) Deparament of Environment, Water and Natural Resources

Presenter: Mrs Daniela Conesa

Tomorrow's forecast: Still Farming in the South East

You don't have to believe in climate change to do climate change adaptation. Even the most sceptical climate change denier is happy to work through options that better prepare them for drought, floods or bushfires. Farmers and other primary producers such as foresters, have been adapting to change for centuries and even millennia - new lands, new climates, new crops, new customer expectations.

Members of primary industries dependent on natural resources, were invited to help NRM planners to better understand their industry and its needs. Questions such as "Why do you farm?" "Why do you live here?" "What do you love about your landscape?" were used to identify primary producers' values, the drivers of their industry, pressures and threats to their activities, and what actions they take or should take to manage these threats. Input was used to develop conceptual models of each industry, which were then used in discussions about what impacts a changed climate would have on their activities. These adaptation actions were then incorporated into locally relevant (subregional scale) NRM action plans. These subregional NRM plans were developed involving all sectors of the community and contain adaptation actions for primary production, natural and urban landscapes at a scale more relevant to the community.

Open community forums will be held in mid-2018, to identify which actions form the subregional NRM plans will be implemented for the next 1-3 years in their subregion, and which individuals, groups, landholders and/or organisations will partner to carry them out.

CASCADE: "Collaborative Analysis for Secure, Alternative, Affordable Energy, tools to support viability assessment of waste to energy projects".

Riddell, G (1), Nathan, G (2), Maier, H (1), Packer, J (3), Adamson, D (4), Binenbaum, E (5), Simpson, A (1), Woei, S (2), Burton, R (6), Cavagnaro, T (6), Lewis, M (3), van Eyck, P (2), Ashman, P (2), Dally, B (2)..

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Presenter: Mr Graeme Riddell

Fuelling the energy transition with waste. Collaborative analysis to support the use of waste resources and renewable energy for biofuel production.

The CASCADE project looks to develop a modelling framework allowing for an integrated systems analysis of sustainable energy approaches, combining under-utilised biomass resources (e.g. agricultural, environmental, municipal and food) and variable renewable energy sources (e.g. solar). This will allow the assessment of the economic and environmental viability of alternative energy system in a designated location or region.

This approach enables modelling to be conducted on both current and future scenarios, thereby contributing to the longer-term development of secure, affordable and sustainable energy sources. The resultant modelling capacity will provide real solutions, responsive to a variety of economic, environmental and social factors including alternative energy demands and policy targets from under-utilised resources.

The project is driven by an interdisciplinary research team to untangle the complexity of co-ordinating geographically disperse and under-utilised biomass to maximise the economic returns from investing in sustainable energy systems. This will be facilitated by collaborating with actors across the sustainable energy system including State Government departments, local communities and industry partners. The outcome along with advanced modelling capability is the development of an ecosystem of actors at the science-policy-industry interface co-producing and implementing new solutions to complex energy problems.

Threatened Species Conservation

Research in partnership for threatened species recovery

Maron, M (1,2.

(1) National Environmental Science Program Threatened Species Recovery Hub, (2) University ofQueensland

Presenter: Martine Maron

The most effective path to uptake of conservation research is when it is done in partnership with those working at the coalface - in environmental management, policy and industry. The National Environmental Science Program's Threatened Species Recovery Hub aims to support real conservation gains by directly engaging those who will use its research, right from the project design stage and throughout the research process. This talk will outline the scope of research under the Hub, describe the types of partnerships we have developed, and give examples of where these partnerships with natural resource managers, decision-makers, businesses and the wider community are improving the chances for recovery of threatened species. It will also identify the challenges and opportunities involved in working across sectors to deliver research for threatened species recovery. The Threatened Species Recovery Hub has been built through partnerships, and we see it as a new and effective model for threatened species research in Australia.

The usefulness of a national Threatened Bird Index for NRM regions

Bayraktarov, E (1), Ehmke, G (2), Nguyen, H (1), Watmuff, J (3), O'Connor, J (2), Tulloch, A (1,4), Rogers, D (5,6), Woinarski, J (7), Garnett, S (7), Wintle, B (8), Possingham, H (1,9).

(1) The University of Queensland, (2) BirdLife Australia, (3) Planticle Pty Ltd, (4) The University of Sydney, (5) Department for Environment and Water, (6) The University of Adelaide, (7) Charles Darwin University, (8) The University of Melbourne, (9) The Nature Conservancy

Presenter: Elisa Bayraktarov

Australia's Threatened Species Index - should it report to NRM regions?

Understanding trends in the population of individual threatened species, and collectively across species, is crucial for reporting on progress towards national and global biodiversity conservation targets, justifying management resourcing, and stimulating a targeted response to environmental problems. To date, most monitoring, and reporting, of trends for threatened species involves independent programs for individual threatened species. In 2016, the Threatened Species Recovery Hub of the National Environmental Science Program (NESP), in collaboration with currently 24 organisations, committed to the establishment of an integrated headline national threatened species index for Australia – analogous to other national performance indicators (e.g. stock market indices, gross domestic product, or unemployment rate). By collating available information on population trends across many Australian threatened birds and analysing that data in a consistent, integrated way, a multi-species composite index reporting on changes in species population trends is being developed, with an initial index now established for threatened birds. Here we explore the usefulness of dis-aggregating the national index to report on trends at the level of NRM regions. We identify the NRM regions with sufficient data for such reporting, but note that there is insufficient data currently available in many NRM regions to allow such reporting.

Warru translocation in APY lands

Backhouse, B.

APY Land Management, Ecological Horizons, Zoos SA, University of NSW

Presenter: Mr Brett Backhouse

Warru run free on Wamitijara after 12 year absence

The warru (Black-flanked rock-wallaby) *Petrogale lateralis* is one of the most endangered of South Australia's mammals. They have decreased significantly since European settlement, now found only within the APY lands. Even in these small isolated pockets, the species has declined, becoming a rarity even in this stronghold. As such, works began on reducing this decline, with a Warru Recovery Team being established in 2007, focusing on addressing key threats to the species. This involved the establishment of an insurance population with Zoos SA, as well as regular monitoring of known populations and controlling introduced carnivores.
Multiple reintroductions of captive bred animals have occurred since 2011, with warru returned to the predator proof area known as 'the pintji'. This population, principally an insurance population, has thrived and as of late 2016, a large scale translocation was proposed, to reduce stocking pressure in the pintji, but also to expand the range of warru. Extensive site selection was undertaken, with Wamitjara being chosen, due to the warru only recently disappearing from this site and its favourable habitat. Site preparation was undertaken, reducing feral animals, reducing weeds and undertaking controlled burns, ensuing that the site was appropriate for the introduction.
A total of 40 animals were moved, 25 from the pintji and 15 from wild populations in the east APY, in May 2017. Animals were tracked via VHF collars, allowing for a determination of success or failure of the project as well as preferred den sites and home ranges to be established

Natural Resource Management and the local community working together to help conserve a nationally endangered marsupial

Sparrow, E (1), Lawrence, W (1), Della Torre, B (1), Price, L (1), Beaton J (2), Duigan, S (2)

(1) Department for Environment and Water, (2) Kangarilla Landcare Group

Presenter: Dr Elisa Sparrow

Local community rallies around endangered native maruspial

Within the Mount Lofty Ranges, resides a population of the last remaining bandicoot species in South Australia; the southern brown bandicoot (*Isoodon obesulus obesulus*). People do not often know that these nationally endangered marsupials are living in their local area, because they prefer the protection of thick dense understorey. Bandicoots provide important ecosystem services, and therefore the species' continued persistence may play a significant role in maintaining the function and health of some of our remaining bushland ecosystems.

Long-term conservation of bandicoots in the peri-urban environment will rely on the knowledge and capacity of the local community. Natural Resources Adelaide and Mounty Lofty Ranges' staff are working with community groups on a variety of onground projects. The groups are involved in protecting and restoring bandicoot habitat, determining extent of local populations, creating connectivity between populations, propagation of native plants for use in habitat restoration, educating local communities, and confirming bandicoot presence on properties. In addition, the groups' leadership within the community is invaluable for driving onground recovery actions.

Collaboration with the broader community has been fantastic for knowledge and resource sharing. This presentation will share some of our experiences with you on our quest to conserve South Australia's last bandicoot species.

Finding the Bunyip - Surveying for Australasian Bitterns (*Botaurus poiciloptilus*) in South Australia

Price, L (1), Green, R (2), Gitsham, J (3), Van Weenen, J (1).

(1) Department for Environment and Water, (2) Avian Monitoring Services, (3) Birds SA.

Presenter: Mr John Gitsham

In search of the elusive Bunyip bird

The contemporary distribution and abundance of the Endangered Australasian Bittern, a cryptic wetland bird species, is poorly understood in South Australia. Natural Resources Adelaide and Mount Lofty Ranges, with the support of Birds SA and Avian Monitoring Services, attempted to implement the first state-wide survey to address these key knowledge gaps, and better understand the significance of both natural and artificial wetland habitats. The project also aimed to increase community participation in the survey program to broaden survey coverage across the state. Bittern survey training workshops, led by experienced ornithologists, were conducted with more than 30 volunteers participating in the project. Field surveys were successful, recording Australasian Bitterns at 9 sites in South Australia. The preliminary results also highlight the need for a refinement of survey methodology in urban wetlands, where high levels of background noise levels proved problematic in detecting the low frequency calls of male bitterns. There was also significant potential to expand the survey to additional sites. It is anticipated that future surveys will now be able to build on the achievements to date, and trial alternative emerging survey methodologies to maximise detection in natural and artificial wetlands across both urban and rural landscapes.

Reintroduction of the Mallee Emu-wren to Ngarkat Conservation Park, South Australia: Phase 1

Stubbs, W (1), Hedger, C (1), Olds, L (2).

Department for Environment and Water (1), Zoos SA (2)

Presenter: Dr Rebecca Boulton

The Mallee Emu-wren returns to South Australia

Over the next 18 months, our team aims to determine whether translocations are a suitable conservation tool for reintroducing viable Mallee Emu-wren populations. This planning was initiated in 2014, when South Australia saw the likely extinction of the endangered Mallee Emu-wren with wildfires burning the only know populations in Ngarkat and Billiatt Conservation Parks. These losses, coupled with the simultaneous loss of other key mallee bird populations prompted an emergency summit to determine the immediate and ongoing actions and funding needed to prevent extinction. This event lead to the development of the Threatened Mallee Birds Conservation Action Plan (TMB CAP), a large collaborative project between State and Commonwealth governments, fire and threatened mallee bird experts from universities, natural resource management agencies and zoos. Priority species and threats were identified for the Murray Mallee, with objectives tackling both species specific targets and the broader landscape threats. The establishment and maintenance of four separate reserve populations of the Mallee Emu-wren was identified as a key goal. After a huge collaborative effort, the SA Murray-Darling Basin NRM were successful in securing Threatened Species Recovery Funding to implement the Mallee Emu-wren Phase 1 translocation from Victoria to South Australia commencing in April 2018. The translocation design allows refinement of the release strategy by testing a number of key aspects that may affect establishment success and our ability to measure this success.

Co-designed priorities, based on habitat suitability mapping, improves conservation planning for threatened populations in patchy habitats

Packer, JG (1,2), Guevara, D (1,3), Franco, A (3), Stubbs, W (4).

(1) School of Biological Sciences, The University of Adelaide, Australia (2) Environment Institute, The University of Adelaide, Australia (3) University of East Anglia, England (4) Natural Resources SA Murray-Darling Basin Board, Australia

Presenter: Dr Jasmin Packer

Habitat suitability models correctly predict threatened populations in patchy disturbed habitats

Landscapes that have been highly, then minimally, disturbed (e.g. recently protected reserves) can be vulnerable to cosmopolitan ecosystem engineers (e.g. *Phragmites australis*, common reed) that reduce heterogeneity. For taxa that require habitat complexity, such as the endangered Mount Lofty Ranges southern emu-wren (*Stipiturus malachurus intermedius*; emu-wren from hereon), common reed may threaten their habitat and populations. To test the predictive power of habitat suitability mapping for populations in patchy landscapes, we investigated the emu-wren at habitat (0.25 ha) and patch (1 ha) scales within the Fleurieu Peninsula Swamps. New field data was collected on emu-wren activity and vegetation (structure, density and dominance), analysed with mixed modelling, and then mapped at both scales. We then assessed the usefulness of this approach for conservation decision-making, by hosting and evaluating a stakeholder workshop to identify conservation priorities from the mapping.
Habitat suitability models showed emu-wren presence was best predicted by patch configuration, including vegetation communities, distance to farmland, and flooding. Habitat structure, such as height and density, had less predictive power. Together the models correctly predicted emu-wren presence in the breeding season at habitat (0.68% classification rate) and patch (0.72%) scales. Habitats with two or more vegetation communities were the most suitable; those dominated by common reed were among the least. Based on these habitat suitability maps, workshopees co-designed 27 recommendations and 10 priority actions. Our findings suggest that combining habitat suitability mapping with co-designed decision-making can improve conservation management for threatened species, even where they are persisting in patchily disturbed habitats.

Keeping track of reintroduced species: an indispensable tool

Moseby, K (1).

(1) Arid Recovery

Presenter: Miss Georgina Neave

A time honoured method continues to inform novel approaches to wildlife management at Arid Recovery

Trap shy, trap happy, cryptic, overabundant, nomadic, territorial, nocturnal, resource responsive and prone to capture stress. These are characteristics of five threatened mammal species reintroduced to Arid Recovery, a fenced reserve in the arid north of South Australia. Such traits make measuring population dynamics at this reserve a challenging yet necessary task to inform management decisions for continued conservation gains and ecosystem balance. Standardised track counts have been a fundamental monitoring tool at Arid Recovery since 2000. Recent analysis of track count and capture-mark-recapture data for the reserve's most common species, the burrowing bettong, has shown a strong association. Bettong track counts can be used to estimate bettong abundance. Track counts are an inexpensive tool that has generated a detailed long-term dataset on the fluctuating activity of multiple species at Arid Recovery. The method can also be used to indicate breeding events, age classes of certain species and incursions of feral animals. It's an arid land practitioner's one size fits most.

Plight of the Poor Disperser: Contraction of the Climatic Envelope of a Threatened Cunningham's Skink (Egernia cunninghami) Population

Toomes, A (1), Garcia-Diaz, P (2), Cassey, P (1).

(1) School of Biological Sciences, University of Adelaide, (2) Landcare Research Manaaki Whenua

Presenter: Mr Adam Toomes

Artificial Habitat and Translocations are Needed for a Threatened Cunningham's Skink (Egernia cunninghami) Population with a Contracting Climatic Envelope.

Cunningham's Skink (*Egernia cunninghami*) is a philopatric, long-lived skink with a threatened South Australian population subject to multiple intense disturbances. Efforts to conserve this population are hindered by the poor availability of preferred habitat - rocky outcrops. Cunningham's Skink is also unlikely to undergo a distributional shift in response to climate change as a result of poor dispersal ability. We used historic presence data to regress *E. cunninghami* presence probability with bioclimatic variables believed to influence climate suitability. Projections of future climate envelopes for both stable and unstable carbon emission scenarios predicted a contraction of climatically suitable habitat, which is likely to exacerbate the pre-existing scarcity of suitable microhabitat within the current envelope. We simulated dispersal events from 2017-2080 and showed that the threatened population is extremely unlikely to disperse to disparate regions of long-term climate suitability. Potentially viable strategies for the mitigation of local extinction risk include the use of artificial habitat or translocations to climatically stable regions.

Environmental Outcomes in the Murray-Darling Basin

Flexible Options for Returning Water Effectively to River Ecosystems

Jensen, A (1,2)

(1) Healthy Rivers Ambassador, (2) Honorary Research Associate, Nature Foundation SA

Presenter: Dr Anne Jensen

Adding environmental water anytime brings results!

In the changing water regime of the regulated rivers of the Murray-Darling Basin, emerging findings from environmental watering projects indicate that the timing of watering does not need to be restricted to the natural seasonality of the pre-regulation regime. Water returned to the environment at any season can have beneficial outcomes.
These findings make watering options more flexible and extend opportunities for effective environmental watering. Water can be applied for multiple purposes, not just for simulating seasonal flooding in late spring-summer. This means that the limited quantities of water being returned to the river ecosystems can be applied more widely, more effectively and over a longer time span through the water year.
While Murray-Darling ecosystems have natural seasonal patterns for breeding and regeneration which evolved in response to the natural water regime, they are also adapted to the highly variable nature of the Australian climate, and can respond opportunistically to water whenever it is available. Returning water to the environment at any time of the year can replenish soil moisture reserves in the unsaturated zone, reduce stress in mature trees to enhance crop production, and sustain seedlings and saplings through dry conditions. The benefits of serial annual watering have already been identified. Recent results indicate that priming wetlands in late autumn to early winter significantly enhances the effectiveness of watering events in the following spring, with increased biodiversity and biomass in waterplants and food sources for waterbirds. Watering at any time of the year can bring rapid beneficial results!

Increasing Ecological Connectivity in the Murray through Integrated River Management

Gibbs, M (1,2), Brookes, J (1), Gao, L (3), Zampatti, B (4), Welti, N (3), Bice, C (4), Furst, D (1), Marklund, M (1), Nicol, J (4), Wallace, T (1)

(1) University of Adelaide, (2) Department for Environment and Water, (3) Commonwealth Scientific and Industrial Research Organisation, (4) South Australian Research and Development Institute

Presenter: Dr Matt Gibbs

Maintaining connectivity both along the river, and between the river and the floodplain, is critical to provide ecological outcomes and manage water quality risks

Operation of the River Murray is evolving to increase the frequency of watering floodplain ecosystems. It is recognised that structures can be used to further enhance this watering compared to what can be achieved through changes in flow alone. As such, manipulation of structures in the river, on anabranches and floodplains will play a key role in river management going forward.
Using structures to hold water on the floodplain will reduce the flow in the river. If the flow is reduced too much, fast flowing habitat could be lost, benefits from transporting resources (seeds, food and energy) could be lost, and water quality issues could be more likely if there is not enough mixing or dilution.
These in-channel responses to changes in flow due to operating structures are not as well understood compared to the benefits from floodplain inundation. There is a direct trade-off between increasing inundation for floodplain ecosystems and reducing flow for in-channel ecosystems and subsequent impacts. This trade-off becomes even more difficult to assess as multiple regulators are used in combination, and the potential changes accumulate down the river.
This Goyder Institute for Water Research project involves a multi-disciplinary team focused on increasing the understanding of these in-channel responses. Results will be in a form that is usable for assessing the cumulative changes from regulator operations along the River Murray within South Australia. This information can be combined with broader Basin Plan environmental flow objectives to maximise the outcomes that can be achieved.

Keeping the Murray fresh: science to support salinity management

Bushaway, K (1), Riches, V (1), Purczel, C (1), Woods, J (1,2), Li, C (1,3)

(1) Department for Environment and Water, (2) Flinders University, (3) University of Adelaide

Presenter: Ms Virginia Riches

A new generation of groundwater simulations to help SA manage water quality in the River Murray

A new generation of groundwater computer simulations will help South Australia to manage water quality in the River Murray, benefitting the environment, irrigators, and Adelaide's water supply. Improvements underway include: (i) more accurate representation of irrigation, (ii) simulation of daily or monthly changes, rather than annual, and (iii) much greater detail in the floodplain.
In SA, the groundwater near the River Murray is often naturally saline. Salt from groundwater can flow into the river, and the amount depends on land clearance, irrigation, weir levels, pumping, and environmental watering. Numerical

groundwater models provide estimates of groundwater salt entering the River Murray due to various management actions. The challenge is to simulate both short-term and long-term movement of salt into the river, so that water can be provided to the environment and irrigators while maintaining good quality water downstream.

The groundwater models are routinely updated every five years, so they make use of the latest knowledge. Long-term influences include irrigation, so current and historical irrigation area datasets are being reviewed, including new satellite data. This should improve data, which may be incomplete, dated or limited in coverage.

Short-term influences include floodplain processes and environmental watering: these can store salt within the soil, impacting trees, or can release salt into the river. How do we account for and manage this? What are the key floodplain processes for salt on the move? Detailed groundwater models of the floodplain provide insights and guidance for policy development, operational decision making, statutory reporting and communication with stakeholders.

Don't forgot about the little guys: Conservation of small-bodied freshwater fish in the SA Murray-Darling Basin

Whiterod, N (1)

(1) Aquasave - Nature Glenelg Trust

Presenter: Dr Nick Whiterod

Don't forgot about the little guys: Conservation of small-bodied freshwater fish in the SA Murray-Darling Basin

Globally, many species have experienced population declines and are at risk of extinction. In addition to contributing to the loss of biodiversity, increased rates of extinction may disrupt ecological processes and functions (particularly when a keystone species - which has a disproportionally large effect relative to its abundance - is lost). More than half of the freshwater fish in the Murray-Darling Basin are small-bodied (growing less than 15cm long). These small-bodied freshwater fish typically possess traits that make them vulnerable to environmental change, such as being short-lived, having limited dispersal abilites, and occupying small home ranges (either naturally or as a result of fragmentation of populations) in habitats that have been impacted by river regulation. Not suprisingly, many small-bodied freshwater fish have declined across the Basin, and some are at risk of localised, regional, and even Basin-scale extinction. Yet, these species are often overlooked in management as they are not commerically or recreationally important.

The Lower Murray is a hotspot for small-bodied freshwater fish, despite the region being signficantly altered by river regulation, the loss of habitat and the presence of introduced species. As a result, many small-bodied freshwater fish have been impacted and largely occur as small and heavily fragmented populations. These already threatened species were further placed at risk when habitats deteriorated as critical water shortage (2007 to 2010) was experienced during the millenium drought. Urgent conservation actions were undertaken and, fortunately, key small-bodied freshwater fish were maintained (in one case, only in captivity however). Reintroductions and habitat restoration following the drought has assisted some population recovery but the status of these species has been mixed. The impact and reponses to the millenium drought emphase the critical need for forethought and preparedness to conserve small-bodied freshwater fish in drought-prone regions of the world. Is it also clear that expanded and sustained effort will be required to secure small-bodied fish across the Lower Murray, and the Murray-Darling Basin more broadly.

Using bivalve geochemistry to investigate environmental baseline characteristics of the Ramsar listed Coorong wetland

Chamberlayne, B (1), Tyler, J (1), Gillanders, B (1)

(1) University of Adelaide,

Presenter: Miss Briony Chamberlayne

Coorong micromolluscs hold the key to the past

Management of South Australia's natural resources relies on knowledge of natural limits of change from a well-established baseline condition. Due to Australia's short instrumental record and early anthropogenic interventions, these baseline conditions are largely unknown. This is the case for the Ramsar listed Coorong, and Lakes Alexandrina and Albert Wetland, where management targets are based on scarce knowledge of the past state of the wetland. Palaeolimnology is a widely accepted approach for addressing the challenges of long-term monitoring, providing information on multi-decadal patterns of biodiversity, water chemistry and biogeochemical cycles. One such approach utilises the carbonate chemistry of bivalve shells to assess wetland condition and reconstruct ecosystem change at a high temporal resolution. The bivalve *Arthritica helmsi* is abundant in the modern day Coorong as well as in sediments dating back thousands of years. Understanding the controls of modern bivalve geochemistry will produce a calibration which will then be applied to preserved sub-fossil shells, allowing reconstructions of past environments. Using a multi-proxy approach, we examined the stable isotope and trace elemental chemistries of modern *A. helmsi* shells and Coorong waters to establish a modern analogue. Preliminary data suggest that bivalve shell Sr/Ca ratio is a recorder of water temperature in modern shells and oxygen isotope ratios reflect water salinity, as a function of water mass mixing and evaporation. These modern observations will facilitate a deeper understanding of long-term climate and ecosystem dynamics in the Coorong.

Observations on the gut content of the oriental weatherloach (*Misgurnus anguillicaudatus*) in the South Australian Murray-Darling Basin

Wegener, I (1), Suitor, L (1)

(1) Department for Environment and Water

Presenter: Ms Irene Wegener

Oriental weatherloach have a broad diet that is unlikely to limit its range expansion across the SA Murray-Darling Basin region.

The oriental weatherloach (*Misgurnus anguillicaudatus*), a fish species native to eastern Asia, was first captured in the South Australian Murray-Darling Basin region in February 2011. The specimens discussed here were captured through the Natural Resources SA Murray-Darling Basin Wetland and Floodplain monitoring program.

Although found across the Murray-Darling Basin, there is relatively little known about the species diet in Australia. Much of the information regarding its diet is scare and speculative with few studies and several papers available. This is not unique to Australia. As such, it is difficult to accurately assess the impact of the species on invaded habitats and to inform possible management strategies.

From our observations, it appears the diet of the oriental weatherloach is largely opportunistic, consuming both vegetative material, biota and detritus. Initial observations on the diet of oriental weatherloach in South Australia indicate that diet of the species is varied and comprises of a number of food items that may overlap with the diet of native fish species, including those considered to be of conservation significance. Given the flexibility of its diet as alluded to by others and through our early observations, it is likely that food availability is unlikely to limit the range of this species across the South Australian Murray-Darling Basin.

Testing the globally accepted limits of hypoxia: physiological effects of long-term exposure in freshwater fish

Gilmore K (1), Doubleday Z (1), Gillanders B (1)

(1) University of Adelaide

Presenter: Dr Zoe Doubleday

Fish drowning in water

Hypoxic or oxygen-free zones are linked to large-scale mortalities of fauna in aquatic environments. Currently a single standard oxygen value for aquatic environments (2 mgO_2 L^{-1}) is generally used to define hypoxia and set management targets. However, understanding the thresholds of different species to hypoxic conditions is crucial for establishing more effective targets and to avoid mortalities. We compared the long-term effects of hypoxia on two native freshwater fish species: golden perch (*Macquaria ambigua ambigua*) and silver perch (*Bidyanus bidyanus*). Juvenile fish were exposed to normoxic (6–8 mgO_2 L^{-1}) and hypoxic (3–4 mg mgO_2 L^{-1}) conditions, as well as different temperatures (20, 24 and 28 °C). Most silver perch died after only 1 month exposure to hypoxia, but golden perch survived the full 10 month experimental period. After 10 months, golden perch were placed in individual respirometry chambers to measure standard and maximum metabolic rate (SMR and MMR), absolute aerobic scope (AAS) and hypoxia tolerance. We found that golden perch exposed to hypoxia had reduced MMR at 20 and 28 °C, but there was no change to SMR. Long-term exposure to hypoxia, however, improved the tolerance of golden perch to hypoxia, compared to individuals held under normoxic conditions. The disparity between the two species suggests that golden perch would be protected under the current universal limit (2 mgO_2 L^{-1}), but silver perch would not. Our study highlights our lack of understanding of how hypoxia effects fish after long-term exposure and stresses the importance species-specific management targets.

Environmental Policy and Planning

Using expert elicitation to improve biodiversity offsetting

Evans, MC (1), Hemming, V (2), Maron, M (1).

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Presenter: Dr Megan Evans

Expert elicitation methods can help quantify the benefits of biodiversity offset activities

Biodiversity offsets are routinely prescribed as conditions of approval for urban, mining and infrastructure projects which impact on threatened species and ecological communities. Decision makers rely on rapid and easy access to data on the costs and benefits of on-ground conservation management actions when prescribing offset conditions, but such data are notoriously difficult to obtain, due to the long time frames and significant resourcing required to monitor and evaluate conservation actions. Formal expert elicitation processes are increasingly being used to fill these gaps in knowledge, and can provide a relatively inexpensive and rapidly acquired source of information to better inform offset decision making. Here, we describe research which aims to identify the best offset strategies for threatened species and ecological communities listed under the EPBC Act, and specifically for which there is currently: (i) limited data available to inform offset strategies; (ii) offsets are challenging to identify or highly costly; and/or (iii) habitat protection offsets may be of limited benefit. We outline preliminary findings from our first round of expert elicitation surveys using the IDEA Protocol (Investigate, Discuss, Estimate, Aggregate), which is a repeatable and transparent approach for deriving quantitative estimates from expert judgement. We conclude by describing our plans to conduct further surveys for species including the Northern Quoll, Spiny rice flower, and the Tasmanian Wedge-tailed Eagle, and reflect on the pros and cons of engaging participants in expert elicitation surveys using remote methods (email and telephone).

Using structured expert elicitation to develop expected environmental outcomes

Smith, J K (1), Quin, R (1).

Department of Environment andWater

Presenter: Ms Justine Smith

Expert judgement quantified for environmental good

Structured expert elicitation processes have been shown to improve the quality of expert judgements, informing critical conservation and environmental management decisions. In the River Murray, complete knowledge and data around ecosystem responses to environmental water is not currently available. In the absence of this, an expert elicitation process was used to develop quantitative expected environmental outcomes for long-term watering plan targets.
The process used draws on recent research, adopting the four-step question format which asks for the lowest estimate, highest estimate, best guess estimate and level of confidence that the true value sits within the estimated range established. Both internal and external experts were engaged through a series of facilitated workshops. This enabled discussion and agreement on assumptions and limitations, documentation of scenarios which may result in the range of outcomes estimated, and the opportunity to revise estimates. Quantitative expected environmental outcomes were successfully developed for a subset of long-term watering plan targets, covering three time points post-Basin Plan implementation.
Lessons learnt from trialling this process have been documented and it is anticipated this process will be adopted to develop additional expected environmental outcomes. This will feed directly into the evaluation and reporting of environmental outcomes in the SA River Murray, an important Basin Plan reporting obligation for the State. Further, this process can be used in other situations to ensure expert knowledge is elicited and used in a robust manner to effectively inform decision making.

Jack of all Trades, Master of One

Phyland, R

Flinders University

Presenter: Ms Rebecca Phyland

Multi-agency approaches to improve graduate education

If multi-disciplinary teams are the key to effective environmental management, then it is clearly the role of tertiary educators to equip graduates with the skills and knowledge of NRM practices to enable them to work in such teams. NRM skills go far beyond ecological knowledge; therefore science graduates require specific training in the intricacies of environmental agency workings.
This can only be done when environmental agencies and tertiary institutions develop collaborative relationships that allow academics, often Masters of One, to embrace education programs that include and integrate NRM practitioners, the ultimate Jack of all Trades, to be mentors and lead projects within and beyond the University spaces.
We propose that the solutions to building these collaborative education programs are multi-faceted and include guest lecturing, Work Integrated Learning, but also meaningful project management experiences for the students working alongside NRM practitioners in multi-disciplinary teams.
The project opportunities are only limited by the imagination of the Masters and Jacks. Three examples of plans for tertiary-industry cross-fertilisation will be outlined: Coastal Connections; Igniting Interpretation; and, Trail Trackers.

Beyond Natural: Improving Decision Making for Nature Conservation in a Changing World

Rogers, DJ (1,2), Gates, JA (1), Ryan, P (3), Woodlands, J (4).

(1) Department of Environment and Water, (2) University of Adelaide, (3) Australian Resilience Centre, (4) Conservation Council of South Australia

Presenter: Dr Dan Rogers

Climate change provides an opportunity for better conservation planning

A changing world means that we can no longer rely solely on historic templates to guide future goals for nature conservation. If the role of 'natural' templates in setting goals is changing, how do we set goals in a time of change? What information do we need, and how do we best use it, to set meaningful conservation objectives?
In South Australia, the government and non-government environment sectors are developing a nature conservation strategy (the 'Nature of SA'). A key part of this strategy is looking at how we can better make conservation decisions in the context of scientific evidence, community values, and legal and ethical commitments. In addition to supporting future-focused nature conservation planning, describing the intersect between evidence, values and rules helps describe the role that science can play in environmental decision making, within a broader social and political context. By helping both managers and scientists understand this context, we hope to improve the design and communication of evidence to better meet the needs of decision makers.
Here we present the application of these frameworks using examples from South Australian environmental policy and management that inform conservation planning under future environmental change.

Designing "safe to fail" experiments for NRM

Kumar, S. (1), Cowell, S. (1).

(1) Conservation Management Pty Ltd

Presenter: Ms Saras Kumar

Dugong populations on the rise thanks to the collaborative efforts of Traditional Owners, fishers, tourism operators, NGOs and government.

"Safe to fail experiments" that are reviewed and adapted help natural resource managers implement actions and learn about the system they are managing. Natural Resource Management (NRM) works with socio-ecological systems. These systems are complex and constantly changing. In practice, we often do not fully understand even simple systems. One response to improve our chance for success is to use an adaptive approach.

In response to managing in these complex systems, a partnership of international environmental Non-Government Organisations (ENGO) and funders have designed an adaptive management process to improve the outcomes of their programmes. It aims to use the best available science and knowledge to develop conceptual models of the socio-ecological systems for a specified area. The conceptual models are used to develop and record series of strategies and 'theories of change' which show how the strategies are expected work. When the strategies are implemented the results can be regularly checked and adjusted against the theory of change.

This process creates a series of "safe to fail" experiments that help managers implement actions and learn about the system at the same time. As the systems change and evolve so do the management strategies.

Why Do NRM Regional Planning Processes and Tools Have Limited Effect?

Meyer, W (1), Reiter, D (2), Parrott, L (3).

(1) University of Adelaide, Landscape Systems (2) Queensland University of Technology (3) University of British Columbia, Canada

Presenter: Wayne Meyer

Regional NRM stakeholders need government agencies to learn and maintain new NRM planning tools

Natural resource managers are required to prepare plans for managing in their regions. Environmental decision support systems (EDSS) have been developed to assist managers and stakeholders make decisions. Research shows that EDSS are valuable and used internationally. However, sustainability science literature reports that too often these NRM plans are not consulted upon completion, and the EDSS are no longer used. To gain insight into why the EDSS are no longer used after the R & D phase of a planning project, we asked the stakeholders, as end users of the EDSS tool, to share their perceptions of, and experience with development of the tool and then the tool itself. We report on the perspectives of the end users of an EDSS used in a South Australian NRM planning project from 2011 to 2013. The majority of respondents felt the EDSS had overall value, yet it was virtually abandoned after completion of the planning project. Half the respondents thought that the EDSS should have been used on a continuing basis. We conclude that genuine capacity development, aided by the EDSS, took place during

the project. However, the lack of use of the EDSS after the pilot project finished resulted from failures both with researcher follow up and especially with lack of commitment from government agencies who support and influence end users. Unless agencies commit to changed practices identified by end users that support the ongoing use of EDSS it is inevitable that the legacy value of EDSS development will remain limited.

Communicating Science

Rethinking science communication: from deficit to dialogue

Bray, H

School of Humanities, University of Adelaide

Presenter: Dr Heather Bray

It's time to shift science communication from 'deficit model' to dialogue

Most of our efforts in science communication have been based on the idea that if people 'understood the science', then they'd be more accepting of scientific concepts and technologies. This idea, known as the deficit model of science communication, has been widely refuted in the research literature, and yet it persists as a dominant form of communication about science and technology. In this presentation, I will discuss why the deficit model became the dominant communication paradigm in the nineties and naughties, and why some concerns about science might have been overlooked in communication efforts. I will draw genetically-modified crops as a case study to explore how placing science and technology within a broader social context is important to understanding how to move beyond the deficit model and explore other ways of engaging the community in conversations about science, including the role of trust and transparency, values, and community participation and engagement in research. I conclude with some recommendations on current best practices for science communication.

Animate Your Science

Rossi, T

Animate Your Science

Presenter: Dr Tullio Rossi

Paper accepted! Now what? Find your way to real impact using animation video.

You are about to publish new and exciting research you have been working on for a long time. You believe that the broader scientific community and even the general public would be

interested in your research. Also, you realize that with 2.5 million scientific papers published every year, it is very hard to stand out from the crowd and obtain the recognition you deserve. On top of this, your journal editor is strongly encouraging you to create a video abstract. You love the idea of making an outreach video for your research, however, you don't really know where to start. You are stuck...
Sounds familiar?
In this talk, Dr. Tullio Rossi will show how to communicate research to the general public using animation video and storytelling. This talk will inspire you to create an animation video about your own research.
Dr. Tullio Rossi is an award-winning science communicator and the founder of Animate Your Science.

Science: clearly

Duncan, K

Biotext

Presenter: Ms Kirsten Duncan

Science information designer Kirsten Duncan illuminates the right approach to strategic science communication

Science - and scientific data - can be complex or abstract and often seems opaque to a non-scientist or even across disciplinary boundaries. Yet scientists are regularly required to communicate their work to multiple audiences, and the array of ways to do this can be bewildering.
Science information designer Kirsten Duncan will illuminate some key ways to determine the right approach. She'll discuss bringing clarity and accessibility to your content through strategic communication design, and why enabling interactivity with your data and publications is important. Kirsten's presentation will be illustrated by practical examples from Australia: State of the Environment reports 2011 and 2016 and other environment-related projects that she has worked on over the past seven years with Canberra science communication company Biotext.
This session is ideal for people seeking tips about the importance of narrative, digital communication methods, bringing interactivity to data, designing infographics that work, and understanding your audience.

Strategy in Animation for Science Communication

Adrian, K

Producer / Creative Director of Redboat

Presenter: Adrian King

Strategy in Animation for Science Communication

Much thought and effort goes into the details of animation for science communication. But to really generate impact and engagement that meets our communication goals, we need to think strategically about the creative process from a high level.
In this session, Adrian will unpack the key strategic approach he uses producing animation and video for scientific research organisations such as CSIRO, DATA61, Geoscience Australia and several Government departments.
Adrian will draw on case studies reviews of the effectiveness of animation as a means of engaging government, business and public to dive deeper into fact-sheets, summaries, reports, and take action. The session will include strategies that you can immediately apply to advance the communication goals of your project or department.

Science literacy: why it matters so much and how it can be achieved

Pitman, S

(1) South Australian Museum, (2) University of South Australia

Presenter: Dr Sheryn Pitman

What do science and the imagination have in common? Only the whole wide world!

It is argued that civic science literacy is a necessity in the 21st century, not only for business and employment but for an informed citizenry able to understand and contribute to public policy issues. Every day governments, industries and citizens are confronted with daunting policy issues such as energy generation and supply, the rapid growth of cities and urbanisation, human health and wellbeing, agriculture and food production, pollution and waste management, biodiversity loss and ecosystem management. We are regularly required to make decisions that will impact the wellbeing and sustainability of our own communities and of the world around us. Civic science literacy is associated with support for basic scientific research and for the intellectual freedom needed for good science fundamental to good decision-making. Sadly it is also argued that no major industrialised nation in the world has a sufficient number of scientifically literate adults. Because we learn in so many varied ways there are diverse pathways available for developing science literacy, formal and informal. This presentation explores just some of the possibilities for improving science literacy within our wider community, and looks at some innovative and imaginative approaches that can engage and inspire new audiences and make a difference.

Biosecurity and Invasive Species

PIRSA's role in invasive species biosecurity

Virtue, J, Page, B, Meffin, R.

Primary Industries & Regions South Australia

Presenter: Dr John Virtue

The NRM Biosecurity unit in Biosecurity SA, PIRSA, provides policy development, technical advice and tools development for South Australia's NRM system.

The NRM Biosecurity unit in Biosecurity SA, PIRSA, has a focus on invasive species management.

Nationally, Biosecurity SA represents South Australia in various intergovernmental committees and working groups, including the Environment and Invasives Committee and the Marine Pests Sectoral Committee, which are guided by national strategic plans. We also participate in decision-making on national incursion responses under the National Environmental Biosecurity Response Agreement, and in national policy and systems improvement under the Intergovernmental Agreement on Biosecurity. Thirdly, we oversight the South Australian government's participation in the new Centre for Invasive Species Solutions, including involvement in research and development projects on pest animal incursions, rabbit biological control and feral deer management.

At the state level the NRM Biosecurity unit guides and supports the pest management activities of Natural Resources Management Boards (DEW). This includes development and review of weed and pest animal state policies under the Natural Resources Management Act 2004, extension resources (e.g. the SA Weed Control App), incursion responses and control tools development (e.g. weed biological control research).

Aquatic pests, including freshwater and marine fish, algae and invertebrates, fall under the scope of the Fisheries Management Act 2007. Areas of state focus for aquatic pests in the NRM Biosecurity unit include managing risk pathways to prevent new pests, fostering surveillance for early detection of incursions and reducing the spread and impacts of established pests (e.g. coordinating South Australian government input into the development of the National Carp Control Plan).

Science required to inform pest animal policy in South Australia

Wiebkin, A (1), Page, B (1), Virtue, J (1).

(1) Biosecurity SA, Primary Industries and Regions SA

Presenter: Dr Annelise Wiebkin

Future science needed to help landholders control pest animals

Pest animals eat and compete with native and agricultural plants and animals, costing agriculture about $740 million every year, and more in environmental impacts. South Australian landholders are legally obliged to control several established pest animals, including feral goats, foxes, deer, wild dogs and rabbits. Existing control techniques include shooting, trapping and baiting.

Gradual changes in land use and property sizes have reduced abilities, awareness or willingness of landholders to control pests. There are now more landholders who do not live or work on their properties, or who do not have firearms, traps or economic incentive to control pests.

Science is offering solutions that reduce time and costs of controlling some pests, including biological controls for rabbits, and baiting devices for wild dogs and feral pigs. Social science is critical in understanding why some landholders do not control pest animals. This information hones the skills of NRM practitioners, who need to tailor community engagement techniques to coordinate control efforts across landscapes. New surveillance systems are also required to show landholders the impact of pest control, using metrics that resonate with different landholders. For example, scientific models showing impacts of pest animals, or trends in their abundance, are of interest to many landholders, but not all. Additional metrics may include improvements in native animal and plant communities or stories about rural communities banding together to tackle pests.

This talk will present how technologies, engagement techniques and evaluation in pest animal management have evolved, and why the job is far from done.

Biological control is not a silver bullet: The importance of using multiple tools to control weeds and pest animals at the landscape scale.

Kovaliski, J (1), Meffin, R (1), Mutze, G (1), Peacock, D (1), Heap, J (1), Page, B (1), Virtue, J (1).

(1) NRM Biosecurity, Biosecurity SA, PIRSA

Presenter: John Kovaliski

Biosecurity SA and NRM working together to ensure stakeholder engagement and control programs are appropriately targeted.

Each year weeds cost the Australian economy $4 billion and pest animals cost $720 million in control measures and lost production. The economic impact of invasive species on native environments is thought to be of a similar magnitude. Biological controls can reduce recurrent management costs and slow the rate at which pest and weeds re-establish. New biological controls are being developed for pest animals such as rabbits and for weeds such as silver leaf nightshade. Biological controls do not eradicate populations on their own, but are effective as part of a suite of coordinated on-ground techniques. Local community groups and producer groups have the knowledge and networks, to promote coordinated best practice control methods to landholders.

Several coordinators will be employed by PIRSA Biosecurity SA to re-invigorate strategic control of weeds, feral deer and

rabbits across landscape scales, to deliver economic and environmental outcomes. The coordinators will raise awareness of impacts and costs of invasive species; ensure stakeholder engagement and control programs are appropriately targeted; foster connections among groups and individuals; promote shared responsibility for control of weeds and pest animals; lead education campaigns and extension activities. They will support individuals with information on best practice management and ensure landholders get maximum value from biological controls together with conventional control techniques.
This presentation will outline how we will be looking to partner with NRM boards and community groups to deliver the programs and provide an update on current and new biological controls.

Alien species provenance and validation using stable isotopes

Hill K (1) , Nielson K (1) , Pistevos J (2) , Cassey P (1), Tyler J (1) , McInerney F (1).

(1) University of Adelaide, (2) Centre de Recherche Insulaire et Observatoire de l'Environnement

Presenter: Miss Katherine Hill

Alien species provenance and validation using stable isotopes

The illegal wildlife trade facilitates the global movement of exotic animals as pets, creating pathways for non-native species to establish wild populations as individuals escape from captivity or are intentionally released. Novel surveillance tools are required to detect, prevent and respond to the evolving threat of exotic pet incursions. This study aims to develop a set of best-practice methods using stable isotope ratios of key alien vertebrate species to determine the environmental history and provenance of seized or at-large specimens.
We focus on the red-eared slider turtle (Trachemys scripta elegans), a North American species with established wild populations worldwide due to unregulated pet trade until the 1970s. Five specimens with different incursion and seizure histories were selected and stable carbon, nitrogen, and oxygen isotope ratios in scute keratin were measured. Additionally, elemental analysis of bone (vertebra, femur, and toe) and scute keratin was performed by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Variation was minimal across each turtle carapace and bone. However, differences in oxygen isotope ratios, and concentrations of uranium (U238) and barium (Ba137) were correlated to environmental history. Thus, chemical differentiation of captive and wild animals appears promising.

A shift in approach. Using financial and ecological risk assessment based on evidence and decision support tools to guide the

development of a feral goat management strategy for North-Western Victoria.

Lethbridge, M.

Parks Victoria

Presenter: Dr Mark Lethbridge

Using financial planning and ecological risk assessments to guide pest management planning and policy.

A cross-tenure, multi-agency plan was developed to implement management actions in the control of manage feral goats on public land in North-Western Victoria. The plan identifies enhancing existing partnerships and the building new partnerships with key stakeholders. In this talk I focus on the mechanics that underpinned this plan, rather than the plan itself. Based on extensive tracking data and aerial surveys, a decision tool was developed to consider the investment risks associated with different goat control strategies and partner/landholder incentive programs. This tool considers target densities, goat population growth rate and the level of movement of goats in and out of public lands. The tool quantifies the level of government investment saved in culling programs through a 'knock-down' strategy and increased support to community groups, partner organisations and landholders. Separately, a native vegetation evidence-based impact (not damage) survey methodology was devised to set target densities for goats in these public lands.

Rabbits, viruses and poison: what is happening with Australia's most costly pest animal

Peacock, D (1), Mutze, G (1), Sinclair, R (1), Kovaliski, J (1), Barnett, L (2), Prowse, T (3), Bradshaw, C (2), Andrews L (1), Capucci, L (4).

(1) Biosecurity SA, (2) Flinders University, (3) The University of Adelaide, (4) Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia, Brescia, Italy

Presenter: David Peacock

RHDV2 kills RHDV1 immunised rabbits enabling native plant recruitment and likely increased recovery of threatened native fauna.

My talk will highlight why rabbit control remains a priority in Australia. Rabbit population sizes are currently low in many regions, but they are still not low enough to enable palatable native plant recruitment and, being rabbits, they can quickly recover. For the last 21 years, a rabbit project at Turretfield Research Centre, about 50 km north of Adelaide, has enabled us to monitor and learn about the interactions and impacts of rabbit haemorrhagic disease virus (RHDV) and myxomatosis on this rabbit population. The large dataset of physical and antibody status of the rabbits, with virus samples from dead individuals, can test hypotheses related to different biocontrol options. We have so far determined that (1) the recent strain of RHDV (RHDV2) is killing rabbits immunised by the

Remote Sensing Applications

Measuring native vegetation in South Australia: SA Land Cover 1987-2015

Miles, M (1), Willoughby, N (1), Royal, M (1), Thompson, D (1), Rogers, D. (1)

(1) Department for Environment and Water

Presenter: Mr Matt Miles

New dataset tracks SA Native Veg

This presentation marks the public release of SA Land Cover data (1987-2015), a new set of land surface models that use satellite imagery to show land cover changes in South Australia. The dataset shows unprecedented levels of detail in changes in South Australia's land cover over 6, 5 year periods to 1990, 1995, 2000, 2005, 2010 and 2015. Output layers are at the scale of 25 x 25m pixels and classes include native woodland, hardwood plantations, orchards and vineyards, cropland, water, salt lakes, rocky outcrops, built-up and urban areas. Like any modelled and remotely sensed information, the layers will have some limitations, so it is important to understand the scale of the data and the class definitions for a given application.

A major driver for the creation of this data was the need to track changes in the extent of our native vegetation. We have produced a set of report cards describing trends from this data in woody native, low native, mangrove, saltmarsh and wetland vegetation. Native vegetation cover estimates are higher than historically presented due to new mapping definitions.

The data also allows us to go further by quantifying the change between classes in order to understand more than simply the change within a land cover class. Results show that the data describes issues we knew were happening but previously could not measure E.g. conversion of native grasslands to cropping, loss of native wetland vegetation in agricultural landscapes, shrub encroachment back into cleared or grazed pastures.

Mapping change in mangrove and saltmarsh communities for carbon sequestration - SA Land Cover

Foster, N (1), Jones, A. (1)

(1) The University of Adelaide, Faculty of Sciences

Presenter: Ms Nicole Foster

New data tracks coastal carbon

As part of a study into blue carbon in South Australian coastal vegetated ecosystems, we explored the use of SA Land Cover data to map mangrove and saltmarsh communities. This talk demonstrates what the Landsat based data could show us and how we analysed it to measure change in those communities overtime.

Mapping flora and fauna communities in the Cooper-Eromanga basin – SA Land Cover

Hobbs, T. (1)

(1) Department for Environment and Water

Presenter: Mr Trevor Hobbs

New data maps arid vegetation

In past decades, regional conservation planning and environmental assessments by natural resource managers and energy industries were constrained by the lack of consistent and spatial information on the biodiversity assets of the region. Prior to this work, vegetation mapping and ecosystem information were unavailable for large portions of the region (54 000 km²), especially within Strzelecki Desert and Cooper Creek channel country. During 2016–17, this study collated biological and environmental information from government and industry sources, identified gaps in existing information, conducted new surveys in priority landscapes, analysed relationships between flora and fauna and their environment, and identified dominant ecosystems and their associated flora and fauna species. The study developed new maps of the distribution of ecosystems across the region, based on a variety of environmental information sources, including the SA Land Cover dataset.

Mapping River Murry irrigation areas - SA Land Cover

Woods, J (1), Bushaway, K. (1)

(1) Department for Environment and Water

Presenter: Mr Peter Kretschmer

New data tracks irrigation footprint

Saline groundwater discharge to the River Murray caused by irrigation drainage remains a long-term management issue for river health. The Department for Environment and Water requires maps of irrigation area to inform our salinity management. Historically, irrigation areas were digitised from aerial photos which are both costly to obtain and time consuming to process. With Landsat based SA Land Cover data we have automated image processing of time-series data to reduce the costs and time associated with mapping irrigation areas.

Mining national datasets for local scale NRM uses: Water Observations from Space datasets provide remote monitoring of wetland water levels in the South East

Claire Harding (1), Darren Herpich (1), Roger Cranswick (1).

(1) Department for Environment and Water

Presenter: Mr Darren Herpich

No data? No problems: remotely monitoring wetland surface water levels from space

The lack of consistent long-term surface water monitoring data for wetlands is often a limiting factor for determining trends in wetland extent and condition. Historic surface water observations are also useful in setting baselines for environmental water requirements, and for modeling surface water and ecological response to observed or predicted changes in rainfall, groundwater levels, and surface water and groundwater resource management – yet this data is commonly absent or incomplete. With use of nationally available Water Observations from Space (WOfS) datasets, we developed a method to overcome this common data shortfall. We recreated approximations of surface water level hydrographs from over 2000 WOfS analysed satellite images, from 1987 to present, for multiple wetlands across the South East of South Australia. The resulting surface water level hydrographs, in conjunction with a digital elevation model (DEM), enabled spatial analysis of changes in surface water extent, depth, and frequency of inundation in response to changing management and groundwater level conditions over time.

Our method for deriving hydrographs from the WOfS products overcomes some of the limitations of satellite imagery for monitoring spatial changes in wetland surface water inundation at the site scale – where wetland basin topography, cloud cover, and vegetation interference influences the effectiveness of using satellite imagery alone. Our approach has the potential to be an efficient and cost-effective method of supplementing existing surface water level monitoring, using freely available national scale data.

Improving State Fire Mapping and Monitoring using AusCover products

Turner, D (1), Clark, K (1,2), Lewis, M (1,2).

(1) University of Adelaide, (2) SA node of TERN AusCover

Presenter: Dr Dorothy Turner

Improving State Fire Mapping

There is a view that fire frequency is increasing in South Australia. But there is no good evidence to allow examination of that question, particularly in the arid and semi-arid regions of SA, where fire mapping has been ad-hoc, intermittent and inconsistent, and where mapping discontinuities across state borders are most obvious.

This project was a collaboration between the South Australian node of the Terrestrial Ecosystem Research Network (TERN) AusCover, at the University of Adelaide, and the SA Department for Environment and Water (DEW). It demonstrates the untapped potential of existing TERN AusCover products (in particular the 30 metre resolution 'Seasonal fractional cover – Landsat, JRSRP algorithm, Australia coverage' and the 250 metre resolution 'Burnt area and approximate day of burn – MODIS') by creating a new way to map and monitor bush-fire 'burnt areas' in the arid and semi-arid three-quarters of the state.

Our methodology improved the spatial accuracy and resolution of burnt area delineation over existing MODIS products and DEW mapping. It also resulted in more spatially and temporally comprehensive coverage, with more accurate burn dating than the existing ad-hoc DEW burnt area mapping.

This method could provide more reliable, consistent, timely, comprehensive and cost effective fire extent and frequency monitoring than existing methods. Further, while this new method has higher resolution than some methods used by neighbouring states, it is harmonious with those approaches and could therefore potentially create seamless mapping across state borders.

This study has the potential for development into operational tools for the department.

Drones for Conservation

Hennekam, M. E. (1), Koh, L. P. (1), Raja Segaran, R. (1), Kilpatrick, A. (1).

(1) University of Adelaide

Presenter: Ms Molly Hennekam

From Kangaroo Island to the Amazon: the University of Adelaide's Unmanned Research Aircraft Facility work at the forefront of drone use for conservation

Drone technology is rapidly developing, as are the potential applications. The University of Adelaide's Unmanned Research Aircraft Facility (URAF) work at the forefront of the use of this technology for conservation applications. We have worked globally to develop monitoring techniques that lead to improved management outcomes. From surveying koala populations on Kangaroo Island to monitoring the forests of the Amazon for illegal logging, Molly Hennekam from the facility will share some of our experiences implementing this technology for conservation purposes.

Mr Percival in a new millennium: drone-facilitated population monitoring of Australian pelicans

Hodgson, JC (1), Terauds, A (2), Koh, LP (1).

(1) University of Adelaide, (2) Australian Antarctic Division

Presenter: Mr Jarrod Hodgson

Drones have emerged as a powerful tool for wildlife population monitoring – Mr Percival isn't the only one who knows why

With drone technology now accessible to poorly-funded researchers and managers, we welcome new horizons for wildlife monitoring. In this case, we took this novel angle to check up on Mr Percival's friends in the Coorong. We will share the preliminary results which present a unique opportunity for science and policy, and highlight the benefits of this drone-facilitated approach. While this project sought to quantify breeding effort and success of an island population of Australian pelicans, the approach is equally applicable to other waterbirds and colonial seabirds, among other less feathery flocks. Come along for a punchy 3 minute session with pseudo-Storm Boy.

Mind the gap between drones and traditional airborne platforms

Hacker, JM (1); Bannehr, L (2); Junkermann, W (3); Neininger, B (4); Lieff, W (1); McGrath, AJ (1); Zubot D (5); Zulueta R (6).

(1) ARA - Airborne Research Australia, Adelaide, SA (1), (2) Hochschule Anhalt, Dessau, Germany, (3) Karlsruhe Institute of Technology, Garmisch-Partnekirchen, Germany, (4) Metair AG, Menzingen, Switzerland,(5) Z-Air Inc., Leduc County, Alberta, Canada, (6) National Ecological Observatory Network (NEON), Boulder, Colorado, USA

Presenter: Mr Jorg Hacker

"Mind the gap" between drones and traditional airborne platforms

"Drones can do everything better" – or can they? And if there are tasks that drones really cannot do, then it's large manned airborne platforms with all their complications and usually rather high cost levels. So are these the only two choices? This presentation is about a third choice/type of airborne platform which fits neatly into the gap between the two, combining drone-like ease of operation and cost levels with un-restricted operations and payload capabilities that go far beyond drone payloads in just about every sense, opening doors to comprehensive multi-sensor tasks and applications. This presentation will showcase a few examples of such platforms – often purpose-built derivatives of motorised gliders or ultra-light aeroplanes – that have successfully been used in many projects and tasks around the world – at cost levels considerably lower than traditional airborne platforms, as well as leaving a smaller environmental footprint from their operation. Many of these tasks would simply not have been possible using any other airborne technology.

Mapping erosion gullies 20 minutes in the air or 2 weeks in the gullies

Hacker, JM (1); Brooks, A (2); Spencer J (2).

(1) ARA - Airborne Research Australia, Adelaide, SA, (2) Griffith Centre for Coastal Management, Southport, QLD

Presenter: Mr Jorg Hacker

Studying erosion gullies – 20 minutes in the air or 2 weeks in the gullies

River gully erosion is a problem with many effects. Not only is it destroying arable land, but the eroded material can be transported by the rivers into highly sensitive maritime environments. A prime example is the river systems in Northern Queensland which transport large amounts of soil into the Great Barrier Reef. Considerable efforts are in place to reduce gully erosion there, supported by detailed observations of the erosion patterns. With today's technology, quantitative methods can be used to determine the amount of soil that is eroded. The standard method is to use terrestrial Lidar systems to map gully systems in great detail. The manpower and with it the cost required is considerable. Airborne Lidar techniques were so far not able to achieve sufficient resolution to replace the ground-based mapping activities. However, combining a low and slow flying aircraft with sufficient payload capability has now enabled such mapping to be carried out in a very short time and at resolutions suitable for a quantitative approach. Furthermore, such platforms can carry ancillary sensors, such as multi- or hyperspectral cameras or scanners which give a more complete image of the processes in a very short period of time and over large areas.

Groundwater

Mechanisms for Change - Great Artesian Basin

Gogoll, M (1), West, A (1).

(1) Department for Environment and

Water

Presenter: Mr Michael Gogoll

Saving Ancient Water from Waste

The Great Artesian Basin (GAB) and Murray Darling Basin are Australia's two most significant water resources. The life blood of much of the country.
The greatest difficulty with the GAB is that it is mostly unseen. It lies beneath the surface, an ancient relic of a much different geological era.
Policy and Science are essential, but from what I have learnt, tangible on ground action is the key to ensuring that the resource improved rather than degraded into the future.
Policy, legislation and regulation can attempt to coerce proponents into positive action. Likewise, Science can measure and predict the state of the resource.
Mechanisms that are established and endorsed within the Policy and Science spheres to positively react to changes are essential.
The NHT, GABSI, IGABIIP programs are great examples of physical action, enabled by policy and science. Cumulatively they have fixed more than 650 leaky water wells, more than 15,000km of bore drains closed and ensured significant water savings across the basin.
Several key changes to policy surrounding the GAB are currently being discussed. An update of the South Australian Arid Lands Water Allocation Plan is due next year and discussions surrounding the roles of the Lake Eyre Basin Rivers Assessment and Great Artesian Basin Coordinating Committee are ongoing. Context surrounding what this might mean for South Australia and the subsequent policy framework are essential to understanding the context for Science for Policy and Policy or Science within the GAB region.

Lincoln Basin Managed Aquifer Recharge Scheme

Sibly, L. (1).

(1) University of Queensland

Presenter: Mr Liam Sibly

Poo water to the rescue!

A projected water deficit and reducing rainfall for the Eyre Peninsula are forcing decision makers to consider future water supply options over the following decade including seawater desalination or additional supply from the River Murray. This study presents an overlooked option in managed aquifer recharge (MAR), where it is proposes to recharge the Lincoln Basin aquifer with treated wastewater. Technical and economic assessments were undertaken to assess the preliminary feasibility of the scheme. Preliminary findings identified that the MAR scheme is technically feasible yet has a high degree of difficulty, and further investigation is required to address information gaps. The scheme's net present value is $0.37 million over twenty years, and a levelised cost of supply of $2.24 per kilolitre. These preliminary economic findings suggest that the Lincoln Basin MAR scheme is cost competitive with seawater desalination. However, further evaluation is required to collectively assess the social, economic and environmental merits of all options in a transparent and participatory decision-making process. Before this occurs, it is recommended that investigations be undertaken to further assess the feasibility of the Lincoln Basin MAR scheme including: testing the social acceptability of recycling wastewater, assessing the ecological response to artificial recharge, confirming the regulatory requirements, identifying a willing proponent, and refining the preliminary technical and economic assessments. These investigations require considerable lead time, and it is consequently recommended that they commence well before the next drought.

Dynamics of low-salinity groundwater lenses in the SA River Murray floodplain

Cartwright, I (1), Laattoe, T (2), Werner, AD (2,4), Woods, J (2,3).

(1) Monash University, (2) Flinders University, (3) Department for Environment and Water, (4) National Centre for Groundwater Research and Training

Presenter: Dr Juliette Woods

Freshwater lenses in saline Murray floodplain now better understood.

One source of water for trees in the River Murray floodplain may be more precarious in SA and western Victoria and New South Wales than further upstream. Murray floodplain groundwater is typically very saline, between half and twice the salinity of seawater, but "lenses" of fresher groundwater exist near the river. A hydrogeochemical study has found that, at two sites in SA, the lenses are recharged mainly during floods, through vertical infiltration during inundation, and not directly through the riverbank. Simulations demonstrate that lenses can shrink or grow depending on river operation and environmental watering. However, it was also found that lenses could theoretically exist under "gaining stream" conditions, where groundwater is generally flowing into the river, which is counter-intuitive.
The lenses affect how much salt from groundwater flows into the river, impacting downstream uses such as irrigation and town water supply, as well as floodplain ecological health. Improving our understanding of how the lenses are recharged, and how they change due to river management, informs river operators on how different options may impact river salinity and floodplain health.
Hydrogeochemical sampling was undertaken at Pike and Katarapko floodplains. Mathematical and simulation studies were used to explore lens behavior. The results complement

previous studies which found recharge through the riverbank as the main source of water for some lenses further upstream (Jolly et al., 1994; Cartwright et al., 2010), while suggesting other sources. The work supports the South Australian Riverland Floodplain Integrated Infrastructure Project (SARFIIP).

Show me the water - visualising groundwater using Nuclear Magnetic Resonance

Li, C (1, 2, 3), Doble, R (1), Hatch, M (2), Heinson, G (2), Green, G (3).

(1) CSIRO Land and Water, (2) University of Adelaide, (3) Department for Environment and Water

Presenter: Mr Chris Li

Show me the water - visualising groundwater using Nuclear Magnetic Resonance

Groundwater is important for many industries such as agriculture and mining. It is vital to manage groundwater resources properly and often numerical groundwater models are involved to assist management decisions. However, groundwater models suffer from large uncertainty partly due to insufficient understanding of the subsurface, as traditional hydrogeological approaches such as drilling can only provide point-scale information.
Geophysics, especially airborne-electromagnetics (EM), is commonly used to complement hydrogeological data due to its large spatial coverage. However, EM has a number of limitations. Firstly, its interpretation of lithology and pore water salinity is ambiguous. For instance, a high electrical conductivity signal can be interpreted as the presence of clay or saline groundwater. Secondly, the EM inversion process can be subjective and largely depends on the type of constraint used, which can produce notably different results. Thirdly, the petrophysical relationship that relates electrical resistivity to hydraulic conductivity (one of the most important parameters for groundwater modelling) contains high uncertainty as it is highly site specific and spatially variable.
These limitations may be improved by another geophysical technique: Nuclear Magnetic Resonance (NMR). This technique exploits the magnetic properties of the subsurface water protons by oscillating magnetic fields. Currently it is the only geophysical technique that can detect groundwater directly. It can estimate critical hydraulic parameters including subsurface water content, depth to watertable, aquifer thickness and depth, porosity, pore size distribution, hydraulic conductivity and specific yield. This work is about investigating how NMR can be used to improve the aforementioned EM limitations and groundwater modelling.

Multiple lines of evidence point to multiple sources of water used by arid zone floodplain trees

Catherine Miles (1), Mark Keppel (2), Claire Harding (2), Dorothy Turner (3), Justin Costelloe, Kenneth Clarke (3), Megan Lewis (3).

(1) Miles Environmental Pty Ltd, (2) Department for Environment and Water, (3) University of Adelaide, (4) University of Melbourne

Presenter: Ms Catherine Miles

Arid zone floodplain and trees utilise multiple water sources

The floodplains and riparian environments of the Lake Eyre Basin support large tracts of woodlands. As this desert region face increasing development pressure, understanding vulnerability of these ecosystems is essential to inform polices so that risks to these ecosystems are minimised.
This project aimed to address gaps in the knowledge of the distribution and characteristics of shallow groundwater in floodplain and riverine environments, the degree to which ecosystems are dependent on shallow groundwater and the inter-connectedness between shallow and deep groundwater and surface waters in arid areas.
Multiple methods were used:
• Water chemistry sampling from groundwater and surface water
• Tree sapflow monitoring
• Tree and soil water potential
• Tree and water isotope sampling, and
• Remotely sensed imagery analysis.
In all cases, no riparian ecosystem investigated appeared to be solely reliant on shallow groundwater, with observations suggesting either mixed sources, or predominant reliance on soil water (i.e. unsaturated zone). The riparian trees were found to have very low base level sapflow (transpiration) fluxes and very low pre-dawn leaf water potentials and yet were in healthy condition (e.g. compared with lower River Murray floodplain trees).
Groundwater hydrochemistry indicates the various aquifers sampled are unlikely to be closely interconnected.
Investigations at more sites and over longer timeframes are required to up-scale the results, but detailed conceptual hydro-ecological models were able to be developed. These provide a framework to explain how groundwater extraction and surface water diversion may or may not impact the ecosystems and guide risk assessments.

A potential offshore freshwater resource in the Gambier Embayment, South Australia

Knight, AC (1), Werner, AD (1,2).

(1) Flinders University, (2) National Centre for Groundwater Research and Training

Presenter: Mr. Andrew Knight

Recent work indicates that a significant freshwater body may be found offshore in South Australia's south east

Freshwater has been identified within the offshore extensions of coastal aquifers globally. Recent work has identified that when present, offshore fresh groundwater (OFG) likely influences onshore salinities and may assist in delaying seawater intrusion onshore. Previous studies of the Gambier Embayment in South Australia have inferred OFG using onshore indicators. If present, OFG may play a key role in the future municipal water supply of three coastal towns. This study uses downhole geophysical data to calculate offshore pore-water salinity profiles. Onshore well data are used to obtain regional parameters for the semi-confined aquifer. Using these parameters, pore-water salinity profiles that include uncertainty ranges are calculated for four offshore wells. The results indicate that in the south of the Gambier Embayment, pore water with a calculated mean total dissolved solids (TDS) of 1.8 g/L and 2.9 g/L are found 12.2 km and 11.1 km offshore, respectively. In the north of the Gambier Embayment, the pore water salinities in offshore aquifers is more saline, with mean TDS values of 18 g/L and 4.8 g/L found 31.1 km and 27.8 km offshore, respectively. The northward increasing offshore salinities coincide with a northward thinning regional confining unit, identified in concurrent work that characterizes the offshore hydro-stratigraphy. These findings suggest that a significant offshore freshwater resource may be found in the south of the area, which may be considered as part of the water management options for the wider region.

Urban Water

Understanding water treatment during managed aquifer recharge (MAR)

Vanderzalm, JL (1) *, Page, DW (1), Dillon, PJ (1), Donn M (2), Gonzalez, D (1) and Barry, KE (1).

(1) CSIRO Land and Water (2) CSIRO Land and Water,

Presenter: Dr Joanne Vanderzalm

Aquifers treating urban waste water

Aquifers can provide passive water treatment for potential contaminants in urban waste waters, including pathogens, nutrients and organic chemicals. Managed aquifer recharge (MAR) is the intentional recharge to aquifers for subsequent use or environmental benefit. MAR can take many forms, such as infiltration of roof runoff into the watertable aquifer, or injection of urban waste waters into deeper, confined aquifers. One type of MAR, aquifer storage and recovery (ASR), is used extensively across the Adelaide Plains for the storage and use of urban stormwater, with growing application to treated wastewater, or recycled water. While the storage benefits of MAR are obvious, the potential for the aquifer to provide passive water treatment is often undervalued. The water treatment capacity of the aquifer is challenging to assess due to the heterogeneity of aquifers and MAR operations. This presentation demonstrates a probabilistic method to evaluate aquifer treatment performance that has been applied to various MAR types, and is suited to schemes were data is limited and may not support more detailed reactive transport modelling. Examples illustrate removal efficiency for E. coli, turbidity, total organic carbon (TOC), total nitrogen (TN) and total phosphorus (TP) during ASR with urban stormwater and recycled water. Median removal efficiency in selected stormwater and/or recycled water ASR operations was ~99% for E. coli, 25-80% for turbidity, 40-50% for TOC, 30-90% for TN and 30-50% for TP. This passive treatment can be considered a barrier within a multi-barrier treatment train for environmental and human health protection.

Making an economic case for water sensitive and green infrastructure – a project-focused Monetised Benefits Tool

Allen, M.

Department for Environment and Water

Presenter: Mr Martin Allen

A new South Australian tool aims to make more dollars and sense out of water sensitive green infrastructure

It is widely acknowledged that water sensitive urban design (WSUD) and other green infrastructure (GI) offer potential benefits over traditional, less multi-purposed infrastructure. However, much of the evidence of the benefits has been in a form that has been difficult to translate to benefit-cost analysis. This is seen as a key reason why WSUD and greening are difficult to justify including in built works.

To address this, various quantitative-evidence from several research fields was used to develop a tool to assist urban planners and designers strengthen the case for making WSUD and green infrastructure investments as part of new projects such as streetscapes and buildings.

The tool supports a monetary equivalent calculation of WSUD/GI improvements relating to specific aspects of health, water quality, runoff attenuation, and place. The tool is easy to use, requires minimal data, and is supported by documented, relatively conservative evidence from peer reviewed academic papers of local, national and international origins.

The presentation will cover the tool's key elements and supporting evidence. It will also discuss a test application of the tool in a recently completed streetscape project in the City of Onkaparinga, which demonstrated the tool's practicality and calculated a monetary equivalent value potential for the WSUD/GI features well exceeding the costs.

Are the Bee Gees bleached blonde or Stayin' Alive? Real-world science in natural resource management: the story blue green algae and hydrogen peroxide.

Kilsby, N (1), Hobbs, P (2), Jenkins,, C (3), Smith, A (4).

(1) Department for Environment and Water, (2) SA Water, (3) Environment Protection Authority, (4) City of Adelaide

Presenter: Dr Nadine Kilsby

Are the Bee Gees bleached blonde or Stayin' Alive?

You've got a NRM problem. You've just read some scientific literature about how someone on the other side of the world dealt with the problem. Could it apply at home? And how do you start finding out? This presentation charts the development of exactly that: reading about the application of hydrogen peroxide to manage blue green algae growth in an European public lake, to applying one tonne of stablished hydrogen peroxide to Adelaide's own Torrens Lake - in an Australian first trial.

Torrens Lake, situated in the centre of Adelaide, is the backdrop to many of the city's important cultural and sporting events, from nightly news reports, to international conference, art festivals and sporting festivities. It has been built upon, danced upon, lit up, rowed, paddled and skied across. The once-natural, now highly-modified river channel is the heart of the city but is fed by nutrient and sediment-rich urban stormwater. Still, warm conditions - like Adelaide summers - promote the growth of cyanobacteria (blue green algae) in Torrens Lake. Hydrogen peroxide has been investigated through a cross-agency, collaborative working group as a potential method to control blue green algae growth in Torrens Lake: progressing from the laboratory, to mesocosms, to in-lake trails. As well as continuously increasing our scientific understanding of the effects of hydrogen peroxide on organisms in a natural environment, the technology to apply large quantities of a chemical in a

safe and efficient manner has also required development.

Oaklands Wetland: Research, Teaching and Community Engagement.

Fallowfield, HJ, (1) Reeve, PJ,(1) Esfahani, AR, (1) Wallis, I, (1) Hutson, J, (1) Batelaan, O (1) & Ricketts, G (2).

(1) College of Science and Engineering, Flinders University and (2) City of Marion

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Presenter: Howard Fallowfield

Community befifits from Marion City Council collaboration with Flinders University to promote sustainable stormwater reuse

Oaklands Wetland, located south of Adelaide and managed by City of Marion, treats stormwater from the Sturt River. An on-site managed aquifer recharge scheme targets the confined tertiary (T2) aquifer, storing water in the winter for subsequent irrigation of amenity spaces in the summer. A collaboration between the City of Marion and the College of Science and Engineering at Flinders University has resulted in the installation of continuous solar powered monitoring and logging equipment (dissolved oxygen, pH, turbidity, salinity and temperature) in two of the open ponds. The data are used for both teaching and research. Two PhD student research projects are focussed on the site. The first is determining the interaction between microorganisms within stormwater and the T2 aquifer substrate. The second, funded by the Local Government Association of South Australia, is determining the effect of aquifer material on the removal of emerging chemicals of concern, which may be present in stormwater. Additional research is evaluating the performance of the wetlands for the removal of nutrients and microorganisms of public health significance. The City of Marion is currently considering a proposal to jointly develop, with Flinders University, an education facility at Oaklands Wetland for both university and school students, along with the wider community. An overview of the research, teaching and community engagement activities at the Oaklands Wetland site will be presented.

Applying Multi-criteria Decision Analysis Technique in Water Resources Planning and Management: A Case of Lower Brown Hill Creek

Ahammed, F.

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Presenter: Dr Faisal Ahammed

Applying Multi-criteria Decision Analysis Technique in Water Resources Planning and Management: A Case of Lower Brown Hill Creek

The Stormwater Management Plan indicates that the flow carrying capacity of Lower Brown Hill Creek, located from Anzac Highway to the confluence with Keswick Creek, Adelaide, South Australia should be upgraded from 25 m^3/s to 60 m^3/s to cope with 100 years average recurrence interval rainfall events. Four feasible alternatives were identified and designed to upgrade the capacity of the creek: i) fully constructed natural waterway (earth), ii) fully lined rectangular concrete channel, iii) existing channel with box culvert and iv) option three with wetlands. We applied multi-criteria decision analysis approach and chose the Analytic Hierarchy Process (AHP) model to select the most appropriate alternative. Eight criteria (flow carrying capacity, flora and fauna, water quality, social heritage, recreation and amenity, property impacts, land acquisition cost and project cost) under three categories (technical, environmental and socio-economic) were considered to quantify to relative priorities of alternatives. After the analysis, it was found that fully constructed natural waterway (percentage priority 29.2%) followed by existing channel with box culvert and wetland (26%) is the most appropriate option to upgrade the capacity of Lower Brown Hill Creek.

Greg ingleton SA water should be here

Landscape Restoration

Guidelines for establishing experimental plantings in restoration projects

Linda Broadhurst (1), Suzanne Prober (2), Guy Boggs (3), David Bush (1), Paul Rymer (4), Jasmyn Lynch (5) and Martin Breed (6).

(1) CSIRO National Research Collections Australia, (2) CSIRO Land and Water, (3) Western Australian Science Biodiversity Institute, (4) University of Western Sydney, (5) University of Canberra, (6) University of Adelaide

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Presenter: Dr Guy Boggs

Investing in the environment for future Australians

Past investment in restoration across Australia has developed a distributed network of highly knowledgeable and experienced practitioners. Predicted growth in the restoration sector to meet national and international restoration targets provides an opportunity to value-add to this investment by upskilling practitioners to undertake experimental plantings within some of the projects. These plantings can be used to address a broad range of important questions such as the role of seed choice or the influence of microbial inoculation on plant growth, the adaptability of plants to different environmental stressors, or the optimal species combinations and spatial arrangements of plantings. Partnerships between practitioners and scientists to undertake experimental plantings would have significant additional benefits if the data derived are scalable beyond local areas to regional and national levels, to address core national research questions. Working together on experimental plantings also better enables two-way flow of information between practitioners and scientists. Scalability of data, however, requires consistency in decisions regarding experimental variables such as planting design and treatments, how and what to monitor, and reporting metrics. It also requires development of mechanisms for long-term data security and accessibility. We are leading the development of 'National Guidelines for Experimental Restoration Plantings' (aka Guidelines) to assist practitioners to incorporate experimental plantings into their projects such that the outcomes will also contribute to future biodiversity analysis and decision-making. We will report on our progress and will be seeking expressions of interest from practitioners and agencies wishing to take part in road testing the Guidelines.

Implementation and early results of hydrological restoration works at Glenshera Swamp, Stipiturus CP, across public and private land

Bachmann, M (1), Taylor, B (2), Farrington, L (3).

(1), (2) and (3) Nature Glenelg Trust

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Presenter: Mr Mark Bachmann

Turning restoration planning into on-ground action, to improve the water regime of Fleurieu Peninsula swamps

Glenshera Swamp, within Stipiturus Conservation Park, is one of the most important remnants of the Swamps of the Fleurieu Peninsula, a nationally threatened ecological community. At the 2016 State NRM Conference, an overview of a hydrological restoration options feasibility assessment process was presented.
This multi-faceted scientific and historic assessment, which occurred from September 2015 until January 2016, also included detailed discussions with a wide range of people and organisations (e.g. CCSA) that have an intimate knowledge of the site and the issues surrounding Fleurieu Swamp management. This work culminated in the production of a report in March 2016 with six key on-ground actions recommended for proposed implementation, to ensure the future sustainability of the wetland ecosystem.
Since this preparatory work was completed, the first steps in the on-ground restoration process, including back-filling drains (off-park) and installation of trial structures to reinstate seasonal surface flows to the swamp (on-park) for the first time in over 70 years, were completed in autumn 2017. The early positive, and highly visual, results will provide a sound basis for proposing swamp recovery works of a similar nature elsewhere.
This project is a detailed and complex case study, ideal for exploring the logic of different hydrological restoration methods on public and private land, with broad application to those interested in improving modified wetland ecosystems elsewhere. It also provides an opportunity to explain how a transparent and inclusive approach to consultation during project development, can help facilitate a rapid transition towards tangible, on-ground restoration action.

Closing the Gaps in Restoration using Seed Science

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Presenter: Dr Jenny Guerin

Save our seeds

Understanding seed biology and germination requirements can lead to higher levels of biodiversity in restoration programs. This presentation highlights working examples from the AMLR and SAMBD regions overcoming problems reintroducing difficult plants such as species of *Triodia*, *Eremophila*, *Prostanthera*, *Gahnia*, *Persoonia*, *Astroloma* and others. Tactics used to increase seedling numbers of these plants included; refining seed collection strategies; assessing the viability of seed lots, understanding dormancy; applying germination enhancing treatments and provision of tube-stock plants. Some plant species are rarely, or never reintroduced in restoration programs because of difficulties in sourcing sufficient quantities of viable seeds, complex dormancy mechanisms suppressing germination, lack of propagation techniques, or problems with plant identification. Plant taxa that are not readily reintroduced can be species

that dominate the landscape or rare species localised to a particular habitat niche. The South Australian Seed Conservation Centre collects and germinates seeds from all regions across the state with the aim of conserving threatened flora in long term storage conditions in the seed bank. The team work with regional ecologists and restoration managers to improve the number of species that can be successfully used in revegetation programs. The centre provides a range of useful information for practitioners, including seed collection advice and seed germination data via the Seeds of South Australia website.

The woodlands, the landholders and the stewardship program: What more do we need to know?

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Presenter: Ms Anthelia Bond

Absentee and group landholders: important environmental stewards

Stewardship programs, where landholders are paid to provide environmental services, are widely used for biodiversity conservation on private land. In order to refine and improve these programs, it is important to have adequate knowledge of potential participants and program impacts. Our research aims to address some significant knowledge gaps in this area using the BushBids stewardship program as a case study. We challenge the common assumption that participants are resident, farming individuals or families and also investigate how vegetation changes as a result of management under stewardship contracts.

The new and shiny, and the tried and tested: early learnings from delivering large-scale habitat restoration in the Mount Lofty Ranges

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Presenter: Mr Randall Johnson

Early learnings from delivering large-scale habitat restoration in the Mount Lofty Ranges

Previous analytical work determined that most of the declining terrestrial bird species in the region were associated with two broad ecosystems:
• Grassy ecosystems (and particularly grassy woodlands) in lower rainfall areas of the landscape, on gentle slopes
• Closed shrublands (particularly heathy habitats) associated with a variety of settings, with or without an overstorey
Inadequate area of suitable habitat is regarded as one of the

key drivers of species declines in both of these broad ecosystems. Habitat reconstruction, in tandem with enhancement and manipulation of remnant habitats, is therefore viewed as an important strategy to arrest or reverse species declines in these ecosystems.

Reconstructing heathy habitats requires a traditional 'land-sparing' approach, where cleared farm land is revegetated at scale. Drawing on established techniques such as conventional direct seeding, habitats are being established with the aim of enhancing maximum shrubland productivity via the omission of trees from revegetation, high plant density in the desired strata, and emphasis on particular food or habitat plants. Large herbivores are excluded via reusable steel fencing.

In grassy systems, the approach has largely been a new 'land sharing' one, where the focus has been on enhancing potential habitat in the relatively extensive pastoral landscapes of the northern and eastern AMLR – landscapes which support much of the regional population of these open woodland decliners. Lack of recruitment of overstorey species and loss of woody cover through senescence is being addressed via establishment of plants within stock-proof tree guards. The Paddock Tree Project has partnered with landholders in key areas of the region.

Detecting the undetectable: designing a monitoring program to determine the effectiveness of restoration on woodland birds in the northern and eastern Mount Lofty Ranges

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Optimising monitoring gives the power to detect change

Ensuring monitoring has the best possible chance of detecting change is vital to effectively answer research questions and prevent wasting limited resources, and requires careful design around the relevant settings, scale, and sampling regime. However, due to time and budgetary constraints, or simply adherence to tradition, many of these elements are often overlooked. Here, all of these aspects were addressed in designing a program to monitor the effectiveness of restoration on seven species of declining woodland birds in the northern and eastern Mount Lofty Ranges. Landscape-level sampling was conducted to provide inferences on population trajectories, not simply use by individuals at sites. To enhance detection, the sampling was also undertaken in core habitat of the target species and where management actions were performed. The sampling regime was determined by power analyses of existing data, rather than arbitrary judgement or convention. These analyses indicated that four versus the conventional three visits were required per site, and that there was almost no chance of detecting change for three species despite nearly 100 days' survey effort, suggesting alternate sampling strategies were

needed. These findings demonstrate how difficult it is to effectively detect change even when the most optimal settings, scales and sampling regimes are used. Moreover, given many studies are concerned with rarer, more cryptic species, and have less sampling effort to allocate, it demonstrates the need to at least consider all aspects of design, and potentially be even more strategic by choosing not to sample when resources are insufficient to detect change.

What ecosystem is that? Managing SA's novel ecosystems in the Anthropocene.

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Presenter: Kerri Muller

What ecosystem is that? Ecological engineering best bet for SA NRM in the perverse Anthropocene.

As uncomfortable as it may be, NRM in the Anthropocene is about ecological engineering and the drivers are often perverse. The Anthropocene is characterised by "surprise and uncertainty" and an increasing need to manage novel ecosystems, many of which are constructed or heavily modified. Attempted ecosystem restoration or invasive species eradication may not be the best long-term bet in every case and may not be the 'popular' option.
The science that informs NRM policy is moving away from 'traditional western' notions of humans acting on the rest of nature towards a position more compatible with Indigenous frames of reference where humans cohabit with the rest of nature. Simultaneously, urbanites are reconnecting with nature, sometimes disruptively, through scrumping, guerila farming, community gardens, constructed wetlands, ecotourism, nature play, YourSAy voting etc. 'Nature' is undeniable as a sense of place and irreplaceable a source of mutual sustenance, a 'truth' that persists through public opinion cycles. But what 'nature' do we want and how do we, as experts, exert due influence in a changing world?
Using South Australian examples, I will describe an adaptive NRM system for SA that could achieve 'common' understanding with optimised management and use of ecosystem resources. NRM challenges such as "weedy" roadsides, residential developments, constructed wetlands and novel 'natural' wetlands will be used to show what a decision- and policy-making system, which is based on multiple party inputs and robust assessment of risks and benefits, could look like in the Anthropocene.

Natural capital of the Mallee at Calperum Station near Renmark in South Australia, mutual beneficial outcomes from a bushfire and from TERN researchers collaborating with citizens.

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Presenter: Dr Georgia Koerber

Rally for the Mallee

In 2015 and 2017, the Earthwatch Institute (Aust.) and the Australian Landscape Trust's Calperum station near Renmark in South Australia hosted two expeditions and TERN researchers from Adelaide University facilitated the application of the economic carbon metrics for understanding the natural capital dynamics part of these expeditions.
The setting was a bushfire had destroyed a mallee forest in January 2014. In 2015, we had a group of NAB employees and in 2017, a group of year 10 students sourced nationally. The groups provided valuable person power for determining the carbon in unburnt trees, regrowth and burnt debris.
The results were: unburnt mallee had 26.6 tC ha^{-1}. After one year, regrowth was 1.5 tC ha^{-1} (6%) and 7 tC ha$_{-1}$ remained in standing burnt trunks (26%). Therefore 32% carbon remained and 68% had been lost from this ecosystem. After three years, regrowth had increased to 4.6 tC ha^{-1} (17%) and 5.4 tC ha^{-1} remained in standing and now fallen burnt trunks (20%). Therefore carbon in this ecosystem had increased to 38% of unburnt trees and 62% remains lost from this ecosystem.
The annual gain is 1.5 tC ha^{-1} if the burnt material were to remain constant and it would be 18 years before the natural capital of this ecosystem is restored. However, an annual loss in burnt debris of 0.8 tC ha^{-1} extends restoration out to 38 years. A range of 18-38 years agrees with decadal restoration timescales from spatial fire scar studies.
These expeditions have been mutually beneficial.

Natural Hazard Management

Understanding and predicting fire-atmosphere interactions

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Presenter: Dr Mika Peace

How bushfires can change the surrounding weather

Bushfires release substantial amounts of energy and this changes the structure of the surrounding atmosphere, which can consequently change the speed and direction of fire spread as well as affect fire intensity. In numerous documented major fire events in Australia in recent years, fire-atmosphere interactions have created dangerous and changeable fire conditions. These may occur at a time that does not coincide with the hottest, windiest time of day; the period traditionally associated with highest fire risk. Examples of fire-atmosphere interactions include; development of pyrocumulus, or in extreme cases pyrocumulonimbus cloud over a fire. The resulting deep plume and convection can be linked to more intense fire behaviour and downdrafts may produce gusty and erratic winds, driving rapid fire spread anomalous to the prevailing winds.   Another example is the interaction of fire plumes with local winds near the steep lee slopes of mountain ranges, similar to the Adelaide foothills. The gusty, turbulent downslope winds (gully winds) can produce fast-moving destructive evening embers showers over homes and properties.

Some of these fire-atmosphere interactions can be explored using coupled fire-atmosphere models. These have a numerical weather prediction model coupled to a fire spread model. ACCESS-fire is a coupled model linked to the Australian operational weather prediction capability. Results of simulations show how a fire changes the surrounding atmosphere, with features including fire-modified winds in the environmental flow, dynamic plume effects near steep topography and some pyrocumulonimbus processes.

Forecasting rainfall over the Mount Lofty Ranges; challenges and downscaling methods

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Presenter: Mr Jonathan Fischer

Improved rainfall forecasts over the Mount Lofty Ranges

The sharp topographic gradient between the Adelaide Plains and the Mount Lofty Ranges leads to a complex orographically enhanced rainfall distribution over a short distance. Depending on the weather pattern and atmospheric conditions, significant variations in rainfall amounts are observed.

The current forecast process in the State Forecasting Centre (SFC) involves meteorologists inputting blends of relatively low resolution Numerical Weather Prediction (NWP) guidance into a Graphical Forecast Editor (GFE). They then apply various edits using 'Smart Tools' based on conceptual models of orographic rainfall and knowledge of local effects to produce a high resolution gridded rainfall forecast.

The problem with this method is that the parameterisation schemes in low resolution NWP guidance fails to accurately resolve the scale of complex topography and does not sufficiently propagate rainfall downstream of the forcing. The result is an enhancement often too small in magnitude and skewed towards the upslope side of the ranges, when the peak rainfall regularly occurs over and just downstream of the highest topography.

To address this problem, the SFC has built a dataset of the rainfall enhancement between Adelaide and the Mount Lofty Ranges under various mesoscale wind, moisture and stability regimes. This dataset is now used in the forecast process, in conjunction with climatological reference grids to better predict the orographic rainfall enhancement.

The new method has shown good results, especially during the major flood events of 2016. However, further research is needed to produce an efficient method for downscaling NWP rainfall over any complex topography.

Modelling the South Australian Bushfire Risk Landscape

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Presenter: Ms Bridget Milanowski

Modelling the South Australian Bushfire Risk Landscape: A fusion of burning science and a stockpile of assets

Bushfires are a regular event in South Australia, with six significant bushfires (fires ~ 50,000 hectares) in the last ten years; an annual recurrence interval of one in three years. We have combined data, expert knowledge and current science to produce maps and analysis of state-wide risk and impacts on values of life, property and environmental assets. Our aim has been to provide an overview of landscape risk for the management of bushfires. By using the National Emergency Risk Assessment Guidelines (NERAG), a range of agencies can make decisions with common, shared knowledge and data.

We started by generating bushfire hazard data. Using detailed local weather data, we added fuel load and calculated fire spread rates for five vegetation (fuel) types. Ignition and suppression parameters were estimated to construct fire intensity and a likelihood of fire suppression. Likelihood has been further refined using fire simulations to generate relative risk levels.

The consequence for life and assets were classified into categories based on NERAG definitions for regional risk

assessment and local economic production. Environmental assets include parks, threatened species and ecological communities.

We have produced a risk matrix to identify areas and assets at high risk, so that mitigation treatments and risk management actions can be better communicated and prioritised.

The spatial datasets of Risk, Consequence and Likelihood are for planning at many scale levels, supported by 100 metre data cells. It will enable improved collaboration between agencies before, during and after bushfire events to assist in bushfire risk reduction.

Valuing Environmental Assets

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Presenter: Matthew Humphrey

Firies valuing important environmentassets to better manage bushfires

Life. Property. ENVIRONMENT.
These are the three key elements that are considered when a fire is posing a risk to the community and we need to be cognoscente of all of them. Over several years the SA Murray Darling Basin region has developed a spatially embedded data set of environmental assets that can be negatively affected by fire. This data set has evolved to become an important planning tool for both prevention and response. A critical to the value of the data has become communicating the information to the key people that make critical decisions in a fire scenario. A program was been developed to engage and inform key personnel in the region of the assets that are present, and their nature. This information can then be utilised operationally during an emergency to inform tactics and risks.

Through engagement of key staff, production of appropriate communication materials and a localised delivery model we are beginning to increase knowledge of key fire staff in the region. This should result in a greater awareness and value of the important environmental assets in the region and also aid in their protection and value.

This project will continue to build on current information through regular review of asset status and ensure that key fire decision makers are kept informed. Through this system of updating and communicating it is envisioned that fire management in the region will improve through both increased information for planning and during emergency operations.

A Holistic and Consistent Approach to Prescribed Burning

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Presenter: Ms Deb Sparkes

Nationally agreed frameworks and guidelines for prescribed burning

Prescribed burning in Australia is undertaken to meet various objectives including fuel reduction and maintaining ecological processes. Historically, prescribed burning programs have been regionally focussed depending on agency priorities and the processes that have developed in response to the natural and socio-political environments in which they operate.

In 2011, recognising a need for a nationally consistent approach to prescribed burning, AFAC and the Forest Fire Management Group, commenced the National Burning Project to develop nationally agreed principles, guidelines and frameworks for prescribed burn planning and delivery. Between 2011 and 2017 the project developed a National Position along with a range of products that encompass the end to end process of prescribed burn planning from setting objectives, strategic, program and operational planning, risk management, and performance measures.

The material produced draws on extensive consultation across the fire and land management sector, and reflects best practice considerations for prescribed burning that are relevant irrespective of location, size or complexity of the organisation.

At the conclusion of the project it was recognised that it was important to continue to support agencies to embed the national frameworks into practice. A Centre of Excellence for Prescribed Burning has been established to lead and support the development of innovative, evidence based principles, policies, programs and practice for prescribed fire.

This presentation discusses the key principles of the National Burning Project outcomes and the objectives and initiatives of the Centre of Excellence that will be used to increase the capability of practitioners to deliver prescribed burning programs.

Insects, Orchids & Fire: The effects of fire on orchid pollinating insects.

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Presenter: Mrs. Anita Marquart

Burning question solved: Orchid pollinators cope well with fire!

Populations of orchids are declining throughout Australia, mainly because of habitat destruction and the effects of habitat fragmentation. This study investigated the effect of prescribed burns and a wildfire on selected orchid pollinating insects, as the loss of pollinators due to fire events may have an important impact on orchid populations. Fire induced changes of selected insect habitat characteristics including plant composition, floral abundance and nesting resources were also investigated. Potential orchid pollinators were identified using DNA barcoding methods combined with morphological identification.

Although prescribed burning and wildfires affected insect

habitat differently, orchid pollinator responses to both fire regimes did not differ. A fire induced decline in floral resources did not affect pollinators in the first year following fire, but the availability of nesting sites seems to influence the responses of certain insect species. This study suggests that pollination success of orchids in South Australia is unlikely to be negatively impacted by fire, as pollinators were still abundant and diverse in fire affected field sites.

Use of ecological burns to recover endangered plants in endangered South Australian swamps

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Presenter: Dr Richard Davies

Ecological burns of dense senescent swamps in the Mount Lofty Ranges brings critically endangered plants back from the brink of extinction

Threatened freshwater swamps of the Mount Lofty Ranges provide habitat for over 120 plant species threatened at the national, state or regional levels, including six EPBC-listed species. Over 90% of these threatened species are small understorey plants. Without disturbance, these species are outcompeted by dense shrubs, sedges and ferns. Fire is becoming an important tool used by Natural Resources AMLR & SAMDB to recover these swamps and their threatened flora.
One such example is the Naked Sun-orchid which is critically endangered in South Australia, surviving in SA as only one population in a swamp near Mount Lofty. A prescription burn was carefully planned to maximise benefits to the orchid, with half the population left unburnt as a precaution. Early results are encouraging with 13 orchids counted after the fire compared with 11 in 2016.
An ecological burn undertaken by NR AMLR on a private swamp at Yundi, aimed at regenerating the EPBC-listed critically endangered Fleurieu Peninsula Guinea-flower, has also had outstanding preliminary results with 1000 seedlings germinating, up from ~100 plants nationally before the fire. The decision to burn was based on PhD research at Adelaide University, funded by NR AMLR & SAMDB.
Planning is also well advanced for an ecologically burn in Stipiturus Conservation Park to regenerate the EPBC-listed critically endangered Maroon Leek-orchid which has declined from over 90 plants to only five in 2017 due to apparent competition from dense shrubs. A population of senescent nationally endangered Mount Compass Oak-bush will also benefit from this burn.

Co-designing a disaster risk reduction decision support system for integrated long-term natural hazard mitigation planning

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Presenter: Mr Graeme Riddell

Reducing the risks from future natural hazards, researchers and policy-makers working together to develop software for better informed planning and decision making.

Natural hazards are an unavoidable component of life in Australia. Analysis shows an average cost of natural hazards in 2015 totalled $9.6billion, and this figure is projected to increase to $33billion by 2050. Tomorrow's risk though is a function of decisions we make today and as such there exists significant scope to be understand the drivers of risk and better reduce the impacts. To enable this a decision support system, UNHaRMED (Unified Natural Hazard Risk Mitigation Exploratory Decision support system) has been developed through a collaborative approach including policy makers from multiple government departments, researchers and software developers.
The tool aims to enable planners and policy makers develop adaptation plans for the changing threats of multiple natural hazards in a systematic, transparent and consistent manner. The paper will present an overview of the software, including the interactions between external drivers of economic and population trends, influencing the exposure components of disaster risk through land use and building stock models, the hazard models including flooding (riverine and coastal), earthquake, and bushfire, and vulnerability functions to allow for damage calculations. Emphasis will also be placed design process using an iterative, user-centred process and involving a series of interviews and workshops with members of agencies across three Australian states, considering risk reduction measures, policy relevant indicators and future uncertainties to be included, focussing on how the system can sit within existing policy processes.

Thresholds in bushfire risk perception in South Australia

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Presenter: Dr Douglas Bardsley

Biodiversity conservation in South Australia could be undermined if people fear bushfire

There is increasing uncertainty about how climate change will influence lifestyles and livelihoods in South Australia. As attitudes change, social thresholds may be reached after which the majority of people will demand changes in environmental management based on fear rather than a full analysis of the situation. We present research on how

residents' perceptions of climate change relate to understandings of bushfire risk and biodiversity conservation in peri-urban Adelaide and Port Lincoln (N = 988, 30% response rate), and how those perceptions translate into personal actions and/or support for policy. Three groups emerged from the analysis. Group 1 are aware that climate change increases bushfire risk and are enacting responses. Group 2 recognise the implications of climate change for bushfire risk, but are less likely to be prepare their properties or support prevention policy. A third group do not recognise that climate change is increasing bushfire risk, yet are willing to sacrifice ecological values to mitigate risk. While a risk perception threshold has not been crossed, the lack of action by Group 2 suggests that a potential threshold could exist associated with their reliance upon, and confidence in, agencies to manage the hazard.

People and the Environment

Conservation psychology: the duality of optimism and pessimism

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Presenter: Sean Connell

Conservation optimism enagages minds to change

We show how optimism engaged people to work across cultural barriers to collaborate and work strategically on broader and more inclusive conservation project. Our seminar brings together analysis from conservation psychology, media, business and politics, together with hard-won experiences from a local restoration project (Windara Reef on Yorkes Penninsula). Psychology shows that whilst positive and negative emotions are both highly socially contagious, optimism tends to encourage creative problem-solving. Nationally, we have all observed how some environmental issues can create learned helplessness in society, and how this is associated with reduced pro-environmental behaviour among those concerned about the environment. From our South Australian experience, we found that positive news can change the way people think about government initiatives, whereas negative news tends to only reinforce thought patterns among fractured groups. This seminar recognises humanity's innate attraction to optimism and how it can galvanise collaboration and extraordinary generosity by individuals in society and creative governance. Yet, we also recognise the duality; how uncertainty stimulates hope and fear and how they can work together. In contrast to fear, which provokes a fight-or-flight response, hopeful thought patterns tend to encourage individuals to remain engaged with goals and take productive action toward achieving them. Psychology emphasises how fear can reduce a distorted reality (e.g. overly simplistic messages), which if managed with realism (e.g. scientifically informed), can stimulate awareness and urgency, and a public willingness to trial solutions with government.

Tradeoffs in deliberative public engagement with science

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Presenter: Dr Cobi Calyx

Deliberative public engagement with science involves tradeoffs

Deliberative democracy and public engagement with science have developed in theory enough for areas of consensus about best practice to emerge. However in practice some areas of consensus require tradeoffs. Tradeoffs help us make decisions in design that will otherwise be made in process, which can lack transparency and accountability. Three tradeoffs discussed in this presentation using NRM examples are representative or inclusive participation; public or organisational ownership; and upstream or actionable outcomes.

What information becomes part of a deliberative process depends on which scientists present and with which expert witnesses participants can engage. Communicative actions of participants can change what information people use to develop mutual understandings. Diversity in perspectives and knowledge increases the pool of arguments with which participants can develop mutual understandings.

An alternative to considering representativeness in recruitment is inclusion, particularly for localised NRM issues. Engaging with specific groups can address systemic power imbalances and ensure voices that may otherwise be left out of the public sphere are included. There is no claim to representativeness in deliberations among specific groups. Thus deliberative public engagement with science among specific groups is more valuable if iterated across multiple sites of place and time. These iterations can be linked together in a decentred deliberative democracy strategy.

Don't get Trump-ed: An argument to engage with knowledge outside of western scientific inquiry

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Presenter: Dr Vincent van Uitregt

How can and should scientists engage with indigenous knowledge?

In a post-truth world of Trump-isms, it would be easy for scientists to retreat from any form of knowledge acquired outside the realms of scientific inquiry. At the same time though, environmentalists and Indigenous groups around the world are combining forces to strengthen their campaigns to protect what they both hold dear – 'the natural environment' or 'Country'. While there are clearly significant differences between conceptualisations of 'Country' vs 'the natural environment', there are also similarities that should be noted. Through my career change from empirical scientist to engaging with Aboriginal Australians in water policy, I've been forced to grapple with these different forms of knowledge and particularly, conceptualisations of Country. I've come to see that Indigenous peoples' intimate knowledge of, and relationship to, Country can provide a solution to global environmental problems. I'm quite sure I'm not the first but am convinced that more scientists need to think so. Far from providing empirical evidence to support this claim, my presentation will be a korero (my story) to get you thinking about whether and how you should engage with Indigenous knowledge. Consider it an experiment - if you're into that sort of thing.

Healthy Country Planning in the Alinytjara Wilurara Natural Resource Management Unit

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Presenter: Dr Ben Daly

Healthy Country Planning in the Alinytjara Wilurara Natural Resource Management Region

Healthy Country Planning (HCP) represents a new and innovative approach to community-led natural resource management. Developed from internationally-recognised Open Standards for the Practice of Conservation, in the Alinytjara Wilurara Natural Resource Management Unit, HCP represents an adaptation for the Indigenous Australian Context. The HCP process focuses on participation and engagement of Aboriginal community members and the inclusion of their traditional knowledge and priorities as the foundation of future NRM Plans.
Across the Alinytjara Wilurara Natural Resource Management Unit, Healthy Country Plans have been developed for the Yalata Indigenous Protected Area, Tallaringa Conservation Park, Kanpi-Nyapari area in the Anangu Pitjantjatjara Yankunytjatjara Lands, and in the Far West Coast region of South Australia. More planning is underway where HCPs have been requested by Traditional Owners. Taken together, these plans developed in partnership with Traditional Owner groups, will allow for a roll-up into a whole-of-region plan. This community-led approach ensures that Natural Resources Alinytjara Wilurara's strategic and operational support provided to Traditional Owners and project partners leverages the benefits of traditional knowledge and western science toward achieving environmental and agricultural outcomes across the Alinytjara Wilurara Management Unit.

Managing Aboriginal Knowledge Just Got Easier For You

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Presenter: Ms Mel White

Managing Aboriginal Knowledge Just Got Easier For You

Aboriginal Cultural Knowledge describes knowledge that encompasses people, language and culture and their relationship to the environment. The use of Aboriginal Cultural Knowledge in projects, research and planning is part of DEW's reconciliation statement to work in partnership with the First peoples of South Australia to conserve and manage our natural resources. A new online system of tools and guidelines has been develop to Protect Aboriginal Cultural Information.
The online tools and guidelines to Protect Aboriginal Cultural Information are embedded within existing project planning tools, so that planners better understand their obligations to protect Aboriginal Cultural Knowledge.
To increase uptake, the tools and guidelines were developed within existing frameworks, additions were also made to the Project Management Framework (PMF) Form for Aboriginal Engagement, to include considerations about Aboriginal Cultural Knowledge. The new tools within the PMF Form covers: cultural awareness training for DEW staff, awareness of existing Aboriginal Agreements, payment advice for engaging Aboriginal people, ethical research, procurement (Aboriginal Business Register), Aboriginal Heritage Act and the Aboriginal employment register. This online tool also provides a newly developed template for staff to develop a Cultural Knowledge Agreement when working with Aboriginal people. The template aligns with existing terminology used in the DEW Information Classification Guidelines and Data Handling Guidelines e.g. [For Official Use Only], [Public] etc.

Translating Ngarrindjeri Yannarumi into water resource risk assessment

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Presenter: Steven Hemming

Translating Ngarrindjeri Yannarumi into water resource risk assessment

Risk assessment is a fundamental process that underpins natural resources management. Based on the AS/NZS ISO31000:2009, the Department for Environment and Water' (DEW) water resource risk assessment focusses on western concepts of natural resource management: economic production and environmental conservation. This western framework fails to engage with Indigenous worldviews that focus on reproduction and interconnected benefit and give effect to Indigenous values and interests. The Murray-Darling Basin Plan requires Basin states to consider Aboriginal cultural values in water resource risk assessment, further highlighting a significant policy gap for DEW and other jurisdictions with possible implications for the accreditation of South Australia's water resource plans.
Over the past 15 years, Ngarrindjeri have emerged as a leading Indigenous Nation in relation to Indigenous engagement in water resource management. Recent Ngarrindjeri collaborations with Flinders University have supported the emergence of the Ngarrindjeri Yannarumi Assessment process that enables assessments of environmental and water health, based on Ngarrindjeri principles and philosophies. Flinders University, DEW and the Ngarrindjeri Regional Authority are partnering in a new Goyder Research Institute project that seeks to translate Ngarrindjeri Yannarumi assessments into water resource risk assessments. The project will seek to articulate the points of connection between the two processes and inform the necessary adaptations required to DEW's current water risk assessment conceptual models to integrate Aboriginal cultural values. The outcomes of this project may have

application across all aspects of natural resources management improving the recognition of Aboriginal values and interests.

South Australians and the environment: values and behaviours

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Presenter: Ms Kim Krebs

1 in 3 say we've all got a role to look after the environment. Everyone else says they support them.

In 2016, a statistically robust social survey was undertaken to capture the values and behaviours of South Australians towards the environment. It was commissioned by the Adelaide & Mt Lofty Ranges NRM Board to help inform the communications and engagement tactics for NRM agents across the state. Designed to become a longitudinal study, 2016 has become the benchmark for how South Australians are connected to nature.
Key finding show that the SA population has given the social licence for natural resources management work to be done, with 94% of the population saying that looking after the environment is a non-negotiable responsibility.
The research uncovers the barriers and benefits for people to be natural resources managers and will help the user to craft messages and opportunities that influence people's impact on natural resources.
This investigation can benefit any organisation that works with communities to foster environmental stewardship and sustainability, as it also identifies segmentations in the population.
This work represents a major contribution towards a national measure of who cares for the environment, with South Australia being the third state (behind NSW and ACT) to undertake this investigation to shape state NRM policies at various scales.

Social Return on Investment in the Rangelands; We Think What We Are Doing is Important, But Does Anybody Else Care?

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Presenter: Ms Leah Feuerherdt

NRM program achieves social outcomes for Aboriginal communities

Social Return on Investment (SROI) is an internationally recognised methodology used to measure and value the impact of programs. Like a traditional cost-benefit analysis, SROI examines economic outcomes, but also includes the social, environmental and cultural outcomes created by the investment. These outcomes are evaluated against their cost, using financial proxies to estimate their relative value. SROI is particularly valuable in the indigenous natural resource management context, because of the strong 'value' or importance of non-economic (particularly cultural) costs and benefits. The Alinytjara Wilurara Natural Resources Management Board (AW NRMB) undertook a study of the economic, social, environmental and cultural impacts of large feral herbivores in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands, in the far northwest of South Australia. Camels, donkeys and horses present significant impacts for the community in terms of vehicle collisions, community health, damage to infrastructure and water pollution. With the costs incurred by pest animals in the APY lands valued at $4.2m and possible benefits valued at $140,000, the study found that there was a net cost impact of approximately $4m. This study also found significant cultural impacts of pest animals, which requires further analysis. Future investment models that consider a broad range of costs and benefits, are considered appropriate for Australian rangelands, particularly Indigenous-owned land.

Surface Water

Hydrological Predictive Uncertainty Analysis for Decision Making

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Presenter: Dr David McInerney

Practical techniques for estimating hydrological predictive uncertainty allow quantification of risks and better-informed decisions in planning and managing water resources

Predictions from hydrological and environmental models are widely used for informing the management of water resources, e.g. environmental flow releases, irrigation allocations and reservoir management. These models inevitably make substantial simplifications in their representations of environmental processes, and consequently their predictive capabilities vary in quality. Understanding and quantifying the uncertainty in these predictions is critical for risk assessment and making better-informed decisions in planning and management of water resources.
While methods for quantifying predictive uncertainty are widely used in the research community, there is a common perception in industry that these methods are difficult to implement. As a result, single "best estimate" predictions, which ignore predictive uncertainty, are commonly used to inform decisions, resulting in potentially significant under-estimation of the real system risk.
This presentation focuses on techniques for obtaining reliable estimates of uncertainty in model predictions, and estimates of risk for use in decision-making. More specifically, we will
(i) introduce simple and practical techniques developed by our group for providing reliable and sharp probabilistic predictions;
(ii) highlight the uptake of these methods by industry users, including operationalisation in the Bureau of Meteorology's seasonal streamflow forecasting service, and a pilot study by DEW on monthly streamflow forecasting in the south-east of South Australia; and
(iii) demonstrate how hydrological predictive uncertainty can be used to quantify ecological health risk, and to better inform environmental flow management.
The outcomes of this study can help reduce the barriers between research and industry, and increase the uptake of predictive uncertainty quantification techniques.

Going with the flow - Securing Low Flows Trials in the Mt Lofty Ranges

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Presenter: Mr Paul Wainwright

Low flow trials monitoring with community to prove concept

Water managers seek to maintain the necessary balance between water use for primary production and water provision to the environment. In the Eastern and Western Mount Lofty Ranges water allocations are underpinned by the need to secure low flows in order to meet environmental water targets. This is necessary because water-dependent ecosystems in seasonally flowing streams across the Mount Lofty Ranges are degraded. The reduction in low flows as a result of interception by thousands of farm dams and watercourse diversions has been identified as a key driver of this degradation.
To inform the broader implementation of low flows work, and to complement community engagement, the Adelaide and Mount Lofty Ranges and SA Murray-Darling Basin Natural Resources Management Boards established eleven low flow trial sites in 2015-16.
Innovative low flow devices were designed and constructed at privately owned farm dams to improve understanding about how to provide low flow releases in a range of challenging catchment settings. The project seeks to test how the various devices operate, clarify how the provision of low flows will affect water security for landholders' and address community concerns about hydrological and ecological responses to low flows. The trials also serve as demonstration sites to share knowledge with the community and are all monitored in real-time using telemetry.
The project has been rewarding and challenging since its inception and many lessons have been learnt and documented along the way.

Improving the understanding of runoff generation at the hillslope scale with low-cost instream sensors

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Presenter: Miss Alicja Makarewicz

Improving the understanding of runoff generation at the hillslope scale with low-cost instream sensors

Understanding runoff generation in hillslopes is critical in understanding localised and fine scale hydrological processes. Differences in catchment characteristics such as size, topography, vegetation and geology result in highly variable drainage patterns through localised surface and subsurface pathways. These differences in drainage pathways present challenges in the understanding of inter-catchment functioning and calibration of hydrological models to appropriately represent flow patterns at the local scale. In the absence of streamflow monitoring at finer scales, traditional approaches are less likely to be scalable and pose challenges

in effectively representing surface and sub-surface runoff generation at finer scales. These challenges present opportunities for alternative low-cost sensors to supplement and complement expensive in-stream gauged data collection methods, with the purpose of validating and improving the representation of finer scale hydrological processes.

The study will present insights into the effectiveness of a combined modelling and monitoring study which assesses the effectiveness of simulated flow pathways at a finer scale. The HydroGeoSphere model was developed to investigate flow pathways on the hillslope while maintaining a similar response at the aggregated scale. The implementation of low-cost sensors in headwater catchments addressed data deficiencies at the local scale and provided insight into the intermittency of streamflow and the contributing flows for individual tributaries. The local scale data allows for improved calibration of hydrological models that couple surface-subsurface water processes.

Demonstrating hydro-ecological responses to the return of low flows in intermittent streams

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Presenter: Dr Sally Maxwell

Low flows improve riverine ecosystems

The hydro-ecological impacts of reducing the low flow components of riverine flow regimes have been demonstrated worldwide. While long-term monitoring programs have the ability to assess trend or change in condition, they are insufficient to determine the effects of intervention activities such as the introduction of low flow restoration measures. Despite modelled evidence that the restoration of low flows will have a positive effect on the receiving environment, there have been few, if any, opportunities to empirically test these responses.

Responses to restoration of low flows are likely to manifest at multiple spatial and temporal scales, which are important to different stakeholders. Short term, local-scale responses are of particular interest to individual landowners while broader-scale responses are the target of restoration programs. The design of a monitoring program must therefore include a suite of indicators capable of detecting short to long-term, fine to broad scales of responses.

The current monitoring and research program has been developed to assess the hydro-ecological response to the return of low flows across catchments using a Multiple Before-After Control-Impact design (MBACI). Short-term indicators, such as wetted perimeter, and macroinvertebrates, have been selected to characterise the short-term response, while indicators such as fish and vegetation, will utilise existing condition monitoring programs, to monitor the effects longer term. The use of a MBACI design will provide a means to detect responses irrespective of natural variation and provide robust and defensible answers to inform the ongoing restoration of lowflows in South Australia and beyond.

Science underpinning operational procedures for weirs in the South East

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Presenter: Mr Ryan Judd

Natural Resources South East strives for management optimisation of the South East Drainage Network

The South Eastern Water Conservation and Drainage Board (SEWCDB) is responsible for managing over 2500 km of agricultural drains and associated watercourses and wetlands. The south east drainage network (SEDN) is unique in applying a multi-objective approach towards water management at a regional landscape scale to achieve economic, social and environmental objectives. To achieve this, associated with the SEDN is 187 regulator weirs.

Using data collection and science, operation manuals are being developed for major regulators within the system based on these economic, social and environmental objectives. Since the installation of the Magarey Lane Experimental Weir in 1981 there has been much debate among landholders on the effect that management practices of the weir has on the local water table and land productivity.

To test the effects of the Magarey Lane Weir and different management practices, a monitoring transect covering ~1.5 km each side of Drain M (using observation wells and private bores) was developed and investigated. Data was collected from this transect on a regular basis over a period of eight months and was interpreted as a cross section across the drain to identify the effects that the Magarey Lane Weir and the surface water level in Drain M has on the local groundwater table.

The surrounding observation wells within 10 km of Drain M were monitored on a monthly schedule, with the data being interpreted as groundwater contour maps to identify the effects of management practices on the surrounding agricultural land.

DEW

Connecting People to Nature

The impact of unbanisation on biodiversity - a case study for Greater Adelaide

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Presenter: Mr James Plummer

Growing Adelaide and keeping our biodiversity

Currently, half of the world's population live in urban places, but this is expected to increase to two thirds by 2050. Often an outcome of rapid urbanisation is a significant decline in biodiversity as landscapes are increasingly altered and become less natural. Adelaide, South Australia seems typical of many rapidly urbanising cities where an extra 500,000 people to be accommodated over the next 25 years - without substantially increasing the urban footprint. This project, using Adelaide as a case study is examining the fundamental relationship between urban development and biodiversity as a way of predicting the future impacts of various urban forms. Bird species distributions (a good biodiversity indicator) and other key environmental features across the region have been mapped to produce biodiversity models. These models help predict the impacts of future urban development scenarios on biodiversity, from which tools are being developed that will inform governments, planners, developers and local communities.

Large amounts of data had to be collected, so citizen scientists (in this case expert bird identifiers) were recruited to conduct parts of the various bird surveys needed. This type of research is as challenging as it is novel, requiring robust data collection methods, surveys over large areas for extensive periods, very careful design and extensive support from citizen scientists. This approach can be modified to enable it to be applied to many urban and urbanising landscapes both nationally and globally.

Science Supporting Nature-based Tourism: an adaptive management framework for great white shark tours

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Presenter: Mr Barry Hayden

Science supporting nature-based tourism - Nature-based tourism supporting science

Diving with white sharks at the Neptune islands Group (Ron and Valerie Taylor) Marine Park is a spectacular experience that attracts people from all over the world to South Australia. The South Australian Government is actively facilitating the sustainable growth of this industry in partnership with tour operators. The industry supports 80 jobs, contributes over $12 million per annum to the State economy and is continuing to grow.

The regulation of this activity comes under close scrutiny from tour operators, conservation interest groups and marine users. Government requires policy to guide its regulation of this activity. Ideally, this regulation needs to be cost effective, robust, precautionary and able to evolve as scientific knowledge about white sharks and their ecological requirements evolves.

To ensure that tour activities are able to support viable businesses without impacting white sharks, the duration of white shark residency at the Neptune islands Group is used as an indicator of tourism impacts on white sharks. Monitoring of white shark residency ensures that tourism effects are understood and managed through an adaptive management framework. This approach utilises a simple and cost effective partnership between tour operators, research organisations and the State Government.

Academics often complain that policy makers do not use the best available science to inform their policies. Policy makers often lament how hard it is to engage scientists and get them to deliver fit-for-purpose science.

Healthy environmental microbiomes ... or why humans need nature

Liddicoat, C (1) and the Healthy environmental microbiome team.

The University of Adelaide

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Presenter: Mr Craig Liddicoat

Biodiversity is nature's immune booster

Greater exposure to biodiverse environments and soils may boost human health and help cut spiralling public health costs. Many will understand the important intangible benefits of contact with nature, but what if there was a real biological mechanism linking people and nature, that if broken, translated to adverse health outcomes and costly health bills? Well, medical researchers now believe that contact with microbial diversity from biodiverse environments and soils (or the environmental microbiome) provides such a link. These microbiomes, comprising the communities of microbes from our natural environments, are thought to provide immune system training and regulation that is critical for establishing immune fitness, to give us the best chance of a healthy life. We are accumulating evidence of such a link through continent-wide population-level epidemiology studies. Our research so far shows benefits both from surrounding vegetation diversity on respiratory health; and from biodiverse soils on rates of infectious and parasitic disease in regional Australia.

Measuring changes in NRM Skills and Knowledge in the City of Kalamunda

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Presenter: Mr Mick Davis

Measuring NRM skills and knowledge demonstrates impact of the City of Kalamunda's NRM skills training programs

The City of Kalamunda straddles the urban and rural landscapes on the outskirts of Perth, Western Australia (in the Perth NRM region). Our City is lucky to have the highest tree canopy cover in the Perth metro area and has a correspondingly high biodiversity value in our natural bushland reserves.

Managing threats to biodiversity in these bushland areas is complex, relying on an understanding of the bushland and the threats that reduce their biodiversity values, plus an understanding of how to engage our community in on-ground activities to mitigate threats and improve habitat values.

The City is a consumer of research largely undertaken by others – using information to prioritise and direct our resources towards meaningful action on-ground. We contribute to science in partnership with others – e.g. through water monitoring, natural area assessment, planning processes and Citizen Science initiatives.

When we deliver NRM skills and knowledge training to our community we seek to use scientific principles to measure and understand our effectiveness. For example during the Federal Government's Green Army program we used a 5-point Likert scale to measure participant skill and knowledge across 19 different areas of 30 participants.

Doing this simple science helps us to be confident our training works and provides confidence to funders that we can effectively fill knowledge gaps in our community group. We leave complex science to others and support research in our City wherever we can.

Human health and ecosystem benefits of environmental volunteering on Kangaroo Island

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Presenter: Dr Robyn Molsher

Volunteering in nature improves wellbeing and environmental stewardship

Environmental volunteering can provide a unique way to optimise the wellbeing of participants while fostering environmental stewardship. However, not all sectors of a community tend to engage in environmental volunteering, as some experience barriers to participation. This project examined changes in wellbeing and environmental awareness of participants from diverse backgrounds undertaking environmental volunteering activities on Kangaroo Island. Strategic partnerships were established between conservation, regional development and employment organisations and the Kangaroo Island Health Service to create community ownership and cohesion around project goals.

Of the 32 people who participated, 78% were considered marginalised and only 9% were currently engaged in environmental volunteering. Social connectedness and learning about the environment were considered by the participants to be the greatest benefits of the program. Significant improvements in wellbeing and elevated mood states were detected. Other benefits included: 31% of those seeking work obtained it; and 50% joined a volunteer group at program completion. The program allowed people from diverse backgrounds to be supported to come together for a common purpose (i.e. conserving the environment), and gain improvements in their own health and social inclusion. This program provides evidence for the wellbeing benefits of volunteering in nature.

Citizen Science

EchidnaCSI: Using Citizen Science and Molecular Biology for Conservation

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Presenter: Ms Tahlia Perry

Calling citizen scientists: more data needed to protect echidnas

Short-beaked echidnas are iconic native Australian animals and one of only three egg-laying mammals. While we know that they occur widely across Australia we lack detailed information about their exact distribution and many aspects of their biology. The citizen science approach using technology and media, as well as the availability of molecular data, enables us to obtain more information about wild echidna populations and how they are affected by environmental changes. The recent listing of the well-studied Kangaroo Island echidna population as endangered shows the urgent need to better understand distribution and fundamental biology of these fascinating mammals. The Echidna Conservation Science Initiative – EchidnaCSI – is a new app-based, citizen science project that combines molecular biology, ecology, community engagement and education. EchidnaCSI encourages the public to take photos of wild echidnas to understand more about their distributions throughout Australia. The app also provides information and instructions about how to identify and send in echidna scats for molecular analysis to investigate diet, health and breeding. EchidnaCSI was launched in September 2017 and has achieved over 2000 app registrations and almost 1500 submissions of data. We have already established reliable DNA extraction and amplification techniques to verify the scats are from echidnas. We are proceeding to Next Generation Sequencing on the scats to reveal diet, population diversity, microbiome and parasite abundance whilst generating robust protocols to analyse hormones involved in reproduction and stress. This project will ultimately unlock fundamental biology of echidnas in Australia and inform policy and conservation.

Reef Watch: The results of 20 years of monitoring two South Australian reefs

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Presenter: Tim Kildea

Is Noarlunga Reef being loved to death!?

Hallett Cove and Noarlunga reefs, located on the southern Adelaide metropolitan coast, have been historically noted for their unique, natural ecosystems. Noarlunga Reef has been an aquatic reserve since 1971 and is now part of the Encounter Marine Park. Similarly, Hallett Cove reef abuts a coastal conservation park that is noted for both its geological and biological importance. Despite their protected status, both reefs have been exposed to a range of anthropogenic impacts from the ever increasing coastal urban sprawl. Since 1998, these reefs have been regularly surveyed via a citizen science program called Reef Watch. Volunteer divers have undertaken seasonal reefs surveys, measuring a range of parameters from fish and invertebrate numbers to percentage cover of macroalgae.

This presentation focuses on the results from this community study and discusses changes observed at Noarlunga and Hallett Cove over the past 20 years, in particular a disturbing decline in the cover of large macroalgae on Noarlunga reef. Macroalgal communities provide the fundamental building blocks of temperate reef ecosystems and any decline represents a warning bell for a decrease in biodiversity and thus reef health. These long term changes could not have been quantified if it was not for the time and effort expended by a large team of dedicated volunteers. It is programs such as Reef Watch that reinforce the importance of developing and maintaining long term datasets and highlight the capacity of citizen science projects to contribute meaningful results in monitoring the health of threatened ecosystems.

The MEGA Murray-Darling Microbat Project

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Presenter: Dr Sylvia Clarke

Improving batting averages in the Basin

The MEGA Murray-Darling Microbat Project was one of a select few projects across the country awarded *Inspiring Australian Citizen Science* grant funding. This journey has taken a small, community-driven project to the national stage and expanded its geographic and scientific boundaries. The project is now on track to provide much needed information about insectivorous bat species in the Murray-Darling Basin, in particular the links between species diversity and habitat type and condition. We aim to introduce people to the secret world of microbats, change their perceptions about living with bats and enable them to improve bat habitat on their land. All the ingredients for a comprehensive citizen science project are provided by the partners: project coordinators from DEW (SA Murray-Darling Basin) and Mid Murray Landcare who devised the original successful community project and have links with natural resource management policy makers,

Landcare associations and communities; a citizen science team from the University of South Australia Discovery Circle; and a bat specialist scientist from the South Australian Museum.

The project works by teaching 'citizen scientists' to survey for bats with ultrasonic recorders on their properties, while collecting associated habitat information. The social survey records people's land management practices and their awareness of bats, before and after involvement in the project. Ultimately, the data will be used to reassess microbat species distribution, diversity, habitat needs, relevant management practices and microbat species' conservation status. The project can then be up-scaled to include the Victorian and NSW parts of the Basin.

Strengthening the Community through Scientific Collaboration

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Presenter: Mr. Alejandro Bohorquez

Science at Large: Kangaroo Island NRM Hits Home Run with Community Engagement thanks to BioBlitz Macroinvertebrate Surveys

Being a scientist isn't a requisite to contributing to, or learning about, the health of your local ecosystems. This presentation focuses on a community member's involvement in an aquatic macroinvertebrate survey undertaken on Kangaroo Island in the Spring of 2017. The survey strove to amalgamate scientific methodology and knowledge, with the passion of local volunteers, by creating a program which focused on involving community members under the guidance of professional ecologists. Questions answered include: why you should care about aquatic macroinvertebrates, their importance as indicators of river health and why community members should be involved in scientific endeavours.

Waterbug Bioblitz: a new collaborative approach to water monitoring in the SA Murray-Darling Basin

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Presenter: Dr. Katie Irvine

Waterwatch Our Way: Citizen Science reinvents the old model with benefits for community, research, policy and planning.

Our engaging and productive Waterwatch project incorporates three parts: co-creation, co-monitoring and co-interpretation.
Recent research has shown that with adequate professional support, community-based water monitoring can reliably contribute to professional datasets. The SA Murray-Darling Basin region's Citizen Science Program has worked to ensure Waterwatch data is fit for purpose with adequate data quality protocols. This project has been developed in consultation with local catchment groups, government researchers and policy makers.
A key component is the twice yearly Waterbug Bioblitzes, held across multiple catchments and wetlands, in which macroinvertebrate sampling and water quality measurements are undertaken by volunteers with scientists alongside to verify results.
Community workshops facilitated by citizen science practitioners and community groups, provide a forum for discussion of water quality, macroinvertebrate and habitat results. Trends are identified and local knowledge is shared. The resulting reports incorporate data interpretation by both community participants and aquatic ecologists.
Strong partnerships with scientists and community members are key to this model of Waterwatch and creating a sustainable catchment management model for the future.

The Great Goolwa Cockle Challenge: population monitoring and community awareness to inform management of an important recreational fishery in South Australia.

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Presenter: Dr Sylvia Zukowski

The Great Goolwa Cockle Challenge: population monitoring and community awareness to inform management of an important recreational fishery in South Australia.

Have you ever done the cockle shuffle along Goolwa Beach? Pipis (locally known as Goolwa cockles) are an iconic species for locals and the beach ecosystem and support important recreational and commercial fisheries. The effective management of species subject to harvest pressure - through engagement of stakeholders, regulations and monitoring of catch and population status - is critical for long-term sustainability. This multi-faceted approach occurs for the commercial fishery, but the recreational fishery is primarily managed by regulations (size and catch limits and a closed season) and compliance/engagement, with limited monitoring of population status. Yet, it is unclear if this management is adequate given the recreational harvest is considerable (e.g. ~33 tonnes or 7% of state-wide catch in 2013-14) and likely to have increased over recent years. Here we detail a novel project to raise the profile of the recreational fishery as well as establishing the monitoring protocol to assess changes in the population status over time. Engagement was achieved through the Great Goolwa Cockle Challenge, where recreational fishers and the broader community became citizens scientists to catch as many of the pre-tagged cockles. The monitoring program, guided by that of the commercial fishery, aims to assess key performance

indicators (density, size structure, presence of pre-recruits) before, during and after the recreational fishing season, whilst accounting for the inherent patchiness of the species. It is hoped the project will continue to allow for engagement and assessment of long-term trends in population status, to help manage the recreational fishery.

Sustainable Agriculture

A health check for our agricultural soils: key messages from the science and implications for policy

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Presenter: Mrs Amanda Schapel

Soil health the buried truth: Uncover the secrets in a 5 step health check

Healthy soils have high levels of productivity. Many agricultural soils are said to be operating below this level and the sustainability of farming practices have been questioned. Creating a healthy soil is one of the top priorities for many farmers but how can this be achieved in a practical and economic way? A soil in good condition has key chemical, physical and biological components in balance. Organic carbon is often used as a benchmark for soil health but it is only one indicator of what is going on in the soil. In a healthy soil, there is constant cycling between the living, actively decomposing and stable carbon fractions. Soil organisms are responsible for this cycling and any chemical, biological or physical component can affect the outcome. To assess the overall health of the soil, it is critical to understand the soil you are working with and be able to identify components that may affect the balance. A number of programs are investigating the impact of modifying soil using engineering solutions to overcome an imbalance in these critical components and the effect this has on agricultural productivity and soil health. Concepts are discussed in relation to South Australian agricultural soils with examples of how data gathered from these soils has been used to shape state policy.

Emerging soil acidity in South Australia- connecting policy to actions!

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Presenter: Mr Brian Hughes

Soil acidity is emerging as a widespread sustainable ag issue across South Australia

Estimations are that soil acidification currently affects 2 million hectares of agricultural land in South Australia. Predictions are that it will continue to expand over the next 50 years probably affecting up to 5 million hectares of agricultural land.
Acid soils are associated with a decline in soil health including soil biota, issues with leaching and tie-up of some soil nutrients and has various offsite impacts including acidification of water, release of toxic compounds and the implications of declining ground cover and water use to erosion and salinity.
The key drivers to this increase are the high use of nitrogen fertiliser, greater cropping intensity and removal of high crop and hay yields and it is unrealistic for landholders to change to a lower intensity land with lower acidification rates.
DEW has been leading the development of a statewide soil acidity strategy which has determined the annual cost of acidity from lost production to be around $88 million/year.
Improved mapping using inherent soil characteristics and current land use has shown where low buffering soils are likely to become more acidic.
The development of a model determining liming targets based on the soils, land use and acidification rates has been undertaken and from this a progressive lime deficit can be calculated.
Other key strategies identified to manage emerging acidity include improved understanding of soil acidification rates, soil buffering capacities, soil pH stratification, contribution of nitrogen management, precision paddock assessment techniques and mitigation in the low to medium rainfall affected areas.

DEWHappy plants and healthy soils : Monitoring landscape condition using remote sensing

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Presenter: Mr Trevor Hobbs

Happy plants and healthy soils

Cropping and livestock industries across South Australia rely on the sustainable use of our soils and native vegetation. Adverse changes in the condition or resilience of these vital assets have the potential to threaten the viability of these industries at local and regional scales. To minimise or avoid these threats land managers need to better tools to assess changing conditions across their paddocks and over time. DEW is currently developing novel remote sensing applications to better understand the distribution primary productivity, soil health and vegetation condition in South Australia. These tools use hybrid sources of spatial data (e.g. satellite imagery, soil mapping, DEM) over many years to quantify and monitor changes in landscape productivity, health and resilience.
This presentation will discuss the sources of information and analytic methods used to evaluate crop, pasture and vegetation dynamics in dryland agriculture and pastoral grazing systems of the state. We addresses key issues and limitations for many monitoring programs, including inherent and management-induced variability across landscapes, sampling versus total area assessments, repeatability of measurements; identifying benchmarks for comparative assessments, and the timing and resolution of available satellite imagery.

Phylloxera free: the South Australian viticultural imagination

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Presenter: Dr William Skinner

Despite absence, grape phylloxera continues to strikes fear into the hearts of winegrowers

Grape phylloxera has become extraordinarily significant to winegrowing in South Australia, not through its presence but rather its absence. The spread of the phylloxera vineyard root louse from the second half of the nineteenth century onwards represents a fundamental rupture in the world of wine, reshaping the global economic and political landscape of wine production and trade and forever altering viticultural techniques and practices. Unlike most other Australian states South Australia has avoided phylloxera infection, due to a combination of strong biosecurity measures, geographical remoteness and luck. This placed the SA wine industry at a competitive advantage, and South Australia has maintained its prominence since, now accounting for nearly fifty per cent of Australia's total production.

This paper focuses on the social and cultural dimensions of phylloxera. It draws primarily from my anthropological research in the McLaren Vale region, where local producers expressed concern about the perceived influence of large wine corporations in proposed relaxation of biosecurity regulations to enable more economic transport of machinery and equipment. This, they feared, would greatly increase the risk of South Australian vineyards to phylloxera exposure. I argue that the absence of phylloxera has not diminished its symbolic importance among wine producers in South Australia. Instead, the local industry largely defines itself against its ever-present 'threat', and it is in relation to this that particular local discourses of tradition and authenticity have developed that emphasise vineyard purity and continuity and valorise wine from old, ungrafted vines.

Remote sensing applications for soil erosion modelling in South Australian agricultural landscapes

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Presenter: Ms Amelie Jeanneau

Where has the soil gone? Soil erosion modelling case-study in agricultural landscapes of South Australia.

Healthy soils are crucial for food and fibre production and critical for air quality. Understanding factors and processes that lead to soil loss is pivotal for ensuring community wealth and health. Recent improvement in land management practices have resulted in an increase of protective cover from 276 days in 2002 to 340 days in 2015. However, there is high uncertainty about how changes in land management and climate conditions affect future soil loss as current erosion models were developed under data limitations of past decades. Advances in remote sensing and digital soil mapping, together with vastly enhanced computing power, provide the basis for predictive modelling of soil erosion at much improved spatial and temporal resolution.

Taking advantage of modern geospatial technologies, we have compiled models of soil erosion by wind and water in low rainfall cropping regions of South Australia. The aim is to provide erosion hindcasts and forecast for different climate scenarios. In order to improve detail and reliability of future soil loss estimates we are also investigating how relative magnitudes of wind and water erosion have been changing over time and how spatio-temporal erosion pattern may be linked to changes in land management and weather conditions.

A Major Water Imbalance Issue in the SA Murray Mallee – Mallee Dune Seepage: a Symptom of a Much Larger Issue.

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Presenter: Mr James Hall

Mallee Dune Seepage Highlights a Larger Water Imbalance and Productivity Issue in Sandy Mallee Districts

Mallee dune seepage is a phenomenon caused by water imbalances in dune-swale 'mallee' landscapes utilised for rainfed annual cropping. Saturated areas known as seeps have increased in occurrence, extent and severity in recent years – most probably as a result of farming system change. This has resulted in the loss of valuable prime farmland and other significant NRM consequences.

Natural Resources SAMDB and the Australian Government's National Landcare Program are supporting investigations into the processes involved and have established farm trials, together with monitoring of seeps, soil moisture and perched groundwater across four sub-catchments.

The manifestation of seeps in sandy landscapes is a symptom of a much larger issue – poor overall water use by plants in subcatchments and on farms. There are economic, social and environmental consequences of this inadequate water use. The magnitude of water loss to seepage or deep drainage, or the productivity and economic consequences of this are, however, unknown – but are likely to be substantial.

Preliminary work and understanding was presented at the 2016 NRM Science Conference. Since then, substantial monitoring data have been compiled and analysed – including comparing land use change options with current systems. Also further investigations have been undertaken and new approaches and thinking developed. A summary report has recently been published that includes key recommendations (see

www.naturalresources.sa.gov.au/samurraydarlingbasin/land-and-farming/soils/soils-resources).

The issues raised in this report suggest that modern farming systems on sandy mallee soils are in a state of immaturity, and require further development to better utilise rainfall, boost productivity, increase economic

Seascape Management

5-years in: Is South Australia's marine parks network delivering?

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Presenter: Dr Simon Bryars

Marine parks are on track; Assessment of the first 5 years

The introduction in 2012 of a network of 19 marine parks across South Australia was one of the biggest conservation initiatives in the state's history. So five years later, is the network delivering?
In order to answer this question, DEW monitors the performance of the four sub-programs that comprise the marine parks program: protection, stewardship, compliance, and performance. Each of the sub-programs are inter-linked to deliver the objects of the Marine Parks Act 2007. In 2018 a 5-year status report was released that documents the management activities undertaken through the sub-programs, and early ecological and socio-economic outcomes observed.
The findings of the report highlight that the marine parks program is on track to meet its statutory obligations through the implementation of activities aligned with the strategies of the management plans. The report has been used to develop recommendations that guide the direction and allow adaptive management of the marine parks program over the next five years leading up to the legislated 10-year review.

Fishery quota setting made easy

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Presenter: Dr Richard McGarvey

Yearly lobster quotas set by pre-agreed decision rule

Is there a simple way to design a decision rule for yearly quota setting in a fishery? We present one approach applied to South Australian lobster based on a target yearly harvest fraction. Until this decade, setting a catch quota involved interpreting reported indices from a stock assessment using weight of evidence. This approach sometimes led to uncertainty on quota outcomes that was not optimal from a management or industry stakeholder perspective. Recent PIRSA policy in South Australian fisheries, now applied widely, is to agree on a decision rule, based on one or several quantitative yearly inputs. But constructing a decision rule is challenging. We present a recipe for constructing a decision table, based on the previous year's catch rate as the primary input. For lobsters, catch rate serves as an index of relative biomass, as the weight of lobsters captured in an average pot set overnight. Within the accepted normal range of stock abundance, a decision rule table can be constructed based on a chosen target harvest fraction. If catch rate rises or falls between discrete bands, the yearly harvest quota will rise or fall accordingly. At lower-than-normal stock abundance, where overfishing becomes a risk, the targeted yearly fraction harvested is reduced linearly from the normal level downward. If catch rate falls further, below a chosen (lower) limit reference point, the fishery is closed. Decision rules with this underlying structure have been implemented in both South Australian commercial lobster fisheries.

Developing knowledge and tools to inform integrated marine management: Ports and shipping in Spencer Gulf as a case study

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Presenter: Prof Bronwyn Gillanders

Crowded marine waters require integrated management solutions

Coastal and marine waters are becoming increasingly crowded. Besides fishing and aquaculture ventures there are also significant shipping and port developments associated with new mining and processing operations. Integrated approaches to marine management are required to provide stakeholders with independent and credible regional information, including opportunities to better understand and manage the potential impacts of human activities. A critical gap in integrated marine management is understanding the cumulative impacts of multiple activities. Independent and cumulative impacts of human uses and associated stressors on marine habitats and key marine species in Spencer Gulf were identified based on expert elicitation and existing data, and used to estimate cumulative risk for the entire Spencer Gulf region. Our modelling of shipping traffic under differing development scenarios indicates a large likely increase in the size and number of vessels per year in Spencer Gulf, with the northern Gulf area subject to the majority of increased shipping pressure. Increases in shipping will further add to the existing cumulative pressures on the Gulf's marine habitats and species. Due to the large projected increase in shipping in Spencer Gulf, integrated management solutions are required to avoid congestion in the narrow shipping paths of northern Spencer Gulf, and to minimise the potential impacts and risks of increased disturbance on the Gulf's environment and other industries.

Identifying biologically important areas in the Great Australian Bight: valuable information for

the conservation and management of marine megafauna

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Presenter: Dr Frederic Bailleul

Multi species of apex marine predators reveal biologically important areas in the Great Australian Bight

Apex marine predators generally use different habitats from the open ocean to the continental shelves. However, they sometimes converge to the same location simultaneously or at different times of the year revealing important underlying biological activity, generally supported by specific physical structures, and hence can highlight areas of importance for conservation and management. We analysed 4,924 satellite telemetry tracks, and 15,698 observations collected from 11 species (pinnipeds, cetaceans, seabirds, pelagic fish) over the last 20 years in the Great Australian Bight (GAB). Spatial distribution models identified differences in use of the region by species that are annual residents, and those that are migratory. However, a combination of inter-species overlap models identified two main regions highly used by marine predators, one in the eastern GAB and the other in the western GAB. While these two regions have common features like narrow shelves and steep slopes, they are influenced by different oceanographic features. A coastal upwelling in the eastern GAB and the Leeuwin Current in the western GAB seasonally affect local nutrient supply and production, which ultimately attract foraging predators. This work was part of the Great Australian Bight Research Program. The Great Australian Bight Research Program is a collaboration between BP, CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide, and Flinders University. The Program aims to provide a whole-of-system understanding of the environmental, economic and social values of the region; providing an information source for all to use.

Further declines in Australian sea lion abundance: where to from here for SA's ecotourism posterchild?

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Presenter: Prof Simon Goldsworthy

Australian sea lions are the poster-child of SA's burgeoning nature-based tourism industry, yet their populations are declining rapidly. Where to from here?

Australian sea lions are an iconic part of South Australia's marine megafauna and the poster-child of the State's burgeoning nature-based tourism industry. Yet the current status of the species is bleak. Recent surveys indicate the SA population has declined by almost a quarter over the last decade, with a median colony pup production of just 23 and mean rate of decline of 3%/year. The Seal Bay colony on Kangaroo Island (one of the State's top nature-based tourism experiences), has been steadily declining for at least 30 years. Bycatch from demersal gillnet fisheries has been identified as a major source of mortality, and management measures to mitigate impacts were introduced into the fishery between 2010 and 2012. These include fishery closures, on-board camera systems and bycatch trigger limits. These measures have undoubtedly reduced sea lion bycatch interactions, and although the systems for monitoring fishery interactions are excellent, there are no programs in place to assess whether any of the mitigation measures have delivered their intended benefits and enabled the recovery of populations. Major issues include a lack of resources to support ongoing assessment of population trends, an ability to assess the effectiveness of current management actions to recover populations and to identify additional threats. With reductions to traditional funding sources, we need to look towards more end-user focused support, such as nature-based tourism, to bridge the gap. Active investment by end-users in research to recover and rebuild populations has been highly successful in the Phillip Island Nature Park in Victoria.

Wildlife Management

Do relentless rabbits or killer kangaroos limit revegetation success in the mallee parks?

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Presenter: Dr David Duncan

Relentless rabbits and killer kangaroos limit revegetation success in the mallee parks.

Large scale revegetation of plant communities is often attempted in heavily cleared and degraded ecosystems where the spatial scale of restoration, or the sense of a ticking ecological clock, exceeds the scale of natural regeneration. Success of such projects is highly variable, and whilst risk factors may be identifiable in a general sense it is rarely clear how they might play out individually, or in combination. We addressed this problem with a large-scale field experiment with 1275 hand-planted Buloke (*Allocasuarina luehmannii*) seedlings in a nationally Threatened Ecological Community in Wyperfeld National Park in the Victorian mallee. Buloke seedlings were planted in 17 sites representing 4 different landscape positions and with 3 different levels of protection from kangaroo and rabbit browsing. We assessed the fates of the seedlings, and measured herbivore activity, on four census occasions during the first 400 days post-planting. The results enable us to untangle generic mortality risks of hand planted (tube stock) individuals from those additional risks posed by browsing animals and to learn how those risks may vary across space and time. Importantly, from the perspective of seedling survival, the idea of 'building out' from remnant patches is not supported, whereas alternative locations may be good or poor prospects depending on the degree to which browsers are excluded.

Foraging behaviour and consumption effort of long-nosed fur seals relative to key commercial fisheries in South Australia

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Presenter: Dr Alice Mackay

Who is taking what? Comparison of the distribution and estimated consumption effort by long-nosed fur seals and commercial fisheries in South Australia.

In South Australia, there are concerns over how recovering seal populations in the region may impact commercial fisheries and the broader ecosystem. This is particularly the case for long-nosed fur seals (*Arctocephalus forsteri*) whose population has increased more than threefold between 1990 and 2014. Understanding the potential extent of direct or indirect interactions between seal populations and commercial fisheries requires data on the spatial overlap of seal foraging and commercial fishing effort. Most long-nosed fur seals that interact with fisheries and aquaculture are likely to be sub-adult males, however, the foraging distribution of this portion of the population is not well understood. We present new information on the movement patterns of sub-adult (n=10) and adult (n=3) male long-nosed fur seals equipped with satellite linked GPS tags in 2015. This includes information on fine-scale temporal associations of some individuals with fin-fish aquaculture farms in Spencer Gulf, and movement patterns of individuals in and out of the Coorong area. We integrated these tracks with existing data on adult male and female foraging behaviour, and developed models of the spatial distribution and consumption effort of fur seals in South Australia. These models were used to estimate the spatial overlap between the distribution of fur seal foraging and fishing effort of key commercial fisheries, and to estimate the amount of removal of key commercial species, by fisheries and fur seals.

Seals in the Coorong: government and industry working together

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Presenter: Jason Higham

Heading

Abstract

Koala sterilisation on Kangaroo Island, SA: changes in population size

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Presenter: Dr Robyn Molsher

Koala population on Kangaroo Island undergoes a managed decline but then rapidly increased. Factors involved in the increase and the management response are discussed.

The introduced koala population on Kangaroo Island SA has been managed through fertility suppression since 1996 with ~13,000 koalas sterilised to protect native vegetation. Regular monitoring and census has shown that the koala population declined steadily in native vegetation and was almost half the size in 2010 compared to 2001. In the last few years, however, despite continued sterilisation effort, koala numbers have significantly increased as a result of a range of enabling factors. These include: the availability of new habitats (e.g. blue gum plantations), reduced sterilisation and translocation targets, inaccessibility to some properties for koala management and favourable climatic conditions.
The population increase has prompted an in-depth evaluation

of the program that has emphasised the need for applied research and innovative tools to address key knowledge gaps. This paper discusses the challenges and successes of one of the largest mammalian fertility control programs in the world. It describes the recent application of drone technology to support koala monitoring, as well as the role of spatial modelling in assisting managers to determine appropriate adaptive management strategies.

Overabundant icons: kangaroo population trends and models for South Australia

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Presenter: Dr Thomas Prowse

Roos reach plague proportions

South of the wild-dog fence, the control of dingoes and establishment of permanent water points have produced favourable conditions for kangaroos (*Macropus fuliginosus* and *M. rufus*) and euros (*M. robustus*). Since the breaking of the Millennium Drought in 2009, kangaroo populations have grown largely unchecked, and anecdotal reports suggest kangaroos are thwarting restoration efforts and are grazing unsustainably in some regions. In this talk, I will review the evidence for an increase in grazing pressure on private lands and reserves over the last decade using data collected with the Bushland Condition Monitoring method, and use long-term aerial kangaroo monitoring data to explore spatial and temporal patterns in kangaroo population density. I will then detail the development of a spatial population model for kangaroos that is fit to data using simulation-based inference to flexibly accommodate the effects of climate, habitat type, and harvesting. This model will be used to generate updated estimates of kangaroo population size, and to evaluate the harvesting/culling effort required to maintain kangaroo populations below target densities.

Management of southern hairy-nosed wombats (*Lasiorhinus latifrons*) in South Australia: what is the real state of affairs?

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Presenter: Mr Michael Swinbourne

Wombat numbers on the increase - but misinformation and poor management practices persist

Management of the southern hairy-nosed wombat population in South Australia can be controversial. On the one hand the species is highly susceptible to the effects of drought and human persecution, while on the other, the removal of wild dogs and land clearing across much of its distribution have potentially benefited the species. Even a cursory internet search will reveal a variety of articles and web-sites presenting conflicting messages about the species, including that wombats are endangered, illegal culling is rife, and their habitat is being destroyed. In contrast, landholders in many wombat areas have consistently claimed in surveys that wombats have been increasing in both distribution and abundance compared to a few decades ago. But how do we go about determining which of these claims are correct so that we can provide a sound scientific basis for population management decisions?

Using a combination of very-high resolution satellite imagery, ground surveys and remote sensing, we have mapped the distribution and estimated the current abundance of southern hairy-nosed wombats at the local, regional and species-wide scales. By combining this information with historical data, we can confirm that the wombat population declined substantially following European settlement, but has been recovering in many areas over the past few decades. We also have evidence that illegal culling activity is occurring. These findings create challenges for wildlife managers. Work is currently underway to correlate this information with landscape and climate change data in order to make predictions regarding how the population might change in the future.

A multi-scale and multi-method approach to assessing Southern Hairy-nosed Wombat population and abundance in the Murraylands, South Australia.

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Presenter: Ms Grace Porter-Dabrowski

Wombats from space

The Southern hairy-nosed wombat (*Lasiohinus latifrons*) is a large burrowing marsupial native to South Australia. There are difficulties estimating the population of the Southern hairy-nosed wombat and past estimates have been highly variable, and likely inaccurate. Wombat warrens can be identified from satellite imagery and provide a means of determining the species spatial distribution.

This study used imagery from air photos, Geographic Information Systems and statistical analysis to locate warrens and assess warren density. Wombat activity at the warren scale was investigated using motion detection cameras and spotlighting. These methods, in particular air photos, aided in mapping the Southern hairy-nosed wombat's distribution, as well as determining warren dimensions and characteristics.

This study aimed to find a relationship between spatially observable warren dimensions, active burrows, and the number of wombats occupying a warren.

This study found warrens on the sheep grazing station Kooloola, in the Murraylands contained an average of 0.4 wombats per active burrow. There was a substantial temporal and spatial bias in wombat observations during spotlighting. The time of the year, vegetation height and density as well as the density of warrens influenced observed numbers. However, wombat densities derived from spotlighting

corresponded with spatial patterns observable from air photos. A strong positive relationship between the number of active burrows in a warren and its size was also found. Hence, single spotlighting surveys were insufficiently accurate to estimate population numbers. This study highlights the use of a range of methods across spatial scales towards accurately estimating Southern hairy-nosed wombat populations over large areas.