Book of Abstracts

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Ecology in the Anthropocene
Predicting habitat suitability for greater glider (*Petauroides volans*) using remote sensing: implications for conservation planning

**Mr. Benjamin Wagner**, **Prof Patrick Baker**, **Dr Craig Nitschke**

1The University Of Melbourne, Richmond, Australia

**Biography:**
POSTER 113 - Currently PhD Candidate at the University of Melbourne, Benjamin Wagner completed a Bachelors degree in forestry and Masters degree in tropical forestry in Germany and worked on projects in Germany, Indonesia and Vietnam, specializing in UAV based remote sensing.

The greater glider (*Petauroides volans*) is Australia’s largest gliding possum and distributed along the entire eastern coast. While long considered common, recent research indicates local population declines at annual rates up to 9% and modelling predicts substantial shrinking of greater glider habitat across its range in the future, resulting in a new ‘vulnerable’ conservation status. Declines have commonly been attributed to logging and burning activities, resulting in a range of conservation measures developed and emplaced accordingly. Other research indicates that the decline might be related to a wider range of factors such as changes in habitat quality or climate, but these factors are often not considered in conservation planning. This project seeks to address the interactions between these factors at a landscape-scale using a combination of remote-sensing, field validation and empirical modelling. The project will use four approaches: 1) landscape-scale processing and analysis of satellite imagery and detailed climate data for habitat and historic analysis, 2) collection and analysis of high-resolution index-imagery of known greater glider presence and absence sites in the Victorian Central Highlands and East Gippsland, 3) development of models of forest nutrition and ground validation through forest inventory and lab foliage analysis and 4) analysis of temporal changes in occurrence using high resolution climatic, topographic and land use data over the past 30 years. The combination of these are to be used for recommendations to improve reserve design and forest management, as well as to understand the spatial distribution of nutrients in the forests of southeastern Australia.

The challenge of incorporating cultural values and perspectives of First Peoples’ (Aboriginal People) into water planning and threatened species management.

**Bradley Moggridge**

**Biography:**
I am a proud Murri from the Kamaroi Nation (North-West NSW), and I grew up in Western Sydney on Darug land and now live in Canberra on Ngunnawal land. I am currently a PhD Candidate (full-time) at the University of Canberra’s Institute for Applied Ecology, hoping to give Aboriginal people a water voice. I am also part-time Indigenous Liaison Officer for Threatened Species Recovery Hub under NESP and Special Advisor First Peoples Water with Water Stewardship Australia. My qualifications include - Master of Science (Hydrogeology and Groundwater Management) from UTS and Bachelor of Science (Environmental Science) from ACU. In 2017 I was awarded by ACU the Aboriginal and Torres Strait Islander Alumni Award. Previously to the PhD I was employed by NSW DPI Water as the Team Leader Aboriginal Water Initiative (AWI) and was honored to lead the then only dedicated Aboriginal water unit in Australia for nearly 5 years.
Australia’s First Peoples (Indigenous people) have managed and sustained this landscape called Australia for thousands of generations. With Australia being the driest inhabited continent on earth, and the 250+ language groups/Nations across the continent having their own set of Lore’s, beliefs, customs and practices their knowledge of the landscape, waters and sky and the species that exist has formed part of their successful survival. This knowledge has several terms to describe it, but for this talk Traditional Ecological Knowledge (TEK) is used. TEK has been evolving and adapting to the Australian landscape through climate, drought, floods and government policies. This knowledge is becoming ever more sort after to inform landscape management and can play a part in western science to better understand water management, species conservation, fire, climate adaptation, and for this talk the emphasis will be on threatened species and water management. Threatened species range across many Taxa aquatic and terrestrial species - fish and plant, also mammals, reptiles, birds and insects and some of these species occur on Indigenous lands and may well be water dependent. Threatened species conservation must include Indigenous Peoples knowledge and relationship with species, this is being advanced through the Threatened Species Recovery Hub, and partner Universities who are working closely with Indigenous people whether that is fee for service or combing TEK and western science to better manage threatened species across the country. Water management is old business for Indigenous people and with policy shifts to include Indigenous values in water planning this has shaped water management prospects and the challenge for the inclusion of these values for Indigenous people.

Keyword: 1) Indigenous People 2) Threatened Species 3) Traditional Ecological Knowledge 4) Water

Detecting resource availability through time in the arid zone

Mr Al Healy

In Australia’s drylands, small, higher productivity patches provide an important resource for arid specialist species such as the endangered Night Parrot (Pezoporus occidentalis). Identifying the availability of these resources through time and space requires accurate, consistent maps of variation in vegetation productivity. In rainfall-driven arid environments, different vegetation types respond at different rates, with some grasses and forbs responding to even small rainfall events while others require high rainfall events to green, flower and seed. This project uses phenological measurements derived from fieldwork, repeat digital photography and satellite imagery to measure the response rates of different vegetation communities in the arid zone. This dataset will allow identification of small higher productivity patches that are too small or change too rapidly to be mapped by current landscape-scale categorisations but are likely critical functional habitats for multiple arid-zone species. As well as improving understanding of fine scale variation in productivity, the project directly supports identification of potentially suitable habitat for the endangered and poorly-known Night Parrot.

Do heatwaves cause maladaptation? A case study using Drosophila

Jennifer Cocciardi

Human-induced climate change is causing more extreme heat events. Over the past decade, heatwaves have not only become more common, but more intense and longer-lasting. In order to mitigate and manage how heatwaves affect biodiversity, we must first understand how populations respond to them. During a heat event, rapid adaptation may occur by acting on standing genetic variation. While this may select for traits specifically suited to withstanding current and future heatwaves, we’re not sure how this will affect the overall long-term health of the population. This study uses two populations of a rainforest Drosophila species (D. birchii) to determine if increased selection on an ecologically-relevant thermal stress trait causes maladaptation. Gravid females were captured from the field and maintained in the laboratory in lines. A static heat-knockdown assay was performed on 10 lines per population and heat-knockdown times were calculated. Lines were then bred to create populations with differing
genetic diversity in relation to their response to high temperatures. For each population, subset populations were made to mimic the following population “types”; 1) a “natural” population comprised of the full range of variation in the thermal trait, 2) a population affected by a moderate heatwave where the 5 most thermal-tolerant phenotypes were selected for, and 3) a population affected by a severe heatwave where only the most thermal-tolerant phenotype remains. These populations were maintained for 25 generations before being submitted to a second round of heat-knockdowns (i.e., 2nd artificial heatwave). In addition, the thermal niche of each population after the first heatwave was determined by placing a male/female pair in a vial containing drosophila food at each temperature from 20°C to 36°C and measuring key fitness traits. By comparing these and the results of the 2nd heat knockdown, we can determine how the initial heatwave has affected each population and if maladaptation has occurred. This study is important when determining how populations will respond to future heatwaves and what we can do to manage these responses.

How does my data drive my priorities? Influence of data types and characteristics in conservation

Dr Heini Kujala<sup>1,2</sup>, Dr José Lahoz-Monfort<sup>1,2</sup>, Dr Ascelin Gordon<sup>2,3</sup>, A/Prof Jane Elith<sup>1</sup>, Prof Atte Moilanen<sup>4,5</sup>

<sup>1</sup>QAECO / School of BioSciences, The University of Melbourne, Australia, <sup>2</sup>NESP Threatened Species Recovery Hub, Australia, <sup>3</sup>School of Global, Urban and Social Studies, RMIT University, Australia, <sup>4</sup>Department of Geoscience and Geography, University of Helsinki, Finland, <sup>5</sup>Finnish Museum of Natural History, University of Helsinki, Finland

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Dr Heini Kujala is a Senior Research Fellow at University of Melbourne and a Project Leader in NESP TSR Hub. Her research focuses on spatial conservation optimisations, decision-making under uncertainty, and how to translate these complex concepts into conservation practices.

Spatial prioritisation, where priority locations for conservation actions are identified, is a critical step in conservation planning. The foundation of all conservation planning is in ecological data on species and communities and how they are distributed in space, but information on other data types, such as costs, threats and condition, are also frequently used. Uncertainties in data and how these may affect prioritisation solutions are of great interest to both ecologists and conservation practitioners, but their behavior and relative importance in multi-species prioritisations are poorly understood.

Here we show how the ways in which different data types are combined to define the priority of a location, together with information on data amount, characteristics and spatial correlations, can be used to understand how different data types, and hence uncertainties in them, influence conservation outcomes.

In scoring based approaches, information on costs, threats, and habitat condition quickly dominate prioritisation solutions, particularly when analyses include a large number of species. When complementarity based prioritisation approaches are used, the solutions become more sensitive to the type of included species. In such optimisations, priority patterns are driven by the distributions of intermediatively rare species that occupy species poor areas. The most important and least important areas also behave differently to changes in ecological data.

Understanding how and when spatial priorities are driven by different data types is useful as it improves the transparency of prioritisation results, and helps to understand when uncertainties in data may be important to resolve.
Can basic connectivity measures in spatial prioritization reduce extinction risk?

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1The University Of Melbourne, Melbourne, Australia, 2ENS Paris, Paris, France

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Natasha is a research assistant in the Quantitative and Applied Ecology lab at the University of Melbourne, and is a part of the NESP Threatened Species Recovery Hub. She works largely on species distribution modelling and population viability analyses.

A key tool for preserving biodiversity is to set aside protected areas of habitat. Conservation planning tools, like Zonation and Marxan, are now commonly used to decide where to place these habitat reserves. While they are indisputably useful approaches, we still lack an understanding of how the different choices we make in the modelling process, and the level of ecological detail we include, impact species’ risk of extinction. How well do different spatial planning approaches actually support species’ long-term persistence in the landscape? And, given that increasing the ecological complexity of a model increases the time and cost involved in parameterising it, does it translate into better performing networks of protected areas? We assessed the impacts of different reserve-selection methods in Zonation through population viability analyses.

We explored the performance of alternative network configurations for five species in the Greater Hunter Valley, NSW. We varied the reserve-selection methods by altering the level of ecological information on species habitat quality, dispersal capability or sensitivity to fragmentation. Our prioritization methods ranged from random selection to highly detailed, systematic optimization with explicit information about species landscape use and needs. These methods were assessed by simulating the long-term persistence of the species through population viability analysis. We found that investing more energy in the ecological realism of your models didn’t translate to better outcomes for the species of interest. This work provides valuable information on the practical effectiveness of many of the already adopted but still poorly understood principles of spatial conservation planning.

Experimental reintroductions, the leg work before the party starts

Dr Stephanie Pulsford1, Dr Murray Evans1, Professor Adrian Manning2
1Environment Planning and Sustainable Development Directorate, ACT Government, Mitchell, Australia, 2Fenner School of Environment and Society, Australian National University, Acton, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Stephanie completed her PhD on reptile and frog ecology and conservation in agricultural woodland landscapes. She now works as an ecologist for the ACT Government in the Conservation Research unit.

Due to the high extinction rate of Australian mammals and the loss of function that these animals provide, translocations of species back into sites where feral pests have been eradicated is an important step in improving our understanding of methods of ecosystem restoration and preventing further extinctions. While wide-spread, the Yellow-footed Antechinus is no longer found in the ACT and the urban reserves of the ACT are largely depauperate of any native small mammals. For this study we wished to determine the local distributions of Yellow-footed Antechinus in order to determine the feasibility of a future translocations project. We surveyed for small mammals using Elliot trapping in the Southern Tablelands, NSW. We captured only two species of small mammals: Yellow-footed antechinus.
and Agile Antechinus. We only captured a single species of antechinus at each site we surveyed. These two species usually occur allopatrically but some studies have observed sites with sympatry between the species. We also found that the local distributions of the two antechinus species have shifted compared to previous surveys in the region. We determined that three of the surveyed sites contain feasible source populations of Yellow-footed Antechinus and have identified other likely source locations.

**Applying Innovative Conservation Physiology Tools to Aid Endangered Species Recovery Programs**

**Dr Edward Narayan**

1Western Sydney University, Sydney, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**

*Dr Edward Narayan is a Comparative Animal Physiologist and specialises in non-invasive hormone monitoring techniques to evaluate the eco-physiological responses of animals towards environmental stressors. Dr Narayan's research work has been applied to improve animal welfare and rehabilitation success.*

Conservation physiology is an emerging theme in the field of biology that applies innovative non-invasive physiological technologies to assess the health and physiological responses of animals that are undergoing management interventions such as captive breeding, rescues and rehabilitation. Applications of non-invasive hormone monitoring tools can provide useful information on the reproductive status and physiological stress levels in animals to enable researchers to make rapid and reliable assessments on animal health and ecology. Non-invasive reproductive and stress hormone monitoring tools were developed for amphibians using standard laboratory and biological validation methods. The optimized methods were applied under field conditions to monitor the on-going changes in reproductive hormonal activity and stress physiology of amphibians as part of field ecology and captive breeding research. Application of conservation physiology tools directly benefited the conservation and recovery of endangered amphibian species through new scientific knowledge on the animals’ reproductive biology and eco-physiological adaptation during human intervention. Thus, this paper discusses the applications of conservation physiology tools in the conservation of animals by exploring examples of studies conducted in amphibians. It provides current information on how the field of non-invasive hormone monitoring is progressing to increased high-throughput to cater for species-specific research and also provides recommendations for closely integrating conservation physiology tools into animal ecology and conservation research to aid recovery programs.

**Impact of nectar-feeding birds and European Honeybee's on Anigozanthos manglesii's reproductive success**

**Ms Bronwyn Ayre**

1University Of Western Australia, , Australia; 2Kings Park Science; The Department of Conservation, Biology and Attractions, , Australia; 3La Trobe University, , Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**

*Bronwyn Ayre is a PhD student at the University of Western Australia and the Botanic Gardens and Parks Authority. She is interested in the use of genetic techniques in ecology and conservation.*
Anigozanthos manglesii, the Red and Green Kangaroo Paw, is a historically bird-pollinated South West wildflower that is now visited by the introduced European Honeybee, Apis mellifera. To infer the different consequences of pollination by nectar-feeding birds from A. mellifera, we ran pollinator exclusion experiments across two years and four populations. Plants were netted to exclude all potential pollinators, exclude birds but allow access by insects, or left open and un-manipulated. Bird visitations were recorded with camera traps and honeybee visitation with a hand-held camera. Honeybees were more frequent visitors than birds with only one bird species- the brown honeyeater- visiting an average of once per plant each week. Analysis of foraging recordings show that honeybees contact the stigma 12.8% of the time, and birds 48%. Although there is variation between population and year, on average seed set was significantly lower amongst honeybee pollinated flowers- 24% fruits set seed with an average of 10 seeds/fruit compared to 70% and 43.9 seeds/fruit in open flowers. Paternity assignment is being used to determine how far birds and honeybees disperse pollen within and between populations, and the levels of multiple paternity within fruits. Lower than expected bird visitation rates coupled with the negative impact of honeybees on reproductive success will impact the long-term survival of A. manglesii populations.

The importance of large-diameter trees in the wet tropical rainforests of Australia

Dr Helen Murphy1, Mr Matt Bradford1
1CSIRO, Atherton, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Dr Helen Murphy is a research scientist based at CSIRO Land & Water in Atherton, Queensland. Helen uses field- and modelling-based approaches to understand the relationship between weed invasion, disturbance, climate change and the structure and functioning of ecological communities.

Large trees are keystone structures in nearly all terrestrial ecosystems. They contribute disproportionately to reproduction, recruitment and succession, and influence the structure, dynamics, and diversity of forests. Recently, researchers have become concerned about evidence showing rapid declines in large, old trees in a range of ecosystems across the globe. We have monitored growth, recruitment and mortality of stems (≥10 cm DBH) in twenty, 0.5 ha plots in the wet tropical rainforests of Australia for nearly 5 decades. Here, we assess the contribution of large-diameter trees (>70 cm DBH) to above ground biomass (AGB) in Australian tropical rainforests and examine their richness, dominance, mortality and recruitment over nearly 50 years. We show consistencies with tropical rainforests across the globe in that much of the biomass (33%) in plots is contributed by a relatively small number of large-diameter trees (2.4% of stems) and the density of largest trees explains much of the variation (62%) in AGB across plots. Although the number of large trees increased by 8% since the 1970’s, mortality has increased and recruitment decreased in recent decades. Large trees have recently been described as being ‘biomass hyperdominant’ in tropical forests, that is, the functions of storing and producing carbon are concentrated in a small number of species. In contrast to rainforests in Africa and the neo-tropics, we show that a high proportion of species are capable of reaching a large-diameter in Australian rainforests resulting in weak biomass hyperdominance and conferring a relatively high level of resilience to ongoing environmental change.
The threats to Australia's imperilled species and implications for a national conservation response

Mr Stephen Kearney, Dr Josie Carwardine, Dr April Reside, Assoc. Prof. Diana Fisher, Assoc. Prof. Martine Maron, Dr Tim Doherty, Assoc. Prof. Sarah Legge, Dr Jennifer Silcock, Prof. John Woinarski, Prof. Stephen Garnett, Prof. Brendan Wintle, Prof. James Watson
1School of Earth and Environmental Sciences, University Of Queensland, Brisbane, Australia, 2CSIRO Land and Water, Brisbane, Australia, 3School of Biological Science, University of Queensland, Brisbane, Australia, 4Centre for Integrative Ecology (Burwood campus), School of Life and Environmental Sciences, Deakin University, Geelong, Australia, 5NESP Threatened Species Recovery Hub, Centre for Biodiversity and Conservation Research, University of Queensland, Brisbane, Australia, 6Fenner School of the Environment and Society, The Australian National University, Canberra, Australia, 7NESP Threatened Species Recovery Hub, Research Institute for the Environment and Livelihoods, Charles Darwin University, Casuarina, Australia, 8School of Biosciences, University of Melbourne, Melbourne, Australia, 9Wildlife Conservation Society, Global Conservation Program, Bronx, USA

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Poster 066 - Stephen Kearney is a PhD candidate at the School of Earth and Environmental Sciences at the University of Queensland researching what threatens Australian species, the management actions in place to mitigate these threats, and the current management shortfalls.

Since European occupation of Australia, human activities have caused the dramatic decline and sometimes global extinction of many of the continent’s unique species. Here we provide a review of threats to species listed as threatened under Australia’s Environment Protection and Biodiversity Conservation Act 1999. Following accepted global categories of threat, we find that invasive species affect the largest number of listed threatened species (1,257 species, or 82% of all threatened species); system modifications (e.g. fire) (74% of listed species) and agricultural activity (57%) are also important. The ranking of threats was largely consistent across taxonomic groups and the degree of species’ endangerment. These results were significantly different (P < 0.01) from recent analyses of threats to endangered species globally, which highlight overexploitation, agriculture and urban development as the major drivers of decline. As the classification scheme separates the numerous threats that cause habitat loss, fragmentation and degradation (e.g. urban development, agriculture, mining, transportation), it is possible this masks different drivers of decline and extinction of Australian species and there is a need for future research on this. Our review highlights the urgent need for a coordinated planning approach supported by stronger policy and legislation to mitigate the impacts of the numerous threats contributing to the ongoing decline of Australia’s threatened species.
Assessing risks to ecosystems and ecosystem services

Dr Lucie Bland¹, Prof David Keith²,³, Dr Tracey Regan⁴, Dr Emily Nicholson¹
¹Deakin University, Burwood, Australia, ²University of New South Wales, Kensington, Australia, ³NSW Office of Environment and Heritage, Hurtsville, Australia, ⁴Arthur Rylah Institute for Environmental Research, Heidelberg, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
I am a Research Fellow at the Centre for Integrative Ecology at Deakin University. I create simulation models of ecosystems to assess risks to ecosystems services. My interests include biodiversity indicators and the use of models in conservation.

Humans depend on ecosystems for their well-being, yet risks to ecosystems and the services they provide are often poorly understood. In this study, we provide a framework to link ecosystem services with IUCN Red List of Ecosystems assessments using the Meso-American Reef as a case study. Using a stochastic “whole-of-ecosystem” model, we derived spatially explicit indicators of four ecosystem services (ecological integrity, fisheries, recreation, and coastal protection) and predicted those over a 50-year horizon under five scenarios of threat. We found that the piscivore fishery and the coastal protection service were at high risk of decline (60–80% decline) in scenarios of high threat, but that risks to recreational services remained low under all scenarios (<10% decline). We identified trade-offs in the supply of different services among scenarios, with fisheries and coastal protection (but not recreation) mapping closely to indices of ecological integrity (i.e., IUCN Red List status). We identified areas with current high service valuation and predicted high declines in ecosystem service supply that could be the focus of targeted ecosystem management. We recommend the use of production functions and carefully constructed indices of ecosystem service supply to assess the risk of collapse of ecosystem services. Our study highlights the potential for Red List assessments to inform the management of ecosystem services in an uncertain future.

Local drivers of migratory shorebird abundance and population trends in the Great Sandy Strait

Dr Bradley K Woodworth¹, Dr Sam Nicol², Prof Richard A Fuller¹
¹School of Biological Sciences, The University of Queensland, St Lucia, Australia, ²CSIRO Land and Water, Dutton Park, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Brad is a postdoctoral research fellow at The University of Queensland studying the conservation and ecology of migratory shorebirds of the East Asian-Australasian Flyway in partnership with the Burnett Mary Regional Group, Queensland Wader Study Group, and Queensland Wetlands Program.

Migratory shorebirds are in steep decline in the East Asian-Australasian Flyway. Loss of intertidal habitat in the Yellow Sea has largely driven these declines, but wetlands in Australia are also threatened by disturbance, habitat loss, and habitat degradation. Threats at Australian non-breeding sites are likely to be contributing to flyway-level population declines, necessitating an improved understanding of how local conditions contribute to variation in abundance and trends. We evaluated how local factors (demographic, environmental, and anthropogenic) affect spatial variation in the abundance and population trends of migratory shorebirds in the Great Sandy Strait, a sand estuary that stretches 90 km along Queensland’s Fraser Coast and supports >25,000 migratory shorebirds each summer, including nationally significant numbers of Australia’s three critically endangered species: Eastern curlew, Great...
knot, and Curlew sandpiper. Analysis of count data collected by the Queensland Wader Study Group at >50 high tide roost sites from 1988-2018 revealed strait-wide average annual declines of at least -3.6%/year for 8 species, including Eastern curlew and Curlew sandpiper but not Great knot, whose abundance was stable. Initial results suggest a relationship between abundance and rate of decline, whereby large roosts have declined less severely than small roosts, and that the extent of intertidal habitat in proximity to roosts is positively correlated with abundance. These results are being used to identify the best set of management actions to implement and will be provided to government, local councils, and natural resource management bodies to aid in conserving and managing Queensland’s migratory shorebirds and their habitats.

Protected Area performance is about more than biodiversity

Dr Ali Chauvenet1, Mr Scott Atkinson2, Dr Vanessa Adams3, Prof Hugh Possingham4
1Griffith University, Gold Coast, Australia, 2University of Queensland, St Lucia, Australia, 3University of Tasmania, Hobart, Australia, 4The Nature Conservancy, Brisbane, Australia

Conserving imperiled species and ecosystems (1), Meeting Room 6, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Dr Chauvenet works at the interface of ecology, conservation and mathematics. She is interested in measuring the quality of protected areas, and promoting better decisions for land management in Australia and elsewhere.

There is a large focus on protected area (PA) expansion worldwide, mostly driven by the CBD Aichi targets, but there is not much thought given to the adequacy of the current PA system and whether it makes sense to expand it. The subject of PAs that underperform for conservation purposes, and what to do with them, is a controversial but important one. Fuller et al. (2010) investigated the performance of the PA network in Australia with regards to their cost-efficiency for biodiversity conservation and concluded that for the same cost, we could replace a percentage of “underperforming” PAs with some that deliver more for conservation. This is the first step towards answering the question of whether we should expand the current system or better manage it. However, there is more to PAs that just vegetation types. One aspect that has been overlooked is human preference and usage. While some PAs may underperform for conservation purposes, they could still be highly valued by the human population. As such they can contribute to the human-nature relationship critical for human health, but also the success of future conservation projects. Here we analyse the value placed by Australian and non-Australian visitors on Australian terrestrial PAs using social media and citizen science data, and reassess which PAs could truly be replaced from the Australian PA system given both human and biodiversity value.
A search for Leadbeater’s possums outside its known range, guided by SDMs and experts.

Ms Arabella Eyre1, Dr Pia Lentini1, Dr Natalie Briscoe1, Dr Dan Harley2, Dr Lindy Lumsden3
1The University Of Melbourne, Parkville, Australia, 2Zoos Victoria, Parkville, Australia, 3The Arthur Rylah Institute for Environmental Research, Department of Environment Land Water and Planning, Heidelberg, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Arabella Eyre is a Masters of BioSciences student at the University of Melbourne. She is interested in using innovative scientific approaches to conserve Australia’s threatened species.

Cryptic species are challenging to locate, and we often have a poor understanding of their distributions. A case in point is the Critically Endangered Leadbeater’s possum (Gymnobelideus leadbeateri), which was thought to be extinct for 52 years before its rediscovery in 1961. Historical records from outside its current known range suggest there may be additional undiscovered populations, and technological advancements now allow for more cost-effective surveys. We set out to locate additional Leadbeater’s possum populations and assess the suitability of survey sites for potential future translocations. To guide survey efforts we modelled the species’ distribution using MaxEnt, incorporating both contemporary and historical records. Our model predicted that high suitability areas were cold (<4.5°C in coldest months), had not been burnt in 15 years, and experienced high annual rainfall (>1400 mm). We combined model predictions with other criteria to narrow our search to specific regions. These regions were then assessed to identify survey sites, guided by information elicited from experts about the location of high-quality habitat. We deployed 154 motion-sensor cameras at 77 sites across eight regions, resulting in 6,102 trap nights. Five cameras yielded new Leadbeater’s possum sightings, but these records fell just outside the species’ traditionally accepted distribution. Hence, this population is unlikely to help safeguard the species from extinction due to expected future large wildfires. Instead, new insurance populations may be established in areas that are further removed from the Central Highlands; we are investigating the suitability of our sites for potential future translocations.

How quoll-ified are detection dogs?

Ms La Toya Jamieson1, Mrs Amanda Hancock2, Dr Greg Baxter1, Dr Peter Murray1
1The University Of Queensland, Gatton, Australia, 2Saddler Springs Education Centre, Injune, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
La Toya is a Ph.D. candidate at The University of Queensland. Her research focus is on improving the selection and management of working dogs, and exploring wildlife detection dog use in Australia.

Wildlife detection dogs are trained to non-invasively locate wildlife species (including plants) or their biological traces. Locating these individuals or samples can provide valuable information for environmental management. Whilst this methodology has been successfully used globally for several decades, the use of wildlife detection dogs is relatively novel in Australia. There is a poor understanding of their current use in Australia, and their accuracy and success during field surveys. Our research therefore aimed to improve our knowledge of this methodology to determine its benefits and possible future applications. Online questionnaires were distributed to current Australian wildlife detection dog handlers to collect information on their environmental work. Quoll detection dog teams were also accuracy assessed in simulated searches to determine their odour discrimination ability, and efficacy in comparison to human surveyors. Field surveys were also completed, in conjunction with camera trapping, for Northern quolls (Dasyurus hallucatus). The tested dog teams had an average sensitivity and
specificity of 100% and 98.4% for Northern quolls, and 100% and 98% for Spotted-tailed quolls (D. maculatus), respectively. The teams took on average 6.52 minutes to survey a one-hectare area for Northern and Spotted-tailed quoll scats, which was significantly faster than the human surveyor (p < 0.001). During field surveys, the detection dogs located confirmed Northern quoll scat in sites where camera trapping failed to determine species presence. Our research demonstrates the versatility and accuracy of wildlife detection dogs, and the benefits of their use in conjunction with traditional survey methods.

Health and Fitness Impacts of Chlamydial Infection in Koalas and Their Implications for Conservation

Mallory Wilson1, Dr Jonathan Hanger2, Jo Loader2, Deidre de Villiers2, Dr Amy Robbins2, Prof Kerrie A. Wilson3, Dr Hawthorne L. Beyer1

1University Of Queensland, St Lucia, Australia, 2Endeavour Veterinary Ecology Pty Ltd, Toorbul, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Mallory Wilson is an Honours Student at the School of Biological Sciences at UQ. She is interested in ecological and zoological research that has practical applications for wildlife conservation.

Koalas are a vulnerable species that are threatened by multiple factors including disease. Chlamydia has significant but variable health impacts on individuals, depending on factors such as the duration and site of infection (ocular versus urogenital). A mechanistic understanding of how these individual-scale effects develop over time and scale up to population-level processes is lacking but is essential for informing decisions about the value of disease control in koala management. We analysed a detailed, longitudinal (4 year) veterinary dataset of over 500 koalas from a population in southeast Queensland in order to: (1) estimate the relative frequency of ocular and urogenital disease among individuals and how that varies by sex and age; (2) examine evidence for vertical transmission from infected females to their joeys; (3) estimate the rates at which disease impacts within individuals arise, with a focus on mortality and infertility; (4) document the variation in rates of disease development among individuals; and (5) rates of re-infection of individuals following treatment by antibiotics to clear infection. We synthesize this information as a conceptual model that documents the key pathways linking disease locations to fitness outcomes. We then constructed a mathematical model of disease transmission and population dynamics, and used this model to quantify the link between disease control and population growth rates. We find substantial variability in the severity and rate of development of disease impacts among individuals that have important consequences for population dynamics.
Microhabitat use and spatial-temporal abundance of torrent frogs in Brazilian Atlantic forest: a long-term assessment

Ms Thais Sasso Lopes¹, Dr Laura Alencar², Dr. Marilia Gaiarsa³, Prof Marcio Martins²
¹Griffith University, Brisbane, Australia, ²University of São Paulo, São Paulo, Brazil, ³University of California, Riverside, United States

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
I am a PhD candidate at Griffith University. I completed a Bachelor in Biology and a Masters in Ecology at the University of São Paulo. I am interested in combining wildlife disease and modelling to explore amphibian communities dynamics.

Amphibians are among the most diverse vertebrates regarding geographic distribution. Spatial and temporal occurrences vary widely among species with some requiring specific habitat conditions. Based on long-term data, we described the microhabitat and the spatial-temporal abundance patterns of three torrent frogs endemic to the Brazilian Atlantic forest (Cycloramphus boraceiensis, Hylodes asper and Hylodes phyllodes). From 2007 to 2011, we performed monthly visual survey for post-metamorphic frogs within a 110 m transect at four streams in Núcleo Picinguaba, Southeastern Brazil. We classified microhabitats based on five environmental variables and investigated species abundance variation within and between streams, as well as along the year. We observed 6,556 encounters. All species were active mainly on wet or humid rocks without cover, and adjacent to the water. Inactive H. asper and H. phyllodes were mainly on dry leaves without moss. The abundances of C. boraceiensis and H. asper were significantly higher in the wet season, potentially reflecting a higher reproduction rate. Four stream aspects (land area, water area, slope and number of waterfalls) influenced species abundance variation among streams’ sections. Species abundance also varied across streams, with H. phyllodes being the only species in stream 2. This potentially reflects variation between streams habitat suitability. This key ecological information show that although three species use similar microhabitats, they vary in occurrence along and across streams, and during certain months due to abiotic factors. Our results contribute to the understanding of occurrence patterns of amphibians in a biodiversity hotspot while helping to guide future conservation management.

Can trading land clearing limits help biodiversity?

Dr Kate Helmstedt¹, Prof Matthew Potts²
¹Queensland University of Technology, Brisbane, Australia, ²University of California Berkeley, Berkeley, United States

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Kate is a mathematician at QUT using maths and economics to model and guide management of the environment

Deforestation on private land threatens biodiversity, even in areas with native habitat requirements stipulated by law. In some circumstances where deforestation limits are imposed, landholders can buy and sell land-clearing rights. While this strategy may prevent native habitat area loss, the spatial pattern of reserved areas will shift, creating novel landscape patterns. The resulting altered fragmentation and connectivity of habitat will impact biodiversity. Trading land-clearing rights may also allow landholders to earn rent on land they never intended on converting, resulting in additional deforestation elsewhere and net habitat loss.
We construct a simulation model to explore the potential implications for biodiversity when land-clearing rights can be traded, compared with the landscape resulting from enforced individual compliance with deforestation laws.

We find that where future deforestation is very likely, a rights market can provide better outcomes for both biodiversity and agriculture, resulting in more connected habitat networks with larger fragments and fewer edge effects. However, the market can be harmful if future deforestation is unlikely, or if one habitat type is tightly spatially correlated with high economic returns from agriculture.

Allowing landholders to buy and sell the rights to keep more cleared land than legally stipulated will result in transformed multi-use landscapes. Losses of native habitat in some areas will be offset in others. We conclude that trading forest development rights has the potential to improve habitat configurations, but that careful consideration should be given to current species distributions and likely future deforestation scenarios.

Exploring the barriers to evolutionary enlightened conservation

**Dr Carla Sgro¹, Dr Carly Cook¹**

¹School of Biological Sciences, Monash University, Melbourne, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Despite wide acceptance that conservation could benefit from greater attention to principles and processes from evolutionary biology, little attention has been given to quantifying the degree to which relevant evolutionary concepts are being integrated into management practices. There has also been increasing discussion of the potential reasons for a lack of evolutionarily enlightened management, but no attempts to understand the challenges from the perspective of those making management decisions. In this study, we asked conservation managers and scientists for their views on the importance of a range of key evolutionary concepts, the degree to which these concepts are being integrated into management, and what would need to change to support better integration into management practices. We found that while managers recognise the importance of a wide range of evolutionary concepts for conservation outcomes, they acknowledge these concepts are rarely incorporated into management. Managers and scientists were in strong agreement about the range of barriers that need to be overcome, with a lack of knowledge reported as the most important barrier to better integration of evolutionary biology into conservation decision-making. Although managers tended to be more focused on the need for more training in evolutionary biology, scientists reported greater engagement between managers and evolutionary biologists as most important to achieve the necessary change. Nevertheless, the challenges appear to be multifaceted, and several are outside the control of managers, suggesting solutions will need to be multidimensional.

Ups and downs of the endangered northern quoll: fluctuations in density on an island refugee

**Dr Skye Cameron¹, Ms Jaime Heiniger¹, Ms Natalie Freeman¹, Ass Prof Robbie Wilson¹**

¹University Of Queensland, St Lucia, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

I am an ecological, conservation and comparative physiologist. My research examines interactions between behavioural, physiological and morphological traits to further our understanding on how an organism’s performance relates to population-level processes, enabling better conservation practices in urban and wild habitats.
As small mammal populations continue to decline in northern Australia, baseline data on their ecology is more important than ever. Northern quolls (Dasyurus hallucatus) were once widespread across northern Australia, but are now listed as endangered due to marked declines over much of their range. Despite this, a few healthy populations have persisted, largely limited to islands where known threats are absent or operating at reduced levels. Groote Eylandt in the Northern Territory is Australia’s fourth largest island and is an important refuge for 12 threatened species, including northern quolls. Groote provides a unique opportunity to gain baseline data on natural fluctuations in population densities of northern quolls due to climatic variabilities and/or life history cycles. Over the last seven years we have conducted a tri-annual mark-recapture program on a population of northern quolls within a 128 ha region of rocky habitat. Sampling encompasses three important life stages of this species: pre-breeding, breeding and post-breeding. Although Groote has one of the highest recorded densities of northern quolls, our data shows that this population can fluctuate dramatically. Over the 7-year period, population density went from 0.49 quolls/ha in 2012 to 0.26 quolls/ha in 2015 (a decline of 47%), only to recover to 0.50 quolls/ha in 2018. Changes in population densities correlated with wet season rainfall, which may reflect shifts in resource availability. Such marked annual fluctuations in densities are likely due to the northern quoll’s semelparous breeding cycle. This information is vital for understanding how we assess and manage northern quolls.

Value of information for conservation planning

Dr William Morris

1The University Of Melbourne, The University Of Melbourne, Australia

Conserving imperiled species and ecosystems (2), Meeting Room 6, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Research Fellow at the University of Melbourne

Value of information (VOI) analyses indicate how beneficial new information is when addressing a decision problem. The field of spatial conservation prioritization has yet to embrace a method for assessing the value of new information to a spatial conservation plan. We demonstrate how a VOI analysis can be applied to a spatial conservation plan in a real-world setting. We show how a VOI analysis can be combined with traditional conservation planning tools to determine the benefit of new information about species distributions and optimize a reserve network to protect them. Optimally incorporating new information into conservation plans will reduce the loss of resources spent on unnecessary information gathering where new data has no or little benefit to the fundamental objectives of the plan. In our case study, we found that reducing uncertainty in threatened species distributions, by including new information, will increase the expected performance of a conservation plan allowing for a greater level of protection while maintaining the same cost of protecting habitat. The payoff of VOI analyses in conservation planning is that it allows the planner to identify three categories of conservation units: those that warrant investment by acquisition (or other conservation action) but not further information gathering, those that may warrant investment after further investigation and those that do not warrant investment in any conservation action nor in gathering more information.

Parrots in peril: Beak and Feather Disease Virus in wild Australian psittacines

Ms Johanne Marie Martens, Ms Helena Stokes, Dr Mathew Berg, Prof Ken Walder, Dr Michael Magrath, Prof Shane Raidal, Prof Andy TD Bennett

1Deakin University, Waurn Ponds, Australia, 2Zoos Victoria, Melbourne, Australia, 3Charles Sturt University, Wagga Wagga, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM
Infectious diseases are of major ecological concern, because they can have profound effects on host reproduction and survival, resulting in severe population declines. Beak and Feather Disease Virus (BFDV) affects parrots world-wide, and is listed as a “key threatening process to biodiversity” by the Australian Government. Due to human impact, parrots are considered as one of the most threatened bird groups globally. BFDV can cause chronic and often fatal disease. Data on BFDV prevalence, transmission dynamics and fitness impacts in wild populations are scarce, but vital to understand how the virus impacts wild hosts and what can be done to reduce these impacts. We collected over 500 blood samples from adult breeding Crimson Rosellas (Platycercus elegans), as well as their offspring at two ages in the nest over two breeding seasons. We also trapped and sampled from three other locally abundant psittacines, namely Galahs (Eolophus roseicapillus), Sulphur-crested Cockatoos (Cacatua galerita), and Eastern Rosellas (Platycercus eximius), and we continued to trap P. elegans throughout the year. BFDV infection was determined using quantitative real-time PCR. Preliminary results suggest that BFDV prevalence was much lower in breeding P. elegans and their chicks than in non-breeding birds, suggesting that reproductive success may be lower in infected birds. Prevalence and intensity of infection appear to vary between species, as well as seasonally. Prevalence seemed higher in summer, which may therefore be considered a high-risk time for BFDV transmission. Our findings can improve wildlife disease management and conservation of wild psittacines around the globe.
Queensland provenances had lower genetic diversity, whereas Sydney provenances presented higher genetic diversity likely due to hybridization with closely related Eucalyptus species. Further studies are necessary to evaluate whether hybridization contributes to psyllid susceptibility in E. moluccana and eucalypts in general.

**Determining habitat selection by plains-wanderer (Pedionomus torquatus): spatial scale of observation is important**

**Dr Nick Schultz**1, Dr Mark Antos2
1Federation University Australia, Ballarat, Australia, 2Parks Victoria, Melbourne, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Nick Schultz is a plant ecologist and lecturer at Federation University Australia, in Ballarat. He feels strange about his recent interest in grassland fauna.

The critically endangered plains-wanderer (Pedionomus torquatus) relies on native grasslands for its survival, and previous studies suggest they require open grassland structure. We analysed long-term monitoring (2009-present) of plains-wanderers and habitat variables in Riverine Plains grasslands to relate their habitat preferences to specific elements of grassland structure. Indeed, encounter rates of plains-wanderers declined dramatically after periods of high rainfall lead to high grass cover. Encounter rates recovered slowly as open grassland structure returned. We also compared three classes of grassland habitat assessments from a single year (2015/16): (1) randomly-located sites in paddocks with no recorded plains-wanderers, (2) randomly-located sites in paddocks with plains-wanderers, and (3) local scale habitat assessments at the precise locations within paddocks where plains-wanderers were recorded. At the local scale, plains-wanderers were recorded in areas with more open grassland structure—i.e. higher cover of bare ground and lichen, and lower cover of native grass and litter. However, native grass cover and bare ground were not significantly different between the paddocks with and without plains-wanderers, as has been previously assumed. Rather, the plains-wander paddocks were characterised by low litter and high herb cover, compared with non-plains-wanderer paddocks. The results suggest that plains-wanderers may select for paddock-scale factors that are not evident from the local scale data and analyses. Questions remain about the most critical aspects of plains-wanderer habitat, but our study demonstrates the importance of monitoring and analysing data at multiple spatial scales, and that this may be critical to our conservation management of these grasslands.

**Differences in alpine plant communities’ tolerance to human trampling: examples from the Patagonian Andes**

**Dr. Agustina Barros**1, Dr. Claudia Guerrido2, Mrs. Marcela Ferreyra3, Dr. Aschero Valeria1, Dr. Clara Pissolito4, Mrs. Ana Hernando Jiménez1, Mr. Maximiliano Cañiú5, Mr. Marcos Bladauskas5, Dr. Catherine Pickering6
1IANIGLA, CONICET CCT-Mendoza, , Argentina, 2Universidad Nacional de la Patagonia Austral, Río Turbio,, Argentina, 3Club de Naturalistas, Bariloche,, Argentina, 4Universidad Nacional de Río Negro, El Bolsón,, Argentina, 5Universidad Nacional del Comahue, Bariloche,, Argentina, 6Environmental Futures Research Institute, School of Environment and Science, Griffith University, Gold Coast,, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM
Biography:
Dr. Barros is a researcher at IANIGLA, CONICET in Argentina. Her research field is plant ecology, with a particular emphasis on mountain plant invasions and tourism disturbance on alpine vegetation in the Andes region.

Mountain protected areas are key mechanisms for conserving biodiversity while also providing opportunities for tourism and recreation. In areas such as Patagonia, hiking is popular, but has damaged some plant communities of high conservation value. We compared the tolerance, resistance and resilience, of four common alpine plant communities (two in meadows and two in dry sites) in the Northern Patagonian Andes in Argentina. Species cover and richness was recorded prior to trampling, 2 weeks and one year post trampling using a standardized experimental protocol in lanes subjected to different trampling intensities (none, 15, 30, 75, 120, 230 passes by hikers). Functional traits commonly used as indicators of disturbance were also measured for all species surveyed. Two weeks post trampling, species richness and cover had declined, but there was some recovery a year later. Thresholds from disturbance varied among communities, with the shrub-forb community in the dry site the most sensitive. Declines in plant cover were evident with as few as 30 passes while changes in species richness occurred after 75 passes by hikers. Tolerance to trampling was mainly determined by the traits of dominant species, with communities dominated by cushion shrubs that had low leaf tensile strength and moderate Specific Leaf Area the least tolerant to trampling. The results from this study highlight the importance of limiting trampling in these alpine plant communities, how slow such communities are to recover, and how functional traits can help explain patterns in species responses to disturbance.

Home-range Analysis of Varied Tit(Parus varius) in the post fledging period by Using Radio-tracking

Mr Seoungyeal Kim¹, Mr Whee-Moon Kim¹, Prof Wonkyoung Song¹
¹Dan-kook Univ, Cheonan-city, South Korea

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
2011-2017 University degrees (Landscape architecture)
2017~ Master's course

Only the habitat characteristics and breeding status of Paridae have been studied, in addition to the lack of research on Parus varius varius, there is no study on the home-range in the post fledging period. This study was analyzed the home-range size of Parus varius varius in the post fledging period. The survey was conducted in the site located in Dankook Univ. (Middle Chungcheong Province in South Korea). We captured five newborn Parus varius varius using artificial nest was installed before. Radio-tracking was carried out for analysis of home-range, and MCP (Minimum Convex Polygon). We analyzed 1 individual tracked 15 days (VT5) and 4 individuals which missing radio-tracking transmitter within 3 days (VT1~VT4). Home-range of VT5 gradually increased to 1.38ha, 1.42ha, 2.14ha in the order of early, middle, late period. On the other hand, moving distance was decreased to 174.558m 125.129m, 120.180m. Home-range of V1~VT4 was estimated as 0.81ha which was 75.3% share of home-range of VT5 in early period. As the result, home-range is formed far apart from artificial nest that has been influenced by human being interference, thereafter gradually adapting to interference and spreading close to artificial nest. After, we will analyze how their home-range are separated from parents. through this research, we can construct basic ecological data for protecting habitat of Parus varius varius and increasing life rate. As first radio-tracking study of Parus varius varius home-range in the post fledging period, it is expected to be useful for the future study of home-range.
Rapid assessment for prioritising threat status: using IUCN criteria to identify at-risk taxa

**Mr Tom Le Breton**1,5, Dr Heidi Zimmer1, Dr Rachael Gallagher2, Ms Michelle Cox1, Mr Stuart Allen2, Mr Tony D Auld1,4,5

1New South Wales Office of Environment and Heritage, Hurstville, Australia, 2Department of Biological Sciences, Macquarie University, Australia, 3New South Wales Office of Environment and Heritage, Regional Operations Group, Sydney, Australia, 4School of Biological Sciences, University of Wollongong, Wollongong, Australia, 5Centre for Ecosystem Science, University of New South Wales, Sydney, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Poster 021

The IUCN Red List criteria are a globally accepted method of assessing species extinction risk. Countries around the world are adapting these criteria for domestic use.

First, we compared trends in IUCN Red List criteria used in threatened plant species listings in Australia and globally. Second, using the state of New South Wales (NSW), Australia, as a study region, we conducted two complementary analyses: (1) An assessment of ~5000 currently unlisted NSW plant species against the thresholds for the geographic range criterion (Criterion B) to identify species which may require full assessment; and (2) A rapid assessment of currently listed threatened plant species, applying the IUCN Red List Critically Endangered thresholds for all criteria, to identify species likely to be at the highest risk of extinction from further decline. Impacts on these species could be considered to be "serious and irreversible impacts" (SAII).

Geographic range size was the most the common criterion used in Australia and globally. Our assessment of unlisted NSW plant species revealed 92 species that met the geographic range thresholds for Critically Endangered. Our rapid assessments of currently listed NSW threatened plant species identified 53.5% as being at increased risk of extinction should further decline occur. Of these, most were flagged under Criterion B (88.8%).

Geographic range is the major driver of threatened plant listings in Australia and globally. Geographic range and the other IUCN Red List criteria thresholds for Critically Endangered provide a useful framework to identify species at increased extinction risk from ongoing decline.

State and rates of mangrove fragmentation

**Mr. Dale Bryan-Brown**1,2, Prof. Rod Connolly1,2, Dr. Daniel Richards3, Dr. Fernanda Adame3,4, Dr. Chris Brown3,4

1Griffith University, Southport, Australia, 2Australian Rivers Institute, Southport, Australia, 3Griffith University, Nathan, Australia, 4Australian Rivers Institute, Nathan, Australia, 5National University of Singapore, Singapore, Singapore

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Dale is a PhD student at Griffith University, Gold Coast. His project focuses on mangrove dispersal, but he’s passionate about R (and other freely available data-processing software) as well as spatial data acquisition, management, analysis and communication.
Mangroves deliver important ecosystem services; including providing critical habitat for many coastal organisms, long-term Carbon storage, shoreline stabilization and improving coastal water-quality. The provisioning of these ecosystem services may be linked to the spatial arrangement of mangroves around coastlines. Habitat fragmentation is the process of changing the spatial arrangement of habitat patches through breaking up large, contiguous patches into smaller, more isolated patches. Mangroves are threatened in many areas of the world, with some areas experiencing losses as high as 1% per year. As such, considering fragmentation in mangrove habitats is a critical area of research.

We utilized high resolution, annually replicated Landsat derived estimates of mangrove density to assess rates of mangrove fragmentation globally for 12 years. Results indicate that areas with high rates of mangrove loss have experienced substantial shifts in mangrove habitat arrangement. However, the spatial arrangement of patches has remained relatively stable in some areas with high loss rates. The effect of loss is related to the specific habitat degradation that has occurred (entire patch/local deforestation or patch fragmentation). Regions dominated by mangroves are buffered against shifts in patch arrangement. Indicating that areas with fewer mangroves are more likely to suffer the ecological consequences of mangrove fragmentation, and need to be managed with greater care. We have also identified the influence of specific forms of degradation (aquaculture, urbanisation etc.) on mangrove fragmentation. This study is an important step in recognizing the threat that habitat fragmentation poses to coastal systems.

Understanding biomass dynamics for the management of grazing pressure in endangered Buloke (Allocasuarina luehmannii) Woodlands

Linda Riquelme\(^1\), A/Prof Peter Vesk\(^1\), Dr Libby Rumpff\(^1\), Dr David Duncan\(^1\)
\(^1\)The University Of Melbourne, Parkville, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Linda Riquelme is a PhD student in the School of BioSciences at the University of Melbourne. Her research interests range from plant ecology and conservation to remote sensing. Linda’s PhD focuses on herbivore management for regeneration of endangered Buloke Woodlands.

Ongoing grazing is threatening endangered semi-arid Buloke (Allocasuarina luehmannii) Woodlands of south-eastern Australia. Western grey kangaroos have been identified as a key component of total grazing pressure, inhibiting Buloke regeneration at high numbers. Although kangaroos graze preferentially on grass, it is thought that they switch to lower-quality browse, such as seedlings, when grass biomass drops to 400 kg ha\(^{-1}\). Managers at Wyperfeld National Park, north-western Victoria, carry out annual kangaroo culls, with targets based on population size; however, they are keen to incorporate forage availability into the management decision-making process. In order to understand the spatial and temporal dynamics of understorey biomass, biomass and species composition data were collected over 6 seasons from November 2016 to May 2018. Generalised Linear Mixed Models (GLMMs) were used to describe relationships between biomass and environmental variables, including soil moisture, overstorey canopy type, and dominant understorey vegetation. Biomass varied seasonally, with a peak recorded in early spring, after winter rains. The lowest level of biomass was recorded in autumn. Biomass also varied over vegetation types. Canopy type was found to influence the amount of biomass, with more biomass present in open areas than in woodland areas. Information on forage availability will allow managers to anticipate a decline to levels where high kangaroo numbers may threaten regeneration; forage information will also help refine their cull targets, allowing managers to more effectively manage the regeneration of this endangered Woodland Community.
Quantifying niche shift in declining species: The northern quoll as a case study

Mr Harry Moore¹, Assoc. Prof Dale Nimmo
¹Charles Stuart University, Albury, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
PhD candidate at Charles Stuart University. I'm interested in the impacts large scale disturbances such as fire and grazing have on intraguild interactions between predators.

Species range collapses are stark examples of the ecological consequences of anthropogenic change and are driven by interactions between focal species and a range of environmental factors. These interactions are highly complex, occur across multiple spatial scales, and are difficult to quantify. A concept commonly employed by ecologists to better understand these interactions is the niche reduction hypothesis, which recognises that heterogeneity in threat impacts across environmental space can result in reductions in the realized niche (the occupied space within a species theoretical niche) of a species. In this study, we apply the niche reduction hypothesis to investigate the recent decline of northern Australia’s largest marsupial predator, the northern quoll, Dasyurus hallucatus. We use a combination of species distribution modelling techniques and niche hypervolume comparisons to quantitatively define the realised niche width of northern quolls through time across four main populations (Pilbara, Kimberley, Northern Territory and Queensland). We then examine how northern quolls respond spatially and temporally to environmental variables thought to be ecologically significant. Our results support a series of anecdotal trends, suggesting the contemporary niche of northern quolls is reduced from the historical niche, and characterized by high topographical ruggedness and proximity to permeant water; attributes previously identified as key components of optimal quoll habitat, most commonly manifested in the form of rocky outcrops or ranges. We suggest two main reasons for the contractions to this area: increased protection from climatic exposure and predators and an increased diversity of vertebrate and invertebrate prey, facilitated by augmented floristic diversity.

Multi-scale modeling identifies threats and conservation opportunities for the Sunda clouded leopard

Dr. Helen Bothwell¹,², Dr. David Macdonald¹, Dr. Andrew Hearn¹, Dr. Susan Cheyne¹,³, Iding Haidir¹,⁴, Luke Hunter⁵, Dr. Zaneta Kasztala, Matthew Linkie⁶, Dr. Ewan Macdonald¹, Joanna Ross¹, Dr. Samuel Cushman¹,⁷
¹WildCRU, University Of Oxford, , United Kingdom, ²Australian National University, Canberra, Australia, ³Borneo Nature Foundation, , Indonesia, ⁴Kerinci Seblat National Park Management Authority, , Indonesia, ⁵Panthera, New York, USA, ⁶Wildlife Conservation Society, Indonesia Program, , Indonesia, ⁷Rocky Mountain Research Station, United States Forest Service, Flagstaff, USA

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Dr. Bothwell works at the intersection of spatial statistics, landscape ecology, and genomics. Her research aims to provide insights into the environmental and anthropogenic factors structuring species and genetic variation across the landscape, with the goal of informing conservation management.
Clouded leopards are among Asia’s most widely distributed felids, but also amongst its least known and most vulnerable. Clouded leopards occur in some of the most rapidly disappearing forests in the world, yet a comprehensive assessment of their status and habitat use is lacking, which in turn limits identification of their priority conservation needs and capacity to act as umbrella species for conserving associated forest biodiversity. To address this need for the Sunda species (Neofelis diardi), we applied multi-scale modeling to identify both key environmental variables influencing habitat use and optimal scales of relationship with these variables. We detected clouded leopards at 18.3% of 1,544 camera stations and 17 of 22 sampling locations on the islands of Borneo and Sumatra. Multi-scale GLMM revealed that recent forest loss and large-scale plantations strongly and negatively influence clouded leopard detection. Our findings also suggest that higher elevations and ridges are important components of N. diardi habitat use. We illustrate how scale optimization of habitat use can provide critical information for characterizing the requirements of protected areas, and identify core habitat patches and connectivity gaps in need of future protection. Our findings indicate greater challenges facing clouded leopards on Sumatra, including higher poaching pressure, greater fragmentation, and roughly half the habitat area available to N. diardi on Borneo. This research contributes vital insights to assist in prioritizing habitat conservation networks for the protection of this vulnerable felid and the forest biodiversity for which it is an ambassador species.

Using automated acoustic recognition to monitor the endangered black-throated finch (*Poephila cincta cincta*)

**Mr John Van Osta¹, Mr Brad Dreis¹**  
¹E2M Consulting, West End, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

John is a terrestrial ecologist at E2M consulting. John conducts ecological assessments that address Commonwealth, State and Local Government legislative requirements. John is also completing an MPhil (research) on threatened species likelihood of occurrence assessment at The University of Queensland.

Remote acoustic monitoring combined with automatic recognition of target signals potentially provides an efficient, robust and unobtrusive method to monitor certain threatened species. We investigated the use of automated signal recognition techniques combined with bioacoustic recording devices to monitor the endangered black-throated finch (BTF) (*Poephila cincta cincta*). Our case study demonstrates an industry application of automated acoustic recognition in threatened species monitoring and the opportunities and challenges faced.

We simultaneously monitored known BTF habitats using automated signal recognition and human observers to compare detection rates of BTF. Human observers were found to have a higher BTF detection rate than automated recognition, primarily because i) BTF did not call when in range of the bioacoustic recorder; or ii) the target BTF call signal was not detected by our automated recogniser.

While automated recognition did not detect BTF presence as reliably as human observers, the method was found to be viable to detect BTF presence at sites that may be infrequently used by BTF and are impractical to manually monitor through in-field human observers or manual screening of acoustic data.
A cost-effective conservation planning combining strict protection and sustainable use for Brazilian Pampa's biome

Dr Daniela Oliveira de Lima1,2, Dr Renato Crouzeilles2,3, Dr Emily Nicholson4, Dr Marcus Vinícius Vieira2
1Campus Cerro Largo, Universidade Federal da Fronteira Sul, Cerro Largo, Brazil, 2Laboratório de Vertebrados, Departamento de Ecologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil, 3Rio Conservation and Sustainability Science Centre, Department of Geography and the Environment, Pontifícia Universidade Católica, Rio de Janeiro, Brasil, 4Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Melbourne, Australia

Conserving imperiled species and ecosystems (3), Meeting Room 6, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Dr. Lima is a lecturer in south of Brazil interested in conservation of Atlantic forest and Pampa biomes. She focuses her research in an ecotone area between these two biomes. She is now on a postdoc intern at Deakin University.

This study presents a Systematic Conservation Planning for the Brazilian Pampa biome, one of the most threatened areas in South America. Our goal is to present three scenarios where at least 17% (Aichi target for terrestrial lands) of the biome’s 12 types of vegetation were protected. These three scenarios differ in their percentage of strict protection (SP) and sustainable use (SU) areas. Cattle density, urban and rural areas were used as priorization costs aiming at minimizing possible human–conservation conflicts. The study area was divided in 1,510 hexagons (~10,000ha). This priorization was done through the software Marxan with zones. Four main areas were pointed as priorities: (1) the northwest, (2) the west, adjacent to the Ibirapuitã SU protection area, (3) the center and (4) south of the Rio Grande do Sul state. In the first scenario (5% SP/ 12% SU) 379 planning units were selected (137 SP/ 242 SU). In the second scenario (10% SP/ 7% SU) 376 planning units were selected (230 SP/ 146 SU). In the third scenario (15% SP/ 2% SU) 419 planning units were selected (338 SP/ 81 SU). The higher number of planning units selected in the last scenario provides evidence on how deficient in SP areas the current protected area network is, since a larger number of planning units had to be added to the current network to meet a more rigorous goal for this protection zone. SP areas should be prioritized, as they use to deliver better conservation results comparing to SU areas.

Wildfire plus climate change–type drought: how much can a forest stand?

Mr Lewis Walden1, Dr Joseph Fontaine1, Dr Katinka Ruthrof1,2, Dr George Matusick1, Prof Richard Harper1
1Murdoch University, Murdoch, Australia; 2Kings Park Science, Kings Park, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Lewis Walden is a PhD student researching the double disturbance effects of drought and fire on forest stand structure. Disturbance ecology and fire ecology are his main interests, particularly plant community response to the impacts of multiple stressors.

Forest disturbance events have become more prevalent and are predicted to increase in frequency and severity with a changing climate. These events can have profound impacts on forest stand structure and function. While the impact of single disturbance events has been well documented, the combined effect of drought + fire, and how they may interact, remains a pressing, yet largely unanswered question, particularly for non-coniferous forests.
A factorial design of plots in eucalyptus–dominated forest in southwestern Australia was established following a 2016 wildfire. There had been previous episodes of drought in this forest. Thirty-six plots were split across two levels of pre-fire drought impact (high and low) and two levels of fire severity (canopy scorched and canopy consumed). Data were collected on tree and shrub survival, regeneration, woody debris, stumps and soil carbon.

Preliminary results suggest that the largest tree mortality occurred in areas of high drought impact plus high severity fire. Forest experiencing lower fire severity and drought impacts resprouted more vigorously than the high severity plus drought affected sites. These lower disturbance severity sites also had many more seedlings and resprouts than higher severity sites.

Mediterranean-type eucalypt forests, long regarded as strongly fire resilient, may be undergoing significant changes in stand structure due to multiple, interacting stressors of varying severities such as drought and wildfire. Given the prediction of more frequent and more intensive fires and droughts, the results from the study may provide an insight into how the forest may respond under a changing climate.

Mortality and post-fire resprouting in Eucalyptus forests is modified by drought and fire frequency

Mr Eli Bendall1, A/Prof Matthias Boer2, Dr Luke Collins3,4, A/Prof Andrea Leigh5, Prof Ross Bradstock1

1Centre for Environmental Risk Management of Bushfires, University Of Wollongong, Wollongong, Australia, 2Hawkesbury Institute for the Environment, Western Sydney University, Richmond, Australia, 3La Trobe University, Melbourne, Australia, 4Arthur Rylah Institute for Environmental Research, Melbourne, Australia, 5School of Life Sciences Ecosystem Security Team, University of Technology Sydney, Ultimo, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Eli Bendall is a PhD student at the University of Wollongong. His work focuses on the responses of eucalypt forests to fire and drought, with particular attention to the drivers of mortality and recruitment.

Rapid anthropogenic climate change poses a significant threat to forest biodiversity, with increasingly severe and frequent disturbances contributing to the degradation of forest condition across the globe. Increased drought and fire may push resilient forests into unknown ecological territory. Eucalypts are the dominant canopy trees in southeastern Australian forests, where post-fire resprouting is the main regenerative strategy developed to survive disturbance. Our study examines the interactive effect of fire frequency and drought on eucalypt mortality and resprouting syndrome (epicormics vs basal) on ridgetops and gullies of the Sydney region. There were differences in the response of eucalypts to fire and drought between ridges and gullies. On ridgetops, stem mortality was greatest in areas that experienced a combination of frequent fire and severe drought. Crown dieback was highest in frequently burnt areas that experienced mild drought, but was mostly limited to ridgetops, suggesting that species in severely droughted areas of the study region may be better adapted (e.g. thicker bark) to cope with disturbance. There was a higher proportion of basal resprouting in frequently burnt, severely droughted areas, suggesting that drought–fire interactions have the capacity to change tree morphology. The increase in mortality and shift toward smaller, multi-stemmed trees found in this study suggests that drought and frequent burning can induce state changes in highly resilient forests. These relatively rapid changes occurring across a large part of the Sydney region need to be contrasted with data from other bioregions to further understand the contributions of local and region drivers.
Local adaptation to climate in Sydney sandstone plant species

**Mr Thomas Pyne**, Dr Rachael Gallagher, Dr Marlien van der Merwe, Dr Hannah Mcpherson, Dr Maurizio Rossetto
1Macquarie University, Ryde, Australia, 2National Herbarium of New South Wales, Sydney, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**
I have just completed a Masters of Research at Macquarie University. I am interested in how species adapt to climate variation across their range.

Plants have limited options for responding to anthropogenic climate change: migrate to new environments through dispersal, adapt to changes through phenotypic plasticity or genetic change, or risk extinction. As dispersal ability may be limited – making migration less feasible – many plants will rely on their capacity to adapt to new conditions. With adequate selective pressures and gene flow, genotypes adapted to local conditions may persist in populations leading to local adaptation. The benefits of local adaptation in a rapidly changing climate are important to understand for conservation planning and restoration ecology.

My research findings indicate that the climate of a parent population directly impacts the germination optimum of Banksia serrata (L.f). and Acacia suaveolens (Sm.) Willd. These preliminary results may indicate some level of germination adaptation to temperature, potentially as a defense against heat waves or frosts.

A. suaveolens and B. serrata occur across much of the east Australian coast and there is spatial heterogeneity of climate across their ranges. In my research, I specifically tested for local adaptation to temperature using experiments on populations located across the strong mean annual temperature gradient between the Central Coast and Blue Mountains regions of NSW. Germination and early establishment of seeds has been tested in both growth chambers and in glasshouse settings. The findings of my work will be relevant to climate change adaptation planning for sandstone flora species and for the improvement of restoration practices.

Higher order interactions regulated by drought result in selection in semi-arid annual plants

**Dr. Abigail Pastore**, Ms Trace Martyn, Dr. Thomas Guillerme, Dr Margaret Mayfield
1University Of Queensland, Brisbane, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**
Abigail Pastore studies eco-evo feedbacks and plant-soil feedbacks. She aims to understand species interactions in a changing world.

Species interactions are recognized to have non-linear effects on density, known as higher order interactions (HOIs). But HOIs are rarely quantified though they can have significant effects on population dynamics. In an annual plant system in Western Australia, HOIs affect the fecundity of many species, which could result in selection on populations. We quantified HOIs between individuals, and looked for selection on the traits of several plant species by using fecundity as a proxy for fitness. This experiment was performed in an extreme drought year, and a watering treatment was also implemented, allowing us to test how drought changes the selection regime experienced at the individual level. Here we show that HOIs between plants and drought interact to regulate selection on plant traits. This indicates that complex selection pressures are mediating community composition and extreme weather events will be important for the preservation of this diverse but threatened community.
Applying time to our understanding of plant thermal tolerance

Ms Alicia Cook¹, Associate Professor Andrea Leigh¹
¹University of Technology Sydney, Ultimo, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Alicia Cook is a PhD candidate at the University of Technology Sydney with a passion for how plants survive extreme conditions. Current research focuses on the temporal variation of desert plants ability to tolerate and recover from extreme high temperatures.

Assessing plant thermal tolerance seems fairly straight forward. Expose a plant to a range of temperatures, measure response, calculate a metric and compare among plants. However, generalising thermal tolerance to a broader context is a more difficult task. One often overlooked limitation is that temperature is time-dependent. To assess thermal tolerance, methods typically keep the stress duration constant. But the same duration is not used in every study, compromising comparisons across studies or to naturally occurring stress durations. Therefore, a single metric can only describe part of the story of plant thermal tolerance. Understanding these limitations and testing thermal tolerance at varying duration may help expand this story.

Here, we adapted the Thermal Tolerance Landscape framework used in animal studies to incorporate standard T50 threshold tolerance metric measured at varying test durations. The slope of the log-linear relationship between the T50 threshold and duration creates the thermal sensitivity parameter, calculated here for the first time in plants using two Australian desert species. For Myoporum montanum, thermal sensitivity fluctuated over summer and displayed greater sensitivity to changes in stress duration than Eucalyptus socialis. Because of the differences in thermal sensitivity to duration, two species can have different thermal tolerance temperatures (Δ1°C) at a 15 min duration but converge at a shorter duration (e.g. 5 min). The addition of time to thermal tolerance concepts may help advance our understanding of how plants survive extreme high temperatures under varying conditions and widen the applicability of the thermal tolerance metric.

Transgenerational Plasticity for Drought Tolerance in Invasive Plants

Claudia Crowther¹, Prof Stephen Bonser¹
¹University Of New South Wales, Cowan, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Claudia completed her honours thesis in 2018 in the Bonser lab and is planning on continuing her studies in evolutionary ecology.

Understanding the mechanisms by which plants adapt to stressful environments is a major goal for plant ecologists. Recently it has been suggested that adaptive transgenerational plasticity may play a role in plant responses to stress. It has also been theorised that transgenerational plasticity may improve the capacity of invasive plants to colonise novel ecosystems. However these ideas have not been tested using ecologically relevant populations experiencing stress on a regional scale. Here we determine the ability of three invasive plant species to express adaptive transgenerational plasticity for drought tolerance. Additionally, we compare levels of transgenerational plasticity in populations of the same species growing in mesic and drought-prone conditions. Our results suggest that transgenerational effects are common in herbaceous plants and may contribute to the success of plant invasions. However these effects are not always adaptive and may be costly to express.
Seasonal change of thermal tolerance and proteins in Australian desert plant species

Ms Kirsty Milner1, Dr Steve Van Sluyter2, Prof Kris French3, Associate Prof Stella Valenzuela1, Associate Prof Andy Leigh1
1University Of Technology Sydney, Sydney, Australia, 2Macquarie University, Sydney, Australia, 3University of Wollongong, Wollongong, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Poster 059 - Kirsty is a final year PhD candidate interested in plants and how they cope in extreme conditions. She is looking to address questions surrounding the costs of heat stress and thermal tolerance.

Plants in Australia’s southern arid zone experience a wide range of extreme temperatures, from -4.5 °C in winter to 48.1 °C in summer and show plasticity in their thermal tolerance thresholds, with the ability to shift photosynthetic thresholds upwards 5 °C from winter to summer. An understanding of how they are able to make these seasonal threshold adjustments is required. With a new absolute protein quantification method, we have the opportunity to identify protein changes that may explain this ability. Three species of desert plants, from different functional groups, were grown in an experimental garden in arid South Australia. Sampling occurred in winter, spring and summer where the assessment of thermal tolerance included a series of temperature assays for photosynthetic thermal tolerance (T₅₀, using chlorophyll fluorescence) and membrane stability (Tcrit, using electrical conductivity). Protein identification and absolute quantification used a new extraction method and QconCAT-spiked samples coupled with MS/MS and SWATH acquisition. All species were able to adjust thermal tolerance thresholds upwardly from cooler to warmer months, with membrane thermal tolerance always higher than photosynthetic thermal tolerance. However, the changes seen in proteins differed depending on plant species and the protein of interest. This unique exploration of temporal protein changes provides insight into acclimatisation mechanisms used by Australian desert plants to cope in difficult climates.

How does structural complexity affect ant foraging decisions?

Ms Caitlyn Drayton-taylor1, Dr Tanya Latty1, Assoc. Prof. Dieter Hochuli1
1University Of Sydney, Camperdown, Australia

Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Poster 047 - Caitlyn Drayton-Taylor is a PhD student at the University of Sydney interested in insect decision-making. She is currently researching how pollinators make multi-attribute decisions when foraging within and between floral patches.

Ecological interactions and foraging behaviours can be mediated by the structural complexity of habitats. I investigated the effects of complexity on foraging decisions, discovery time, species richness and persistence in ant species using artificial 3D printed environments. To examine the effects of complexity on the foraging behaviour of ants, I identified morphospecies of ants that arrived at the bait during a two-hour period, noting which species arrived at baits first, and which ones ultimately remained on the baits after 2 hours. Twelve species were recorded foraging on the discs, of which three provided sufficient observations for further analyses; Meat ants Iridomyrmex purpureus, Green-headed ants Rhytidoponera metallica and Pheidole sp., which were more often observed in simple, complex and intermediate treatments, respectively. There was an increase in species richness with increased complexity; however, a drop-off occurred in the most complex treatment. Iridomyrmex purpureus abundance decreased with complexity and Rhytidoponera metallica abundance increased. Size was not an indicator of which species used more complex or simple routes. My results suggest that complexity...
can have opposite effects on foraging choices in ant species potentially resulting in changes to community structure.

My experiments highlight the how fine-scale complexity can influence foraging choice by ant species. My results show the importance of understanding species-specific drivers affecting the ecology of dominant species within an area.

**Thermal variability, arboreality, and vulnerability to climate change in a rainforest ant community.**

**Ms Lily Leahy**, Associate Professor Brett Scheffers², Prof Alan Andersen³, Dr Ben Hirsch¹, Prof Stephen Williams¹

¹James Cook University, Townsville, Australia, ²University of Florida, Gainesville, USA, ³Charles Darwin University, Darwin, Australia

**Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM**

**Biography:**
Lily Leahy, PhD candidate, Zoology/Ecology, James Cook University. Previous published research on northern mammal decline. Lily is currently investigating the influence of thermal variability in space and time on species vulnerability to climate change, focusing on arboreal rainforest communities.

Climate variability is an important factor influencing species sensitivity to climate change. The climate variability hypothesis predicts that high climate variability in temperate regions selects for thermal generalists with broad distributional ranges, in relation to both latitude and elevation. Conversely, tropical species experience low climate variability and are predicted to be thermal specialists, with narrow ranges. Tropical species are therefore forecast to be more sensitive to anthropogenic climate change than are their temperate counterparts. However, tropical forests have under-appreciated microclimatic variability in the form of a vertical gradient of thermal microhabitats – the canopy is a more extreme and highly variable microclimate compared to the forest floor. Therefore, arboreal species might be expected to show less thermal specialisation than do ground-foraging species, and therefore have broader distributional ranges. My project tests this prediction in the Australian Wet Tropics Bioregion. Ants were sampled using baited vials along the vertical gradients represented by 60 trees at 15 sites along four elevation gradients: Finnegan, Windsor, Carbine and Atherton. I will describe compositional differences between ground and arboreal ant communities, and will compare distributional ranges between ground and arboreal species. I will then discuss these findings in the context of predicting the vulnerability of rainforest ant species to climate change.

**Fungal communities in the ant-plant Myrmecodia beccarii differ between ‘waste’ and ‘nursery’ chambers**

**Ms Melinda Greenfield**, Dr Lori Lach¹, Dr Leho Tedersoo³, Dr Sten Anslan³, Professor Joseph Holtum¹, Dr Bradley Congdon¹, Dr Sandra Abell²

¹James Cook University, College of Science & Engineering, Cairns, Australia, ²Australian Tropical Herbarium, James Cook University, Cairns, Australia, ³Natural History Museum, University of Tartu, Tartu, Estonia

**Drought Impacts and Thermal Tolerance, Meeting Rooms 4-5, November 27, 2018, 1:30 PM - 3:30 PM**

**Biography:**
Melinda Greenfield, PhD candidate at James Cook University, is interested in interactions involving fungi and other organisms. She currently studies fungi and its potential role in the ant-plant mutualism between the plant Myrmecodia beccarii and its resident ants Philidris cordata.
Ant-plants are useful systems for investigating the evolution and maintenance of mutualistic associations. The epiphytic ant-plant *Myrmecodia beccarii* has a domatia with a network of tunnels and chambers in which its resident ant colony lives. This domatia also contains a microcosm of other organisms, including fungi. Fungi were first observed in this species of ant-plant almost 40 years ago but until now, the identity of these fungi and their possible role in this ant-plant mutualism have never been investigated. We surveyed the fungal communities in the domatia chambers of *M. beccarii* from five locations across 1000 km in north Queensland. These included ‘waste’ chambers, where ant workers defecate and deposit dead ants, and ‘nursery’ chambers, where the brood of the colony are kept. Fungal DNA samples from the chambers were extracted and sequenced using third-generation sequencing to identify whole fungal communities. A total of 377 fungal operational taxonomic units (OTUs) were assigned to the sequences obtained based on 97% similarity. This allowed a comparison of the fungal communities present in the different chambers across the distribution of *M. beccarii*. We established that the fungal communities in the ‘waste’ chambers are distinct from those in the ‘nursery’ chambers, suggesting fungi play different roles in each of the chamber types. This pattern of fungal specificity in the different chambers is constant across the 5 locations surveyed, suggesting fungi have a long association with this ant-plant mutualism.

Circadian rhythms enable efficient resource selection in a human-modified landscape

Manuela Fischer1, Dr Milena Stillfried2, Dr Pierre Gras3, Dr Duncan Sutherland3, Dr Stephanie Kramer-Schadt3, Associate Professor Graeme Coulson4, Dr Julian Di Stefano1

1School of Ecosystem and Forest Sciences, University of Melbourne, Creswick, Australia, 2Department of Ecological Dynamics, Leibniz Institute for Zoo and Wildlife Research, Berlin, Germany, 3Research Department, Phillip Island Nature Parks, Summerlands, Australia, 4Department of BioSciences, University of Melbourne, Parkville, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Manuela’s background is in applied ecology, with an emphasis on mammals and a passion in studying carnivores. Manuela’s research was in some ways always linked to conservation, human-wildlife interactions, telemetry, movement ecology and spatial modelling.

Animals inhabiting fragmented landscapes access resources such as food and shelter, but acquiring these resources in human-modified landscapes can be risky. Some animals are able to mitigate these risks by adjusting their spatiotemporal patterns of resource selection. Phillip Island is a human-modified landscape and supports an abundant population of swamp wallabies but little is known about how they select resources in such landscapes to persist. We developed custom-made GPS trackers to gather data of 48 swamp wallabies to compare the use of landscape features to their availability, generated by simulated random walks. We investigated which features were selected by wallabies and created habitat-suitability maps to identify areas of use and avoidance depending on the level of human disturbance. At daytime, wallabies were more likely to be found within natural landscape features such as woodland, wetland and coastal vegetation, while avoiding more risky features (roads, housing, waterbodies and farmland), but those features were selected more at night. Habitat suitability maps showed that in human-modified landscapes, features likely to provide food and shelter are important for wallabies during the day when risky landscape features were avoided, but that these patterns change at night. Our results indicate that wallabies show behavioural flexibility to access resources in a human-modified landscape by selecting different landscape features during day or night. We insist that behavioural flexibility might enhance the persistence of species in landscapes where resources are fragmented and disturbed and that it is important to consider circadian behaviour variations to implement successful management actions.
The Laughing Kookaburra, impacted by a complex set of 'synergistic wicked problems', highlights human-wildlife conflict.

Ms Diana Kuchinke
1Federation University, Mt Helen, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Diana has recently submitted her PhD thesis 'Investigating bird responses to fire in the Heathy Dry Forests of Victoria, Australia'. She is now busy writing papers.

Human-wildlife conflict is a growing issue in conservation. Australia has the dubious honour of being a front-runner in faunal extinction rates. Further, range retractions result in localised extirpations. These problems are exacerbated when conflict arises, when human needs are at odds with fauna requirements, requirements that are essential for their ongoing survival. The drop in abundance of the Laughing Kookaburra, down the entire east coast of Australia, highlights the issue of human-wildlife conflict. This common species is impacted by a complex set of ‘synergistic wicked problems’ – problems that seems unsolvable, with one of the problems linked to a changing climate. Land clearing extent in Queensland and NSW removes suitable Laughing Kookaburra habitat, permits to control this species have been issued in Victoria and the label of ‘exotic species’ exists for Laughing Kookaburras in Tasmania and Western Australia. Overarching these issues is a further pressure, related to fire frequency. Recent studies have shown that the Laughing Kookaburra drops in abundance in dense regrowth vegetation post-fire. Further, they may be impacted in this dense vegetation by competitive exclusion with Grey Currawongs. The latter result aligns with another study that highlighted a drop in basking prey in dense regrowth - these two birds are therefore competing for a reduced food source. As fire events increase in frequency and land-use changes reduce nest site options, the Laughing Kookaburra may be even further restricted in range and its mainstay may become open landscapes, with trees old enough to hold nest hollows.

Optimal resource reallocation among ecological management projects

Mr. Chung-huey Wu1, Dr Aaron Dodd1, Dr Cindy Hauser1, Prof Michael McCarthy1
1University Of Melbourne, Parkville, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Chung-Huey is passionate about applying operation research and decision science in tackling environmental challenges. He currently focuses on adaptive resource allocation in conservation and biosecurity management. He is also interested in AI-augmented decision support for sustainability and social goods.

Conserving biodiversity and combating bio-security risks require cost-effective allocation of limited resources among management projects. Project priorities, however, can be stochastic and dynamic as underlying social-ecological systems progress, novel priorities emerge, and our management capabilities evolve. Reallocation of existing budget in response to shifting priorities could improve management outcomes and address emerging demands in time.

Resource reallocation, however, could incur transaction costs, require project monitoring and reassessment, and be constrained by operational, financial, and institutional flexibility. Such complexities may refrain managers from considering reallocation strategies. An analytic framework for optimal reallocation is needed but still lacking.
We propose a general framework, based on iterative return-on-invest estimation and portfolio optimization, that guides optimal resource reallocation among ecological management projects. The framework extends existing optimal allocation methods to consider costs and constraints in reassessment and reallocation, and provides a decision-support protocol for managers.

Applying the proposed framework, we found that regular budget reallocation could improve the management of stochastically emerging invasive weeds in Australia, reducing weed risk by up to 22.5% compared to a static budget. On the contrary, budget reallocation in a case study of threatened Australian birds brings no benefits, and may even risk more extinction if substantial funds are required for reassessment.

Resource reallocation can be an effective yet underappreciated strategy for ecological management. Structured analysis of costs, benefits and constraints of reallocation would help inform managers about the value of adopting an adaptive project portfolio and develop an optimal and practical reassessment-reallocation schemes.

The effects of vertebrate engineers on terrestrial ecosystems: a global meta-analysis

Max Mallen-Cooper¹, A/Prof Shinichi Nakagawa¹, Prof David Eldridge¹
¹University Of New South Wales, Kensington, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Max is a second-year PhD candidate who usually explores the impacts of climate change on biocrust communities, but also does some meta-analyses on the side relating to macroecology.

Organisms that disturb soils while foraging for food or creating shelter (ecosystem engineers) have surprisingly extensive effects on ecosystem processes. The general notion is that soil disturbances capture eroding nutrients and seeds and develop into localised hotspots of biological activity. At the landscape scale, these localised disturbances are thought to create a heterogeneous mosaic of patches, particularly in nutrient-poor systems, with important implications for biodiversity. We undertook the first global meta-analysis of the effects of vertebrate engineers on terrestrial ecosystems using 150 published studies, which included 64 engineer species. We found that vertebrate engineers significantly enhanced soil nutrients and plant recruitment, and this effect substantially increased with increasing aridity. Soil disturbance also increased the cover of bare soil and reduced plant abundance, which might explain a common perception that vertebrate engineers degrade landscapes. This finding, however, represents a bias in the literature, because approximately 75 % of studies reporting these particular properties took measurements within the first year of the disturbance, which is generally too soon for disturbances to accumulate nutrients and enhance productivity. We present a novel conceptual model that emphasises the different timescales on which engineering effects occur. Our results affirm the hypothesis that soil disturbances develop into biological hotspots, providing strong evidence that the extermination or loss of vertebrate engineers can substantially alter ecosystem functioning.
Conserving migratory birds in human-dominated landscapes

Ms Micha V. Jackson1, Dr Chi-Yeung Choi1,2, Prof Richard A. Fuller1
1School of Biological Sciences, The University Of Queensland, Brisbane, Australia, 2Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Geelong, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Micha is a PhD candidate at the University of Queensland with an interest in using migration ecology to inform conservation in human-dominated landscapes. Before starting her PhD Micha spent 7 years working to support Indigenous land management in northern Australia.

Much of the world’s wildlife must find habitat for at least part of its life within human-dominated landscapes, including the coastal migratory shorebirds of the East Asian-Australasian Flyway (EAAF). Shorebirds’ non-breeding behaviour is largely governed by the tide, with extensive use of intertidal flats at lower tides and movement to supratidal areas at higher tides. But enormous development pressure has resulted in extensive loss, degradation and transformation of both the intertidal and supratidal habitats that shorebirds rely on. As a result, we found that artificial wetlands including aquaculture, agriculture, salt and power production, ports, undeveloped reclamation and wastewater treatment areas now support shorebird aggregations at more than 60 sites in the EAAF. The presence of 77 species on at least one artificial site, and the similarity in species composition across most land use types, indicate that artificial habitats act as a fairly stable “novel ecosystem” across the flyway. Nonetheless abundance varies widely across land uses (for example, mean shorebird abundance was >11,000 at undeveloped reclamation sites and <200 at agriculture sites). Artificial habitats are also used by many species primarily as roosting (rather than foraging) habitat, meaning intertidal habitat also remains vital, but because artificial sites are generally not specifically managed for waterbirds, there is a threat that land use change could cause many to be lost as shorebird habitat without their importance being recognised. These findings necessitate joined-up conservation and management of artificial wetlands and natural intertidal flats to help arrest current shorebird population declines.

Halimeda algal bioherms: a critical inter-reef habitat to support ecosystem function and biodiversity

Ms Mardi McNeil1, Dr Luke Nothdurft1, Mr Alan Pearse1, Dr Jody Webster2, Dr Robin Beaman3, Dr Jennifer Firn1, Dr Roland Pitcher4
1Queensland University Of Technology, Brisbane, Australia, 2The University of Sydney, Sydney, Australia, 3James Cook University, Cairns, Australia, 4CSIRO Oceans and Atmosphere, Brisbane, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Mardi is a PhD candidate in the School of Earth, Environmental and Biological Sciences. Her interest is in cross-disciplinary research in marine geoscience, specifically biogenic carbonate sediments and structures at various spatial scales from calcareous epiphytes to bioherms and reefs.

Tropical marine habitat mapping and biodiversity studies have primarily focused on easily accessible coastal and shallow coral reef habitats, with efforts concentrated on taxa of commercial interest or conservation value. The biodiversity status and ecological trends in deeper inter-reef waters remains a significant knowledge gap, thus our assessments of regional biodiversity may be underestimated. One such habitat is the Halimeda bioherms in the northern Great Barrier Reef (GBR). Built up over millennia by the calcareous macroalgae genus Halimeda, these complex geomorphic features are the second largest living structure on the Reef after coral reefs. Recent mapping over 6000 km2 and six degrees of latitude of inter-reef seafloor in the northern GBR revealed that bioherm morphology is structurally complex, with potential to support a more diverse community of benthic fish and invertebrates than has
previously been recognised. We analysed data from the CSIRO/AIMS Seabed Biodiversity Project to compare fish and invertebrate species richness between bioherm and non-bioherm sites in the northern GBR, and found that sites on Halimeda bioherms supported average species richness up to three times greater than non-bioherm sites. A total of 1,367 unique taxa from 20 animal and seven plant classes were recorded from Halimeda bioherm sites, with sponges, fishes, and molluscs dominating. This work represents the first quantified assessment of Halimeda bioherms as critical inter-reef habitat to support biodiversity in the GBR, providing management agencies and scientists with a new morphological and ecological framework to evaluate potential impacts (positive and negative) from current and future environmental change.

The threat web: re-framing the co-occurrence and interactions of threats to biodiversity

Mr William Geary1,2, Dr Dale Nimmo3, Dr Tim Doherty1, Dr Euan Ritchie1, Dr Ayesha Tulloch4,5
1Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Burwood, Australia, 2Biodiversity Division, Department of Environment, Land, Water & Planning, East Melbourne, Australia, 3School of Environmental Science, Institute for Land, Water and Society, Charles Sturt University, Albury, Australia, 4School of Life and Environmental Sciences, University of Sydney, Sydney, Australia, 5Centre of Excellence for Environmental Decisions, Centre for Biodiversity and Conservation Science, The University of Queensland, St Lucia, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Post 065 - William is a PhD student at Deakin University’s Centre for Integrative Ecology. He is interested in how better understanding of ecological interactions, such as threats, trophic and disturbances, can be used to inform conservation and management.

Interactions between anthropogenic threats and their effects on biodiversity are a prominent theme in contemporary ecological and conservation research and have important applications (e.g. pest management, threatened species conservation). Threats may interact where they spatially or temporally co-occur. However, the nature of threat co-occurrence relationships—whether the co-occurrence of two threats is causally linked or coincidental—is poorly understood. Here, we suggest that accounting for the co-occurrence of threats can help to identify which threats may interact (and where), and hence better inform proactive interventions. We demonstrate how to evaluate threat relationships by modelling the co-occurrence of major threats affecting insular mammal species listed on the IUCN Red List. Recognition that multiple threats co-occur for a variety of reasons forces us to think of threats as a network—a threat web. We illustrate the importance of network thinking for threat evaluations using a case study from south-eastern Australia’s woodland bird community, showing that such thinking promotes understanding of how the effects of threats flow through ecosystems, and therefore where the best place(s) to target management actions are.

Zombie Myths of climate projections for ecological studies

Mr John Clarke1, Dr Rebecca Harris2
1CSIRO Climate Science Centre, Aspendale, Australia, 2Antarctic Climate & Ecosystems CRC, University of Tasmania, Hobart, Australia

Ecology for the New World Order (1), Meeting Room 3, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
John has over 25 years’ experience researching, applying and communicating climate change and conservation biology, within Australia and internationally. He has particular expertise in developing fit-for-purpose, scientifically robust climate projections and assisting users understand them and put them into practice.
Have you ever gone looking for that one “best” climate model that will give you the most “correct” future climate “forecast”? Have you heard that very high resolution climate model data will provide more “accurate” information with less “uncertainty”? If you answered “yes” to any of those questions, chances are you’ve fallen foul of the zombie myths of climate projections.

Projecting future climate is complex stuff! Making use of those projections to assess plausible impacts is also complex – more so than working with historic climate. For example, we’re accustomed to working with a single version of the past climate. However, it’s misleading to use just one picture of the future – this can lead to overconfidence and incorrect conclusions. It is far more useful (and valid) to assess the range of possibilities, accounting for different emissions scenarios and models, then assess what this means in a risk management framework rather than a ‘predict then act’ framework.

Choosing the right data for the job is not straightforward, and depends on the specific requirements of the study. Also, models used to assess the impacts of climate change – such as species distribution models – can be sensitive to changes in input datasets. For this reason, it’s in everyone’s interests to ensure the climate projections inputs are as robust as possible.

In this presentation, we’ll work through a handful of the most persistent zombie myths. We’ll tackle multi-model ensembles, internal consistency, model selection, uncertainty, resolution and emissions scenarios. A few zombie-heads will roll! Then, we’ll use case studies to demonstrate how to avoid the zombie issues while ensuring the most robust projections inputs are used.

Post-Anthropocene conservation: what can we do to maximise life on earth after we're gone?

Prof David Watson1, Dr Maggie Watson1
1Charles Sturt University, Albury, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Dave Watson is a community ecologist with a diverse research program, spanning biogeography and connectivity conservation, plant-animal interactions and acoustic ecology.

Since life began, organisms have come and gone as cataclysms have wrought mass extinctions and catalyzed diversification. Some organisms have dominated energy flux and modified the biosphere, nudging the trajectory of subsequent life-forms through altered availability of oxygen, water or other raw materials. Dominant life forms are necessarily transitory, conditions successively favoring some groups of organisms over others. Humans are no different—we will inevitably go extinct. When and how the Anthropocene ends will frame the next era, motivating our question: “Is there anything we can do in the interim to promote post-Anthropocene life on Earth?” Or, rephrased; “Can we minimize the collateral damage of human existence and our eventual extinction to maximize the raw material for whatever comes next?” While a post-human earth has occupied the minds of science fiction writers and led to the emergence of astrobiology, to-date, conservation science has contributed little to the topic. Considering these time frames and reflecting upon the inevitability of global change, we suggest conservation science is best-placed to frame these difficult discussions which define humanity’s ultimate ecological footprint. To initiate this conversation, we offer three take-home messages:

• a guiding principle: choose a lineage or place that you care deeply about and do whatever you can to maximize the likelihood that it will outlive us

• a cautionary projection: many invasive species are the single most likely representatives of their entire group to survive the human-driven mass extinction

• a guiding principle: life will persist: humans couldn’t extinguish life if we wanted to.
Riding into the sunset: how mountain bikers can disperse weed seed

Prof Catherine Pickering1
1Environmental Futures Research Institute, Griffith University, Gold Coast, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Prof Pickering is the Head of Discipline for Ecology and Evolution in the School of Environment and Science at Griffith University and has published extensively in recreation ecology as well as protected area management, alpine ecology and climate change.

Humans are deliberately and unintentionally moving plants and animals well beyond their natural range. This includes the unintentional long distance dispersal of weed seed including when people engage in recreational activities in areas of high conservation value in parks. Although many studies have shown the range of seed types and the long distance they can be dispersed from cars and clothing, there is very limited research for activities such as mountain biking despite its popularity. The number and type of seed attaching to mountain bikers and hikers were experimentally compared in a field and in a national park in wet and dry conditions. Seed from a wide variety of plants including 24 species (15 weeds) attached to the bike, while seed from 22 species (10 weeds) attached to hikers clothing and boots. The seeds were mainly graminoids, weeds, and had a range of attachment structures. Nearly all seed that attached to hikers and riders was in the field with weeds seeding and it was wet, with only a few seed attaching in dry conditions on trails in the Park. Although most seed attached and detached over short distances (a few meters), some seed can be dispersed longer distances (>500m) including when bikes and clothing are not cleaned between trips. Recommendations to minimise the risk of spreading weeds include cleaning clothing and bikes between trips, avoiding areas with weeds seeding and conditions are wet, particular before travelling to areas of high conservation value.

Landscape attributes affect insect pollination during tropical fruit production

Miss Khwankhao Sinhaseni1, Prof Carla Catterall1
1Environmental Future Research Institute, Griffith University, Brisbane, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
I have worked as a researcher and education officer for seven years at Forest Restoration Research Unit, Chiang Mai University, Thailand. Now I am a Ph.D. candidate at Griffith University. My research topic is the wild pollination service for tropical fruit production.

Insect pollination plays a very important role in the world food production. About 1/3 of the crops in the world relies on insects. Most of the major insect pollinators in Apidae require their habitat in natural forests for foraging and nesting. Landscape attributes surrounding farmlands have affected on the pollinators to support crop production base on other research evident. Moreover, location and characters of orchard also have some effect on the pollinators.

The research questions were how do landscape attribute and location and areas of orchard effect the lychee flower visitors and pollination success? Lychee production in Thailand is one of the top four countries to export around the world, so the studied species of us was lychee. Our case study was lychee which is the highland variety of the northern of Thailand. Twenty small-scale orchards close to Doi Suthep- Pui national park (800-1200 m above sea level) were studied. Lychee was the major income of the community in this region. Landscape attributes: lychee orchard, other farmland, old and regrowth forests, forest plantation, man-made areas, were measured in the area of a 500-meter radius of the center in each orchard. And the characters of each orchard were recorded. The direct observation of
pollinators was carried out. The relationship of the landscape and orchard characters VS numbers of pollinator were analysed. The resulted showed that there were more numbers of pollinator in orchards located the valley than in the slope. And the orchards have more percentage of forest plantation surrounding trended to fewer pollinators. The pollination is not limitation in this region and the natural forests were more 50%.

Effects of environmental and temporal factors on Glomeromycotina spores in sand dunes along the Gulf of Valencia (Spain)

Alberto Guillén1, Francesc Mesquita-Joanes2, Juan Bautista Peris3, Isabel Arrillaga1
1ERIBiotecMed and Department of Plant Biology, University of Valencia, Burjassot, 46100, Spain, 2Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, , Paterna, 46980, Spain, 3Department of Botany and Geology, University of Valencia, , Burjassot, 46100, Spain

AMF symbiosis in sand dunes is the key for maintenance of stable vegetation. The main goal of this work was to determine the effects of environmental and temporal factors on AMF living in sand dunes (Gulf of Valencia, Spain). Soil samples were collected seasonally at 6 sites, during 2 yrs, from three habitats and four plant species and the frequency and relative abundance of AMF was examined. AMF were more frequent in mobile than in embryonic dunes, in spring and in sites with old vegetation. Ten AMF species were identified, their distribution depending mainly on the anthropogenic disturbance of the site. Gigasporaceae Cetraspora sp. and Dentiscutata sp. preferred undisturbed soil whereas Diversisporaceae, Glomeraceae and other Gigasporaceae were associated with recently restored soils. All AMF species were found in all plant species although Corymboglomus corymbiforme was mainly associated with Echinophora spinosa. Our results might be of help for Mediterranean sand dune restoration.

Keywords
Coastal sand dunes; Environmental factors; Glomeromycotina spores; Mediterranean climate; Seasonal variation

Increasing habitat loss and anthropogenic activities in the Sundarbans: Can plant-pollinator community sustain the threat?

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1Biology Centre of Czech Academy of Sciences, Ceske Budejovice, Czech Republic, 2University of South Bohemia, Ceske Budejovice, Czech Republic, 3Khulna University, Khulna, Bangladesh, 4University of Göttingen, Göttingen, Germany

Biography:
I am a doctoral researcher, studying integrative ecology focusing on plant-pollinator interactions and how they are affected by the different environmental factors, from species to community level. I am also working on plant conservation with a focus on pollination strategies.
The Sundarbans, the largest single patch mangrove forest in the world, has been facing an increasing pressure of habitat loss and human exploitation over the years. Yet, no information is available about how these factors affect the plant-pollinator interactions in this world heritage ecosystem. This research was first effort to study the impact of habitat loss and anthropogenic activities on plant-pollinator interactions and plant reproduction. For this study, 12 Sites were selected in Shyamnagar, north-western region of the Sundarbans in Bangladesh, along the gradient of increasing habitat loss and human activities from continuous pristine forests to forest fragments near the human settlements.

Pollinators were observed and collected from two focal plant species, Avicennia marina and Acanthus ilicifolius. Giant honey bee (Apis dorsata) and solitary bees were found to be the most important pollinators in this forest but declined along the gradient of increasing habitat changes. Apis dorsata were mostly abundant in the deeper forest but decreased in the forest patches nearby villages, where they were replaced by the Apis cerana, commonly found managed honey bee. Both plant species received a wide range of solitary bees but only A. marina received other pollinators like flies, wasps and butterflies. Seed production was 30% higher per fruit for A. ilicifolius in the least disturbed forest sites, indicated that mangrove pollinators are more efficient.

We conclude that plant-pollinator interactions are sensitive to anthropogenic activities and the loss of mangrove pollinators have negative impacts on the pollination success of native plants in the Sundarbans.

Bird community assembly at multiple spatial scales in a biodiversity-hotspot: role of land-use and climate

Mr. Sreekar Rachakonda1, Prof Lian Pin Koh1, Prof Eben Goodale2

1University Of Adelaide, Adelaide, Australia, 2Guangxi University, Nanning, China

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 096 - I am a final year PhD student at the University of Adelaide. I am interested in understanding the synergistic effects of threats on natural ecosystems and wildlife.

While the impacts of land-use change on species compositional change (beta-diversity) are widely known, most studies have been restricted to local spatial scales, with minimal differences in environment and spatial distance. Our goal is to determine the relative importance of land-use change, environment change (temperature and precipitation) and space (geographic distance) on beta-diversity at multiple spatial scales within the Western Ghats – Sri Lanka biodiversity hotspot. We used 32 two-km line transects to record bird diversity in the biodiversity hotspot. We placed 16 transects on either side of the Palk Strait in two different countries for large-scale analysis. In each country, we placed eight transects in low elevation and another eight in middle elevation for intermediate-scale analysis. In each elevation, we placed three transects in protected primary rainforests, three in reserve buffer, and two in intensive agriculture for local-scale analysis. We used variation-partitioning approach to evaluate the relative importance of land-use (ranked value of forest loss), environment (temperature and precipitation) and space (geographic position) on bird beta-diversity for these different spatial scales. Our results show that space was the most important variable to explain bird beta-diversity at large scale. Land-use and environment were equally important for bird beta-diversity at intermediate scales. These findings suggest that forest loss within the biodiversity hotspot can escalate extinction rates due to small distribution sizes and restricted dispersal across spatial and elevation gradients.
Dingoes respond in unpredictable ways to a reduction in anthropogenic foods

**Dr Thomas Newsome**¹
¹The University of Sydney, Camperdown, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Dr Thomas Newsome is a Lecturer at The University of Sydney. His research addresses how species respond to human-induced changes to the landscape. He is particularly interested in how humans and top predators shape and drive ecosystem processes.

As the human population continues to expand its footprint there will be increasing contact between humans and other animals, especially wildlife that take advantage of anthropogenic foods such as garbage and livestock. As a result of this interaction, the evolution and ecological function of many species may be altered through time. In this talk, I will discuss the ecological and management importance of such possibilities using dingoes as a case study. Specifically, I will summarise results from a new study that tracked dingo diets through a period when there was abundant anthropogenic foods, and then several years afterwards when the anthropogenic foods were removed. I will use the results to highlight that dingoes may act as prey specialists in some situations, but also that dingoes respond in unpredictable ways to changes in anthropogenic food availability. The results have important implications for understanding how to conserve and protect the ecological functions of top predators and for mitigating human-wildlife conflicts.

Disturbance has benefits as well as costs for fragmented populations of a cryptic grassland reptile

**Dr Geoffrey Heard**, Dr Michael Scroggie², Mr Garry Peterson³, Dr Detlef Rohr⁴, Ms Evelyn Nicholson⁵
²Charles Sturt University, Albury, Australia, ³Department of Environment, Land, Water and Planning, Heidelberg, Australia, ⁴Department of Environment, Land, Water and Planning, Warrnambool, Australia, ⁵University of New South Wales, Sydney, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Geoff Heard is an applied ecologist and herpetologist. His research focuses on the spatial and temporal dynamics of populations in fragmented landscapes. It seeks insights into demographic processes, particularly for threatened taxa, to guide conservation planning.

Conservation practitioners face complex decisions when seeking to preserve fragmented populations, particularly when disturbance plays an important role in their dynamics. Disturbance events can have important short-term impacts, but may also be crucial for maintaining habitat structure and function. We assessed the role of two disturbance regimes – grazing intensity and fire frequency – in the occupancy dynamics of the threatened Striped Legless Lizard (Delma impar) among native grassland fragments in Victoria, Australia. By coupling nine-years of monitoring data from 291 grassland sites with a dynamic occupancy model, we show that grazing and fire are individually beneficial for D. impar populations, but the interaction of these two disturbances has a strong negative effect on persistence. As such, this study indicates that grazing and fire may be important tools for managing the structural and floristic requirements of D. impar, but that the concurrent use of grazing and fire should be avoided. More broadly, this study demonstrates the value of long-term and spatially extensive datasets for understanding the role of disturbance in the persistence of fragmented populations, and adds empirical support to the long-theorised importance of asynchronous disturbance regimes.
Global mismatch of policy and research on drivers of biodiversity loss

Dr Tessa Mazor¹, Dr Christopher Doropoulos¹, Dr Florian Schwarzmueller¹, Dr Daniel Gladish¹, Dr Nagalingam Kumaran¹, Dr Katharina Merkel², Dr Moreno Di Marco³, Dr Vesna Gagic¹
¹CSIRO, Brisbane, Australia

Ecology for the New World Order (2), Meeting Room 3, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
I am a marine spatial ecologist, with an interest in finding sustainable solutions. My research includes conservation prioritization, spatial planning, species distribution modelling, evaluating threats to biodiversity and integrating social and economic objectives to facilitate the implementation of conservation action.

Global drivers of environmental change are escalating, causing biodiversity loss at unprecedented rates across all natural ecosystems. The UN 2030 Agenda for Sustainable Development calls for urgent actions to reduce global biodiversity loss. Here, we synthesize >44,000 articles published in the past decade to assess the research focus on global drivers of loss. We discovered that relative research efforts on different drivers are not well aligned with their assessed impact and multiple driver interactions are hardly considered. Research on drivers of biodiversity loss needs urgent realignment to match predicted severity and inform policy goals.

Behavioural shifts in urban populations of the Australian Brush-turkey (Alectura lathami)

Mr Matthew Hall¹
¹The University Of Sydney, Sydney, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Matthew Hall is a PhD candidate in the Integrative Ecology Lab of The University of Sydney. He is interested in the responses of wildlife to urbanisation. His PhD research examines how the Australian Brush-turkey exploits highly disturbed urban landscapes.

Cities are highly modified and disturbed environments often requiring urban exploiting species to adjust their behaviour to survive. The Australian Brush-turkey (Alectura lathami) is an endemic Australian forest bird. Formerly rare due to overhunting, the species has made a dramatic recovery and can now be found in the suburbs of major cities including Brisbane and Sydney. This population growth and recolonisation of their former range has brought them into conflict with many homeowners, who find their gardens ruined by foraging and nest building Brush-turkeys. How the species has spread in urban areas and how they are surviving in these modified environments remains poorly understood. Using existing datasets and community sightings reports, we mapped the Brush-turkey distribution in Sydney, Australia to examine changes in distribution over time. We also compared disturbance tolerance and territoriality along an urban to natural land-use gradient by measuring flight initiation distances (FIDs) and male aggression towards a model intruder. Risk allocation and habituation were studied with repeated FID measures on marked individual birds. We found that Brush-turkeys have dramatically increased their range in Sydney over the past two decades. Suburban Brush-turkeys have lower FIDs and less aggressive territory defence than conspecifics in natural habitats. Reduced FIDs show a higher disturbance tolerance, allowing Brush-turkeys to maintain normal foraging behaviour despite high levels of human disturbance. Reduced territorial aggression may allow the species to live at higher than natural densities in small urban habitat remnants. Both behavioural shifts potentially allow the species to thrive in urban environments.
Urban ecosystem service trade-offs and synergies under different revegetation management scenarios

Ms Marie Dade1,2, Dr Matthew Mitchell3, Dr Jonathan Rhodes1,2
1University Of Queensland, St Lucia, Australia, 2Centre for Excellence in Environmental Decisions, St Lucia, Australia, 3University of British Columbia, Vancouver, Canada

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Marie Dade is a PhD candidate at the University of Queensland. Her current research focuses on developing more effective methods to identify and assess ecosystem service trade-offs and synergies in urban landscapes for policy and planning.

Urban greenspaces are becoming increasingly important sites for ecosystem service delivery. Managing these spaces to maintain the provision of multiple ecosystem services is challenging due to the positive (synergistic) and negative (trade-off) relationships that exist between services. To prevent trade-offs from occurring, it is necessary to first identify how different management actions affect the relationships between ecosystem services. We assess the potential relationships among five ecosystem services (carbon storage, and opportunities for exercise, nature interactions, relaxation and social interactions) across the greenspace network of Brisbane, Australia, under three potential urban revegetation management scenarios that increase mid storey vegetation and tree cover. We first conducted a spatial correlation analysis to identify the current trade-offs and synergies occurring and compared this to scenario analysis that identified the relationships among the ecosystem services under the three revegetation scenarios. We found that ecosystem service relationships did change under different revegetation management actions. Scenarios involving increasing mid storey vegetation resulted in no relationships occurring, but scenarios involving increasing tree cover saw increases in carbon storage and nature interactions, but decreases in all other services, leading to trade-offs and synergies occurring. Our results suggest that ecosystem service relationships are not static and identifying current relationships between ecosystem services does not accurately reflect the relationships occurring under different management scenarios. We recommend greater uptake of methods that can identify how ecosystem service relationships will change under different management actions. This will ensure effective implementation of strategies and policies for multiple urban ecosystem services.

Microhabitat Characteristics for prevention of damage hornet(Vespidae) in Urban area, Choenan city, South korea

Mr Whee-Moon Kim1, Mr Seoung-Yeal Kim1, Prof Wonkyong Song1
1Dan-kook Univ., Cheonan-si, South Korea

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
2010-2015
2016-2018

Urban parks and green areas are increasing globally. For wild organisms, green areas in cities may function as corridors to core habitats. However, when wild organisms adapt to and settle in urban green spaces, they may come into conflict with humans. Hornet species(Vespidae) are predators of insects in forests, thus contributing to the maintenance of insect populations. Hornets are also important pollinators and require conservation efforts. However, as a result of their increased occurrence in cities, hornets are coming into ecosystem disservices with local residents. In this study, we captured queen
hornets (Vespa analis, Vespa crabro, Vespa mandarinia, Vespa ducalis) using hornet traps and identified characteristics of these hornets to prevent conflict between hornets and local residents in Cheonan, South Korea. The queen hornets wakes from hibernation between April and June and looks for a place to build a nest. Catching the queen hornets at this time is the same as removing the prime nest in the autumn. We selected three urban areas (natural-type park, city-center park, remnant forest; April to June, 2017) and twenty-seven children’s park (April to June, 2018) and a total of ninety-two hornet traps were installed. We analyzed the correlation between captured queen hornets and microhabitat variables (including normalized difference vegetation index, canopy openness, elevation, land cover, and herbaceous plant cover rate), and green type. Hornet species was positively correlated with elevation, herbaceous plant cover rate, broad-leaved forest, and artificially barren ground. Captured hornet was negatively correlated with coniferous forests and roads.

Finding plant species that can tolerate heat and drought in Australian cities

Dr Renee Marchin1, Diana Backes1, Hugh Burley2, Alessandro Ossola2, Michelle Leishman2, David Ellsworth2
1Hawkesbury Institute for the Environment, Western Sydney University, Richmond, Australia; 2Centre for Smart Green Cities, Department of Biological Sciences, Macquarie University, North Ryde, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Dr. Renée Marchin is a plant ecophysiologist who is determining thermal and drought tolerances of horticultural plant species in order to create urban green spaces in Australia that are resilient to future heat waves and drought.

Urban plantings in Australia are frequently exposed to hot and dry climate extremes. As extremes intensify, climate-hardy species will likely be needed to replace failing urban plantings. The Which Plant Where project aims to discover which plant species can tolerate future climate conditions in Australian cities. We describe a glasshouse testing regime used to screen large numbers of horticultural plant species for (1) heat tolerance and (2) drought tolerance. We hypothesized that native woody species originating in regions of harsh climate extremes would be most tolerant of climate extremes. In contrast with our initial hypothesis, we found that species’ physiological tolerances do not always match their historical climatic tolerances defined using native distribution ranges (e.g., maximum temperature, mean precipitation). Heat and drought tolerance were significantly correlated across all initial 47 species tested, but the relationship was not close ($r^2=0.24$, $p<0.001$). Rainforest and understory species, such as Alectryon coriaceus and Cupaniopsis anacardioides, were particularly vulnerable to thermal damage during experimental heat waves, when leaf temperatures above 55 °C were recorded. Drought exacerbated thermal damage during heat waves by decreasing transpirational cooling and increasing leaf temperatures by as much as 6 °C. The combination of heat waves plus drought stress affected rankings of species’ physiological tolerances, suggesting changing climate will pose new challenges for urban plantings across Australia.
Does climate variability across Australian cities predict species composition in urban forests?

**Dr Manuel Esperon¹,** Dr Paul Rymer¹, Prof Sally Power¹, Prof Mark Tjoelker¹, Dr Linda Beaumont², Dr Hugh Burley²

¹Western Sydney University, Richmond, Australia, ²Macquarie University, Sydney, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**

Manuel Esperon is a postdoctoral fellow in the Which Plant Where research program. He is interested in understanding how species respond to climate change and extreme weather events, such as drought and heat waves.

As Australian cities grow, the benefits of urban green spaces to improve quality of life and well-being, and ecosystem services for their residents, are increasingly important. Urban environments are complex and environmentally heterogeneous, making the selection of tree species for urban forests challenging. Climate change adds to the uncertainty with global warming, variable rainfall, and increased intensity and frequency of extreme events leading to tree stress and death. We asked the question “can the successes and failures of historical urban tree plantings across Australia be used to inform future, climate-resistant, urban greening strategies?” We searched for examples of ‘successes’ (species planted and growing under local climatic conditions) and ‘failures’ (species reported not to survive due to unsuitable climate) of plantings in Australia. We recorded ~5400 tree species planted and growing (successes) across 49 significant urban areas and 212 local government authorities. However, despite large urban forest inventories in Australian cities, there is an overwhelming lack of information related to climate-driven failures, we found no species reported as failures. Additionally, we highlight the lack of climate matching between plant species’ climate-of-origin and presence in urban areas and test the prediction that the climate match between the urban forest and its flora will be greater in cities with more extreme climates. We draw attention to the need to monitor urban forest inventories to understand the causes of success or failure of plantings. These data will aid with optimising planting outcomes and developing sustainable and resilient green cities into the future.

Assessing the Vulnerability of Urban Forests to Climate Change

**Mr Paul Hanley³,** Prof. Stefan Arndt¹, A/Prof. Stephen Livesley¹, Dr Chris Szota¹

¹The University Of Melbourne, Burnley, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**

I am a masters student at the University of Melbourne. My research is focused on the vulnerability of urban forests to climate change and looking to identify physiological mechanisms that explain how trees survive heat and drought stress.

It is difficult to predict which tree species in the urban forest are vulnerable to likely increases of drought and extreme heat events in the future climate. The climate envelope of species has been used to predict vulnerability, but whether temperature or water availability exert more influence remains unanswered. In this study, drought and heat tolerance of common urban tree species were measured to identify which species will be more vulnerable. Using climate envelope analysis, 42 commonly used street trees were selected from a MAT gradient between 10 °C and 27 °C and a MAP gradient between 400 mm and 1600 mm, including a diversity of leaf and wood anatomy types. We quantified vulnerability as stomatal sensitivity to vapour pressure deficit (m). To predict vulnerability, we measured drought and thermal stress indicators including turgor loss point (TLP) and thermal tolerance (T50) and related to climate envelope. We found significant but weak correlations between stomatal sensitivity...
and MAT, but not MAP. TLP and T50 were also not related to either climate variable. Therefore, climate variables alone are insufficient to predict climate change vulnerability. This suggests there are more complex processes that predict vulnerability to climate change.

A simple framework for measuring ecological connectivity in urban landscapes

Dr Holly Kirk1, Dr Caragh Threlfall2, Dr Kylie Soanes3, Dr Cristina Ramalho3, Dr Kirsten Parris3, Dr Marco Amati1, Prof Sarah Bekessy1, Ms Lee Harrison4, Dr Rodney van der Ree5, Dr Luis Mata1

1RMIT University, Melbourne, Australia, 2University of Melbourne, Melbourne, Australia, 3University of Western Australia, Perth, Australia, 4City of Melbourne Council, Melbourne, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Holly Kirk recently completed her PhD in seabird movement ecology at Oxford University, UK. Since moving to Australia she has continued to develop her interests in animal movement and spatial analyses with a particular focus on urban ecosystems.

A key issue for the conservation of animal species in cities and towns is understanding the potential for species' movement across urban landscapes, or how 'connected' the landscape is. Ecological connectivity is important for the survival of animal populations, allowing for key processes such as daily individual activities, natal dispersal and migration. Moreover, understanding ecological connectivity will play a key role in informing future actions aimed at bringing nature back into urban environments.

In close collaboration with the City of Melbourne, we have developed a robust yet simple framework for measuring the ecological connectivity of a range of animal taxa, including insect pollinators, aquatic insects, amphibians, reptiles, woodland birds, hollow-using birds and hollow-using bats. We draw from our findings to illustrate how this framework can be used by local government conservation practitioners and policymakers to (1) measure how ecological connectivity changes over time, (2) compare ecological connectivity amongst cities, (3) plan biodiversity actions aimed at improving ecological connectivity and (4) assess the impact of different development projects. We envisage that our approach will be highly useful for urban conservation practitioners and policymakers as it combines structural and functional aspects of connectivity, is tailored to habitats managed by local governments and is broad enough to capture a wide range of species.

Developing guidance for effective urban conservation

Dr Caragh Threlfall6, Dr Kylie Soanes1, Dr Cristina Ramalho2, Dr Cecily Maller3, Associate Professor Kirsten Parris1

1Clean Air and Urban Landscapes Hub, The University of Melbourne, Melbourne, Parkville Campus, Australia, 2Clean Air and Urban Landscapes Hub, The University of Western Australia, Crawley, Australia, 3Centre for Urban Research, RMIT University, Melbourne, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
I am a post-doc in the Clean Air and Urban Landscapes Hub supported by the National Environment Science Programme. My research interests combine urban ecology, animal behaviour and ecosystem ecology to address questions on human impacts to the urban environment.

The construction and expansion of cities often leads to the loss of native species and ecological communities, to the detriment of biodiversity but also the detriment of the human urban experience. Urban areas are often overlooked and undervalued in conservation planning, representing a significant missed opportunity to protect, enhance and engage with biodiversity. As such, there is currently little
guidance for managers on how to implement effective conservation actions targeted to urban environments. This project aims to fill this gap, by developing an inventory of conservation actions or projects currently implemented in Australian cities, and providing guidance on what influences their effectiveness. To develop this inventory, we used a semi-structured interview approach, to ask city practitioners about the range of actions they undertake, examine the motivations for and effectiveness of these actions, and develop a framework to better understand the opportunities and indicators of success for greater uptake of urban conservation initiatives. This is the first phase or a larger quantitative project. We will present a summary of findings to date showcasing a range of Australian projects. This project forms the first Australian assessment of its kind, where results will be used to develop practical guidelines for urban biodiversity conservation, to facilitate improved practice in Australia and elsewhere.

Prioritising ecosystem services provided by urban rivers: an importance-performance analysis

Mr. Junyi Hua¹, Dr. Wendy Chen¹
¹Department of Geography, The University of Hong Kong, Hong Kong, China

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
My research areas include urban river restoration, urban heritage trees, ecosystem services, public preferences, non-market valuation and environmental attitudes and perceptions. I’m doing a comparative study on resident preferences for urban river restoration in China and Belgium.

Urban rivers provide diverse ecosystem services linking ecological, environmental and social-cultural benefits. However, the functions of rivers serving densely populated cities have been dramatically degraded mainly due to human activities in transitional China. Little work has been performed to investigate urban residents’ satisfaction with the ecosystem services provided by urban rivers. This study initiates the importance-performance analysis (IPA) application to analyse urbanites’ perceived importance of the ecosystem services provided by urban rivers and performance of their provision in the city of Guangzhou, China. Twelve key ecosystem services were identified and involved in the present study. Notable importance-performance gaps for ten of them were found. In the light of importance and performance ratings, the twelve ecosystem services were put into four quadrants (high-high, high-low, low-high and low-low). Public education, natural habitat, symbolic character and water purification fell in high-importance-low-performance. Water purification topped the prioritisation, as it ranked the first bi-dimensionally amongst all. Fresh water supply, transportation and tourism were identified to be in low priority due to their low importance and low performance. The results provide an accurate picture of actual potentials for the improvement and prioritisation of ecosystem services to satisfy local residents’ needs. The IPA offers a feasible way to help tie local residents’ needs with ecosystem services provision for accurate decision-making.

Maternal nesting behaviour in city dragons: a species with temperature-dependent sex determination

Miss Nicola Kent¹, Dr Romane Cristescu², Ms Carme Piza-Roca³, Ms Bethan Littleford-Colquhoun¹, Ms Kasha Strickland¹, Dr Celine Frere¹
¹University Of The Sunshine Coast, Sippy Downs, Australia

Ecology in the city (1), Meeting Room 3, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Nicola is a PhD candidate from The University of the Sunshine Coast, studying the behavioural, genetic and morphological consequences of urbanisation for city dwelling reptiles.
Urban environments present some of the greatest challenges to species. This is particularly true for species which exhibit thermally sensitive traits, such as temperature-dependent sex determination (TSD). This is because urban environments not only present species with entirely novel ecosystems, but they also experience exacerbated temperature increases. These temperatures may result not only in offspring mortality, but also skewed population sex ratios. In order to persist in cities, urban dwellers with TSD will therefore need to actively manage the temperature of the nesting environment. Here, we investigate the nesting ecology of a long-lived, urban dwelling reptile, the eastern water dragon (*Intellagama lesueurii*), to understand how TSD species may respond to urban environments. Based on data collected from 72 nests over two nesting seasons, we show that city dragons not only dug significantly deeper nests than previously observed across their natural riparian habitat, but were also found to nest in novel substrates. Furthermore, we observed a behaviour not previously described in this species, where mothers travel outside of their core home range in order to nest. This excursion behaviour potentially represents a greater maternal investment and is linked to the selection of specific microhabitats.

The impact of tree removal on people’s perceptions and biodiversity activity

Dr Camilo Ordonez, Dr Caragh Threlfall, Ms. Jessica Baumann, Ms. Cherese Sonkkila, Dr Rodney van der Ree, Dr Dieter Hochuli, Dr Richard Fuller, Dr Melanie Davern, Dr Stephen Livesley, Dr Dave Kendal

1University Of Melbourne, Richmond, Australia; 2University of Sydney, Sydney, Australia; 3University of Queensland, Brisbane, Australia; 4RMIT University, Melbourne, Australia; 5University of Tasmania, Hobart, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Cherese Sonkkila is a freelance science writer and a research assistant at the University of Melbourne. She is interested in urban biodiversity, science communication and environmental psychology. In particular, she is interested in how to combine these disciplines to discover ways to connect people with the natural world.

Urban trees are critical for the future of sustainable cities. While many cities have ambitious targets to increase tree-canopy cover, many municipal governments also spend millions of dollars planting and maintaining urban trees every year. The services that trees provide are more significant as trees age and increase in size. However, large, old trees pose a hazard to human safety and hinder construction activities, and hence are often removed. This means that streets and parks where trees are planted often experience rapid loss, absence, and slow recovery in tree canopy cover. While the negative effects of this on environmental service provision, such as shade, are straightforward, today there is no clear understanding of the combined ecological and social effects of tree removal. These effects may include changes in bird density, ecological function, and changes in self-reported human well-being, which can be measured in association with different ecological scales (i.e., landscape- or tree-level) based on experimental procedures. To fill this gap, we report on a before-after-control-impact experimental investigation on the impact of tree loss at selected sites in the City of Melbourne, Australia. The study focused on the changes avian and tree-hollow dependent fauna density, herbivory, perceived benefits, well-being, and nature connectedness. We present some of our initial results and take the opportunity to reflect on the socio-ecological effects of tree-removal at small spatial scales across the city.
Children and nature in Sydney: Exploring the concrete jungle

Mr Ryan Keith¹, Prof Lisa Given², Dr John Martin³, Dr Dieter Hochuli¹
¹The University of Sydney, Sydney, Australia, ²Swinburne University of Technology, Melbourne, Australia, ³The Royal Botanic Garden Sydney, Sydney, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Ryan Keith is a PhD candidate from the Integrative Ecology Lab at the University of Sydney. Ryan is interested in both the social and ecological components of social-ecological systems, currently researching how city kids connect with nature.

As our cities grow, so do concerns about the quality and quantity of human-nature interactions. This perceived “extinction of experience” in nature is considered particularly worrisome for urban youth, who are said to suffer from “nature-deficit disorder”. It is feared that a lack of exposure to nature will not only result in poor health and well-being, but also erode young people’s support for ecological conservation. Yet amidst these concerns, few people have actually consulted the children they are talking about. We recently surveyed 1165 eight- to 15-year-old students attending 16 public schools across Sydney, with the intention of characterising their experiential, cognitive, and emotional connections with nature. Although 98% of respondents reported that nature was important to them, definitions of “nature” varied from child to child, with students valuing nature (sensu lato) for many different reasons. Primary school students were more closely connected with nature than high schoolers, and girls more than boys. Students who were more closely connected with nature were also more likely to support ecological conservation and undertake environmentally responsible behaviours. Overall, one in every three respondents was categorised as nature-connected despite living in a city, indicating that our sample population is less nature-deficient than those recently studied overseas. We use these students’ success stories to identify pathways toward nature connection.

Comparing ground and UAV surveys after fire in an urban bushland

Dr Geoff Lambert¹, Dr Judy Lambert¹, Jeremy Randle²
¹North Head Sanctuary Foundation, Fairlight, Australia, ²Centre for Field Robotics, Sydney University, Camperdown, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Geoff Lambert is a professional neuroscientist and amateur ecologist. He is an active member of the community-based North Head Sanctuary Foundation, with an interest in fire management and restoration of nationally endangered Eastern Suburbs Banksia Scrub ecological communities.

Ground-based sampled vegetation counts from a site can produce skewed estimates of population variables. We therefore explored the correlations between site vegetation UAV and ground quadrat surveys [1] to test the robustness of the latter after fire in an Eastern Suburbs Banksia Scrub community in Sydney.

Prior to a Hazard Reduction burn in 2012 and at intervals for 5 years, we recorded plant and species numbers, ground coverage and plant heights in 84 1m² plots within 21 25m² quadrats. The SW corners of the quadrats were marked with discs visible to the UAV. At the time of the 60-month survey, two UAV surveys using different camera filters, were flown over the site. The 250 resulting images were stitched together making a 250Mbyte geo-tiff file, which was imported into QGIS and compared to Google Earth and Nearmap® imagery. Resolution of the UAV surveys enabled identification and counting of plants across the site.
At five years post-fire, the vegetation of the survey site was significantly different from the pre-fire condition. Several keynote ESBS species present pre-fire almost disappeared. Other species previously non-dominant became dominant in some quadrats. No part of the site had species not present in the 21 quadrats. Correlation of UAV and Nearmap imagery enabled us to make correlations between fire intensity and subsequent vegetation change.

We suggest that UAV surveys can be a valuable adjunct to “prove up” the robustness of ground surveys.

Reference


City life alters the gut microbiome of dragons (Intellagama lesueurii)

Bethan Littleford-Colquhoun, Dr Laura Weyrich, Dr Celine Frere

1University Of The Sunshine Coast, Sippy Downs, Australia, 2Australian Centre for Ancient DNA, Department of Genetics and Evolution, The University of Adelaide, Adelaide, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I am a postdoc at the University of the Sunshine Coast and consider myself an evolutionary ecologist, with a particular interest in understanding how species phenotypically and genetically respond to urbanisation.

Urbanisation is one of the most significant threats to biodiversity, due to the rapid and large-scale environmental alterations it imposes on the natural landscape. It is, therefore, imperative that we understand the consequences of, and mechanisms by which, species can respond to it. In recent years, research has shown that plasticity of the gut microbiome may be an important mechanism by which animals can adapt to environmental change, yet empirical evidence of this in wild non-model species remains sparse. Using an empirical replicated study system, we show that city life alters the gut microbiome of a wild native non-model species – the eastern water dragon (Intellagama lesueurii). City dragons exhibit a more diverse gut microbiome than their native riparian counterparts and show gut microbial signatures of a high fat and plant rich diet. These results highlight the role that gut microbial plasticity plays in an animals’ response to human-altered landscapes.

Large-footed Myotis (Myotis macropus) roost selection in concrete culverts in Brisbane

Ms Vanessa Gorecki, Professor Stuart Parsons, Dr Ramona Maggini, Dr Monika Rhodes

1Queensland University Of Technology, Brisbane, Australia, 2Fauna Surveys on the Wing, Brisbane, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Vanessa Gorecki is a PhD candidate with an interest in insectivorous bat ecology and conservation. She is particularly interested in how animals have adapted to anthropogenic landscapes and how these populations can be best managed.

The large-footed myotis, Myotis macropus, is Australia’s only fishing bat. This species has adapted to living and breeding in urban areas and has been recorded roosting in concrete culverts under roads. However, little is known about the roosting ecology of bats which use these unique roost sites in Australia. This paucity of information makes it difficult for road managers and government departments to make science-based decisions on how to manage such roosts, presenting challenges when works must be carried out on structures containing a roost.
We investigated bat roosting preferences in Brisbane City Council. We developed a stratified sampling design to test which landscape and structure attributes most likely account for the presence of a bat roost in a culvert. A total of 303 concrete culverts were inspected for the presence of roosting bats over the summers and winters of 2017 and 2018. Day, night and maternity roost sites of M. macropus were located. Preliminary results from the fieldwork indicate that roost sites are associated with semi-permanent to permanent waterways and located in large box or pipe culverts. Understanding the types of culverts that are likely to provide suitable bat habitat will prevent the disturbance to bat roosts during the breeding season and this will have greater conservation outcomes for this urban adapted bat.

Can regeneration strategies and fundamental niches inform urban landscape plantings?

Dr Claire Farrell¹, Ms Elspeth Lumsden², Mr Ahmed Ashraf³, Ms Leanne Hanrahan¹, Assoc. Prof John Rayner³
¹The University Of Melbourne, Richmond, Australia

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Claire Farrell is a Senior Lecturer in Green Infrastructure at The University of Melbourne. Her research involves using plants to make cities more liveable. She uses physiological approaches to select plants which survive and maximise their ecological benefits.

Public landscape vegetation in low maintenance urban sites is becoming increasingly simplified, characterised by swathes of grassy monocots with limited diversity. One way to increase diversity while still being low maintenance is the use of naturalistic meadow style plantings based on a diverse range of flowering herbaceous plants. The ‘woody meadow’ project seeks to apply these learnings by using flowering shrubs from Australian heathland communities. Many of these plants are able to regenerate after frequent fire disturbance by resprouting and/or reseeding, a treatment that can be replicated in the landscape through coppicing while producing abundant flowers. Therefore, we evaluated the response to coppicing and drought tolerance of 48 shrubs species selected from a range of climates and planted in field experiments. We found that the fundamental niche was poorly related to their drought tolerance and growth. Regeneration strategies were also not important, with both resprouter and reseeder species growing well after coppicing. We also evaluated whether plant diversity (12 vs 21 species) and density (33 vs 56 plants) influenced the overall success of woody meadow assemblages. Overall, higher density planting of fewer species achieved greater canopy cover, but mortality and flowering were unaffected by either treatment. These shrub plantings are a viable approach for creating visually diverse and low maintenance plantings in urban landscapes, with applicability to roadsides, parks, railway corridors and streetscapes. Species for new urban plantings should therefore be selected using physiological strategies or traits related to stress tolerance and not rely on selecting plants from arid climates.

Bees in urban areas: are gardens or bushland remnants more important habitats?

Miss Kit Prendergast¹, Dr Myles Menz², Dr Philip Bateman¹
¹Curtin University, Bentley, Australia, ²University of Bern, Baltzerstrasse 6, Switzerland

Ecology in the city (2), Meeting Room 3, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Poster 030 - Kit Prendergast is a PhD researcher at Curtin University and Forrest Scholar conducting research on how native bees respond to urbanisation, and investigating the potential for the introduced European honeybee to have negative impacts on native bees through competition.
Native bees are keystone pollinators across Australian ecosystems, yet little is known of their resilience to urbanisation - a leading cause of land-use modification. With urbanisation expanding, remnant natural habitats in urban areas is under threat; it is therefore crucial to determine their value for native bees, and whether residential gardens also serve as quality habitat. A comprehensive study was undertaken in the southwest Western Australian biodiversity hotspot investigating the role of gardens versus bushland fragments in supporting a diversity and abundance of native bee communities. Seven residential gardens and seven bushland remnants were surveyed once a month in spring/summer over 2016/2017 and 2017/18. Due to differences in life-history traits, responses to urbanisation likely differ between the introduced European honeybee and native Australian bee taxa, so these groups were investigated separately. In both years, native bees were significantly more abundant in bushland than residential gardens, whereas honeybee abundance did not differ between these habitat types. Bushland remnants also hosted a higher species diversity of native bees, and a greater number of species were found exclusively in bushland remnants compared with residential gardens. It can be concluded that whilst residential gardens can host native bees, bushland remnants are indispensable if we are to conserve the full suite of native bees in urban areas.

Sharing is caring: Bridging ecological open data and nature conservation using IBRA bioregions

Dr Stefania Ondei1, Prof Barry Brook1, Dr Jessie Buettel1
1University Of Tasmania, Hobart, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Stefania is a postdoctoral researcher at the University of Tasmania. She is broadly interested in biodiversity conservation, with particular focus on landscape ecology, fire ecology, and remote sensing techniques.

Changes in land use are globally recognised as a major threat to biodiversity. However, monitoring these trends at a large scale can be difficult: while spatial data on land use and land cover is available through satellite imagery and governmental organizations, evaluating biodiversity from space is a challenge yet to be fully won. In this context, citizen science is becoming an important tool for biodiversity monitoring, not only by complementing more traditional types of field survey, but also through the direct involvement of the public in the nature conservation process. To effectively do so, it is crucial to link the outcomes of environmental monitoring with land-use trends and the frameworks institutionally used to implement land management. Here we analyse land clearance temporal trends occurring where Australian endemic plant and animal species have been observed. We use data from the Atlas of Living Australia, which is provided open access from a variety of primary sources, including citizen science projects. We link these results with land clearance rates in IBRA bioregions, which divide Australia in homogeneous landscape units, and identify the areas where nature conservation should be prioritised, based on trends occurring at a local and national scale. This approach shows how bridging open-access and citizen science data with institutionally recognised frameworks can help building a better connected and more flexible outlook on biodiversity conservation.
Modelling minimum founding populations of the first people to colonise Australia in the Late Pleistocene

Professor Corey Bradshaw¹, Dr Frédérik Saltré¹
¹Flinders University, Adelaide, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Professor Corey Bradshaw is the Matthew Flinders Fellow in Global Ecology. His research is mainly in the area of global-change ecology — how human endeavour and climate fluctuations have altered past, present and future ecosystems.

The demographic context of the first humans to Australia is poorly understood because of dating uncertainty and unknown vital rates. We address this by quantifying the extinction risk of various founding populations of the first Australians to the mainland 65,000-55,000 years ago. We constructed a pre-breeding Leslie projection matrix for females, applying the 5-parameter Siler hazard model to estimate the age-specific proportion surviving individuals, and a fertility schedule based on age at first breeding estimates for 22 hunter-gatherer groups. We constructed carrying capacity from the intermediate-complexity Earth System Model LOVECLIM’s net primary productivity (NPP) hindcasts at 1000-year intervals and a downscaled 1×1° resolution. We transformed the NPP from 10-18° latitude (northern Australia) into an abundance carrying capacity based on assumptions of human population size of 47,000 continent-wide at the Last Glacial Maximum. Sampling 1000 random uniform start years between 65,000 and 55,000 years, we projected incrementing founding populations (50-1000 females) for 100 generations. With stochastic resampling of the survival and fertility vectors, a generationally scaled catastrophe function, and compensatory density feedback based on the carrying capacity series, we calculated the probability of quasi-extinction (minimum population size < 25 females) over all iterations. A founding population of at least 500 people was necessary to maintain a quasi-extinction threshold (Q) <0.2 (1500 for Q<0.1). This result — also supported by the ecology of minimum viable population sizes — suggests that a large contingent of first peoples arriving within a single human generation was required to colonise Australia successfully in the Late Pleistocene.

Taking a multi-dimensional approach to human-wellbeing - impacts of community forest management in Indonesian Borneo

Professor Kerrie Wilson¹,², Dr Truly Santika¹,²,³, Dr Sugeng Budiharta⁴, Dr Ahmad Kusworo⁵, Dr Freya A.V. St. John⁶, Dr Erik Meijaard²,³, Dr Elizabeth Law¹,², Ms Rachel Friedman¹, Dr Joseph Hutabarat⁵, Dr Tito Indrawan⁵, Dr Matthew Struебиг⁷
¹The University Of Queensland, School of Biological Sciences, Brisbane, Australia, ²ARC Centre of Excellence for Environmental Decisions, The University of Queensland, Brisbane, Australia, ³Borneo Futures, Brunei, ⁴Purwodadi Botanic Garden-Indonesian Institute of Sciences, Pasuruan, Indonesia, ⁵Fauna & Flora International - Indonesia Programme, Jakarta, Indonesia, ⁶Bangor University, School of Environment, Bangor Gwynedd, United Kingdom, ⁷Durrell Institute of Conservation and Ecology (DICE), University of Kent, Canterbury, United Kingdom

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Kerrie is a UQ Vice Chancellor’s Strategic Research Fellow, Director of the ARC Centre of Excellence for Environmental Decisions at UQ, Deputy Associate Dean Research (Engagement and Impact) and an Affiliated Professor in Conservation Science at The University of Copenhagen.

Community forest management seeks to not only avoid forest loss, but also improve social welfare and land rights of rural communities. However, little is known about the impacts of community forestry on aspects of human-wellbeing, other than income-oriented outcomes. We assessed change in five
dimensions of human-wellbeing as a result of Indonesia’s community forestry scheme - Hutan Desa (Village Forest) - using matched villages with and without Hutan Desa. We found that overall, the Village Forest designation successfully improves human-wellbeing; yet these benefits are heterogeneously distributed across land-use zones, reflecting baseline community livelihood characteristics. Communities benefit the most in watershed protection zones and typically rely on subsistence farming. In limited production zones, where communities depend largely on logging, basic wellbeing is reduced due to restrictions on timber harvest. In permanent or convertible production zones, where large monoculture plantations dominate, Hutan Desa has negative impacts on basic and environmental wellbeing, presumably related to land scarcity and the associated pressure to intensify agriculture production. Understanding the human-wellbeing consequences of Village Forests and how this varies spatially can help identify ways to address the heterogeneous needs and constraints of communities, and to inform future policy design.

The dynamics of population release

Professor Richard Duncan¹, Dr Nick Dexter², Professor Jim Hone³, Dr Adrian Wayne³
¹Institute for Applied Ecology, University Of Canberra, , Australia, ²Booderee National Park, Jervis Bay, Australia, ³Department of Parks and Wildlife, Manjimup, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
I am an ecologist with interests in population dynamics, particularly the processes of invasion and extinction.

What happens when populations are released from a strong limiting factor? This can occur in the context of invasions (populations are introduced to locations without their natural enemies) and conservation management (populations increase after removal of an introduced predator). Previous studies of herbivore introductions reveal that populations often display eruptive dynamics associated with resource overshoot: populations increase sufficiently fast that they overexploit the available resources and subsequently decline in abundance. A simple consumer-resource model highlights that we might anticipate a variety of outcomes when populations increase from low levels, ranging from population increase and stabilisation to strong eruptions and population crashes. We tested for the prevalence of eruptive dynamics in data from >100 time series documenting changes in population abundance arising from herbivore introductions around the world and in response to predator removal in Australia. We found evidence for eruptive dynamics in over one-third of cases. This has implications for conservation management: releasing populations from a strong limiting factor, such as removing predators, should allow populations to increase but the default expectation may not be that populations will stabilise at a higher level. Instead, consumer-resource dynamics, along with other factors, could generate a range of outcomes including subsequent population crashes. An additional result of our study is that we may be able to predict the years till the peak of an eruption. Such a prediction would help managers plan translocations from erupting populations.
Regional determinants of megafauna extirpation during the Late Pleistocene in southeastern Australia

Frédérik Saltré is a Research Fellow in palaeoecological modelling. He is an ecologist interested in understanding how ecosystems change through space and time by combining modelling with palaeoecological, archaeological, and genetic data.

The causes and mechanisms of megafauna extinctions during the Late Pleistocene are hotly debated because robust data are rare, and inferences are often biased because taphonomic processes cause underrepresentation of older evidence. Many mechanisms have been proposed to explain the causes of megafauna extinctions: (i) changes in climate conditions increasingly restricted habitats suitable for species; (ii) humans as a ‘new and efficient big predator’ affecting megafauna naïve to human hunting; (iii) a possible combination of human hunting pressure on populations already compromised by climate-driven environmental changes (or vice versa). Most contributions rely on chronological analyses, where the timing of both megafauna extinctions and the initial arrival of humans (associated with the age of the last and first fossil records and archaeological evidence, respectively) are compared to the reconstruction of climate variation at these times. However, such approaches have been heavily criticised because they are not spatially explicit and disregard spatial variation in extinction patterns, human colonisation trajectories, and palaeoclimate change. We combined a new statistical approach to infer the regional timing of megafauna extirpation and first human colonisation compared with palaeoclimate change simulated across southeastern Australia over the last 120,000 years. We show that > 80% of regional megafauna extirpations were likely driven by a combination of human pressure and increasing in aridity. These results provide new insights into how synergistic effects between human pressure and past climate conditions profoundly affected the southeastern Australian ecosystem during the Late Pleistocene.

Questionable Research Practices in Ecology

Hannah Fraser is a quantitative ecologist with an expertise in woodland environments and a passion for evaluating and improving research methodologies.

Psychology, economics and medicine are in crisis due to the low reproducibility of their research findings. In psychology, researchers find contradictory results around half of the time when they redo studies. In ecology, it is more difficult and expensive to redo studies and we expect far more variation due to environmental stochasticity, so we are unsure of how reproducible ecological findings are. However, in other fields low reproducibility has been attributed to a number of practices that increase the chances of finding a significant result where no relationship exists. By comparing the prevalence of these "Questionable Research Practices" in ecology and psychology, it is possible to judge whether low reproducibility is something ecologists should be concerned about.
Our findings suggest that ecologists use Questionable Research Practices just as often as psychologists. For example, 64% of ecologists choose not to present all of the variables they evaluated if they weren’t significant (compared with 63% of psychologists) while and 54% of ecologists report unexpected findings as if they were predicted from the start (compared with 27% of psychologists). With such similar rates of Questionable Research Practices it seems highly likely that ecology has just as big a problem with reproducibility as psychology. What would it mean if half (or fewer) of the results in our literature were false positives?

Gendered disparities in career progression for ecologists at Australian universities

Cindy Hauser¹, Heini Kujala¹, Jessica Roberts¹, Emily Nicholson², Natalie Briscoe¹, Pia Lentini¹, Libby Rumpff¹, Chris Jones³, Reid Tingley³, Jane Elith¹, Therèsa Jones¹, Yung En Chee¹, Luke Kelly¹, Michael McCarthy¹, José Lahoz-Monfort¹, Emma Johnston⁴, Mark Burgman⁵

¹University Of Melbourne, Parkville, Australia, ²Deakin University, Melbourne, Australia, ³Arthur Rylah Institute, Melbourne, Australia, ⁴University of New South Wales, Sydney, Australia, ⁵Imperial College, London, United Kingdom

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Cindy usually researches modelling and survey design for environmental management. She’s a persistent instigator of equity activities within her workplace, currently serving on her department’s Diversity & Inclusion panel. She contributed to the Gender Equity plenary at ESA2015 in Adelaide.

Genders are not equitably represented in academia, particularly in science, technology, engineering, mathematics and medicine (STEMM). There are fewer female academics in senior positions and, in addition to being a social justice issue, this is a significant waste of expertise, talent and investment that limits scientific advances and productivity. In the Ecological Society of Australia, the proportion of women members has grown from 10% in 1963 to more than 50% in the past decade. Yet there is evidence that women remain under-represented in positions of leadership and influence within ecology.

We present data on Australian university-employed ecologists, measure gender representation across levels of seniority, and explore possible causes of the imbalances found. We have collated publicly available online information on ecologists’ gender and seniority from 18 of Australia’s 40 universities over the years 2000-2015. We use these data to build a transition model of seniority level which estimates the influences of gender, level, institution and year on promotion rate. We evaluate to what extent gender imbalances in ecology within Australia are likely driven by: lags associated with historical gender imbalance, broad-scale failure to recognise talents through promotion, stage-specific barriers to promotion (e.g. reduced productivity during child-bearing years), losses to other career paths, and high imbalances at specific institutions. We will discuss if and when we could expect gender parity in Australian academic ecology under current conditions.
Protecting biodiversity and economic returns in resource rich tropical forests

Mr James Ball
1The University of Melbourne, Melbourne, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 055

In pursuit of socioeconomic development, many countries are expanding oil and mineral extraction into tropical forests. These activities seed access to remote, biologically rich areas, precipitating colonisation fronts and introducing novel pressures, thereby endangering global biodiversity. Here we demonstrate that conservation solutions that effectively balance the protection of biodiversity and economic revenues are possible in biologically valuable regions. By mapping the heterogeneity in resource productivity across the landscape and integrating the associated costs into a spatial prioritisation process, we optimise the spatial protection of 741 species and 20 ecosystems of the Ecuadorian Amazon, across a range of opportunity costs. For such an optimisation, giving up 5% of annual oil profits (~US$ 200 million) allows for the retention of an average of 65% of each conservation feature. In contrast, for simple land area optimisation to achieve similar levels of biological protection, 40% of annual oil profits (~US$ 1.7 billion) must be forgone. Using satellite derived forest loss data and spatial statistics (emerging hot spot analysis), we enhance the prioritisation by identifying dynamic habitat threats and focusing conservation efforts onto at-risk areas. We demonstrate that in this region, extractive activities are associated with the continued emergence of forest loss frontiers, emphasizing the urgent need for the to find conservation solutions that balance the trade-offs between economic and ecological goals. Governments should employ the methods presented here when considering extractive led development options, to responsibly manage the associated ecological-economic trade-offs and protect natural capital.

The Web of Death: Exploring the Ecological Role of Carrion in Australian Environments

Ms Emma Spencer
1,2, Dr Philip Barton3, Prof Chris Dickman1,2, Dr Aaron Greenville1,2, Dr Thomas Newsome1,2
1School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia, 2National Environmental Science Programme Threatened Species Recovery Hub, , Australia, 3Fenner School of Environment and Society, Australian National University, Canberra, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 067 - Emma Spencer is a PhD student studying at the University of Sydney, in the School of Life and Environmental Sciences. Her research interests include carrion and predator ecology, and her PhD investigates the ecological role of carrion in Australian environments.

Carrion, or dead animal material, is a nutrient- and energy-rich resource that affects species diversity and contributes to important ecological processes like nutrient cycling. Despite the critical role of this resource, carrion ecology remains understudied, and research on the topic is primarily northern hemisphere based. In this talk, I will firstly provide an overview of a new project that investigates the role of carrion in ecological communities in Australia (ProjectOZscav). This project uses experimentally positioned kangaroo carcasses, motion sensor cameras and insect pitfall traps to explore how carrion is used by carnivores and detritivores, as well as potential cascading effects of carrion on plant and soil ecological processes. I will report on findings from (i) the Simpson Desert, western Queensland where
we have been examining predation rates on artificial nests by scavengers around carcasses, and (ii) the Wolgan Valley, Blue Mountains, regarding scavenger use of carrion across different habitats and seasons. In the Simpson Desert, proximity to carrion led to increased predation of artificial nests. In the Wolgan Valley, carrion detection and biomass loss was influenced by both season and habitat, with carrion in warmer seasons consumed much faster than in cooler seasons, and more open habitats enabling faster detection of carrion resources than forested habitats. My results are providing insights into the role of carrion in Australian food-webs, with implications for carrion management in the conservation and agricultural sectors of Australia.

Analysing 20 years of private land conservation in south-east Queensland

Ms Deborah Metters

1Healthy Land & Water, Brisbane, Australia

Ecology on the Edge, Meeting Rooms 4-5, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Deborah Metters has led the Land for Wildlife program in south-east Queensland for over a decade. She has ensured that the program translates ecological science into practical conservation while also supporting the community.

Recent GIS analysis conducted by Healthy Land & Water demonstrated a suite of on-ground and community outcomes resulting from 20 years of the Land for Wildlife program operating in south-east Queensland.

GIS analysis of 6,976 parcels of land in south-east Queensland with Land for Wildlife status explored membership trends, program hotspots, connectivity with public conservation estates, and extent of threatened species and ecosystems on these properties. For some species and ecosystems, Land for Wildlife properties offer the only form of conservation. The analysis also calculated the extent of restoration that has occurred across Land for Wildlife properties and how this contributes to landscape resilience.

In densely populated regions such as south-east Queensland, the extension model of private land conservation (i.e. Land for Wildlife) offers the most cost-effective approach to protecting some of our threatened and poorly-conserved species and ecosystems. Land for Wildlife properties effectively buffer and extend the conservation estate.

Given the annual membership growth rate has remained roughly consistent since 1998, investment into the program by 11 Local Governments has grown significantly to meet this demand and members’ expectations. Investment has also diversified to adopt new technologies in monitoring and ecological restoration, and to support associated schemes such as voluntary conservation covenants. GIS analysis also offered insight into the program’s future growth opportunities.
The effect of crown fire frequency on the survival and health of resprouting eucalypts

Dr Luke Collins1,2
1La Trobe University, Bundoora, Australia, 2Arthur Rylah Institute, DELWP, Heidelberg, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Dr Collins is a Research Fellow at La Trobe University and the Arthur Rylah Institute. His work focuses on the effect of drought and fuel management on fire regimes, and how future changes to fire regimes may impact forest ecosystems.

Future climate change is predicted to increase the frequency and severity of wildfires across temperate regions of southern Australia. Resprouting eucalypts are relatively tolerant to changes in fire frequency, though little is known about their response to increasing fire severity. This study examined the effect of the severity of two successive wildfires (2007, 2013) on the survival and health of resprouting eucalypts in Victoria, Australia. Four fire regimes were examined: i) successive crown fires; ii) understorey fire then crown fire; iii) crown fire then understorey fire; and iv) successive understorey fires. Eight replicate patches of each fire regime were surveyed and diameter breast height (DBH), mortality, canopy health and basal damage were recorded for trees. Tree mortality responded to the severity of the most recent fire. Mortality was greatest for small trees (<30 cm DBH) with basal damage, that were recently exposed to high severity fire. Trees without basal damage experienced low mortality across all fire regimes. The proportion of dead branches was high for trees experiencing high severity fire in 2013. Trees experiencing successive understorey fires had a low proportion of dead branches. The proportion of dead branches increased with DBH for trees experiencing crown fire followed by understorey fire. The greatest rates of basal damage were recorded for small trees exposed recently to high severity fire. This indicates that high severity fire will reduce small tree survival during future wildfires. Our results suggest that predicted shifts towards more frequent high severity fire will likely decrease eucalypt longevity.

Time is relative in fire-prone ecosystems: what shapes the distribution of bird species?

Mr Frederick Rainsford1
1La Trobe University, Bundoora, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Fred Rainsford is a PhD student at La Trobe University. He is currently in the second year of candidature.

Landscapes are often managed through the paradigm that following fire, ecological communities progress through a series of definable and predictable successional stages until maturity is reached, and that if we have the right combination of these stages throughout the landscape we can conserve all species. However, not all ecosystems respond to fire the same way; in some, fires are stand-replacing and the canopy regenerates from the ground up, whereas in others the canopy trees regenerate rapidly from protected buds along the trunk. It is likely, therefore, that the habitat opportunities available to fauna over time will be different in each system. In this paper I will test the hypothesis that the relative importance of time-since fire (TSF) and habitat structure in shaping the distribution of bird species differs between ecosystems, based on the fire-response strategy.
I used bird occurrence and habitat structure data collected in a space-for-time approach along a chronosequence of 0-91 years-since fire from three disparate, eucalypt-dominated fire-prone ecosystems in SE Australia. I then used non-linear regression modelling to see how species responded to TSF and habitat structure and how the relative importance of each differed between ecosystems. Indeed, I found that when fires are stand-replacing, the relative importance of TSF in driving the distribution of bird species was greater than when the canopy trees survive fire and regeneration occurs rapidly from vertical stems, where the relative importance of habitat structure was greater. These findings have significant implications in how landscapes are managed for fire throughout the world.

**Nutrient availability interacts with fire to drive Eucalypt dominance of Australian tropical savannas**

Mr Harinandanan Paramjyothi¹,², Dr Anna Richards³, Dr Brett Murphy¹, Prof Lindsay Hutley¹

¹Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia, ²CSIRO Land and Water, Tropical Ecosystems Research Centre, Darwin, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Name - Harinandanan Paramjyothi

Present role - PhD student, Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, NT

**Area of research interest** - Fire and tree population dynamics in the northern Australian tropical savannas

Climate and fire are key drivers of tree biomass in tropical savannas. Northern Australia's savannas are amongst the most fire-prone biomes on Earth (typical fire intervals can be as low as 1-2 years), and are dominated by eucalypts (Eucalyptus and Corymbia spp.). However, it is not clear what processes allows this group to dominate under such extreme fire frequencies and if competition for nutrients and water might play a role. There is evidence that eucalypts are adapted to frequent fires; juvenile eucalypts escape the fire trap through rapid height growth between fires. However, non-eucalypts are more common as suppressed juveniles, and appear to be less able to escape the fire trap. The mechanisms that drive these contrasting fire responses are not well understood. Here we describe the results of a controlled glasshouse seedling experiment that tested the relative importance of soil nutrients and water availability, in combination with fire, in determining height and biomass of common eucalypt and non-eucalypt savanna tree species. We demonstrate that growth of eucalypt seedlings is particularly responsive to nutrient addition. Eucalypt seedlings are able to rapidly utilise soil nutrients and accumulate biomass at a greater rate (250-300%) than non-eucalypt seedlings (60%). We provide evidence that a post-fire spike in nutrient availability allows eucalypt seedlings to rapidly gain height and biomass, increasing their likelihood of reaching a fire-resistant size. Our results extend our understanding of how eucalypts dominate northern Australian savannas under extremely high fire frequencies.
Habitat, fuel and fauna: can we use fuel to predict habitat and animals?

Ellen Rochelmeyer1, Julian Di Stefano1, Matthew Swan1
1The University Of Melbourne, Creswick, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Ellen is a Masters student with the Fire Ecology and Biodiversity Group at the University of Melbourne. She is investigating the relationships between fuel hazard, habitat and ground-dwelling mammals in south-eastern Australia.

Every year, we deliberately burn thousands of hectares of native forest to reduce the threat of bushfires to human communities. But fire also affects our native animals. If we are to promote faunal diversity, we need to understand how animals respond to fire and the associated changes in habitat structure.

Fuel hazard assessments are regularly conducted as a part of fire management and involve estimates of vegetation structure and connectivity. Similar vegetation structures are also measured when determining habitat resources for animals. Given the common basis in vegetation structure, we hypothesised that fuel hazard could be used as a surrogate for habitat and fauna. By understanding the relationships between fuel, habitat and fauna, we can then plan fire management to promote faunal diversity.

In this study, we analysed relationships between fuel hazard scores, habitat structure and the occurrence of nine ground-dwelling mammal species in south-eastern Australia. We found that fuel hazard predicted overall habitat complexity and some habitat features moderately well. Seven of the nine species were best predicted by habitat structure. However, six species also had detectable responses to fuel hazard components, and surface fuel hazard was the best predictor of one species.

Traditional habitat assessments still perform best when assessing faunal responses to habitat change. But in the absence of habitat surveys, common fuel hazard scores can be a useful indicator of habitat and animals.

Functional diversity before and after disturbance: an example from a novel, fire-resilient ecosystem

Dr John Patykowski1, Dr Matt Dell2, Dr Tricia Wevill1, Dr Maria Gibson1
1Deakin University, Melbourne, Australia, 2Ecology Australia, Fairfield, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
John Patykowski is a plant biologist interested in the patterns and processes of community assembly, factors that shape plant traits and adaptations, and how natural and anthropogenic disturbance affects biological communities and the contributions of species to ecosystem functioning.

Changes to the biodiversity of natural communities due to anthropogenic disturbance can affect the provision of ecosystem services. Currently, we have a poor understanding of how novel communities reassemble after land-use, and how this affects ecosystem functioning. In novel communities predominantly composed of native, fire-resilient species, it is theorised that post-fire reassembly results in communities that are similar in composition to their unburnt state, but with altered distributions of functional traits. To test this, we examined the effect of prescribed burns differing in season and extent (low-cover autumn burns, and high-cover spring burns) on the floristic composition and functional
diversity of a fire-tolerant box-ironbark ecosystem; a novel, long-unburnt community subjected to centuries of land-clearing and timber harvesting. Woody perennial plant diversity differed between survey years, but was not affected by prescribed burning. Many species resprouted, and drought-breaking rain that occurred during, and after, prescribed burning led to recruitment of obligate-seeding species that was comparable among burnt plots, and unburnt control plots. Of four functional diversity indices examined (richness, evenness, dispersion, divergence), only functional richness increased between survey years. This is likely the result of increased resource availability (water) promoting recruitment and allowing the coexistence of a larger range of traits than during drought. Using ordered simulations of species loss, we determined that common species made a larger contribution to functional diversity than rare species. Partitioning of scarce resources during periods of community assembly in highly disturbed forests could result in competitively successful species holding divergent combinations of traits.

The response of bat communities to fire mediated change in vegetation

Sandra Penman1, Dr Brad Law2, A/Prof Alan York1
1School of Ecosystem and Forest Sciences, University Of Melbourne, Creswick, Australia, 2NSW Department of Primary Industries, Parramatta, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Sandra is a PhD student interested in landscape processes. Her current work examines how fire affects bat communities

Fire is a major driver of vegetation structure and these changes can alter the diversity and abundance of native fauna. Bats are particularly responsive to vegetation structure as dense vegetation or “clutter” impedes flight and reduces the effectiveness of echolocation. It is therefore expected that changes in vegetation structure in response to fire is likely to impact on bat diversity.

Bat community activity, food availability (invertebrate abundance), and vegetation structure were measured across a gradient of time since fire (6 months to 77 years). All sites were within a shrubby dry sclerophyll forest community in the Otway Ranges of Southern Victoria known to undergo structural changes in vegetation with increasing time since fire. Immediately after a fire these forests have an open understorey that becomes dense as the forest regenerates, but later becomes more open over time as vegetation senescence.

Overall bat activity was not significantly different between the fire age classes; however, species richness was lower at sites of intermediate time since fire (3-10 years). Intermediate age class have denser midstorey vegetation which is likely to restrict foraging opportunities and movement. Understanding and quantifying these site scale changes in diversity will allow us to model how landscape fire regimes impact bat assemblages over time.
Error and uncertainty in the NSW fire history database – implications for management.

Miss Jane Williamson¹, Dr Jennifer Taylor¹, Mr Murray Ellis²

¹Australian Catholic University, North Sydney, Australia; ²Office of Environment and Heritage, Hurstville, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
POSTER 042

Jane is a terrestrial ecologist and a PhD student, focusing on the impacts of prescription burning on fauna habitat.

Fire records are generally stored spatially in Geographic Information Systems (GIS) and used for risk assessment, strategic planning and assessing ecological conditions. Error is inherent in spatial data and has the potential to have a large effect on results of analyses of historic fire trends and on predictions or modelling of future fire behaviour and occurrence.

We used the GIS fire databases for NSW as a case study of quality and completeness of stored fire records and assessed the temporal and spatial limitations of the data. Fire records from the two main fire-management agencies in NSW were pooled. Analysis showed forty-two percent of the area burnt was repeated records within and between databases. The amount of error was less in vegetation types of arid areas. Examination of historical fire records shows that it is difficult to interpret fire history from the NSW GIS fire database. Examination of the records show at least three temporal change points in annual area burnt. I will present data on the quality of records for areas that are managed for biodiversity conservation and to areas that are not, and explore the implications of these results for management decisions.

What drives fuel hazard across south-eastern Australia – soil, climate or fire?

Sarah McColl-Gausden¹, Associate Professor Lauren Bennett¹, Associate Professor Trent Penman¹

¹University Of Melbourne, Creswick, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 072 - Sarah is a PhD student examining whether fire management could be used to maintain and enhance biodiversity in a changing climate. Her project will bring together field experiments and simulation modelling in a decision science framework.

Fire regimes are driven by interactive effects of fuel and weather. Fuel hazard provides a multifaceted measure of fuel that integrates load, structure, and availability. Continental-scale patterns in vegetation broadly predict fuel, but fail to predict fuel hazard at a resolution meaningful for fire management. In this study we use a comprehensive database of fuel-hazard ratings from native vegetation across south-eastern Australia to examine the relative importance of soil, climate and fire-history variables on local patterns in fuel hazard. We developed random forest models for each fuel strata: surface, near surface, elevated, and bark, using three sets of predictor variables: climate, soil, and fire-history, along with all two and three predictor set combinations. Models were evaluated on their capacity to predict fuel hazard ratings using k-fold cross validation. Soil, climate and time since fire were all important predictors of fuel hazard, with soil predictors the most important variables across all fuel strata.
physiochemical variables likely represented determinants of productivity that were not captured by climate variables. Fuel hazard across all fuel strata consistently increased with the soil surface bulk density, and with the maximum temperature in the warmest month, with responses to other predictor variables varying depending on the fuel strata. These models allow us to estimate fire behavior at fine resolution (180m) to infer local fire regimes and will be used to explore the implications for fire regimes under future climates.

Topography, climate, fire and habitat: how are they driving mammal communities?

Ms Annalie Dorph1, Dr Julian Di Stefano1, Dr Matthew Swan1
1University Of Melbourne, Creswick, Australia

Global change, fires and landscape interactions in the world’s most flammable continent, Meeting Room 7, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 068 - Annalie is a PhD candidate with the Fire Ecology and Biodiversity Group at the University of Melbourne. She is researching how different sources of environmental variation, both natural and human-mediated, are affecting species diversity within Victorian landscapes.

The positive association between species diversity and environmental variation is a global phenomenon. In flammable ecosystems, managers use fire-mediated variability to promote biodiversity, but variability is caused by multiple factors, and how species respond to variability from different sources is often unclear. In this study, we examined the response of ground-dwelling mammal diversity to four drivers of landscape variation: topography, climate, fire and habitat structure. A secondary objective was to test the consistency of responses through time. We surveyed mammals in four different years between 2010 and 2017 and developed models to test the effect of these four sources of environmental variability on both alpha and beta diversity. Habitat complexity and geographic location were generally the most important predictors of alpha diversity, whereas habitat complexity and climate had the greatest influence on beta diversity. Time since fire had a negligible effect on mammal diversity. While the relative importance of variables in each survey year were similar, the ability of each model to predict onto data from other years was low. Our results demonstrate the importance of habitat structural variability, which is likely to be influenced by interactions between fire and biophysical factors, in driving species diversity. The challenge for land managers is to manipulate fire regimes to enhance habitat variability and species diversity at landscape scales.

Feral cat baiting increases occupancy of the critically endangered Central Rock-rat in its mountain refuges

Mr Alistair Stewart1, Mr Peter McDonald1
1NT Dept. Environment And Natural Resources, Alice Springs, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Alistair is a fauna scientist with the Northern Territory Department of Environment and Natural Resources, Flora and Fauna Division. He has wide interests and expertise in terrestrial fauna, landscape ecology and developing technologies for environmental monitoring and land management.

Australia has the highest rate of mammal extinction in the world and this has been concentrated in the arid zone. The central rock-rat (CRR) Zyzomys pedunculatus is a critically endangered rodent now only found in rugged, mountainous refuges in the western MacDonnell Ranges in arid central Australia. The CRR has the highest risk of extinction of any Australian mammal in the next 20 years and predation by
feral cats is presumed to be the main threat to the species. The CRR has an enigmatic history of disappearing for long periods of time and only being detected after decadal high rainfall “boom” periods. Following the rediscovery of the CRR in their mountain refuges in 2010, camera trapping survey techniques have been refined to accurately define their currently known and very limited distribution. We have undertaken experimental baiting of feral cats to reduce density and predation pressure in the Tjorita / West MacDonnell National Park refuges. Concurrently we have monitored the occupancy of the CRR using camera traps to assess their response and potential for recovery. Previous results from a wetter season showed that CRR occupancy increased in response to removal of cats and we will present the results of this year’s baiting and surveys undertaken in a drier season. We plan to expand the feral cat baiting program to manage other known and potential refuges in an effort to secure and recover the Central Rock-rat population from imminent extinction.

Red fox feeding ecology varies across an urban to natural land use gradient

Ben Stepkovitch¹, Dr Justin Welbergen¹, Prof Chris Dickman², Dr John Martin³
¹Hawkesbury Institute for the Environment, Western Sydney University, Hawkesbury, Australia, ²School of Life and Environmental Sciences, University of Sydney, Camperdown, Australia, ³Royal Botanic Garden & Domain Trust, Sydney, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Ben is a Masters of Research graduate from Western Sydney University, whose interests are in conservation biology and vertebrate pest management.

Urbanisation poses a major threat to biodiversity, often resulting in the decline or local extinction of endemic plant and animal species. Urban and peri-urban areas, in general, contain a mosaic of fragmented natural habitats in which some species find refuge. While the persistence of species is often tenuous in such refuges, little is known about how introduced predators, such as the European red fox (Vulpes vulpes), affect potential prey species in urban Australian environments. This study aimed to address this knowledge gap by assessing the diet composition of foxes along an urban land use gradient, transecting the Sydney region. Over a 2-year period, 132 fox stomachs and 271 scat samples were collected across the Sydney region and analysed to identify prey species. There was no significant change in the proportion of mammals consumed across the land use gradient, in both stomach or scat contents. However, the proportion of native mammalian prey increased away from urban areas (e.g. possums, macropods), and non-native prey increased towards urban areas (e.g. black rat, Rattus rattus). A considerable proportion of mammalian prey in urban areas consisted of native species adapted to urban environments (e.g. brushtail possum, Trichosurus vulpecula). The proportion of anthropogenic food increased along the gradient, peaking in urban areas. We consider our sampling to be rigorous if not extensive, and highlight that no threatened species were identified as being directly preyed upon. These findings expand our understanding of the ecological role foxes perform in urban areas compared with agricultural and natural areas.
Are cats and rats equal? Maximising the benefits of controlling invasive predators in data-poor environments.

**Dr Michaela Plein**¹, Associate Professor Kate O’Brien², Dr Matthew Holden³,⁴,⁵, Dr Christopher M Baker³,⁴,⁶, Professor Nigel Bean⁷, Associate Professor Eve McDonald-Madden¹,³,⁴

¹School of Earth and Environmental Science, University of Queensland, Brisbane/St Lucia, Australia, ²School of Chemical Engineering, University of Queensland, Brisbane/St Lucia, Australia, ³School of Biological Sciences, The University of Queensland, Brisbane/St Lucia, Australia, ⁴ARC Centre of Excellence for Environmental Decisions, The University of Queensland, Brisbane/St Lucia, Australia, ⁵Centre for Applications in Natural Resource Mathematics, School of Mathematics and Physics, The University of Queensland, Brisbane/St Lucia, Australia, ⁶CSIRO Ecosystem Sciences, Ecosciences Precinct, Brisbane/Dutton Park, Australia, ⁷School of Mathematical Sciences, University of Adelaide, Adelaide, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**

Michaela is a postdoctoral researcher at the University of Queensland. As part of the NESP Threatened Species Hub she applies quantitative models to predict the outcomes of conservation actions such as eradications and translocations.

The imminent threat of invasive organisms to native species often requires managers to intervene rapidly to save threatened ecosystems. This urgency leaves little time for further research about the ecosystem. Therefore management actions often rely on experience from other systems or on best guesses. Attempts to predict ecosystem-wide outcomes of invasive species eradications are difficult due to the complexities within ecosystems and common data constraints.

We approach this problem by reducing the complex ecosystem into smaller compartments. We then combine mechanistic understanding from similar systems, with case study-specific data to develop a qualitative risk assessment of perverse outcomes. We illustrate our approach with a three-species network from Christmas Island, where red-tailed tropicbirds are preyed upon by feral cats and invasive black rats. Since cats require more energy per individual than rats, the ecosystem can accommodate more rats than cats. Our model shows that the reproductive success of the seabirds is impacted 3.5 times more strongly by cats than by rats. For the change in seabirds parameter the abundance of rats can be six times higher than the abundance of cats, because rat predation affects mostly the early life stages (i.e., eggs and juveniles) whereas cats eat mostly the later life-stages. Our findings show that after cat eradication, rat abundance should be monitored to ensure that rat numbers remain within thresholds that are safe for red-tailed tropicbirds. Our model is sufficiently general and can be applied to other three-species systems from which one species is being removed.

 Roles of biotic resistance and disturbance in the establishment of an invasive invertebrate

**Ms Pauline Lenancker**¹,², Dr Ben Hoffmann², Dr Lori Lach¹

¹James Cook University, Cairns, Australia, ²CSIRO, Darwin, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**

I am currently exploring the genetic, behavioural and ecological factors limiting the success of two invasive ants in Australia as part of my PhD. I am interested in biological invasions, innovative genetic tools to manage invasive species and social insects.

Several studies have found that disturbance (any discrete event that disrupts community structure and changes available resources, substrate availability, or the physical environment) and the absence of biotic resistance drive biological invasions, but most have focused on plant invasions. We performed a
field experiment to determine the role of disturbance and biotic resistance on the establishment of the invasive tropical fire ant (Solenopsis geminata). We introduced 447 S. geminata queens within 40 hours of their nuptial flight in individual cages that either excluded or allowed access to native ants, into two pairs of uninvaded sites near Darwin. Each pair of sites comprised an undisturbed site which was an unmaintained savannah woodland and a disturbed site which was a maintained open grassland (historically cleared savannah woodland). We retrieved the cages after 7, 14 or 25 days and determined queen survival. We used 19±1 replicates per treatment combination (site, cage type and exposure time). Overall, 48.3% of queens retrieved at 7 days survived, 38.1% at 14 days and 19.3% at 25 days. Queens which were isolated from native ants were 50.7% more likely to survive (GLM:binomial, P>0.01). In the first pair of sites, queens were 21.9% more likely to survive in the disturbed site (GLM:binomial P<0.05), but disturbance did not affect survival in the second pair (P>0.05). We found that abiotic factors and natural causes contributed the most to queen mortality (mean ± SD: 85.7±8%) followed by biotic resistance (14.2±8%). Our findings improve our understanding of the factors limiting invasive species establishment.

Do foxes suppress feral cats?

**Mr Matthew Rees**¹, Dr Bronwyn Hradsky¹, Prof Brendan Wintle³, Mr Mark Le Pla², Dr Jack Pascoe²

¹University Of Melbourne, Parkville, Australia, ²Conservation Ecology Centre, Cape Otway, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**

Matthew Rees is a PhD candidate with the Quantitative and Applied Ecology group at the University of Melbourne. He is investigating the interactions and outcomes of lethal control of invasive predators in mesic environments, and how species’ ecology impacts monitoring.

The lethal control of invasive predators is a prevalent conservation strategy, yet, often has unintended consequences. In Australia, foxes are subject to widespread management, despite concern that this could be leading to a release of feral cats. However, most evidence supporting this concern has been from regions that are arid, semi-arid and/or containing complex predators assemblages, as well as reliant on inferences from count data. The aim of this study was to determine whether feral cats benefit from fox control in a wet forest. We used a before-after, control-impact experimental design to monitor the outcomes of continuous fox-baiting across the Otway Ranges, Victoria. Firstly, we quantified the impact of baiting on the fox population. Fox scats were collected for 70 days in total along two independent 16km transects. Genetic identification allowed population density to be estimated through spatial capture-recapture methods. Secondly, we measured the resulting change in feral cat behaviour and density. Two intensive camera-trapping grids (each ~7km2) were also surveyed before and after fox-baiting commenced. Individual feral cats were identified based on unique physical appearance, and population density estimated through spatial mark-resight methods. Despite being one of the most extensive fox control programs in Australia, initial results cast doubt on the programs ability to substantially reduce fox density. These surveys have also uncovered a significantly higher density of feral cats than predicted in the current literature. Our research greatly increases the information on invasive predators in mesic environments and highlights the importance of robust monitoring for management strategies.
The bottom-up effects of eradication: breeding decline and diet changes of a native top-order predator

Mr Toby Travers1,2, Assoc Prof Mary-Anne Lea1,3, Dr Rachael Alderman1,4, Dr Aleks Terauds5, Dr Justine Shaw2,6

1Institute For Marine And Antarctic Studies, University Of Tasmania, Hobart, Australia, 2Threatened Species Recovery Hub, National Environmental Science Programme, St Lucia, Australia, 3Antarctic Climate and Ecosystems CRC, Hobart, Australia, 4Department of Primary Industries, Parks, Water and Environment, Hobart, Australia, 5Australian Antarctic Division, Department of the Environment and Energy, Kingston, Australia, 6University of Queensland, St Lucia, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Toby Travers is a PhD candidate at the Institute for Marine and Antarctic Studies, University of Tasmania. Toby's primary research interest is the use of applied ecology in conservation, specifically in regards to top-order predators and their prey.

Historically, invasive species on islands have introduced novel trophic roles – such as terrestrial predation and herbivory – which have had devastating consequences for the native biodiversity of these simple, isolated ecosystems. With insufficient defences against introduced threats, island-endemic species have declined globally, and in some cases become extinct. Eradication projects are therefore, a key component of island conservation, and are important for the management and recovery of many plant and animal species.

On larger islands and continents with complex ecosystems, invasive species can also act as novel prey for native predators. In places where native prey have declined, invasive prey may play a vital role in sustaining native predator populations. Top-order predators occur at naturally low population sizes and many already suffer from predator-specific threats. Eradicating invasive prey from complex ecosystems could, therefore, have unintended consequences for native predators, if the bottom-up ecological effects of pest management are not considered.

Here we used long-term monitoring of the diet and breeding of a top-order predator on Macquarie Island, the brown skua (Stercorarius antarcticus lonnbergi), to investigate how the removal of invasive prey, rabbits (Oryctolagus cuniculus) – following a successful small mammal eradication – affects a native predator.

Our work found the eradication of invasive small mammal prey caused a significant decline in the breeding population size and reproductive output of brown skuas. Our work reinforces that consideration of the native-predator/invasive-prey relationship will be vital for the success of future island and continental eradication projects targeting invasive species in complex ecosystems.

Using demographic models to tackle invasive mammals on islands

Mr Hernan Caceres-Escobar1
1The University of Queensland, Brisbane, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

In Australia, European red foxes (Vulpes vulpes, hereafter foxes) have been linked with the decline of 84 threatened species and cause an estimated AUD$227.5m in economic and environmental loss annually, being listed as a key threatening process. Effectively managing foxes requires decision making with limited human and economic resources as well as uncertainty about the efficacy of management actions. Given the ubiquitous and pressing fox problem on islands around the world, we provide a general framework for how to assess proposed management actions to reduce invasive fox populations. The framework includes projecting fox populations under specified management scenarios using matrix
population models. Here, we illustrate our framework for red foxes on Minjerribah–North Stradbroke Island (Queensland, Australia). Local conservation practitioners aim to eradicate foxes from the Island in order to eliminate their impacts on threatened and culturally relevant species. We assessed three management scenarios co-developed with local managers as a strategy for improving invasive species management decisions. The three scenarios use a combination of baiting, hunting, trapping, and den search. We found that the “high-intensity and high investment” scenario was the most cost-effective and efficient strategy to control the impacts of red foxes on Minjerribah. More generally, the outputs from our framework show the required effort, timeframe, and financial investments needed to achieve invasive species management objectives.

Determining island cat ecology for management and threatened species recovery

Ms Vivianna Miritis1, A/Prof Euan Ritchie1, Dr Amy Coetsee2, Dr Tim Doherty1, Mr Anthony Rendall1
1Deakin University, Burwood, Australia, 2Zoos Victoria, Parkville, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Poster 033 - Vivianna has a strong interest in threatened species recovery and is currently completing her honours degree at Deakin University focusing on ecology and wildlife conservation biology.

Cats (Felis catus) have been introduced to many parts of the globe and have established themselves as one of the world’s most damaging predators. In Australia, cats have been linked to a substantial loss of biodiversity, especially in small terrestrial mammals, birds and reptiles. In particular, cats are highly successful in island populations where they are often the apex predator within their trophic webs. Moreover, cats on islands pose a major threat to the success of recovery programs where islands act as threatened species safe havens. In order to optimise feral cat management, understanding habitat use of cats is essential. Therefore, the aims of this study are to determine cat density, distribution, habitat use and home range within French Island, south-eastern Australia. French Island was chosen because it is one of five Australian islands nominated for cat eradication, is fox free, and has over 9000ha of suitable habitat for a planned eastern barred bandicoot (Perameles gunni) introduction. We deployed 40 infrared cameras within the proposed eastern barred bandicoot release site (300ha), and roaming domestic cats were GPS collared between April and July. In this talk we report on cat movement distances, diel activity patterns, home range and habitat use, and discuss the implications for the conservation of native animals on French Island.

What tantalises a dung beetle’s taste buds?

Amrit Pal Kaur1, Dr Jean Holley1, A/Prof. Nigel Andrew1
1University Of New England, Armidale, Nsw, Au, Armidale, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Amrit Pal Kaur is a PhD student in insect ecology laboratory, UNE. Currently, the focus of her research is to assess nutritional resources for dung beetles and to compare these resources over a period of time.

Dung beetles mediate several important ecosystem processes including nutrient cycling, bioturbation, seed dispersal, and pest control. They relocate the manure quickly after finding it, either by burying it under the soil, or rolling it away from the dung pat for feeding and/or nest building. But all these key roles hinge on beetles being attracted to dung in the first place; and they appear highly selective. Few field and laboratory studies have assessed both the selection of a particular dung type and attraction towards particular volatiles of dung resources by dung beetles. The mechanism of resource selection in dung beetles is thought to be based on their ability to detect and discriminate between different
odours, however this is not fully understood. Here we address the question: What olfactory cues does a dung beetle respond to when presented with different resources? We used Gas Chromatography Mass Spectroscopy analysis of cattle manure from cow dung pats collected across four different seasons in northern NSW. The seasonal comparison of fresh cattle manure for different volatiles showed a significant variation in compounds as well as their abundance. Additionally, electroantennography studies will provide the actual response of a beetle’s antennae towards the specific olfaction. The output of this study is predicted to be very useful in constructing artificial diets for dung beetles. And these artificial diets could be promising for mass rearing program to breed and multiply dung beetles independent of seasonal cycles, so that land managers can have year-round access to these industrious nutrient recyclers.

**Trophic cascades and food web effects of rodent eradication on Lord Howe Island**

*Dr John Porter*1,2, Dr Kate Brandis2, Mr Andrew Denham1, Mr Terry O'Dwyer1  
1Office Of Environment & Heritage, Hurstville, Australia; 2University of NSW, Centre for Ecosystem Science, Sydney, Australia

Invasive Animals and Plants (1), Meeting Room 3, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**  
John Porter has worked on long term monitoring and management of waterbirds and wetlands as well as plant community ecology in temporary and arid zone wetlands. John is interested in how plant and animal communities respond to disturbance.

Globally, biological invasions are one of the most serious threats to biodiversity of natural ecosystems. Nationally, invasive species are unequivocally increasing impacts on Australia’s biodiversity. Invasive Black rats have devastated numerous island ecosystems after accidental introductions and been responsible for range of species extinctions of insects, plants & mammals.

Pest eradication and ecological restoration work on islands has focused mainly on recovery of species abundance and distributions. Black Rats on Lord Howe Island World Heritage reserve are implicated in the extinction or near extinction of numerous endemic and endangered plant, insect, lizard, and bird species.

An ambitious rodent eradication is currently planned for Lord Howe Island (LHI). Relatively little is understood of how rodent eradication will effect food webs and ecological interactions, particularly for ecologically important (Currawong) or iconic species (Woodhen). Although a considerable number of biological and ecological studies have been done on LHI, effects of eradication on food web interactions and species trophic status are poorly understood.

Trophic cascades, or the extension effect of changes in one species’ abundance across multiple links in the food web, are increasingly recognized as a likely consequence of eradication. This work aims to determine changes in food web interactions and trophic status of LHI Currawong and LHI Woodhen, by sampling before and after removal of rodents using stable isotope analyses. The implications of predicted trophic shifts are considered for the islands important animal and plant communities.
Shrinking opportunities for establishment of native annuals in fragmented temperate woodlands

Dr John Morgan1, Ms Jemma Ebsary
1La Trobe University, Bundoora, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
John Morgan is a plant ecologist interested in species coexistence processes in herbaceous plant communities, and how to apply this to conservation outcomes

Local extinction of annual plants has been reported in temperate grassy ecosystems. We propose that it may be that 'safe sites' for germination are disappearing because of the loss of ground-dwelling animals that dig soils and fire. Both disturbances create bare ground and reduce competition from neighbouring plants. The loss of safe sites because of fundamental changes in ecosystem disturbance regimes may deprive annual species of the microhabitats they need to survive. We a) quantify patch-type frequency in fragmented temperate grassy woodlands and link this to germination using b) experimental manipulations, matched with c) germination cue studies. Exotic annuals had higher and more rapid germination across a wider range of diurnal temperatures than native annuals. Emergence of native and exotic annuals was highest on bare ground patches but was suppressed by leaf litter and mossmat. Seedling growth of native annuals was suppressed by tree litter whereas growth of exotic species was not suppressed by litter or the mossmat. Many of the differences in response between native and exotic species may be due to seed traits such as seed mass; native annuals have much smaller seeds than exotic annual species. The regeneration niche of native species is typically narrower than that of exotics. This likely affects species persistence in fragmented grassy woodlands that have lost their endogenous disturbance agents.

Assessing the effects of Eragrostis curvula abundance on the soil seedbank within the Bega region

Miss Simone-Louise Yasui1, Dr. Jennifer Firn1, Dr. James McGree2, Dr. Emma Ladouceur1,3,4, Miss Huong Nguyen1
1School of Earth, Environmental and Biological Sciences, Queensland University Of Technology, Brisbane, Australia, 2School of Mathematics, Queensland University of Technology, Brisbane, Australia, 3School of Earth Science and Environment, University of Pavia, Pavia, Italy, 4The German Centre for Integrative Biodiversity Research (iDiv), Leipzig, Germany

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
My name is Simone-Louise Yasui, I am a PhD candidate at Queensland University of Technology, and I am broadly interested in understanding the underlying mechanisms which govern community assembly and how we can use plant invasions to understand these mechanisms

The introduction of African lovegrass (Eragrostis curvula), has significantly influenced community dynamics of Australian grasslands and threatens the conservation of native Australian plant species. To determine the best practice for managing the ecological impacts African lovegrass has on grassland ecosystems, it is necessary to understand both the above and belowground community effects different management techniques will have. Therefore, the aim of this study is to assess if the dominance of African lovegrass in the aboveground vegetation community decreases the species richness and abundance of native plant species in the soil seedbank, or if other external biotic and abiotic factors influence the belowground plant community composition. The experimental field trial conducted in the Bega Valley indicate that there is a negative relationship between the relative abundance of African
lovegrass and aboveground species richness. In response to the management treatments the relative abundance of African lovegrass was lowest in pastures that were managed with spot-spraying individual tussocks, whilst the highest relative abundance was found with the slashing method. From the germination trial, there is a positive relationship between the relative abundance of aboveground African lovegrass and the proportion of germinants that were African lovegrass. However, there is a weak negative relationship between the relative abundance of African lovegrass and the species richness of the belowground community. These results indicate that here are potentially long-lasting effects this invasive grass has on grassland communities, but the aboveground biomass of African lovegrass may be managed using spot-spraying with herbicides.

**Invasion patterns and potential of eastern Australian Acacia species in southwest Western Australia**

**Dr Eddie Van Etten**, Ms Hannah Ayson

1Edith Cowan University, Joondalup, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

Eddie is a lecturer/researcher with the Centre for Ecosystem Management at Edith Cowan University in Perth with research interests in vegetation ecology, including fire ecology, invasive plant species and restoration ecology.

We reviewed the status of Acacia taxa native to eastern Australia using herbarium records and other data to determine which are naturalised and which are potentially invasive in southwest Western Australia. For two taxa, Acacia iteaphylla and Acacia longifolia subsp. longifolia, we used collection localities (where confident of their identification and spatial accuracy) and climatic and substrate information to model and map potential current and future distributions (with various climate change scenarios) using Maxent. Predicted distributions differed substantially between these two taxa, with A. iteaphylla favoring areas with dry summers and low to medium rainfall with predicted distributions covering most of the southwest and wheatbelt even in the face of a drying and warming climate. In contrast, A. longifolia subsp. longifolia was only predicted to occur in wettest parts of the south coast. Field studies in periurban bushland around Perth demonstrated A. longifolia subsp. longifolia can occur in high densities in bushland, especially where there is extra moisture from groundwater or surface flows, and numbers are enhanced by wildfire. In contrast, A. iteaphylla was mainly restricted to bushland edges and disturbed areas, and densities were generally low. Establishment of both taxa was favoured under trees and where there was a more open understory. In conclusion, A. longifolia subsp. longifolia is an invasive species with potential for ecosystem-level impacts, especially in areas of higher rainfall and/or lowland settings receiving extra moisture, whereas A. iteaphylla is presently not of concern but needs to be carefully monitored.

**The influence of exotic grass *Bothriochloa pertusa* on floristic diversity at multiple spatial scales**

**Miss Gabrielle Lebbink**, Assoc. Prof Rod Fensham, Mr John Dwyer

1University Of Queensland, Brisbane, Australia, 2Queensland Herbarium, Mount Coot-tha, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

I am a PhD student at the University of Queensland, researching the impact, spread and management of an invasive grass species. I love plant ecology, particularly researching plant community responses to disturbances like fire, grazing and invasive species.
Since its introduction in the 1930s, the exotic grass Indian couch (Bothriochloa pertusa) continues to spread widely throughout north-eastern Australia and is of growing concern for conservation management. The relationship between Indian couch cover and floristic diversity and composition was investigated at multiple spatial scales (1 m², 10 m², 100 m², 1000 m²) in Eucalyptus woodland in north-eastern Australia. Floristic data from 41 plots with varying levels of invasion by Indian couch were analysed in the context of edaphic and climatic conditions. Species richness and perennial grass and shrub richness and abundance significantly declined with Indian couch cover at all spatial scales. Forbs and annual grasses showed no significant relationship with Indian couch cover. With increasing plot size, the relative reduction in total species richness, between heavily invaded and uninvaded plots remained the same, while for perennial grass and shrub richness the relative reduction increased with plot size. Indian couch cover was greater on plots with greater fine sand content and previous 3 months rainfall.

These results suggest that the spread of Indian couch may lead to significant declines in floristic diversity at both local and landscape scales. Reasons for the species recent rapid spread are unclear, however heavy livestock grazing and active sowing of seed are undoubtedly associated and thus need to be addressed in order to manage its spread. Additional research on the species extant is necessary for a comprehensive understanding of its impact on floristic diversity.

Native and exotic plant populations vary in allelopathic responses to competition

Dr. Akane Uesugi

1 Monash University, Clayton, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

Akane is a research fellow in the School of Biological Sciences at Monash University. She is interested in invasion biology, evolutionary ecology, chemical ecology and plant-herbivore interactions.

Some plants use allelopathy to compete against neighboring plants, and the ability to induce allelopathic compound production in response to competition is hypothesized to be adaptive, as plants can save costs of metabolite production in the absence of competitors. Such plasticity may be particularly beneficial for exotic plants that encounter various competitive environments across their novel range. However, whether plants induce allelopathy has rarely been explored so far.

Using native and invasive genotypes of Solidago altissima, we tested for the inducibility of polyacetylenes—putative allelopathic compounds—in response to competition from Poa pratensis. Solidago altissima plants with higher expression of polyacetylene production suppressed the growth of the neighbor plants more, providing additional evidence for the allelopathic function of the compounds. Competition induced polyacetylenes in a context-dependent manner: Exotic, but not firmly established populations in Australia exhibited strong inducibility, whereas the native populations from the United States and well-established invasive populations from Japan showed no induction, supporting the hypothesis that plasticity may be favoured during the early phase of invasion. Plants also induced polyacetylenes more strongly when competing under low nutrient availability, supporting the hypothesis that induction of allelopathy is most beneficial under severe competition for limited resources.

The observed patterns suggest that plants may adaptively induce allelopathy when it is most needed, and that such plasticity may facilitate invasion of exotic plants in a novel, unpredictable competitor environment.
Combatting canary-grass: Is Carex appressa an effective suppressor?

Mr Rob Dabal1, Dr Joe Greet1, A/Prof Chris Walsh1
1University Of Melbourne, Richmond, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Rob is currently completing a Masters of Science (Ecosystem Sciences), investigating the ecology of the invasive wetland grass Phalaris arundinacea. Rob has 20 years experience in riparian vegetation management.

Phalaris arundinacea, Reed Canary-grass (RCG), occupies over 40 hectares of critically endangered sedge rich Eucalyptus camphora wetland forest. A mere 260 hectares of this vegetation type remains providing habitat for the last remaining wild populations of helmeted honeyeater and lowland leadbeaters possum, both species are critically endangered.

I tested the response of RCG to 6 water regimes and competition in a nursery-based trial. I grew RCG and Carex appressa in dry, waterlogged, flooded and submerged conditions. I fluctuated the water level of two treatments by including an additional waterlogged and flooded treatment which were submerged 5 days per month.

RCGs response was tested both independently and in competition with Carex apressa a robust and structurally dominant native sedge in wetland forests. I measured tiller length over 6 months and dry weight biomass at the commencement and conclusion of the trial.

These results highlight RCGs exceptional phenotypic plasticity. RCG responds swiftly to increasing depth and fluctuation in water level. It rapidly extended its stems and developed extensive adventitious roots when in competition with Carex appressa and when growing independently.

A reduction in RCG biomass when in competition with Carex apressa was observed in all treatments except when fully submerged.

Our results shed light on how managers might manage RCG by manipulating environmental flows.

A water regime that increases waterlogging and minimizes full submergence may protect wetland forests and improve the outlook for the critically endangered fauna that depend on them.

Recovery from global heat stress (2016) was not affected by land use in the Maldives

Mr Dominic Bryant1,2,3, Prof Stuart Phinn3, Prof Ove Hoegh-Guldberg1,2, A/Prof Sophie Dove1,2
1School of Biological Sciences, ARC Centre of excellence in Coral Reef Studies, University of Queensland, St Lucia, Australia, 2Global Change Institute, The University of Queensandd, St Lucia, Australia, 3Remote Sensing Research Centre, School of Earth and Environmental Acinces, University of Queensland, St Lucia, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Dominic Bryant is a coral reef ecologist interested in the dynamics between localised anthropogenic stress and global impacts facing coral reefs. He has particular interest in coral reefs of the Maldives, which he has been diving for many years.

The coral reefs of the Maldives encountered an extraordinary heat stress event followed by mass coral mortality in April-June 2016. This follows a similar event in 1998. In an attempt to improve recovery
from these types global events by reducing local stress factors (i.e. pollution and fishing pressure), the Maldives government has consolidated human populations around local community islands (LCI), while planning to protect other locations through limiting human activities on other islands. LCIs, consequently have increased land reclamation and wastewater effluent compared to other islands. We used linear mixed effects models (LME) to investigate the loss of coral communities after the 2016 heat stress event, exploring the effect of reef location (inside or outside the atoll), land-use regime (unpopulated, resort, LCI), and the presence/absence of Acanthaster planci (COTS) outbreaks between 2014 and 2017, using the absolute change in coral cover between 2015 and 2017. Results confirmed an overall reduction in coral cover from 18.6% (±0.34%SE) in 2015 to 13.0% (±0.21%SE) in 2017. The initial cover, one year before the bleaching event was found to be highly correlated with the subsequent coral decline. Surprisingly, land-use had no effect on coral loss associated with the thermal event; and reef location was only significant for branching coral cover, with reduced impact on the outer versus inner reefs. The results indicate that the 2016 bleaching event affected even the healthiest, relatively undisturbed corals just as much as those already damaged by land use practices and severe though localised COTS outbreaks.

**Shifts to faster growth strategies towards range edges of two invasive plants in eastern Australia**

**Miss Samiya Tabassum**, Professor Michelle Leishman

1Macquarie University, Sydney, Australia

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

POSTER 062 - Samiya has recently completed a PhD at Macquarie University looking at the ecological and evolutionary mechanisms driving range expansion in exotic invasive species. She has broad research interests in enemy release, seed dispersal and invasion biology.

Understanding shifts in traits across the course of an invasion can significantly increase our understanding of mechanisms underpinning range expansion. For example, shifts to traits associated with faster growth may be advantageous in range edge populations of invasive species to decrease generation time and thus promote rapid range expansion. We tested whether populations at the expanding range edges of two coastal plant species invasive in eastern Australia (Gladiolus gueinzii Kunze and Hydrocotyle bonariensis Lam.) possessed different carbon capture strategies compared with range core populations where they were first introduced. To do this, pairwise leaf-trait relationships between specific leaf area (SLA), assimilation rate (Amass), foliar nitrogen (Nmass) and foliar phosphorus (Pmass) were investigated for range edge and range core populations using standardised major axis (SMA) regression. Hydrocotyle bonariensis displayed significant shifts in trait values along a common axis for many pairwise comparisons. Range edge populations were found to have higher values for Nmass, Amass and SLA compared to range core populations, suggesting that range edge populations are positioned further along the leaf economics spectrum towards faster growth strategies. In contrast, for G. gueinzii, leaf traits were positioned along a common slope with no difference in the relative positions of range core and range edge populations. Our results suggest that there is selection for faster carbon capture strategies at range edges for some introduced species undergoing range expansion and this may be a contributing factor in explaining rapid range advance.
Like father, like son: paternal sex allocation in relation to attractiveness in a mammal

**Utas Tiana Pirtle**, Dr Elissa Cameron, Dr Erik Wapstra, Dr Laura Parsley

*University of Tasmania, Hobart, Australia, University of Canterbury, Christchurch, New Zealand*

Invasive Animals and Plants (2), Meeting Room 3, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**

*Poster 049 - Tiana is originally from the USA and is now completing a PhD at the University of Tasmania with Elissa Cameron, Erik Wapstra, and Laura Parsley focusing on sex allocation in male and females mammals, primarily equines*

Parents are predicted to be advantaged by adjusting offspring sex ratios according to mate attractiveness if attractiveness is inherited. Any changes to offspring sex ratios can have profound impacts on population dynamics since, in polygynous mammals, population growth is constrained by the number of females. Feral horses present an ecological dilemma in Australia and elsewhere, so understanding causes of sex ratio skews can be useful for managing population growth rates. Most studies have focused on maternal sex allocation, including in feral horses, but paternal effects have recently been shown to have strong effects in other mammalian species. Stallions compete for bands of mares, with band stallions having the highest reproductive success, limited only by the number of females in their band. Thus, more successful males mate with more females. These stallions would benefit from having sons if these band-holding traits are heritable.

To test whether mate attractiveness influences sex ratios in horses, we investigated sex ratios under two scenarios. We first assessed the sex ratios of band stallions in relation to band size, a proxy for mating activity. Initial results suggest the opposite to our prediction, with stallions with larger bands having more daughters, but I will discuss the effect of including genetically-determined paternity on the pattern. Secondly, we use an extensive thoroughbred studbook database to test if rate of mating (a proxy for attractiveness) influences offspring sex ratios. More males were born with increasing rate of daily mating. The implications for population ecology and management are discussed.

Measuring invader impact with joint-species distribution models.

**Mr Andrew O'Reilly-Nugent**, Dr Elizabeth Wandrag, Dr Jane Catford, Prof Don Driscoll, Prof. Richard Duncan

*Institute for Applied Ecology, University of Canberra, Canberra, Australia, University of Southampton, Southampton, England, Centre For Integrative Ecology, Deakin University, Melbourne, Australia*

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

*I am a PhD student at the Institute for Applied Ecology, Canberra, studying the role of community interactions in invasion ecology. I take particular interest in the advances in community models and their application to Australian ecosystems.*

Dominance of invasive plant species is often associated with lower abundance of native species, but it can be difficult to determine whether invaders are causing native species to decline or if both are responding to underlying environmental variation (i.e. whether invaders are the drivers or passengers of change). Joint-species distribution models (JSDM) aim to disentangle the role of environmental variables and species interactions in determining community composition. JSDMs are potentially useful for quantifying invader impact in environmentally heterogeneous landscapes.
JSDMs traditionally use presence-absence data, but this may be too coarse to detect impacts more subtle than competitive exclusion. We present an extension to the JSDM framework that aims to measure species environmental and competitive responses in terms of abundance.

We applied a JSDM to a 7-year study of invaded grassy-woodland communities in the Australian Capital Territory. Invasive species dominated high fertility sites, especially after herbivore exclusion, primarily due to the high abundance of two annual grass species, Avena fatua and Bromus diandrus. The JSDM indicated these species had significant negative impacts on both native and non-native species, but that these impacts were less severe when herbivores were present. The introduced rhizomatous forb Acetosella vulgaris was also abundant at high fertility sites, but had much less negative impact on native species. The magnitude of invader impact was best explained by differences in canopy height, with taller invaders having greater impact on small resident species. Our findings show JSDMs can help identify problematic invaders and where their impacts are greatest.

Organic aquaculture: Why isn’t it on Australia’s policy radar?

Dr Fran Humphries1
1Griffith University, Nathan, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Fran Humphries is the Program Leader of the Law and Nature Research Program at Griffith University and a Research Consultant for WorldFish, a global aquaculture aid and development organisation. She specialises in aquaculture and biodiversity law and policy.

Humankind is facing a critical global shortage of sustainably sourced fish. Conventional fish farming (aquaculture) is attempting to fill this gap but has attracted criticism for its environmental costs. In response, organic farming (with its emphasis on an integrated multi-trophic approach and high animal welfare) is thriving overseas but not in Australia. Results from a systematic qualitative literature review of global literature relating to the uptake of organic methods revealed that only 0.06% (four peer-reviewed articles) related to Australia’s context, indicating a significant gap in research. The facilitation of organic aquaculture methods is absent from any Australian policy or law, other than the standard for organic aquaculture for market certification. Regulation of Australian aquaculture is complex because three levels of government make environmental decisions in each of Australia’s states and territories under a patchwork of policy and legislation. This paper explores the questions ‘what are the different levels of environmental decisions being made by government agencies for the regulation of aquaculture, and how can scientific inquiry be best designed to meet the knowledge needs of these different levels of decisions if organic aquaculture is to have a future in Australia?’ The National Aquaculture Strategy commits Australia to doubling its value of production by 2027. The outcomes of this paper aim to start a national debate about the knowledge gaps and feasibility of organic aquaculture contributing to that exponential growth.
Food-web consequences of mangrove forest dieback in the Gulf of Carpentaria, Australia

Yota Harada1, Prof Brian Fry1, James Sippo2, Assoc. Prof Damien Maher2, Prof Joe Lee3, Prof Rod Connolly1

1Griffith University, , 2Southern Cross University, , 3The Chinese University of Hong Kong , ,

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
A PhD candidate at Griffith University.

During 2015-16, extreme climatic conditions triggered a severe unprecedented mass mortality of mangroves in tropical Australia. How the function of mangrove ecosystems that support productive coastal communities is impacted by this catastrophic dieback event remains unclear. Here we examine the ecological consequences of the mangrove dieback by using stable isotopes and field survey to compare the trophodynamics and faunal structure of affected and adjacent unaffected forests. The composition of the faunal community in the dieback forests changed from leaf eaters to algal feeders within ~1 year. This change is likely due to the substantial declines in vegetation, and shifts in light regime and leaf-litter abundance. Surprisingly, the animal biomass in the dieback forests remained unchanged and was likely sustained from remaining local detritus, benthic algae and imported phytoplankton. However, rapid N leaching from the forest suggests secondary productivity may decline over time.

Noisy neighbors and myna problems: Does body size mediate competition intensity for a limited resource.

Sir Andrew Rogers1

1University of Queensland, St Lucia, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Andrew is a PhD candidate at the Center of excellence for Environmental Decisions. His research focuses on species use of human-modified habitats and the impact of invasive on native species.

Competition is an important mechanism through which invasive species impact native communities. Differences in resource requirements and species traits, such as body size, often mediate the intensity and outcome of inter-species interactions. Australia has the highest percentage of terrestrial vertebrates that utilize tree hollows, including 31% of birds, and has a uniquely aggressive bird community. We examined aggressive interactions around tree hollows, a critical resource for cavity nesting species, in southeast Queensland in Australia. Between hollows nesting species, birds that were closer in body size interacted more frequently, and larger birds won more interactions. However, the invasive common myna (Acridotheres tristis) won most of the interactions with the rainbow lorikeet (Trichoglossus moluccanus), the native species closest in size and larger. The high levels of aggression exhibited by the common myna help explain why this species has been so successful in Australia. The results of this study show simple relationships between body size and niche occupancy allow predictions of which species invasive birds are likely to impact across Australia.
Culling noisy miners: high costs, low ecological benefits

Mr Richard Beggs¹

¹Fenner School Of Environment & Society, Australian National University, Australian National University, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Born in England of Irish parents, raised in Sudan, schooled in London; BSc in agronomy from the University of Aberdeen in 1987; gap year 1988 – 2012; Msc in Environmental Management, UWA 2014; PhD at ANU 2015 to present

Aggressive exclusion of woodland birds from remnant woodland patches by overabundant noisy miners (Manorina melanocephala) is listed as a Key Threatening Process. In the highly modified agricultural landscapes of eastern Australia, noisy miners structure avian assemblages at low densities (0.6 – 0.8 birds/ha) and at a sub-continental scale (>1 million km²). Culling has been recommended as the only management response capable of halting declines of threatened small woodland birds in the immediate future. Yet many culls worldwide have been ineffective or counterproductive due to ecological release mechanisms or compensatory responses by overabundant species. We completed a controlled, replicated, costed and rigorously monitored experimental patch-scale cull of noisy miners. Our aim was to see if culling enhanced ecological function. Using a Before-After-Control-Impact design we monitored abundance of the overabundant species and occupancy of species of conservation concern. Importantly, we also measured components of ecological function: harassment rates, foraging rates of woodland birds, and artificial nest predation rates. The cull reduced noisy miner abundance by approximately 22% but, due to immediate recolonisation, abundance up to 12 months post-cull was 3-5 times above published impact thresholds. Artificial nest predation rates did not change and we found evidence for compensatory predation. Foraging rates of small woodland birds increased but harassment levels also increased. We conclude that culling at a patch scale without considering additional management such as restoration is not an efficient method of reducing noisy miner abundance to levels likely to benefit threatened woodland birds in the highly modified study landscape.

Impacts of extreme flooding on invasion pathways in subtropical riparian zones

Mr Kurtis Nisbet¹,², Dr Samantha Capon¹,², Dr Catherine Leigh²,³

¹Griffith University, Nathan, Australia, ²Australian Rivers Institute, Griffith University, Nathan, Australia, ³Science & Engineering Faculty, Queensland University of Technology, Brisbane, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Kurtis Nisbet is researching the impacts of extreme flooding upon the environment and plant communities of the riparian zones of the Logan River, Queensland. Kurtis is currently completing his Honours at Griffith University.

Extreme flood events can increase the likelihood of riparian plant invasion. Invasions are not instantaneous and understanding impacts of flooding on various stages of the invasion pathway, from the system of delivery through to establishment and spread, is needed for optimised management of riparian ecosystems. This study incorporates multiple assessments exploring the nature of flood-induced invasions in a large subtropical river including propagule dispersal, seed bank dynamics, and the influence of biotic resistance and standing vegetation. Investigating how these components relate to each other in space and time — and to pre- and post-flood conditions — provides further insight into why riparian zones are susceptible to invasion.
We tested each stage of the invasion pathway (transport, colonisation, establishment, landscape spread) using invasion of the Logan River in southeast Queensland by Lantana camara (Lantana) and Ricinis communis (Ricinus), pre- and post-flood. Through a synthesis of field- and lab-based experiments, we found flooding affected invasion pathways into riparian zones. Inundation imported propagules of invading species, supporting a stronger presence of fast-growing, non-woody invasive species from the seed bank. In pre-flood conditions, Lantana was widely established and acted as a nurse plant of non-woody invaders. Riparian inundation diminished the riparian dominance of Lantana, while promoting invasion and establishment of Ricinus.

Our findings suggest that specialised management strategies are needed to allow for variation among plant invaders of riparian zones across the entire invasion pathway, and particularly given the increasing variability and extremity in flood events occurring in many regions due to climate change.

Killer kangaroos and relentless rabbits. How do they limit restoration of threatened Buloke Woodland communities?

Dr David Duncan¹, Dr Ami Bennett¹, Dr Libby Rumpff¹,², Assoc. Prof. Peter Vesk¹
¹School of BioSciences, University Of Melbourne, Parkville, Australia, ²Centre for Environmental and Economic Research, Parkville, 3010

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
Plant ecologist interested in ecological interventions and ecological restoration, in particular the evidence base required to learn how to do it more effectively.

Ecological restoration of heavily cleared and degraded ecosystems requires the facilitation of natural regeneration, often augmented by large-scale active revegetation. The success of such projects is highly variable, and whilst risk factors may be readily 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 on the survival and browsing damage of 1275 hand-planted Buloke (*Allocasuarina luehmannii*) seedlings in a nationally Threatened semi-arid woodland community. 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 seedlings, and measured herbivore activity, on four census occasions during the first 400 days post-planting. Significant browsing damage on unprotected seedlings was nearly ubiquitous after one year, despite apparently low to moderate browser activity. Survival of protected seedlings was greatest in areas of high browsing risk; and even at very low densities, the impact of rabbits appeared more telling than that of kangaroos. 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 extant remnant patches is not supported, whereas alternative locations may be good or poor prospects depending on the degree to which browsers are excluded.

Gap dynamics in endangered Lord Howe Island cloud forest

Andrew Denham¹
¹NSW Office of Environment & Heritage, Hurstville, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
Poster 044 - Andrew is a Senior Research Scientist who works on understanding ecological processes to minimise threats to biodiversity in a range of ecosystems including fire-prone habitats and arid rangelands.
Forests that are not subject to large scale disturbance are expected to maintain stable size structures until small scale disturbances occur, like lightning strikes or storm events, causing mortality or tree fall. In endangered Gnarled Mossy Cloud Forest on Lord Howe Island, it is unclear whether such canopy gaps are filled by pre-existing suppressed juveniles (a juvenile bank) or by new plants from dispersed seeds. It is also unclear whether introduced black rats (Rattus rattus) are influencing gap filling or plant species turnover. We surveyed standing woody plant size structure in 10 canopy gaps and 18 intact canopy locations. Gaps were of unknown age, but none were less than 5 years old. Gaps had predictably sparse canopy cover, but also had relatively few individuals of several woody species typical of intact forest. Notably, Zygogynum howeanum was less frequent and seedlings were uncommon in gaps. Big Mountain Palms (Hedyscepe canterburyana) were more common in gaps, while Little Mountain Palms (Lepidorrhachis mooreana) were more common in closed sites. In addition, we observed seedlings of lowland tree species that have not been recorded on the Mt Gower plateau, but clearly are dispersed here, probably by LHI currawongs. There was no clear effect of distance to rat baiting stations on presence of woody seedlings. Nevertheless, these initial data provide a baseline upon which to compare post-rodent eradication gap recruitment.

The effects of invasive bird call on the endangered black-throated finch southern subspecies

**Ms Jaimie Hopkins**

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Jaimie Hopkins is a PhD student from James Cook University in Townsville. Jaimie is investigating the calling behaviour of loud and vocal invasive species, and the impacts that invasive species’ calls have on native species.

When foreign noise pollutes an ecosystem, wildlife can be impacted. Foreign noise can mask or reduce the quality of important sounds and may be perceived as threatening. An overlooked, but common foreign noise is invasive species call. Being biotic, invasive species call could be perceived as more threatening to native species and could contain more dominant sound properties than extensively-researched anthropogenic noise. If these noises impact endangered species, the consequences could be dire. The black-throated finch southern subspecies (Poephila cincta cincta) is an endangered bird requiring urgent conservation management. To create or maintain suitable habitat for this species, we need to understand what factors deter them from areas. With invasive birds abundant in parts of the black-throated finch’s range, assessment of this bird’s response to these noisy invaders is required. In this study, we aim to assess the vocal and behavioural responses of the black-throated finch to the calls of three invasive birds: the Indian myna (Acridotheres tristis), the house sparrow (Passer domesticus) and the nutmeg mannikin (Lonchura punctulata). Black-throated finches are located in the field and played recordings of the invasive birds and a native control. Before, during and after stimuli, finches’ calls and behaviours are counted. Using mixed models, we will determine whether finches alter their calling activity or behaviour in response to the stimuli, and which stimuli elicit the greatest changes. Identifying which noises affect black-throated finches is important for effective conservation management and will provide insight into the effects of invasive species call on native species.
Nesting success of Red-tailed tropicbirds on Christmas Island following cat control

Miss Rosalie Willacy1, Dr Sarah Legge1, Dr Eve McDonald-Madden1

1University Of Queensland, Brisbane, Australia

Invasive Animals and Plants (3), Meeting Room 3, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Rosalie Willacy is a PhD candidate at the University of Queensland. Her research, collaborating with Parks Australia, is investigating the impact of black rats on Christmas Island birds and the potential for that impact to increase with feral cat control.

Invasive alien species are a leading cause of global biodiversity loss, especially on islands. Predation by invasive species is recognised as the largest threat for seabird breeding colonies, and both cats and rats have been particularly implicated. On Christmas Island, previous studies have documented high rates of Red-tailed tropicbird (Phaethon rubricauda) chick predation by cats, but the impact of rats has been less clear. We monitored (n=80) red-tailed tropicbird nests across three sites of varying rat abundance on Christmas Island to determine how breeding success has been affected by localised and island-wide cat control carried out by Parks Australia since 2008, and whether nest failure rates are related to rat abundance. Nests were monitored using motion sensor cameras over two consecutive breeding seasons (2017 - 2018) and relative rat abundance was measured using ink-card monitoring. Significantly less Red-tailed tropicbird nest failures were caused by invasive predators during this study than had been previously recorded for Christmas Island. Cats were rarely seen at nests, and despite rats being abundant and frequently observed, rat predation events were uncommon. Rats however, were seen to quickly capitalise on eggs and nestlings that had been abandoned or died due to starvation/exposure on several occasions. Predation of nestlings by the Christmas Island goshawk was also a cause of failure at several nests. While cat control has reduced the risk of cat predation and rats do not appear to be a significant predator of nests, overall nesting success for Red-tailed tropicbirds on Christmas Island remains reasonably low.

Rapid evolution in introduced species: will introduced plant species eventually be accepted as unique native taxa?

Prof Angela Moles

KEYNOTE PRESENTATION: AREA PRESENTATION, Prof Angela Moles, Hall B, November 28, 2018, 2:00 PM - 2:30 PM

Introducing species to a new environment creates excellent conditions for evolution, as the species are released from their old enemies and subjected to a new suite of biotic and abiotic pressures. Our work with herbarium specimens has shown that 70% of the plant species introduced to Australia have undergone significant morphological change since their introduction. Differences between source and introduced populations are retained when they are grown in common conditions, and there is evidence for reproductive isolation developing between introduced and source populations. If we can’t eradicate introduced species (and we seldom can), then it seems inevitable that they will eventually evolve to become unique new taxa (whether we like it or not). At this point, we will have to decide whether to accept them as new native species, or try to exterminate them. While most ecologists don’t like the idea yet, I think acceptance of introduced species is just a matter of time. I have been called a witch for these ideas before - bring on the arguments!
Shedding light on litter decomposition in aridland ecosystems

**Associate Professor Amy Austin**

1University of Buenos Aires, Buenos Aires, Argentina

KEYNOTE PRESENTATION: Associate Professor Amy Austin, Hall B, November 29, 2018, 9:45 AM - 10:30 AM

**Biography:**

Amy Austin is a terrestrial ecosystem ecologist who is a principal research scientist at the National Research Council of Argentina (CONICET) and an associate professor of ecology at the University of Buenos Aires. Her research focuses principally on the climatic and human controls on biogeochemical cycling in a range of terrestrial ecosystems, from semiarid steppe to humid temperate forests. Her principal study sites are in the Patagonian region of South America, where she explores the relative importance of rainfall, vegetation and human impact on ecosystem functioning. Amy completed her undergraduate degree at Willamette University (Oregon, USA) in Environmental Science and her Ph.D. in Biological Sciences at Stanford University. Amy is an editor at New Phytologist, and a senior editor at Journal of Ecology. She has worked more than 15 years in Argentina and has received several awards including the Early Career Award of the Antorchas Foundation of Argentina, the national L’Oreal-UNESCO prize for Women in Science of Argentina in 2015, and most recently, the International L’Oreal-UNESCO prize for Women in Science in 2018.

Plant litter decomposition is an essential process in the first stages of carbon and nutrient turnover in terrestrial ecosystems, and together with soil microbial biomass, provide the principal inputs of carbon for the formation of soil organic matter. While climate, litter quality and soil organisms have been traditionally perceived as the major determinants on litter decomposition, photodegradation (photochemical mineralization of organic matter due to exposure to solar radiation) has recently been identified as a potential mechanism that explains an important fraction of carbon release in arid and semi-arid zones. Challenging the paradigms of slow rates of decomposition in aridlands, lignin as an inhibitor of decomposition and the negative effects of solar radiation on biotic activity, our results suggests that incorporating photodegradation as a control on carbon turnover in terrestrial ecosystems requires a restructuring of our vision of the major controls on aboveground litter decomposition. The quantitative importance of direct photodegradation, and as a control on mass loss and nutrient release through its impacts on biotic decomposition, have implications for the global carbon balance, and for the potential alterations in carbon cycling due to predicted climate or land-use change resulting from human activity.

Chasing David: the nature of broadcasting in Australia

**Ms Ann Jones**

1ABC Radio, ,

KEYNOTE PRESENTATION: Dr Ann Jones, Hall B, November 26, 2018, 9:45 AM - 10:30 AM

**Biography:**

Ann Jones grew up in country Victoria, the youngest of a family of birdwatchers and keen picnickers.

She’s taken the long way round to broadcasting about nature, first completing a PhD in History and birdwatching on the way to the library, then making the career jump and spending years presenting live radio for the ABC throughout regional Australia.

Almost 5 years ago, she took up the role of presenter and producer of Off Track – the ABC’s only permanent natural history offering, and since then has been broadcasting to millions across the ABC, BBC, CBC and Radio Australia.
Though Australia, and the ABC in particular, has a rich broadcast record in the natural history genre, the dominance of David Attenborough on the popular screen and falling budgets has left current local production to largely wither on the vine. As an extinction crisis envelopes the globe and environmental education is perhaps more important than ever: where to for broadcasting about nature in Australia? And what can you do?

**Rarefaction and extrapolation: Standardizing samples to make fair comparisons of biodiversity among multiple assemblages**

Dr Anne Chao  
KEYNOTE PRESENTATION: DR ANNE CHAO, Hall B, November 28, 2018, 2:30 PM - 3:15 PM

**Biography:**

Anne Chao received her BS in mathematics from National Tsing Hua University, Taiwan, in 1973, and her PhD in statistics from the University of Wisconsin-Madison in 1977. Since 1978, she has been with the Institute of Statistics, National Tsing Hua University, Taiwan, where she is currently a Tsing Hua Distinguished Chair Professor. She is a Fellow of the Institute of Mathematical Statistics, and held a Taiwan National Chair Professorship from 2005-2008. Chao has long been fascinated with mathematical and statistical issues arising in ecology and related sciences; her major research interests include ecological statistics, statistical inferences of biodiversity measures, and statistical analysis of ecological and environmental survey data. She and her collaborators have published more than 130 papers with citations &gt; 18000 in Google Scholar. Their papers have (i) developed several biodiversity measures/estimators including Chao1, Chao2, ACE, and ICE for species richness, as well as some novel methods to infer entropy, diversity and related similarity/differentiation measures, (ii) established a unified mathematical/statistical framework for taxonomic, phylogenetic and functional diversities, and (iii) generalized the classic sample-size-based rarefaction method to sample-coverage-based rarefaction and extrapolation, to standardize biodiversity samples. To implement their methodologies, Chao and her colleagues/students have also developed statistical software including CARE (CApture-REcapture), SPADE (Species Prediction And Diversity Estimation), iNEXT (iNterpolation/EXTrapolation), and PhD (Phylogenetic Diversity). For the past 20 years, Chao served in the editorial boards of four major statistical journals, and currently serves as an Associate Editor for Methods in Ecology and Evolution.

The goal in many biodiversity analyses is to make a fair comparison and assessment of diversity measures (e.g., species richness, taxonomic diversity, phylogenetic diversity and functional diversity) among multiple assemblages. For most measures, it is well known that the empirical diversities in a sample are dependent on sample size or sampling efforts. When samples are incomplete, standardization via rarefaction and extrapolation is needed; rarefaction and extrapolation methods allow for fair and meaningful comparison of diversity estimates for standardized samples on the basis of sample size or sample completeness. In this talk, two types of standardization methods are reviewed: (1) Sample-size-based rarefaction and extrapolation methods aim to compare diversity estimates for equally-large samples determined by samplers. (2) Coverage-based rarefaction and extrapolation methods aim to compare diversity estimates for equally-complete samples; the sample completeness in this method is measured by sample coverage (the proportion of the total number of individuals that belong to the species detected in the sample), a concept originally developed by Alan Turing and I. J. Good in their cryptographic analysis during World War II. Contrary to intuition, sample coverage for the observed sample, rarefied samples, and extrapolated samples can be accurately estimated by the observed data themselves. These two types of standardization methods allow researchers to efficiently use all available data to make robust and detailed inferences about the sampled assemblages, and also to make objective comparisons among multiple assemblages. Hypothetical and real examples are presented for illustrating the use of the online software iNEXT (iNterpolation/EXTrapolation) to compute and plot seamless rarefaction/extrapolation sampling curves based on several diversity measures.
Ecological interactions: the dynamics of invasion, time and dodgy old data

Justine Shaw
KEYNOTE PRESENTATION: Dr Justine Shaw, Hall B, November 27, 2018, 9:45 AM - 10:30 AM

Biography:
Justine Shaw is a Research Fellow at the Centre for Biodiversity and Conservation Science, The University of Queensland. She leads a research project with the National Environmental Science Programme, Threatened Species Recovery Hub (UQ). Her research focus is on the conservation of threatened species, island ecosystems and terrestrial Antarctica. Her current research investigates interactions between indigenous and non-native species, the risks posed by non-native species to Antarctic ecosystems.

Justine obtained her PhD in plant ecology from the University of Tasmania (2005). She undertook a postdoctoral fellowship (2007-2010) at the NRF-DST Centre for Excellence for Invasion Biology, Stellenbosch University (South Africa) researching invasion dynamics of sub-Antarctic islands. She has worked for state and federal government as conservation biologist. In 2012 she commenced a postdoctoral fellowship with the ARC Centre for Excellence in Environmental Decisions, UQ. She has been undertaking field work in the sub-Antarctic for 20 years. She has lead research expeditions to remote islands, such as South Georgia and Macquarie Island.

Justine is an advocate for gender equity in science. She is a committee member of the Australian Academy of Science’s Early Mid Career Executive Forum. She is a co-founder of Homeward Bound - a global leadership program for women scientists. She has co-lead two voyages of 80 women to Antarctica. She is a co-founder of Women in Polar Science- a virtual network to inform and connect women in polar research.

Follow Justine on Twitter: @justine_d_shaw

As ecologists we know that biodiversity is declining and homogenizing, wilderness is shrinking and species continue to become extinct locally and globally. As ecologists, where should we focus our research as we enter the Anthropocene? I will explore ecological interactions and how improving our understanding of them, can inform future ecological knowledge and conservation activities. Ecological research often focuses on individual species, for a wide range of reasons, and this drives conservation decision-making and management, as we currently know it. I will discuss invasion dynamics, how invasive species interact with native and other invasive species, and specifically, what we can learn from island ecosystems about ecological interactions. Using island case studies, I will highlight how ecological interactions, their temporal variations and historic data can be incorporated to improve future ecosystem management.

Globally, islands have been invaded by numerous vertebrates, invertebrate and plants, despite this, many remain as hotspots of biodiversity and/or key habitats of threatened species. On Macquarie Island following a multi-species eradication, we are monitoring species and ecological interactions to determine the current ecosystem state and inform future management. By incorporating historic datasets, we are documenting key ecological interactions pre-eradication and how they influenced management outcomes over time. These learnings can be applied to other island conservation initiatives and invasive species management.

As knowledge and technology advance, so too does our ability to undertake large scale management interventions for conservation. This requires ecologists to be poised to respond to queries about potential ecological consequences. Examining ecological interactions, their temporal variations and better incorporating existing data, is a step in the right direction and worthy of our attention.
Non-linear ecology

Chris Dickman¹
¹Desert Ecology Research Group, School of Life and Environmental Sciences, University of Sydney,

KEYNOTE PRESENTATION: ESA Gold Medal Winner, Hall B, November 26, 2018, 2:45 PM - 3:15 PM

Science is often viewed as a smooth and linear process by which we gain ever-increasing understanding of the world. In reality, scientific progress is non-linear: it moves in fits and starts and is driven to a greater extent than we sometimes admit by ideas, trends and accidents. Here, I reflect on the key roles of serendipity and research partnerships in driving the directions of my own research in ecology over the last 40 years. I use two case study examples. The first involves some unexpected discoveries in the marsupial genus Antechinus, while the second describes the highly non-linear path that saw a wannabe forest ecologist / island biogeographer spending 30 years instead trying to understand the forces that drive biotic function and diversity in the arid grasslands of central Australia. Ecological research is done by people: directions in the field and discoveries that are made often depend on forging partnerships with key collaborators and seizing opportunities when they arise.

The intersection of diversity metrics and spatial mapping: new insights into regional vegetation patterns

Dr David Tierney¹²³, Pr Glenda Wardle², Ass.Pr Peter Erskine³
¹Office of Environment and Heritage, NSW, Hurstville, Australia, ²The University of Sydney, Sydney, Australia, ³The University of Queensland, St Lucia, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
David Tierney has worked in a diversity of positions; government and non-government. Currently he works in OEH NSW Science Division (Ecosystem Management Science) as a Senior Scientist. He likes plants.

Understanding vegetation complexity is of increasing importance because of global moves towards conservation at the ecosystem level and an increasing legislative dependence on spatial products that attempt to represent vegetation types or ecosystems. New diversity metrics may have much to offer here, but traditional map products do not reference these. The utility of diversity metrics in understanding spatial complexity was undertaken using over 800 quadrats across a region with high species diversity and complex vegetation patterns at small spatial scales. A novel classification procedure (hybrid classification) informed by small-scale floristic variability as an alternative to a standard classification was also undertaken. Small-scale floristic patterns largely drove regional diversity, but these are never mapped at this scale. The intersection of diversity metrics and spatial mapping can provide critical insights into regional vegetation patterns that otherwise remain obscure. Standard mapping techniques extensively used to drive planning decisions can create vegetation mapping that is largely an artefact of survey and classification limitations. The utility of different metrics will be outlined.
Using networks to place plant interactions in the context of multispecies coexistence

**Malyon D. Bimler**, Trace Martyn, Assoc. Prof. Daniel B. Stouffer, Prof. Margie M. Mayfield
1 *University of Queensland, Brisbane, Australia*, 2 *University of Canterbury, Christchurch, New Zealand*

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**
*I’m a PhD candidate in the Mayfield Lab, exploring the processes maintaining coexistence in ecological communities. In particular, I’m interested in the role of species interactions, as well as broader questions regarding the maintenance and stability of ecosystems.*

Species coexistence in diverse ecosystems cannot be solely explained by processes arising from pairwise interactions. To understand how mechanisms involved in maintaining coexistence arise in complex and species-rich communities, we must understand how multiple species relate to each other within a community. One way to do this is by representing communities as networks, where species are the nodes and interactions are represented by vertices. However, incorporating competitive dynamics within plant community networks presents several major hurdles. Notably, networks of interacting plant species are difficult to construct, as interactions between plants must be measured experimentally or analytically derived, rather than observed. These experiments are expensive and time-consuming, and inferring interactions from naturally-occurring patterns of community dynamics requires large amounts of data.

Here, I present a novel method to construct a network of plant species by estimating interactions from individual fitness models, applied to a large dataset from a natural wildflower community in Western Australia. Using a Bayesian statistical framework allows us to place constraints on which interactions may be meaningful, as informed by observational data and past experiments. I highlight the structure of the resulting plant-plant interaction network and demonstrate how competition structures this diverse plant community. Finally, I will discuss how this framework allows us to incorporate past and future data, and can be adapted to model other ecosystems.

Combining historical datasets with earth observation: a spectral approach for compositional vegetation mapping

**Mr Paul Macintyre**, Prof Adriaan Van Niekerk, Prof Laco Mucina
1 *University Of Western Australia, Perth, Australia*, 2 *Centre for Geographic Analysis, Stellenbosch University, Stellenbosch, South Africa*

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**
*Paul is a PhD student at the University of Western Australia. His primary area of research is the development of new strategies for accurate vegetation mapping across regions utilizing machine learning, remote sensing and "big" data.*

Accurate and reliable maps depicting the patterns of vegetation across a landscape are large components in the adequate management and conservation of landscapes. While traditional, field based approaches have been used in the past to create reliable depictions, limitations exist in the costs and time required for their creation, which restrict their use over large areas and within regular periods of time. While hyper-spectral data has enormous potential limitations of cost and availability mean we need to further examine the possible applications of multi-spectral approaches. With the recent development and availability of new satellite sensors freely delivering remotely sensed imagery with high spatial and spectral resolutions we are well placed to use them in increasingly fine-scale
applications. Using a number of quadrats established and classified previously in conjunction with Sentinel-2 imagery we examined the spectral signatures of the vegetation communities in order to classify the extant vegetation. The results show that the Sentinel-2 imagery can be used to produce classifications of the vegetation at relatively (>70%) high accuracy. In depth analysis of the results showed this accuracy was due to a series of derived features highlighting phenological characteristics of the vegetation below the pixel level. This not only shows the potential ability of multi-spectral approaches but shows they can be applied at scales finer than previously thought. With the added ability of these approaches to update or reclassify a region over time we are well placed to more efficiently manage change across landscapes.

Data driven vegetation classification for large and diverse regions

Dr Mitchell Lyons¹, Prof David Keith¹, Mr Ken Turner², Mr Doug Binns², Mr Tim Hagar², Ms Elizabeth Magarey², Mr Daniel Connolly²

¹University of New South Wales, Sydney, Australia, ²New South Wales Office of Environment and Heritage, Sydney, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Mitchell's research is a mixture of ecology, physical geography and statistics, but all with an underlying quantitative and methods based focus. Interests vary from deserts to forests to coral reefs.

One of the fundamental end-uses of a vegetation classification system is the ability to diagnose the salient features of vegetation communities and assign new data to those communities. Using traditional classification approaches, it is difficult to maintain data-driven routines and end-to-end transparency. Yet these quantitative and transparency properties are critical for commensurately data-driven and transparent decision-making processes. Recent development of model-based methods in multivariate ecology have encouraged increases in quantitative and transparent classification approaches. This talk will present an overview of such an approach, using a newly compiled vegetation database in New South Wales of around 50,000 vegetation plots. We provide an overview of new statistical models that were used, as well as demonstrate the types of tools that allow end-users, particularly non-technical users, to perform quantitate vegetation classification on their own data. First, we detail a multivariate mixture model that simultaneously models floristic data and environmental covariates to partition sites into 'bioregional' groups. These groups represent natural partitions within which fine-scale vegetation classification can be performed. Second, we detail a model-based approach for assessing ecological community classifications, which provides an objective method for 1) comparing competing clustering solutions, 2) making decisions for merging or splitting clusters and 3) determining diagnostic/characteristic species of final community classifications. Finally, we demonstrate a web-based tool that enables users to perform quantitative classifications, along with confidence levels, on their own floristic field data. The statistical models are available as R packages, and the classification tool is implemented on the shinyapps web-engine.
Programs monitoring riparian tree recruitment could be enhanced by strategically surveying rare events

Dr Nerissa Haby¹, Cherie Campbell¹, David Wood³, Fiona Freestone², Dr Susan Gehrig³
¹La Trobe University, Wodonga, Australia, ²University of Western Australia, Perth, Australia, ³Flora, Flow & Floodplains, Mildura, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Nerissa Haby is currently a Research Officer with La Trobe University, aiding in the quantitative analysis of long-term vegetation monitoring programs, and writing grants to research effective conservation of small mammals and reptiles.

One of the primary functions of environmental flows is to halt the serious decline of two semi-arid riparian trees, considered to be keystone species for the geomorphology of a naturally dynamic river system, and the condition and function of associated floodplain communities. To evaluate changes in river red gum and black box recruitment, seedling density was related to a series of hydrological variables using generalised linear mixed models with a negative binomial error function. The model variables drew upon natural flooding, environmental flow, and large rainfall events from temporal periods expected to represent i) opportunity for recruitment, ii) improved seed production, or iii) improved community health and function. On exploring the data, the number of seedlings surveyed were sparse and highly variable. In this context, all models explained little of the variability in seedling recruitment. Seedling density was weakly related to coarse hydrological variables (e.g. 5.8% DE over the null model), and sapling density to the combination of natural flood, environmental flow and large rainfall events in the 12 and 24 months leading up to the survey (e.g. 2.7% DE over the null model). As recruitment events represent a range of ecological functions, seedling density is a useful element to measure within the system to ascertain the most effective timing, amount and frequency of environmental flows. But when events triggering recruitment are rare, monitoring programs would be more effective if they adopted a more flexible sampling strategy aimed at detecting a peak in the response being measured.

Population biology with Plantago lanceolata – a focus on genetics and seed ecology

Ms Stephanie Chen¹, Prof Glenda Wardle¹
¹University of Sydney, Camperdown, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Stephanie Chen is an Honours student at the University of Sydney interested in plant science, genetics, and applied statistics.

Ecological forecasting is crucial under increased environmental change to inform decision-making. However, the predictive capacity of models is currently limited by a lack of within-species sampling over large spatial extents. As part of the multi-site PlantPopNet collaboration (www.plantpopnet.com), I tested key assumptions of the matrix population model concerned with plant reproduction at the population level using the widespread species Plantago lanceolata (ribwort plantain). I found significant variation in plant density and clustering across the study site in Mount Annan, NSW and related these spatial patterns to traits from demographic surveys. I detected a low level of clonality (under 10 %) from the analysis of over 1200 genetic markers (SNPs). I carried out germination experiments on over 2500 seeds and found that seeds from the field population had a lower germination rate (14.7 %) compared to commercially produced seeds originating from the plant’s native range (89.5 %). While a low number
of seeds was found in the soil seed bank, Cox proportional hazard models uncovered that functional traits such as seed colour were strong predictors of the probability of germination. Finally, I considered the interaction between the clonal and seed reproduction pathways and demonstrated their antithetical effect on population growth rate. Recommendations for the future directions of PlantPopNet were developed based on my findings. It is anticipated that the PlantPopNet population models will allow us to understand plant populations in different environments and provide decision-making tools to effectively manage our ecosystems and natural resources.

Progressing ecoinformatics from Machine Learning to Deep Learning.
Big data gain or big data pain?

Dr Peter Griffioen, Dr Graeme Newell, Mr Matt White

Dept. Of Environment, Land, Water And Planning. Victoria, Heidelberg, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Peter Griffioen has used his computational skills on a variety of ecological and technological projects. From programming GPS receivers for Trimble USA, to analysing Australian bird migration patterns and now providing ecological insights for government authorities. It’s been a blast.

Machine learning techniques such as Random Forests and Artificial Neural Networks are commonly used to model species habitat distributions, native vegetation condition and native land cover classification across statewide and larger scales. While these methods are very powerful, they generally use the information from a single pixel or cell, and can struggle to provide context. Newer classification and regression techniques using Deep Learning Neural Networks can incorporate contextual data and promise to achieve superior model performance using freely available software packages such as Google’s Tensorflow or Microsoft’s CNTK. If they are superior, why aren’t we using them already?

In this talk I will present a real-world example of mapping 29 land cover classes across Victoria and South Australia. Both a random forest classification method (RF) and deep learning neural network (DLNN) are applied to the same training data set and assessed on the same test data set. These models are then applied to produce 25m resolution maps across the entire region. The model types differ both in design and data handling. The RF is relatively straightforward to design, implement and apply. The DLNN requires greater training data volume and preprocessing and is more complex in its hardware and computational requirements for both model production and application. However the predictive performance of the DLNN is far superior compared to the RF. The maps produced by the DLNN are more accurate but exhibit some quirks which belie the technique used. For many applications the extra pain is likely worth the extra gain.
Multi-temporal native vegetation & land cover data: telling the story of decadal-scale landscape changes

Matt White1, Peter Griffioen1, Graeme Newell1
1Arthur Rylah Institute, DELWP, Heidelberg, Australia

New Methods (1), Meeting Room 6, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Graeme Newell is a program Leader of a multi-disciplinary team at the Arthur Rylah Institute (ARI), DELWP, Victorian Government. Graeme and colleagues develop innovative spatial products to improve conservation planning and management.

Current native vegetation extent and land cover data products are published on a semi-regular basis by government agencies. The usefulness of these data for conservation / NRM planning objectives can vary widely. Additionally, these products are often single ‘snapshots’, and can struggle to support long term dynamic monitoring and environmental reporting. A new process has been devised to provide consistent data products suitable for reporting on native vegetation extent & land cover units relevant to conservation planning and monitoring. The process has been designed around a consistent logic, using a transparent, repeatable and readily update-able method. The process integrates expertise from various disciplines including remote sensing, ‘big data’ analytics, machine learning, in addition to ecological data and knowledge.

A large geo-database of Landsat imagery covering more than 30 years is accessed to produce summarised imagery for 6 overlapping epochs, each of 5 years duration. Land cover exemplars (>50 hierarchical units) are sampled and collated for each epoch. A single multi-objective and multi-temporal Random Forest model relevant for all land cover types and epochs is developed. This model is then applied to each epoch of imagery, resulting in an internally consistent time-series of spatial data outputs. These data report to both large and finer scale changes in native vegetation and surrounding land covers that extend over three decades, and extend across SA and Vic. These time-series data products are a powerful tool for contextualising trajectories of dynamic ecological changes at landscape-scale, regional and site-scales.

Identifying the pollen diets of bees in heathlands using DNA metabarcoding

Miss Brittany Elliott1, Miss Rachele Wilson3, Associate Professor Alison Shapcott1, Mr Ryan Newis3, Mr Chris Cannizzaro3, Dr Chris Burwell3, Dr Tobias Smith4, Dr Alexander Keller3, Dr Sara Leonhardt3, Dr Wiebke Kämper1, Professor Helen Wallace1
1Genecology Research Centre, University Of The Sunshine Coast, Sippy Downs, Australia, 2Biodiversity Program, Queensland Museum; Australia and Environmental Futures Research Institute and School of Environment and Science, Griffith University, Brisbane, Australia, 3Department of Animal Ecology and Tropical Biology, University of Würzburg, Würzburg, Germany, 4School of Environmental and Rural Science, University of New England, Armidale, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Brittany has completed a BEnvSc with a Plant Ecology minor and BSc (Honours) at the University of the Sunshine Coast. Her passion is studying Australian flora and fauna, ecology, plant-pollinator interactions and bee conservation.

Declines in wild bee populations have been widely reported in the literature for over a decade and there is concern of an impending “global pollinator crisis”. In Australia, there are over 1600 native bee species
but declines are difficult to assess due to the lack of data. Honeybees (A. mellifera) were introduced to Australia in the 1820s, and since then feral populations have established throughout most landscapes. Knowledge on the ecology of both feral honeybees and native bees in Australian landscapes, specifically their foraging behaviour and floral preferences, is limited. Here we report on the diversity and floral preferences of wild bees in coastal heathlands, an endangered ecosystem in Queensland, characterised by mass flowering in late winter and spring. In plots in three different heathland conservation areas, we sampled bees once a week for 10 weeks of the flowering period. We used the innovative technique of DNA metabarcoding to compare the pollen diets of honeybees and native bees. A. mellifera were dominant in coastal heathlands, accounting for 44% of all bees observed. Native genera included the eusocial Tetragonula (37%), and semi-social Exoneura and Braunsapis (19.8%). Our metabarcoding results show significant overlap in the pollen diets of honey bees with stingless bees (0.63) and even more so with Braunsapis spp. (0.72), where values closer to 1 indicate complete niche overlap. The dominance of honeybees in conservation areas is a surprising finding and raises questions about the impact on native bee ecology and the implications for native bee populations and heathland pollination.

**Increasing detectability in camera trap surveys: more cameras, more days or both?**

**Miss Kate Parkins**, Dr Julian Di Stefano, Associate Professor Alan York

1. University Of Melbourne, Creswick, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Kate is a PhD student studying edge effects in flammable landscapes. Her focus is on how fire edges influence movement patterns and resource selection of ground-dwelling mammals.

Camera trapping is an increasingly popular method for surveying wildlife. Two important considerations in the design of camera surveys are (a) the number of detection units (cameras or camera-groups) per site and (b) deployment time. The trade-off between these two factors will likely affect data quality, but there is little information about their relative influence on species detectability. In this study we investigate the trade-off between deploying more detection units or extending the length of the sampling period on two frequently assessed variables in camera trapping studies – species richness and detection probability. We used a bootstrapping procedure to iteratively sample each possible combination of detection units (1-6 camera pairs) and camera days (1-34) to investigate the effect of both factors on species richness and detection probability. We show that increasing the number of cameras deployed per site is an effective way of increasing species richness and probability of detection. Multiple detection units in combination with longer deployment times were necessary to detect a high proportion of species present. Increasing detection units or deployment time (or both) resulted in high overall detection probability for the more detectable species (e.g. wombats, swamp wallabies), but multiple detection units were always needed to achieve high detection probability in a reasonable timeframe (<50 days) for less detectable species (e.g. agile antechinus, mountain brushtail possums). Camera trapping is a widely used survey technique and these findings will help inform decisions about the number of detection units and deployment time required for future camera trapping surveys.
A comparison of spatially explicit density estimators using live trapping and camera data

**Ms Rebecca Groenewegen**¹, Dr Duncan Sutherland², Prof Brendan Wintle¹,³

¹The University Of Melbourne, Parkville, Australia, ²Phillip Island Nature Parks, Ventnor, Australia, ³The University of Queensland, Brisbane, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
A PhD student in applied conservation ecology, Rebecca’s research aims to improve monitoring methods through combining data types and statistical methods. Alongside her partners, she investigates impacts of predator control on threatened species in Victoria and central South Australia.

Estimating population size is a crucial aspect of population management. One important limitation of traditional capture-recapture methods is that density cannot be explicitly estimated. Bias in N also arises from unmodelled heterogeneity in capture probability. Spatially-explicit capture-recapture (SECR) models are increasingly used for monitoring animal populations worldwide and have been shown to produce more precise estimates than conventional mark-recapture methods.

However, not all species are individually identifiable or logistical and ethical restrictions may constrain managers to estimating population sizes using unmarked individuals. Several models have now been developed in response to this challenge. These models have not yet been rigorously tested. Here, we use data from an intensively monitored translocated population of the eastern barred bandicoot, Perameles gunnii, to test these methods.

A spatial capture-recapture model will be used to analyse cage-trapping data. Camera data will be analysed using spatial mark-resight and count data models. Additionally, using auxiliary data (radio telemetry and temporary markings) we will investigate the importance of informative priors on detection parameters for model precision. The outcomes of our study will be used to improve population models for the species and optimise monitoring for cost-effectiveness, logistical constraints, and to minimise animal handling.

Barnacle shell isotopes: a new conservation tool for understanding the movement ecology of sea turtles

**Mr Ryan Pearson**¹, Dr Jason van de Merwe¹, Dr Colin Limpus², Prof Michael Gagan³, Prof Rod Connolly¹

¹Australian Rivers Institute - Coasts And Estuaries, and School of Environment & Science, Griffith University, Southport, Australia, ²Queensland Department of Environment and Science, Brisbane, Australia, ³School of Earth and Environmental Sciences, University of Queensland, Brisbane, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Ryan won the Jill Landsberg trust fund scholarship in 2015, which significantly advanced his PhD research in sea turtle conservation (submitted in July, 2018). Ryan is now focusing on coastal wetland ecosystems as a Research Fellow at Griffith University.

Understanding the geographic distribution of migrating animals within their sub-populations can enhance conservation and management, especially for threatened sub-populations. Here we employ a novel isotope technique to understand the foraging distribution of critically endangered south Pacific loggerhead sea turtles (Caretta caretta), and identify critical habitats for priority management. We use isotope ratios from commensal barnacle shells, which form sequentially and store isotope information that reflects temperature and salinity rather than turtle diet. This makes it possible to assign a date to
samples and compare isotope ratios with the spatial and temporal distribution of remotely collected sea water parameters. We apply this technique to predict the home areas of loggerhead turtles that nested in southern Queensland, Australia, identifying hotspots and relationships between nesting and foraging habitats. We demonstrate that isotopes from barnacle shells can identify the origin and migration distances of host turtles at varying spatial scales. In eastern Australia, for example, we assign turtles to home areas with >86% accuracy when areas are separated by at least 400 km. This is better resolution than other similar techniques and useful for conservation and management, especially considering migration distances can exceed 3,000 km. We further show that estuarine habitats are important foraging habitats for adult turtles foraging in southern areas, while genuinely marine habitats are likely more important than estuaries for turtles foraging in northern Australia and the southern Pacific islands. We expect these techniques to be applied widely to other turtle populations, taxa and objects that carry barnacles throughout marine journeys.

Metagenomics for diet analyses: Nanopore sequencing of metagenomic DNA from stomach contents to quantify diet

William Pearman1, Georgia Breckell1, Dr Adam Smith1, Prof James Dale1, Dr Nikki Freed1, Dr Olin Silander1
1Massey University, Auckland, New Zealand

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
I am a masters student from Massey University, New Zealand. I largely work on population genetics and metagenomic questions regarding both invasive and native species.

The use of metagenomics to determine what an organism is eating offers a new and promising alternative to current methods in diet analysis. Here we show that direct metagenomic sequencing using a portable long-read DNA sequencer (Oxford Nanopore MinION) allows rapid and relatively inexpensive quantification of diet. Using stomach contents from wild-caught rats, we identified diet items from over 50 taxonomic orders, highlighting the wide range of taxa that can be identified using this simple approach. These diet items included plant, vertebrate, invertebrate, and fungal species. We illustrate the accuracy of this method by comparing the characteristics of reads matching host (rat) and diet items. Finally, by implementing a constrained ordination analysis we show that it is possible to pinpoint the sampling location of an individual rat within tens of kilometres based on diet content alone. This work establishes long-read metagenomic methods as a straightforward robust approach for diet quantification. Besides considerably simplifying the workflow compared to metabarcoding, it avoids many of the biases inherent in metabarcoding methods. In the future, we expect that this approach will allow simple, rapid, and less biased assessments of animal diets in field settings. Finally, we also expect this method to improve through increasing accuracy and throughput of nanopore-based sequencing, along with increases in the species diversity of genomic databases.
Heads no longer buried in the sand: new method for studying cryptic and fossorial crabs

Cesar Herrera1,2, Dr Ronald Baker1, Dr Janine Sheaves1, Dr Katya Abrantes1, Prof Marcus Sheaves1
1James Cook University, Townsville, Australia, 2The Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), Townsville, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Cesar typically uses marine invertebrates in coastal ecosystems as models for understanding the processes shaping biodiversity and ecosystem functioning, and the consequences of losing species. Foster a science and nature understanding among the general public is also his passion.

Crabs living in burrows alter sediment physicochemical composition, increase plant productivity, sustain food webs and shape vegetation distribution in coastal habitats. Despite their importance, the cryptic and fossorial nature of crabs has limited our ability to study them thoroughly. Current sampling methods are invasive and destructive, or are unreliable, and conclusions drawn from these are full of uncertainty which impairs generalizations. To improve our understanding of the cryptic crabs’ influence at the ecosystem scale, we created a sampling and analysis workflow that uses videos, machine vision and learning algorithms to assess the number of individuals, size structure and home range size for crabs. We determined that crab densities (family Ocypodidae) were site-specific, with 44-72 individuals/m² and a territory confined to a radius of 12-17 cm from the burrow, however farther excursions were observed. Automated identification of ocypodids, genus Uca, was achieved with a 64% success rate. Density and behaviour estimates were defective for crabs with large wandering territories beyond the camera field of view (e.g. family Grapsidae). Our programming scripts work well in favourable light conditions without hard light/dark contrasts. Reliable estimates of crab density, size-structure and behaviour are essential for developing a sound understanding of crustacean and estuarine ecology. We show that machine vision and learning applied to videos is a non-intrusive method that minimizes fauna harm and produces consistent estimates. Our approach can be rapidly scaled in space and across research disciplines, and its adoption would deliver cost-effective information that can better inform policy, management and conservation.

Platypus and people - environmental DNA, pilot study in south-east Queensland

Ms Tamielle Brunt1,2, Mr Matt Cecil2, Mr Josh Griffiths3, Dr Christine Adams-Hosking4, Associate Professor Peter Murray1
1School of Agriculture and Food Science, The University Of Queensland, Gatton, Australia, 2The Wildlife Preservation Society of Australia, Brisbane, Australia, 3cesar Australia Pty Ltd, Parkville, Australia, 4Global Change Institute, The University of Queensland, St Lucia, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 100

Tamielle volunteered with cesar Australia in 2014 on a platypus survey in the Grampians. This lead her to study platypus in Queensland. She completed her Honours on the habitat requirements of the species and continues further research in her PhD.

Distribution data on platypus (Ornithorhynchus anatinus) populations within the greater Brisbane area have been lacking for over 10 years. Anthropogenic activities are encroaching upon platypus habitat, causing degradation and fragmentation thus impacting their population distribution. Environmental
DNA (eDNA) is a valuable method to determine the distribution of cryptic species, such as the platypus, by determining species occupancy through detecting their genetic material in the environment. This method is highly sensitive and does not require direct observation or capture of the animal. We used eDNA to determine (1) the current distribution of platypus in south-east Queensland and (2) any changes to their distribution.

Historical data and local knowledge were collated to identify waterways where platypuses have previously been recorded since 1990. Fifty individual waterways were tested for platypus eDNA. Of these, 17 (34%) waterways were positive for presence of platypus eDNA. Historically, 72% of the 50 waterways had previous records of platypus sightings.

This is a baseline study to monitor platypus distributions within south-east Queensland. This study suggest that further investigation is needed to identify the extent of decline and determine the state-wide population status of this this unique species.

**Optimal effort allocation for distance sampling of highly abundant species: walk further, measure less.**

Ms Kathryn Knights¹, Dr Gurutzeta Guillera-Arroita¹, Professor Michael McCarthy¹

¹University Of Melbourne, Melbourne, Australia

**New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM**

**Biography:**

Kathryn Knights is a PhD candidate at the University of Melbourne, working in the area of optimal monitoring. Kathryn is investigating trade-offs in precision and cost of monitoring methods, and combining multiple methods to achieve the most efficient protocol.

Distance sampling offers a robust method to estimate population parameters by estimating detectability based on the measurement of distances from the line or point of sampling to the objects of interest. There is a trade-off implicit in conventional distance sampling methods, in which covering more distance is sacrificed to more accurately model the detection function. We investigate whether there may be justification for measuring only a sub-sample of distances under the constraints of a fixed budget, if the variance of the density estimate can be minimised by using time saved from measuring fewer detections to cover more distance and obtain a larger sample. We present preliminary results of a simulation exercise exploring the optimal proportion of distances to measure to minimise the variance of the density estimate under a variety of realistic circumstances (high and low densities, varying detectability, differing costs incurred with measuring distances), and how measures of precision and accuracy are affected. We suggest that measuring a sub-sample of distances could improve monitoring efficiency for highly abundant and detectable species, or where the cost of measuring distances is high. We also suggest that this technique could also help to optimise effort allocation in multi-species surveys, where a more precise estimate is required for rarer species, while an acceptably imprecise estimate for more common species will not compromise the monitoring goals.
Concordance between biophysical models of dispersal and spatial genetic structure for Great Barrier Reef corals

A/Prof Cynthia Riginos1, Dr Karlo Hock1, Prof Madeleine van Oppen2, Prof Peter Mumby1, Dr Vimoksalehi Lukoschek3

1University Of Queensland, St Lucia, Australia, 2University of Melbourne, Parkville, Australia, 3James Cook University, Townsville, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Cynthia Riginos is an Associate Professor at the University of Queensland. She has wide-ranging interests spanning molecular ecology, landscape genetics, population genomics, speciation, hybridization, invasive species, biogeography, and conservation and is particularly fond of marine fishes, molluscs, and corals.

Documenting the extent and variability of planktonic larval dispersal remains a persistent challenge in marine biology. Biophysical models provide compelling and detailed spatial hypotheses of dispersal across seascapes, and inferences from such models are increasingly used to support spatial planning for conservation and fisheries. How well biophysical models provide accurate spatial summaries of dispersal, however, is unresolved. At large geographic scales, intraspecific spatial genetic structure provides an observable, albeit murky, outcome of past generations of dispersal, but is limited both by the high variance of evolutionary genetic processes and constrained sampling efforts. Here, we focus on two foundational corals from the Great Barrier Reef, Acropora tenuis and Acropora millepora; we draw upon customized biophysical dispersal models and spatially extensive microsatellite data sets to test for correlations between independent estimators of dispersal derived from biophysical models and genetics. Using asymmetric eigenvector mapping, we demonstrate that biophysical predictors of dispersal incorporating both directionality and connection strength are superior predictors of spatial genetic patterns as compared to null geographic models. This finding suggests that both biophysical and genetic approaches capture some shared attributes of planktonic larval dispersal and thus support the usage of biophysical models as predictive tools in marine ecology at least at broad geographic scales.

Bangers and cash: Baiting efficiency in a heterogeneous population

Naomi Indigo1,2,3
1University of Technology Sydney, Ultimo, Australia, 2Australian Wildlife Concervancy, Derby, Australia, 3The University of Melbourne, Parkville, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
First-class Honours graduate of Applied Wildlife Science (University of QLD) and PhD candidate (UTS). My current research is focused on investigating the practical application of conditioned taste aversion in northern quolls, to mitigate the impact of invasive cane toads.

The uptake of baits is a key variable in management actions aimed at vaccination, training, or control of many vertebrate species. Increasingly, it is appreciated that individuals of the target species vary in their likelihood of taking baits. To optimise a baiting program, then, we require knowledge, not only on the rate of bait uptake, and how this changes with bait availability, but also knowledge on the proportion of the target population that will take bait. The invasive cane toad (Rhinella marina) is a major threat to northern quolls (Dasyurus hallucatus), which are poisoned when they attack this novel toxic prey item. Conditioned taste aversion baits can be delivered in the field to train individual northern quolls to avoid toads. Here we report on a large-scale field trial across eleven sites in Western Australia. Camera trapping and statistical modelling was used to estimate the proportion of baitable animals in the population, and the proportion of these that were baited at varying bait availabilities. Population estimates varied from 3.5 (±0.76) to 18 (±1.58) quolls per site, resulting in 0.6-4 baits available per
individual. We also estimate that only 62% of individual quolls are baitable. Data and models such as ours provide wildlife managers with information critical to informed decision making and are fundamental to estimate the cost-efficiency of any baiting campaign.

Bandicoot bunkers: training bandicoots to use microchip-automated doors and avoid introduced predators

*Meg Edwards¹, Dr Julia Hoy², Dr Sean FitzGibbon³, Associate Professor Peter Murray¹
¹The University Of Queensland, Gatton, Australia, ²Hidden Vale Wildlife Centre, Grandchester, Australia

As we move further into the 21st century, the incorporation of technology into conservation programs is vital to develop innovative solutions to solve our extinction crisis. Microchip-automated technology has great potential for providing supplementary food and shelter resources in wildlife reintroduction programs, while simultaneously excluding non-target competitor and predator species. To examine this, wild-caught bandicoots were brought into captivity and trained to use microchip-automated doors in a six-stage process. The bandicoots took a mean of 12 days to learn to use the doors to their full functionality. The bandicoots were then tested for recognition of introduced predators, and an attempt was made to train them to avoid introduced predators using association with negative stimuli.

During predator avoidance training, bandicoots were exposed to: live animals (dog, cat and control); faeces (cat, fox and control); and taxidermied animals (cat, fox and control). Training consisted of exposure to the predators coupled with a bandicoot alarm call and rubber-tipped foam darts fired at the bandicoot. No negative stimuli were used during exposure to controls during training. Post-training testing revealed that bandicoots did not significantly change their behaviours or proportion of food consumed for any of the treatments, regardless of predator species. This indicates that bandicoots are highly food motivated, and traditional methods of predator avoidance training may therefore have limited value for this species. Instead, the provision of microchip-automated refuge or feeding stations could provide safety for reintroduced animals in areas where predator pressure is high.
Detecting phenological shifts in pasture grasses and legumes under extreme climate conditions using phenocams

Dr Amy Churchill$^1$, Dr Craig Barton$^1$, Ms Kathryn Fuller$^1$, Dr Sally Power$^1$
$^1$Hawkesbury Institute For The Environment, Western Sydney University, Richmond, Australia

New Methods (2), Meeting Room 6, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
I am a plant ecologist interested in research at the interface of plant community and ecosystem ecology and how plants can affect ecosystem scale processes in response to global change factors, such as nitrogen deposition or extreme climate events.

Global change factors such as drought, warming and heatwaves have important impacts on ecosystem processes both individually and through their interactions. Sustained periods of drought and elevated temperatures can prompt seasonally-dependent ecosystem responses with opposing consequences for ecosystem function. For example, winter warming can potentially benefit plant growth while summer warming can result in mortality when physiological thresholds are exceeded. For managed grasslands the seasonally-explicit consequences of interacting global change factors can have massive economic implications and affect their long-term sustainability. Our Pastures in Climate Extremes (PACE) project uses a factorial manipulation of elevated air temperature and winter + spring extreme drought to examine shifts in pasture phenology and changes in long-term performance. The experiment includes ten grass and legume species, all of which are continuously monitored using phenocams to track shifts in canopy development over time and in response to simulated grazing or weather events (e.g. frost and heatwaves). Phenocam data reveal short and long-term shifts in plant performance, measured using the Green Chromatic Coordinate (GCC), following precipitation applications, frost occurrences and aboveground biomass harvests. Our treatments result in substantial, species-specific effects on plant GCC with, for example, Fescue exhibiting a reduction in GCC during winter months under drought and warming, both singularly and in combination. In contrast, Lucerne showed a higher GCC in heated plots during winter, indicating positive effects of warming on cool-season growth. Climate-driven shifts in growth and performance of pasture species have important implications for the long-term sustainability of the meat and dairy industry.

Pumice rafting: A hitchhiker’s guide to marine biodiversity

Mrs Eleanor Velasquez$^1$
$^1$Queensland University Of Technology, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 085 - I am currently completing my PhD at the Queensland University of Technology in the field of applied Ecology. I previously worked in the Queensland Government for seven years developing legislation and policies for environmental management and protection.

The Theory of Island Biogeography (TIB) was first proposed in 1963 and since that time has evolved to include factors such as age in addition to area and isolation. The basic premise of the TIB is that more species will assemble in larger (and now) older islands (or habitats) as a result of species turnover resulting in a dynamic equilibrium. A unique natural phenomenon which can be used to perform tests of lines of evidence contained within the TIB is that of pumice rafting. Pumice rafts formed from the eruption of submarine volcanoes produce trillions of individual pumice stones at the same time and place with similar underlying structure and chemistry. Results from two studies on 5000 and 500 pumice clasts collected from 38 sites and 3 climatic zones have shown that older pumice clasts have more species and at the same time increased functional diversity. Pumice rafting transports literally trillions of
marine animals and plants throughout Oceania, and yet we are only just beginning to understand the conservation implications of this phenomenon to for example to transport both marine pests and restorative biota. Additionally, as the TIB has been used extensively for understanding impacts on remnant habitats, this study has the potential to assist in the protection of shallow marine reserves.

**Modelling reptile distributions in fragmented landscapes**

Ms Sarah Mulhall¹, Dr Julian Di Stefano¹, Dr Holly Sitters¹

¹University of Melbourne, Creswick, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**
Poster 078 - Sarah Mulhall is a PhD candidate in the Fire Ecology and Biodiversity Group at the University of Melbourne, investigating

reptile persistence and movement in a fire-prone, fragmented landscape.

Reptiles are in decline worldwide, with around a quarter of species estimated to be threatened or near threatened. Species distribution models (SDMs) can aid conservation efforts, as they indicate the location of suitable habitat and identify key drivers of habitat quality. At broad spatial scales, reptile species distributions are driven by biophysical variables such as solar radiation, rainfall, soil type, and vegetation type. However, a range of other processes, including anthropogenic disturbances, are also likely to be important. Combining biophysical variables with other drivers should improve the predictive accuracy of SDMs, and improve conservation efforts.

Habitat fragmentation and landscape modification are key drivers of biodiversity loss, through habitat loss, degradation and isolation. Reptiles may be especially sensitive to fragmentation due to their restricted capacity for dispersal. Thus, reptile conservation in fragmented landscapes will benefit from SDMs that include both biophysical variables and variables quantifying the effects of the fragmentation process that are likely to influence species. The aim of this study is to model reptile species distributions across landscapes using a combination of biophysical variables and variables representing landscape structure and context. In this poster we will present preliminary results of the modelling for reptiles in southeastern Australia using datasets including the Victorian Biodiversity Database and Atlas of Living Australia. Outcomes of this study will improve our understanding of factors influencing reptile species distributions in fragmented landscapes.
Green roofs as biodiversity stepping stones in urban landscapes: How much connectivity is needed?

Ms Julia Schiller¹, Dr Caragh Threlfall², Dr Rodney van der Ree¹, Associate Prof Nicholas Williams¹
¹School of Ecosystem and Forest Sciences, The University of Melbourne, Richmond, Australia, ²Clean Air and Urban Landscapes Hub, The University of Melbourne, Parkville, Australia, ³City of Melbourne, Melbourne, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 102

Julia Schiller  PhD Student

I am interested in urban ecology, landscape ecology and, more precisely, in how connectivity shapes biodiversity on urban green roofs.

Green roofs are becoming more common in cities worldwide, aiming to improve urban climate, storm water retention, human well-being, and to increase habitat for species. Compared to cities in Europe or North America, Australian cities are just at the beginning when it comes to the implementation of green roofs. Well-designed green roofs can act as habitat analogues in cities, where natural habitat is often limited, and can also contribute in connecting natural ground-level habitat by serving as stepping stones for species dispersal. Approximately 40 green roofs have been established in inner Melbourne, but their value for biodiversity is unclear. In my PhD, I will address this knowledge gap by undertaking surveys to assess which bird, bat, bee and butterfly species use Melbourne’s green roofs, including an assessment of the dispersal ability of key species. Green roofs’ local and landscape attributes will also be assessed to determine which factors affect the focal taxa colonization. This data will be used to develop a connectivity model that accounts for both horizontal and vertical isolation of roofs to source habitat. In my poster, I will compare alternative methods for measuring dispersal and approaches for connectivity modelling. Results from this research will help to derive evidence-based management recommendations for green roof design and placement, enabling more connected, biodiversity-friendly cities.

Behavioural responses of Australian fur seals to vessel disturbance at a popular ecotourism site

Ms Cassie Speakman¹,²
¹Monash University, Clayton, Australia, ²Marine Mammal Foundation, Mentone, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 083 - Cassie Speakman is an Honours research student at Monash University, affiliated with the Marine Mammal Foundation. Her research focuses on marine mammal ecology and human-wildlife interactions.

Ecotourism has gained increasing popularity over recent decades, with marine mammal tourism forming a substantial part of the industry. The ecotourism industry plays an important role in fostering positive views of marine wildlife, as it provides an opportunity to view or interact with charismatic and/or playful marine mammals in their natural habitat. However, with tourism participation expected to double over the next 50 years, the importance of maintaining the sustainability of this industry while managing possible human-wildlife conflict is clear and paramount. This study used camera traps to assess the behavioural responses of Australian fur seals (A. doriferus) to tourism and recreational vessels, and their associated swimmers, at a known haul out site in southern Port Phillip Bay, Victoria, Australia. Behavioural responses to some, but not all, measures of human activity were observed. This suggests
that a multifaceted approach may be required to manage human-seal interactions, to best address well-being of seals in these circumstances.

Ants in Australia’s Monsoonal Tropics: CO1 barcoding reveals extensive unrecognised diversity

Ms Jodie Hayward1, Ms Stefanie K. Oberprieler1,2,3, Dr Alan N Andersen2, Dr Craig C. Moritz3
1CSIRO Tropical Ecosystems Research Centre, Berrimah, Australia, 2Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia, 3Research School of Biology, Australian National University, Canberra, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 029 - Research Technician at CSIRO Tropical Ecosystems Research Centre laboratory, of 8 years. Studying and working on the ecology of native ants mainly in Northern Australia. Assisting in sequencing ants for CO1-barcoding of DNA extraction, through the BOLD Barcode of Life.

The Australian monsoonal tropics (AMT) is a significant biodiversity hotspot, and recent genetic studies of several vertebrate groups have revealed its level of diversity is far higher than previously thought. However, the extent to which this applies to the AMT’s insect fauna, which represents most AMT faunal species, remains unknown. Here we examine the extent of unrecognised diversity in the AMT’s ecologically dominant insect group, ants. We used CO1 barcoding in combination with morphological variation and geographic distribution to explore diversity within seven taxa currently recognised as single species occurring throughout the AMT: one species of Papyrius Shattuck 1992, one of Iridomyrmex Mayr 1862, two from the Cardiocondyla nuda (Mayr 1866) group, and three from the Camponotus novaehollandiae (Mayr 1870) group. We found six of the seven target species each to represent several species, based on a combination of CO1 divergence (ranging up to 13%), morphological differentiation and geographic distribution. Our findings indicate that the levels of diversity and endemism of the AMT ant fauna are far higher than currently realised.

We urge the need for further research in insect biodiversity in the AMT, both for a better understanding of the evolution of its remarkable biota, and as a basis for improved conservation planning.
Fun^fun: a fungal functional trait database.

Habacuc Flores1,2, Will Cornwell3, Jeff Powell4, Amy Zanne1
1GWU, Washington, United States, 2JCU, Cairns, Australia, 3UNSW Sydney, Sydney, Australia, 4Western Sydney University, Penrith, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 077 - Habacuc is a post-doctoral researcher in the Zanne lab. He is interested in linking the role of (functional) traits to community and ecosystem process in different environmental and ecological contexts.

Comparing quantitative morphological, physiological, and chemical traits has allowed plant evolutionary biologists and ecologists to assess the causes and consequences of phenotypic variation across spatial, temporal and biological scales (e.g. across populations, genotypes, environments and ecosystems). Such work has led to greater understanding of how plants establish and thrive across an array of environments. The time is ripe for fungal biology to leverage this integrative approach to better understand: a) global generalities in fungal functioning; b) sources and consequences of phenotypic variation across and within fungal guilds and clades; and, c) relationships between fungal traits and ecological strategies, community and ecosystem processes. Here, we introduced Fun^Fun (fun to the fun), a fungal trait database that is a open source, version controlled and updatable-over-time, which at abstract submission contained 25,864 measurements for 3104 fungal species, across 1611 genera. In this presentation, we share ecological insights emerging from this database, showcasing examples where fungal functional research can draw from plant research and vice-versa, as well as similarities and differences in ecological functioning across kingdoms (embryophyte and fungi). We also highlight research areas where our fungal trait database may be suited to answer questions about global generalities in biological patterns and processes, such as characterizing the strength of the genotype-phenotype connection.

Community structure and viral dynamics in flying-fox roosts: tackling non-linearity and heterogeneity in dynamic systems

Miss Tamika Lunn1, Dr Alison Peel1, Miss Maureen Kessler2, Dr Peggy Eby3, Assist Prof Raina Plowright2, Prof Hamish McCallum1
1Griffith University, Nathan, Australia, 2Montana State University, Bozeman, United States, 3University of New South Wales, Sydney, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 031 - Tamika Lunn is a PhD student at Griffith University, investigating mechanisms driving Hendra virus dynamics in flying-foxes. Tamika works collaboratively with an international team of researchers undertaking a large-scale study on bat health, movement and disease under anthropogenic landscape change.

Bats are highly gregarious mammals, with some species roosting in dense, seasonal colonies that can range hundreds to hundreds-of-thousands of animals. This creates frequent opportunities for direct and indirect contact between large numbers of individuals, and contributes to the propensity of bats as important disease reservoirs. Understanding the roosting dynamics of bats is important in the context of infectious disease, as spatio-temporal patterns in abundance and density will influence infectious contacts between individuals, and thus the propensity for infection and spread of disease. However, the underlying functional relationship between abundance and density is complex, being determined by the expansion and contraction of tree occupation in multi-dimensional space. Here, we investigated the roosting structure of two sympatric species of flying-fox (Pteropus alecto and P. poliocephalus), utilising
high-resolution spatial mapping. Data collection is underway, but preliminary analyses indicate that density changes non-linearly with increasing overall abundance, with the functional shape dictated by patterns of animal clustering in vertical and horizontal space, and by heterogeneity in the spatial arrangement of preferred roosting habitat. Future analyses will integrate roosting dynamics with matched data on Hendra virus excretion to explore the influence of roosting non-linearity and heterogeneity on disease parameters. As the first study to systematically evaluate roosting patterns in flying-foxes, this study provides valuable ecological information with practical applications for flying-fox conservation and conflict management. Furthermore, it is anticipated that simulations of virus invasion and spread in bat populations will be important for inferring disease dynamics in species with highly unstable, periodically fluctuating densities.

Potential use of Australian annuals on green roofs: Germination, seed traits and climate of origin

Ms Zahra Saraeian¹, Dr. Claire Farrell¹, Associated Prof. Nicholas Scott Williams¹
¹School of Ecosystem and Forest Sciences, The University of Melbourne, Burnley Campus, Richmond, 3121, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 105 - Zahra Saraeian

PhD student

I am interested in plant ecology, particularly in the context of green roofs. The main objective of my PhD project is to establish a stable plant community on green roofs using plant functional traits.

Annual species may provide advantages in the context of green roofs due to their colourful flowers and visual attractiveness, rapid growth, and the possibility of establishing by direct seeding which reduces planting costs. However, many annual plants exhibit dormancy, impeding synchronous seed germination. Habitat factors and seed traits may also influence germination patterns, as species from arid regions show faster but lower germinability; and larger seeds usually germinate faster and in higher proportion than smaller seeds. Therefore, to establish an annual plant community by direct seeding on green roofs, it is essential to determine seed germinability, particularly in the case of Australian species, where little is known. In this study, we evaluated the relationship between germination and the climate of origin and seed traits (seed mass and shape) for 70 species from across Australia. Climate variables related to each species’ habitat ranges were obtained from the Atlas of Living Australia database. Germination tests were conducted with 4 replicates of 25 seeds of each species on 1% agar in petri dishes sealed with parafilm, with an alternating temperature regime of 20/10°C (12/12 h light/dark photoperiod). Species from drier and hotter areas were found to have larger seed mass. Germination was variable across the 70 species and not all species germinated in this temperature regime. This information will be used to design annual plant communities for green roofs with high coverage and long flowering duration.
Habitat suitability for 11 fruit fly species in Australia under climate change

Mrs. Sabira Sultana¹, Dr. John Baumgartner¹, Dr. Bernard Dominiak², Dr. Jane Royer³, Dr. Linda Beaumont¹

¹Macquarie University, Sydney, Australia, ²New South Wales Department of Primary Industries, Locked Bag 21, Orange, Australia, ³Queensland Department of Agriculture and Fisheries, Biosecurity Queensland, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 112 - I am a PhD candidate in the Department of Biological Sciences, Macquarie University. My thesis explores the impact of climate change on fruit flies, particularly the Queensland Fruit Fly, and implications for Australia’s Horticultural Industry

Tephritid fruit flies are considered one of the most destructive horticultural pests, threatening Australia’s $6.9 billion horticulture industry. Currently, 11 Tephritidae species pose a substantial risk to horticultural crops in this country. Nine of these species are native to Australia (Bactrocera aquilonis, B. tryoni, B. bryoniae, B. cucumis, B. halfordiae, B. jarvisi, B. kraussi, B. musae and B. neohumeralis), while B. frauenfeldi and Ceratitis capitata are introduced. Combined, these species can cause serious crop losses, necessitating in-farm management, monitoring to demonstrate pest freedom, and quarantine and trade restrictions. Here, we used a common species distribution modelling approach, MaxEnt, to assess habitat suitability for the 11 species under current and six future climate scenarios. Projections of future suitability provide an initial estimate of the potential exposure of major horticultural regions to these important pest species. Currently, most of these 11 species have limited distributions in Australia, meaning that production areas in particular regions can operate under a pest-free status for some species. However, under the climate change scenarios species’ distributions are projected to shift, and may jeopardise this pest-free status. Using habitat suitability models, we aim to identify areas at risk of pest incursion, thereby improving preparedness for future pest management.

Investigating the strength of trait response to environmental gradients within species and across communities

Dony Indiarto¹, Dr Daniel Falster¹, Dr Will Conwell¹, Dr Shinichi Nakagawa¹

¹Evolution and Ecology Research Centre, School of Biological Earth and Environmental Science, University of New South Wales, Sydney, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 110 - I am interested in plant ecology and diversity as well as cultural diversity. I make the most of my spare time to explore the fascinating Australian landscapes and wilderness.

Plant traits link community processes with environmental gradients and competitive interaction. As traits often vary widely between species, many trait-based studies have focused on mean trait values of species and ignored the intra-specific variation. Yet, theory suggests that limits to intra-specific variation, both genetic and plastic, may be important in determining biotic thresholds, such as range limits, and thus responses to perturbations like climate change. While we know that intra-specific variation in traits exists, we currently know little about the structure of intra-specific variation in nature. To fill up this gap, we report on a meta-analysis of published studies documenting the responses of plant traits to different gradients at species and community level. We will focus on functional traits that are associated with plant ecological strategies, such as the leaf, height, and seed traits. We test for consistent patterns in intra-specific trait variation among different biomes, climate, spatial, and organisational scale, and compare the strength of these changes with reported changes across
communities. Our results clarify the strength of intra-specific trait variation in comparison to the inter-specific trait variation, and thereby the potential role of restricted trait variation within species in limiting their distribution.

**Using functional traits to predict species' fitness across spatially varying environments**

Mr Isaac Towers\(^1\), Dr. John Dwyer\(^1,2\), Prof. Margaret Mayfield\(^1\)

\(^1\)The University Of Queensland, Brisbane, Australia, \(^2\)CSIRO, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**

Poster 111 - The focus of my research is on the annual plant understorey of York Gum woodlands in Western Australia. Specifically, I investigate the role of spatial coexistence mechanisms in maintaining the incredible diversity found in this part of the world.

Plant diversity and composition is well known to vary systematically along environmental gradients at regional scales, but less is known about how environmental heterogeneity at local scales structures community diversity. Under the “spatial storage effect”, species coexistence is predicted to occur in environmentally heterogeneous communities if different species are more fit in certain local environments and less fit in others. Differential fitness responses should then be captured by species’ functional traits because they determine how organisms interact with their environment. Despite being a relatively intuitive concept, these predictions have been very rarely empirically investigated. In a natural winter annual plant system distributed throughout the Mediterranean climate region of southwest Western Australia, I will address the following questions: (1) How does the fecundity of different species vary over natural gradients of tree cover, leaf litter cover and coarse woody debris and (2) Do species’ functional traits predict these responses? For each of 15 annual plant species I will identify individuals along these key gradients and remove all surrounding neighbours to evaluate their fecundity in the absence of competition. Using a multi-level modelling framework, I will then quantify fecundity – environmental relationships for each species’, and test how carefully selected functional traits predict variation in these relationships. This fundamental research will go beyond standard trait-based approaches to reveal the functional trade-offs theorised to promote diversity in the presence of environmental variation.

**The impacts of urbanisation on riparian vegetation: a review on current knowledge and practices**

Emma Henderson\(^1\)

\(^1\)Griffith University, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**

Poster 091 - Emma Henderson is a PhD candidate at Griffith University and is part of the Riparian and Wetland Lab in the Australian Rivers Institute. With a current research focus on the impacts of urbanisation on riparian vegetation.

With a growing population and increased human development globally, the impacts of urbanisation are being exacerbated across ecosystems. With riparian vegetation already at high risk of impact from climate change and non-native species invasion, the added impact of urbanisation is likely to increase potentially negative effects. To analyse current knowledge and future projections of riparian vegetation in urban areas, a systematic quantitative literature review is being undertaken. All peer reviewed journal articles from the Web of Science including primary data on urban riparian vegetation were collated.
Analyses on these articles will examine the structure and function of urban riparian vegetation, the drivers associated, a spatial and temporal analysis of how the ecosystem changes globally, and through time, as well as management techniques being used to maintain these areas, and whether there are positive outcomes associated. This review aims to discover how riparian plant communities are impacted by urbanisation, to determine trajectories for how newly urbanised areas may be impacted, and to suggest management applications that may be of benefit.

The role of soil microbes and competition in facilitating weed invasion in native grasslands.

Ms Sarah Bates1,2, Prof Richard Ducan1, Dr Elizabeth Wandrag1, Dr Peter Thrall1, Dr Luke Barrett2
1Institute For Applied Ecology, University Of Canberra, Bruce, Australia, 2CSIRO, Crace, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 003 - I am currently doing a PhD at the Institute of Applied Ecology at the University of Canberra and CSIRO. My research is focused on the role plant-soil microbe interactions play in weed invasion.

Exotic plant invasion poses a threat to native ecosystems in Australia and globally. There is increasing evidence that plant-soil microbe interactions play a key role in plant performance, abundance and invasion dynamics. In a glasshouse experiment, we assessed the effects of native soil microbial communities on exotic species performance, and the importance of soil microbe effects relative to competition between native and exotic plants, to explain invader success. We hypothesised that more successful exotic invaders would be more likely to experience positive feedbacks from native soil communities, to be better competitors than resident native species, or both.

We inoculated glasshouse pots with soil biota from three native grassland sites dominated by Themeda triandra. We planted three native and six exotic grass species into pots inoculated with soil from each site, and into pots with sterile soil allowing us to quantify the effect of microbial inoculation on plant performance. The six exotic species were chosen to represent species spanning a wide range of abundance and apparent impact in native grasslands. Intra- and inter-specific competition was assessed by planting seedlings either with the same or a different species. We measured plant performance as biomass after 3 months. Our comparison of biomass allowed us to quantify the effects of native soil microbial communities on plant performance (by comparing growth in sterile versus inoculated pots) and compare this to the effect of inter-specific competition. This allowed us to determine whether more successful invaders benefitted more strongly from interactions with native soil communities.

Evaluating composite indicators for estuaries in NSW and developing state-and-transition models

Ms Katrina Szetey1
1Deakin University, Burwood, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 109 - Katrina has just completed her honours at Deakin University and is hoping to move onto a PhD in "something watery". Her main interest is in large scale systems and she enjoys working with data.

Composite indicators are used in ecology to provide a single metric to assess the state of a system. They must be constructed with care to ensure they are depicting intended outcomes. The NSW Office of Environment and Heritage constructed two composite indicators to assess condition and pressure for
NSW estuaries but these had not been tested to ensure they were giving an accurate picture of estuary health. I evaluated the construction of the composite indicators and created new data-derived models to assist with estuary management. I found that there was no relationship between the pressure and condition composite indicators, despite being based upon a causal-chain framework. The data used to construct the indicators had been strictly constrained in range, which may have obscured patterns in the data. To better elicit those patterns, I constructed univariate and multivariate state-and-transition models. These identified the pressure drivers for each condition indicator independently, and then simultaneously. Where possible, my models were then validated with independent data. I concluded that data used in the composite indicators should not be constrained. The pressure composite indicator should be revised, as I identified potentially redundant component indicators. My univariate models could be used to target action to improve specific condition indicators, while the multivariate model permits investigation of pressures and condition responses together. I developed a method for creating and testing composite indicators in estuarine systems that can be applied to other systems. The models can assist decision making and tailoring management actions, improving overall natural resource management.

Drought modifies plant root traits and their interaction with fungal communities

Dr Yudi M. Lozano1, Dr. Carlos Aguilar-Trigueros, Dr. Matthias C. Rillig
1Freie Universitat, Berlin, Germany

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 005 - Dr. Lozano is a postdoctoral researcher at Freie Universitat Berlin, studying the effect of drought on plant and microbial traits. She's forest engineer with a PhD in environmental sciences.

Drought events are recurrent phenomena, which are predicted to increase both in frequency and in severity over the next few decades. The response of grasslands to drought seems to be determined by species diversity and community composition. However, how drought modifies root traits and soil fungal communities is poorly known. To address this gap, we grew 25 different grasslands species under drought (30 % WHC) and non-drought (70 % WHC) conditions. The plants used included all major functional types (grasses, legumes and forbs). At the end of the experiment, we measured soil properties, root traits and fungal community structure.

Plant trait responses to drought depended on plant functional type. For example, grasses and herbs had increased root diameters but decreased specific root length and root tissue density. On the other hand, legumes showed a smaller diameter under drought. These different trait responses seem to correspond to different strategies to reduce embolism under drought: the greater diameter of grasses and herbs is more favorable for water and nutrient transportation, while the reduced specific root length might be due to the reduction in fine roots diminishing the risk of hydraulic rupture.

Fungal composition also changed under drought, and in particular, the abundance of fungal pathogens, saprotrophs and AMF decreased with drought. In summary, drought modifies plant root traits, fungal composition and abundance. We also uncovered correlations among these parameters, for example a decrease in specific root length was correlated with a decrease in abundance and richness of AMF.
The effects of plant-soil interaction networks on the diversity and restoration of plant communities

Miss Elizabeth Trevenen, Dr Michael Renton, Dr Ladislav Mucina
University Of Western Australia, Crawley, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 002 - I am a PhD student from the University of Western Australia. I am interested in how plant-soil interactions affect the diversity, resilience and restoration of plant communities, and how these relationships can be explored through the use of virtual experimentation.

Plant Soil Feedbacks (PSFs) are plant-induced changes to the abiotic/biotic (microbial) conditions of the soil that either positively or negatively impact plant growth. In plant communities, such feedbacks create complex interaction networks that have been shown to play a key role in promoting and maintaining high levels of diversity in communities. Little is known however about how the architecture of these complex plant-soil interaction networks influence the diversity and restoration of plant communities, and whether particular network architectures are sensitive to initial species selection and founder effects in sites undergoing restoration.

Therefore to explore the effects of plant-soil interaction (PSI) network architecture on the diversity and restoration of plant communities, we created several theoretical PSI network scenarios and explored how well they performed on virtual restoration sites using different initial species pool selections. To do this we used a spatially-explicit stochastic cellular automata simulation model.

Each PSI scenario consisting of 100 species, and was designed to highlight different feedback types – including different combinations of positive and negative conspecific and heterospecific interactions, as well as equivalent systems with no interactions.

We found that the PSI network architecture had significant implications for the outcomes of restoration regarding species abundances and community diversity. Our findings highlight the potential importance of PSI scenarios network structure in the diversity of and restoration of plant communities.

The state of pollinators and pollination within Australia: Are we missing something?

Dr Amy-Marie Gilpin, Prof James Cook, Prof Sally Power
Western Sydney University, Hawkesbury Institute for the Environment, Richmond, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 079 - I am an ecologist with research interests in pollination ecology, global change biology, behavioural ecology, invasion ecology and agroeconomy.

Worldwide the importance of insect pollinators has never been more realised or studied. Recently particular attention in Australia and abroad has focused upon determining the contribution and role of managed honeybees and wild pollinators to crop pollination. Australia is in a unique position in that it is the only continent without the Varroa mite and subsequent Colony Collapse Disorder. This presents a unique opportunity for ecologists to collect data within agricultural and native pollination systems before its impending arrival. My research to date has focussed upon
• Determining the quality and quantity of floral resources available to pollinators within agricultural systems throughout the year.

• Understanding the interactions between co-flowering and crop species for pollination.

• Determining the impact of climate change upon key pollinator floral resources.

• Determining whether pollinators are habitat limited.

But are we missing something?

Through a poster presentation at the 2018 ESA I aim to promote discussion into unstudied or overlooked areas of research surrounding the state of wild and managed pollinators and native and crop pollination within Australia.

Does spatial patterning determine survival of seedlings in ecological restoration after sand mining?

Ms Lauren Svejcar1,2, Dr Rachel Standish1, Dr Ben Miller2, Dr Jason Stevens2, Dr Joe Fontaine1

1Murdoch University, Murdoch, Australia, 2Department of Biodiversity, Conservation and Attractions, Perth, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 089 - Lauren Svejcar worked in various fields of ecology including weed science and restoration ecology, and is currently pursuing a PhD at Murdoch University and Kings Park Botanic Garden with Drs. Rachel Standish, Ben Miller, Jason Stevens and Joe Fontaine.

Plant-plant interactions drive plant community structure and dynamics. In the last 20 years, a renewed interest in facilitation, rather than competition, has driven a change in perspective from one of all species being independent to a more integrated community perspective. Facilitation is likely to play a large role in environments where abiotic factors limit establishment. For example, in post-mine restoration sites in the Swan Coastal Plain seedlings are exposed to high surface soil temperatures, frequent wind and low nutrient soils. The goal of our research is to test the intraspecific interactions of a N-fixing and non N-fixing species in a post-mine restoration site, and to determine whether a comparison of spatial patterns at emergence and after the summer drought suggest N-fixers help one another more than non-N-fixers to establish. We planted 640 seeds of Acacia pulchella (N-fixing) and Regelia inops (non N-fixing) in random spatial patterns within two separate plots (each 2 m x 4 m) to obtain a range of different distances between seedlings. Seedling emergence and height was measured periodically from spring 2016 to autumn 2018. We utilized point pattern analysis to determine spatial relations of seedlings over time. Results suggest spatial patterns of emergence play a critical role in seedling persistence.
The Streetscape Ecological Design Tool – integrating ecology and landscape architecture

Ms Zoe Metherell1,2, Dr Amy Hahs1,3, Professor Gini Lee2, Associate Professor Mark McDonnell3,4
1School of BioSciences, Faculty of Science, University of Melbourne, Parkville, Australia, 2Melbourne School of Design, Faculty of Architecture, Building & Planning, University of Melbourne, Parkville, Australia, 3School of Design & Environment, National University of Singapore, , , 4School of BioSciences, Faculty of Science, University of Melbourne, Singapore

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 106 - Zoë Metherell is a landscape architect and a PhD candidate at the University of Melbourne. Her research focuses on the integration of ecology and design in urban landscapes.

The field of urban ecology has produced a growing evidence base for how urbanisation impacts on the local environment and biodiversity, as well as providing insights for how we can design and build cities differently. This information is increasingly being reflected in city policies and strategies. Meanwhile, the practice of landscape architects focuses on the design of urban sites, and each project provides an opportunity to enhance aspects such as biodiversity and liveability of cities. While there is interest in incorporating ecological knowledge into the design process, it can be a challenge for landscape architects to access and interpret the scientific evidence to achieve this. Therefore, this research sought to investigate some of the effective ways in which we can integrate ecological knowledge with the practice of landscape architecture.

To achieve this, we undertook a case study project with landscape architects, ecologists and other decision makers at the City of Melbourne, to create a Streetscape Ecological Design Tool. The tool uses a pattern language approach and aids landscape architects to implement council policies, particularly the Nature in the City Strategy, in an evidence-based way.

Our case study analysis uses a reflective practice methodology and reveals; that different levels of ecological knowledge are required at each stage of the design process, that the concept stage involves a creative leap from analysis into designing something new, and is therefore a critical moment for integrating ecology, and, the importance of language, visual communication and the naming of ecological design patterns for transdisciplinary conversation.

Do patchy prescribed burns improve the persistence of small mammals post-fire?

Ms Katharine Senior1, Dr Luke Kelly1
1The University Of Melbourne, Parkville, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 037 - Katharine Senior is a PhD candidate with the Quantitative and Applied Ecology Group at the University of Melbourne. Her PhD focuses on going beyond time since fire to explore how the spatial context of fires influences small mammal distributions.

Fire is a key process in Australian landscapes, including in semi-arid mallee environments, where species are often adapted to specific fire regimes. These regimes are actively managed through prescribed burning; however, little is known about how the patchiness of fires influences mammal populations, how the arrangement of fires interacts with other threatening processes such as predation, and the specific mechanisms through which small mammals persist in post-fire landscapes. This study aims to
determine the influence of spatial heterogeneity in prescribed fire on small mammal, reptile and invasive predator persistence, and small mammal movement and refuge use. We designed a before-after-control-impact experiment in an area of Murray Sunset National Park subjected to a planned burn in May 2018. Twelve sites were stratified within the burn area at increasing distance from the burn perimeter, with eight controls. Patchiness was assessed at each site with a UAV and varied from <10% to >90% burnt. Pitfall, Elliott and camera trapping was conducted at each site before and after the prescribed burn to monitor small mammals, reptiles and predators, with future monitoring planned. We also opportunistically tracked individual small mammals with small luminescent tags to record their habitat use and how this changes with fire. Preliminary results show high initial survivorship of small mammals within the burn area. Native mammal abundance was low due to suspected competition from the introduced house mouse, which was present in high densities at both control and impact sites and used similar habitat elements as the native mammals.

Determining environmental limits of threatened species

Jon Shuker1, Prof Jean-Marc Hero2
1Not applicable, Tweed Heads, Australia, 2University of the Sunshine Coast, Sippy Downs, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 108 - Jon Shuker's primary interest is the ecology of threatened species. He has published research on the ecology of threatened frogs, and has contributed to research on other threatened fauna, including bilbies.

In an environment that is changing due to anthropogenic processes, managers responsible for conservation of a threatened species need to know environmental limits beyond which the species is at risk of extinction. We demonstrate estimation of environmental limits from theoretical response models fitted to a species’ maximum response, instead of its mean response, based on Liebig’s Law of the Minimum. The method is applied to two threatened frogs: wallum sedgefrogs (Litoria olongburensis), which breed in acidic wetlands of coastal sandy lowlands (‘wallum’); and giant barred frogs (Mixophyes iteratus), which breed along streams with riparian forest. For wallum sedgefrogs, we investigated environmental limits that determine the species’ presence and density throughout its geographical distribution, and for giant barred frogs we investigated limits that determine its activity over time within a single population. Wallum sedgefrogs were surveyed at sites spread across their geographical distribution, while giant barred frogs were surveyed monthly over five years on a stream transect. For each environmental variable recorded during the surveys, we used quantile regression to test the fit of increasingly complex response models to the highest quantiles of frog density. If a response was found, the best-fitting model was then applied to estimate environmental limits. Estimates provided by the analysis included optimal acidity and water depth for wallum sedgefrogs, and optimal temperature for giant barred frog activity. The estimates provide necessary baselines for managing the threatening processes for the frogs. Our modelling framework can be applied to other species exposed to anthropogenic threats including climate change.
Phylogenetic Diversity patterns of DNA Barcoded subtropical rainforest of Great Sandy Region, Australia, indicate refugia.

Ms Marion Howard1
1University Of The Sunshine Coast, Sippy Downs, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 054 - My name is Marion Howard. I am a first year PhD candidate at USC, supervised by Associate Professor Dr. Alison Shapcott. My research focuses on the conservation of phylogenetic variability of rainforest plants using DNA Barcoding and Phylogenetic Diversity measures.

Australian rainforests contain a high proportion of the continents terrestrial biodiversity. Previous studies indicated that highly fragmented subtropical rainforests of South East Queensland (SEQ) contained areas of high endemism, indicative of climatic refugia. Significant levels of endemism were found in the Great Sandy Region including World Heritage listed Fraser Island and Cooloola National Park. This contrasted with results of studies of rainforest on white sand in Peru.

This research aimed to improve our understanding and assessment of Australian rainforest biodiversity, its importance for global rainforest conservation and to determine distribution of diversity in the Great Sandy Region by expanding and updating the DNA barcode library of the South East Queensland rainforest flora.

DNA barcoded phylogeny was created for 95% of SEQ rainforest plants. Species composition in fixed area plots from 100 sites were sampled. Phylogenetic diversity (PD) assessments were undertaken.

We found 40% of sites in the Great Sandy Region exhibited significant phylogenetic evenness of more distantly related taxa than expected which correlates with centres of endemism and climatic refugia. Sites from adjacent areas were not significant or significantly more related than random. Communities from northern sites near central Queensland had the highest phylogenetic diversity (PD) and species richness (SR), however only 16% were found to be phylogenetically distinctive, indicative of recolonisation and expansion.

This research emphasises the importance of the Great Sandy Region for the conservation of phylogenetic variability necessary for the recolonisation of surrounding landscapes in the event of disturbance, especially as the result of future climate change.

Effects of deforestation, fragmentation and regeneration on rainforest bird communities

Ms Guohualing Huang1, Dr. Jacinta Zalucki1, Prof. Carla Catterall1
1Griffith University, Nathan, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
I am a PhD student from Griffith University. My study interests lie in bird community ecology, rainforest fragmentation, forest regeneration and seed dispersal.

Rainforest fragmentation is an important consequence of human caused habitat loss. When mature rainforest is cleared and converted for agriculture and grazing, many species that depend on old-growth habitat declines or disappear. Some may persist even in small habitat fragments, and benefit from habitat restoration. While the effects of forest fragmentation have been widely studied, the responses
of species to the full range of fragmentation intensity and habitat recovery have rarely been quantified. We assessed the effects of both rainforest fragmentation and regeneration on bird communities in the Big Scrub region, of subtropical Australia. In each of 42 sites, we conducted quantitative observational bird surveys. These sites represented seven stages of habitat conversion: 1) continuous rainforest (150 ha), 2) 5-21ha fragments, 3) 1-3ha fragments, 4) regrowth forest patches, 5) isolated native Ficus trees, 6) isolated camphor laurel trees, and 7) pasture (each with 6 sites). Converting mature rainforest to pasture was associated with reduced abundance of all birds and of many individual species, with lower richness, and altered species composition; while a small number of species were most abundant in pasture. Fragments had generally similar abundance, richness, and species composition to mature forest, although 1-3 ha fragments tended to show most divergence. The camphor regrowth had recovered a bird community that was most similar to that of the smallest fragments. We concluded that maximizing the total rainforest habitat area in the landscape (including fragments and regenerating forest) will be critical to conserving most species in the region’s bird community.

Leveraging the Atlas of Living Australia’s Species Observations and Environmental Data

Mr Lee Belbin
The Atlas Of Living Australia, Carlton, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 013 - I am a geoscience graduate and IT postgraduate who has evolved from exploration geology, teaching, research in analytical ecology to management, standards and policy development. Since 2005, I’ve provided management of, and scientific advice to international and national biodiversity-related projects.

A workshop on ecological tools was run in 2009 as a precursor to the establishment of the Atlas of Living Australia’s Spatial Portal (SP: http://www.spatial.ala.org.au). Criteria I developed at the time for including a tool included that it was accepted state-of-the-art, robust, suited to actual or anticipated ALA data (e.g. presence-only), computationally tractable and able to be implemented and maintained cost-effectively. Some of the tools included since 2010 include area reports, scatterplots, cross-tabulations, point and area comparisons, points to grids, classification, phylogenetic diversity, SDM and GDM.

What have I learnt? The long tail applies: Some tools get massive usage while a few get little. Do we maintain those with little use? Probably not. The ~500 environmental layers associated with the SP represent a considerable investment, but are these data ALA core business? Probably not. The development of virtual (analytical) laboratories linked to the SP such as BCCvL (http://www.bccvl.org.au) provide a specialized service that at least reduces the need for similar tools in the ALA. Similarly, we developed ALA4R to provide access from the R environment to ALA data and tools. Tool development in the ALA’s SP over the next few years will focus on leveraging the volume of ALA data, avoiding the need to download large datasets.

The Ecological Society of Australia conference provides an ideal opportunity to seek feedback on ALA issues and priorities as they affect the research community, so please seek me out and discuss your needs and issues.
What’s on the menu? Role of cockatoo granivory on recruitment limitation in a savanna tree.

Mr Simon Heyes¹, Dr Susan Hoebee², Dr Steve Sinclair³, Dr John Morgan¹
¹La Trobe University, Melbourne, Australia, ²Arthur Rylah Institute for Environmental Research, Melbourne, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 073 - Simon Heyes is a plant ecologist at La Trobe University with over ten years experience in ecological restoration and an interest in recruitment and demographic processes in the savannas of Western Victoria.

Silver Banksia savannas on the Victorian Volcanic Plains (VVP) are highly fragmented and have suffered widespread historic land clearing and this decline is continuing. A widespread failure to produce fruit has been reported by many land managers. Are trees really failing to produce fruit or are they being removed prior to maturity by yellow-tailed black cockatoos? The role of birds in pre-dispersal seed predation is poorly documented in Australia and we believe this seed predation is a major contributor to recruitment limitation of Silver Banksia in savanna fragments. We looked at the proportion of mature trees with fruit missing in populations across the VVP, quantified the amount of fruit being removed and compared the germination of remaining seed in cockatoo damaged fruit with those remaining on the trees. We found that most sites had mature trees without fruit and some sites had 100% removal of fruit in a season. Coupled with existing limits on tree recruitment in savannas, such as grass competition, fire and herbivory, we argue that pre-dispersal cockatoo granivory is likely to be a significant contributor to recruitment limitation in savanna fragments by limiting the pool of seed prior to dispersal.

Long term population trends and short term movement patterns of Malleefowl on the Eyre Peninsula

Peri Stenhouse¹, Dr Katherine Moseby¹,²
¹University Of Adelaide, Adelaide, Australia, ²Ecological Horizons, P.O. Box 207, Kimba 5641, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 025 - Peri is an alumni of the Ludwig Maximilan University in Munich, Germany. Her primary interests are ornithology, conservation ecology and nature in general. Peri is currently studying Malleefowl for her PhD at the University of Adelaide.

Malleefowl are still extant within areas of remnant Mallee vegetation across the Eyre Peninsula. Many of these areas comprise patches of uncleared scrub within a matrix of agricultural clearing. Monitoring grids are monitored annually with the assistance of volunteers. We investigated long term trends in mound activity over nearly two decades and related this to a number of environmental variables, location information and management actions. Activity trends were similar between grids regardless of management and size of patch with most grids recording a decline in activity over time. Part of this study involved fitting GPS transmitters to birds using backpacks. A total of 5 birds have been successfully radio-tracked in different areas across the Eyre Peninsula. Interim results suggest males move up to 1400 m from the mound during the breeding season. For two males monitored over two breeding seasons, different nests were used each season, located 700 metres and 7 km from the previous mound respectively. Numerous roosting sites were used by each bird. Mortality of adult birds was high and attributed to cat, fox and bird of prey predation as well as vehicle collision. Results suggest that Malleefowl may be declining on the Eyre Peninsula and that a combination of kangaroo control and predator control (cats and foxes) may be needed to reverse the decline. A 900 ha exclosure
has been built to see if removing herbivores leads to increased nesting success. Initial results suggest a significant increase in grass and shrub cover after the removal of herbivores.

Effects of climate variability on the regeneration of Eucalyptus: implications for plant community development

Miss Anu Singh¹
¹University of Melbourne, Burnley, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 097 - PhD student Faculty of Science, University of Melbourne

Effective forest management and conservation require knowledge of the structure and composition of forest stands and how they change over time. Disturbances are important drivers of these forest stand dynamics, providing opportunities for recruitment, shifts in relative dominance of species, and changes in the trajectory of stand development. The type of disturbance, its intensity, and any interactions with previous disturbances all influence how individual species respond and will shape the post-disturbance development patterns. Other factors such as climate may influence these patterns as well. The earliest stages of stand development, when new trees are establishing as seedlings or sprouts, is critical for shaping stand development patterns, but is also the most sensitive to climatic filtering. Many studies have demonstrated that regeneration success is influenced by microclimatic conditions, such as temperature and soil moisture. Understanding how climatic conditions influence longer-term stand dynamics and community composition is vital given projected future changes to regional and global climate. For this project, I will try to understand how tree species recruitment is affected by climatic factors such as temperature and precipitation. Does eucalypt regeneration density influence plant community composition during stand development stage.

When to cut your losses: Dispersal allocation in a filamentous fungus in response to competition

Mr. Justin Chan¹, Dr. William Cornwell², Dr. Jeff Powell², Dr. Stephen Bonser¹
¹UNSW, Sydney, Australia, ²Hawkesbury Institute of the Environment (WSU), Richmond, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
poster - 004 Justin is in the third year of his PhD after an interesting departure from the macro to the micro scale. With his roots in underground plant ecology, he now focuses his efforts on understanding fungal community assembly in wood.

1. Fungal communities often form on ephemeral substrates and dispersal is critical for the persistence of fungi among the islands that form these meta-communities. Within each substrate, competition for space and resources is vital for the local persistence of fungi. Mounting pressures from both competition and resource drawdown produce an environment of declining quality. Fungi able to detect and respond by dispersal away from the unfavourable conditions may have higher fitness. Informed dispersal theory posits that organisms are predicted to detect information about their surroundings which may trigger a dispersal response. As such, we expect that fungi will increase allocation to dispersal in the presence of a strong competitor.

2. In a lab setting, we tested how competition with other filamentous fungi affected the development of conidial pycnidiomata (asexual fruiting bodies) in Phacidium lacerum over ten days.
3. Phacidium lacerum was not observed to produce more asexual fruiting bodies or produce them earlier when experiencing interspecific competition with other filamentous fungi. However, we found that a three-way trade-off existed between growth-rate, allocation to dispersal, and defence against an interspecific neighbour.

4. Our results suggest that P. lacerum have the capacity to detect and respond to their neighbours by inducing a defensive response against competitors. However, this defensive response comes at a cost to growth rate and allocation to dispersal. Thus, it is likely that optimal life history allocation in fungi constrained to ephemeral resources will strongly depend on the competitive strength of neighbours surrounding them.

Are green roof colonising plants functional?

Mr Dean Schriekel, Dr Claire Farrell
1The University Of Melbourne, Melbourne, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 101 - Dean is a PhD student at The University of Melbourne’s Burnley campus with a research interest in wild urban ecology. Dean’s current research is on plant functional traits, resource use economics and ecological strategies in green roofs.

Diverse plant species colonise green roofs and often out-compete intended plantings, however the influence these plants have on green roof functionality is not entirely clear. A key benefit of green roofs is stormwater retention and colonising species may add to this functionality through greater water use. Therefore, this research determined the water use strategies of nine common green roof colonising species under well-watered and water-deficit conditions. Additionally, it determined whether water use was related to C-S-R strategy and whether this relationship was a useful criterion for future green roof plant selection. Species evaluated in this study exhibited diverse water use strategies, including high water users that could contribute significant benefits for stormwater mitigation on green roofs. However, there was significant variation between and within C-S-R strategies in terms of water use and maintenance of water status under water-deficit, with some strategies expressing significant plasticity in water use.

Grass species microclimatic impacts affect germination and vegetation structure in an Australian montane grassland

Mr Jed Brown
1Queensland University Of Technology, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 045 - My name is Jed Brown, I am a research honours student at Queensland University of Technology. I am interested in research regarding invasive species impacts on ecosystems. Specifically, how invasive species impacts effect vegetation community structure.

Non-native invasive plants impose impact on ecosystems that differ from those contributed by native species. The non-native invasive plants impacts are often not novel, rather they represent a combination of interactions that are unique from pre-established species-ecosystem interactions. Unique microclimatic interactions are assumed to be a factor influencing the mechanisms of invasion, often without quantitative evidence to discern them from other species.
The aim of this study is to examine the microclimatic impacts of a non-native tussock grass species, *Eragrostis curvula*, on germination of native tussock grass and ecosystem community structure. We compared the microclimatic impacts of the *E. curvula* with the dominant tussock species found in the grasslands of the Bunya Mountains. Following microclimatic impact identification, germination trials are conducted to assess the observed microclimatic effects of the species on native grass germination and vegetation community structure.

The combination of microclimate impacts imposed by *E. curvula* differ significantly from that of native tussock grasses. Specifically, we found significant differences in photosynthetically active radiation, temperature and humidity among the dominant tussock species studied. Furthermore, we saw that all the tussocks examined in this study differ via unique microsite impacts and vary in species-ecosystem interactions. The data gathered from germination trials will allow for the development of a matrix of ideal microclimatic combinations for native tussock grass germination. The importance of understanding the existence of microsite difference as a function of species identify, develops a robust understanding of community assemblages.

The Future Keepers: Assessing effects of thermal stress and resource limitation on ants

**Dr Sarah Hill**, Assoc. Prof. Nigel Andrew, Prof Nate Sanders, Prof Rob Dunn, Prof Alan Andersen

1University of New England, Armidale, Australia, 2University of Vermont, Burlington, United States, 3North Carolina State University, Raleigh, United States, 4Charles Darwin University, Darwin, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**
Poster 007 - Sarah is the manager of the Insect Ecology Lab, University of New England. She is involved in many research projects and currently oversees a citizen scientist project to assess the effects of thermal stress and resource limitation on ants.

Across Australia, different regions have experienced climatic changes to varying degrees, both seasonally and annually. One of the most fundamental issues is how our biota will respond to rapid changes in climate. Changes in population abundances, modified via changing behaviour, physiology or competition for food resources, could cause major population restructuring of currently common species, leading to the collapse of trophic interactions and depletion of ecosystem function. **AIMS:** To predict how key species (ants) that provide core ecosystem functions may change under thermal stress and resource limitation. **QUESTION 1:** What influence does differential resource limitation have on ant food preference and biological traits along biogeographical gradients? **QUESTION 2:** Does differential resource limitation change ant foraging along the gradients under increased temperatures? **QUESTION 3:** How do physiological traits of ants collected from more arid zones of Australia compare with more coastal populations. **PREDICTIONS:** More ants found on salt diet up to 100km from coastal areas, but not further inland. Ant foraging strategies may change along gradients and with seasonal changes. In chambers – more ants attracted to salt food sources. In extreme temperature sites – summer thermophilic taxa will be more active in the chambers. Sites with greater seasonal variation, will see a bigger change in nutritional preferences. CTmax and thermolimit responses will not change along transects. **CONCLUSION:** Understanding how ants respond to temperature and moisture changes will help determine the impact of climate change on ecosystem engineers: answers to the questions posed here will address this.
Discovering the weevil within: the diversity and evolutionary ecology of Australian Ambrosia Beetles

Mr James Bickerstaff1, Mr Robert Mueller1, A/Prof Bjarte Jordal2, Dr Shannon Smith3, A/Prof Markus Riegler1
1Western Sydney University - Hawkesbury Institute For The Environment, Penrith, Australia, 2University Museum of Bergen, Bergen, Norway, 3Department of Biological Sciences, Macquarie University, North Ryde, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 036 - James Bickerstaff is PhD student at Western Sydney University, investigating the diversity, taxonomy and evolutionary ecology of Australian ambrosia beetles within the subfamily Platypodinae and their symbiotic fungi.

Ambrosia beetles are wood-boring weevils that rely on symbiotic fungi for energy and nutrient supply. The weevil subfamily Platypodinae represents the oldest animal lineage to engage in agricultural behaviour through fungal farming, which evolved about 86 million years ago. Most ambrosia beetles live in freshly fallen trees and are among the early colonisers of this niche, and through the inoculation of fungi, they are at the forefront of wood degradation and nutrient cycling in forest ecosystems. However, several species attack living trees. Some have become invasive and globally distributed pests that cause stress to host trees, while others are aggressive and cause tree mortality, either through their associated fungi or extensive tunnelling by many beetles.

Australian platypodines (46 known species) have not been well characterised, and their fungal partners are mostly unknown. We have previously examined the biogeography, host tree associations, morphological and genetic diversity of 25 species. This enabled preliminary phylogenetic placement of several Australian Platypodinae and also revealed some taxonomic incongruences. Next, we will analyse their fungal associates. According to previous research, several ambrosia beetles form strict symbioses with fungi that are species-specific. However, these beetle lineages are expected to occasionally switch their fungal partners, therefore, introducing noise to co-evolutionary patterns. This study will be the first to incorporate many species across genera and tribes in an Australian phylogeographic context to test the relationships between ambrosia beetles and fungi. Results will highlight the diversity and host-specificity of ambrosia fungi, and whether ambrosia beetles and their fungi have co-evolved.

Reedia spathacea F.Muell: phylogeography & population structure

Ms Jessica Bruce1, Margaret Byrne2, Quinton Burnham1, Kristina Lemson1, Pierre Horwitz1, Annette Koenders3
1School of Science, Centre for Ecosystem Management, Edith Cowan University, Perth, Australia, 2Science and Conservation, Department of Biodiversity, Conservation and Attractions, Perth, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 058 - Jessica Bruce is a masters by research candidate for the School of Science at Edith Cowan University. She has an interest in using molecular taxonomy and comparative phylogeography to drive conservation of our unique Australian ecosystems.

Reedia spathacea F.Muell is a declared rare species of sedge (Cyperaceae) found in the peat swamps of the Jarrah Forest and Warren Biogeographical Regions. Reedia has been identified as a Gondwanan relict species on the basis of (relatively little) morphological and genetic evidence. Characteristics of relictual taxa in the south-west include being of Gondwanan or Pangaean origin, thus having become restricted to mesic habitat from a previously wider distribution and retaining some ancestral morphological states. They also are expected to have high beta genetic diversity with relatively low
alpha diversity and be phylogenetically distinct from sister taxa. Exploration of these criteria through microsatellite analyses will be presented. If this study supports the recognition of Reedia as a highly-restricted relict then the genetic consequences of historical population decline or extinction can be addressed. In a broader sense, our understanding of organisms that have become rare will be improved, in turn bettering our understanding of the pressures that have caused contraction in ranges historically, and helping us to predict future trends in the face of a rapidly changing climate.

Great bowerbirds as ecosystem engineers and niche constructors in semi-arid savannah

Miss Jessica Hodgson
1Deakin University, Belmont, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 046 - Jess has recently completed her PhD with Prof. John Endler at Deakin University studying great bowerbirds and their interactions with multiple other species in the semi-arid savannah of northern Queensland.

Through the construction of their sexual display site, the bower, male great bowerbirds are engineering microhabitats in such a way that potentially has significant repercussions on the greater semi-arid savannah community including the fruit species upon which they depend for mating success, the Burdekin Plum (BP).

Bower building concentrates organic matter underneath nurse shrubs in an inhospitable landscape. When the bower is abandoned, it decomposes, directly enhancing soil fertility. In turn, the greater availability of soil resources is benefiting BP growth rates and survival. In fact, their long term survival appears to be dependent on dispersal to a shrub site. Transect surveys revealed that BP dispersal to a shrub without a bower was extremely rare, therefore great bowerbirds are likely to be the only effective disperser of BP in this ecosystem.

Furthermore, changes in soil fertility at abandoned bowers can be linked to changes in fungal and bacterial community composition and these are hypothesized to be integral to keystone plant establishment in semi-arid savannah systems.

Overall, great bowerbirds provide effective directed dispersal of a key resource tree (BP) for a multitude of species in semi-arid savannah of northern Queensland as well as engineer microhabitats to the benefit of their mutualist plant species and microbial communities. This relationship has potential repercussions for both the geographic distribution of BP and productivity of semi-arid savannah systems. Interspecific interactions of bowerbirds have never been studied before, yet their unique behaviour makes them an ideal study species of ecosystem engineering and niche construction.
Microbat diversity and connectivity in fire-prone fragmented landscapes

Ms Amanda Lo Cascio

1Melbourne University, Creswick, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 006 - I am a Ph.D. student working in the Fire Ecology and Biodiversity group in the School of Ecosystem and Forest Science at the University of Melbourne.

Species are influenced by multiple, potentially interacting drivers. In fire-prone fragmented landscapes, prescribed burning is used to manage the risk of wildfire to human populations, and both fragmentation and fire can affect habitat suitability, as well as the ability of species to move between habitat patches (functional connectivity).

The aim of my research is to investigate how planned fire can be used to improve habitat suitability and functional connectivity for native microbat populations.

While the response of microbats to fragmentation has been well studied, there is less known about the combined effect of fragmentation and fire. Microbats are potentially sensitive to fire mediated changes in the environment. Acoustic clutter is produced by vegetation structure which changes during a fire event and post-fire regeneration. There is a need to quantify the ways in which fire effects the spatial distribution of clutter and how this interacts with fragmentation to influence functional connectivity at landscape scales.

My research will be conducted in the fragmented heathy woodlands of southwest Victoria and southeast South Australia. Field and genetic data will be used to model the response of (a) individual species, (b) community composition and (c) gene flow to variables representing biophysical influences, the fire regime, and resistance to movement. Expected outcomes will contribute to a better understanding of the combined effects of fire and fragmentation and the implications of current fire regimes for native microbat persistence.

Keywords; fragmentation, fire, microbats, landscape connectivity, functional connectivity.

Ant thermal tolerances under climate, land cover and land use change

University of New England Nigel Andrew, Dr Cara Miller, Dr Graham Hall, Mr Zac Hemmings, Dr Ian Oliver

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 028 - Nigel's research focuses on identifying behavioural, ecological and physiological traits of individuals and whether these traits can then be scaled up to predict changes within and across populations, species, communities and spatial scales. He is Managing Editor of Austral Ecology.

Thermal stress is a key issue for species dominant within ecosystems especially those that carry out key ecosystem service roles. Here we integrate the observed phenotypic plasticity of the dominant and ubiquitous meat ant Iridomyrmex purpureus in critical thermal limits across altitudinal, land cover and land use gradients to: (i) predict the adaptive capacity of a key terrestrial ecosystem service provider to changes in climate, land cover and land use, and (ii) assess the ability of multiple use landscapes to confer maximum resilience to terrestrial biodiversity in the face of a changing climate. The research was
carried out along a 270km aridity gradient in northern New South Wales, Australia. When we assessed critical thermal maximum temperatures (CTmax) of meat ants in relation to the environmental variables, and within the model we had critical thermal minimums of meat ants (CTmin) as a random slope and as a fixed effect we detected a negative aridity effect on CTmax, a negative effect of land use intensity, and no overall correlation between CTmax and CTmin. We also found a negative relationship with warming tolerance of I. purpureus and landscape aridity. In conclusion, we expect to see a reduction in the physiological resilience of I. purpureus as land use intensity increases and as the climate becomes more arid. Meat ants are key ecosystem engineers and as they are put under more stress, wider ecological implications may occur if populations decline or disappear.

The thermal suitability of artificial hollows used by Leadbeater’s possum

Mr Leo McComb1, Dr Natalie Briscoe1, Dr Pia Lentini1, Dr Dan Harley2, Dr Lindy Lumsden3
1The University Of Melbourne, Parkville, Australia, 2Zoos Victoria, Healesville, Australia, 3Arthur Rylah Institute, DELWP, Heidelberg, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 080 - I am a current Masters student at the University of Melbourne in the Quantitative and Applied Ecology (QAEco) group. My interests lie in threatened species management and using novel methods to improve population trajectories.

Habitat loss from logging and bushfires has significantly reduced the number of tree hollows available to the critically endangered Leadbeater’s possum (Gymnobelideus leadbeateri) in Victoria’s Central Highlands. Recycled plastic nest boxes are being used to provide supplementary denning sites, and recently a new approach of excavating ‘chainsaw hollows’ has also been trialed. However, little was known about whether these structures provided suitable nesting microclimates for the possum. We recorded temperature and humidity within artificial dens over winter and summer, and across three habitat types spanning an elevational gradient from 100 – 1500m, while also monitoring den occupancy using camera traps. This was paired with laboratory experiments to determine the insulative capacity of Leadbeater’s possum nests. We found that nest boxes closely tracked ambient temperatures over both seasons, compared to chainsaw hollows which provided a more stable thermal environment. Nest box minimum temperatures were 3°C colder than chainsaw hollows over winter, and maximum temperatures were 7°C hotter over summer. Leadbeater’s possums have behavioural strategies such as nest building and huddling that allow them to tolerate cold temperatures, but their ability to cope with high den temperatures is likely to be more limited. As the thermal properties of dens can impact survival and reproduction, it is critical to ensure they provide sites of refuge during climate extremes. This research will help guide decisions on what approaches should be implemented for supplementary den provisioning in order to address the projected shortfall of hollows across the region in the next 50 years.

Fatal pressure on natural resources

Dr Nathalie Butt1
1The University Of Queensland, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 043 - Nathalie Butt is an environmental and conservation scientist whose work focuses largely on climate and biodiversity interactions. Recent research has covered the impacts of climate change on species and ecosystems, and human-nature interactions.
From 2002 to 2017, 1573 environmental defenders in 49 countries have been killed. The victims include community activists, lawyers, journalists, NGO staff, park rangers, and indigenous or peasant leaders. These deaths are primarily related to conflict over land and natural resources, including forests and forest resources. We investigate the drivers of these conflicts and violence, and relate them to six key natural resource sectors: mining and extraction, land, logging, water and dams, poaching, and agriculture. Local or national variables contributing to environmental conflict include corruption, land tenure allocations, and other social, political and environmental factors. Using global datasets on variables such as intact forest, corruption indices, allocation of land concessions, agri-business, and other potential drivers, we explore spatial relationships between natural resources and violence to identify key interactions between drivers, countries, and global commodity chains. We argue that international and multinational companies that profit from natural resources sourced in one country and sold elsewhere are by definition complicit in this supply chain of violence, and have a responsibility for transparency and ethical practices. Indigenous peoples are dying in higher numbers than any other group, and the silencing of voices proximate to the frontline has a chilling effect globally: if people are afraid to speak up or campaign, this could lead to the silencing of important environmental and conservation issues even in theoretically safe and non-corrupt countries.

Does habitat fragmentation impact on the intraspecific traits of subtropical forest plants?

Ms Shilu Zheng1,2, Prof Mingjian Yu4, Dr Bruce Webber1,2,3, Prof Raphael Didham1,2
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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 038 - Shilu was awarded her undergraduate degree from Zhejiang University, China, in 2016. This work is part of Shilu’s doctoral studies at UWA, Australia, where she is pursuing her passion in trait-based mechanisms underpinning ecological responses to environmental change.

Poster 038

Habitat fragmentation can alter selective pressures acting on forest ecosystems and trigger changes in functional composition and community structure of vegetation. The impacts on species-level trait variation has been widely recognized in this context, but relatively little is known about intraspecific trait variation among populations, as well as changes in population trait distributions along fragmentation-induced stress gradients. Such gradients exist from the edge to the interior of forest remnants and differ between small and large remnants. These gradients can be induced by altered microclimatic conditions at the edge, and can modify the selective pressure acting on individual plants. To assess the effects of habitat fragmentation on plant trait distributions through time, we performed a community survey to understand individual-level leaf trait variation for 60 tree and shrub species across 20 islands of varying size at Thousand Island Lake in Zhejiang, China. Characterizing these shift in intraspecific trait distributions in response to fragmentation-induced stress gradients is revealing that individuals with high resource acquisition traits tend to be more abundant at the forest interior compared to the fragment edge. Our findings provide a clearer understanding into the selective pressures acting on native populations in fragmented systems, and the consequences that this important component of global environmental change might have for ecosystem functioning. This research will advance our understanding of habitat fragmentation effects on community assembly process from a trait-based aspect and allow us to explicitly factor such impacts into how we manage forests in the future.
Triodia-dependent fauna do not follow the Triodia cover fire-response: Are we measuring Triodia structure correctly?

Mr Simon Verdon¹
¹La Trobe University, Melbourne, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 070 - Simon is a PhD student at the Research Centre for Future Landscapes, La Trobe University. He studies the effect of fire on the mallee emu-wren, with the goal of improving fire-management for this species and for other mallee animals

Predicting species’ fire responses is both a cornerstone of fire ecology, and vital for effective management. Habitat specialists are often the easiest to predict, especially where their habitat is linked to time-since-fire. However, some habitat specialists have different fire-responses to their habitat. In these instances, either the influential ‘habitat accommodation model’ is incorrect, or we are not measuring habitat correctly. For example, some Triodia-dependent species do not follow the Triodia cover fire-response. We test if this is because a) habitat requirements are dynamic; or b) fauna are responding to changes in Triodia height rather than cover. We compared the predictive capacity of Triodia cover and height models for eight Triodia-dependent species. We then compared the fire-responses of cover, height and fauna to see if species which deviate from cover in their fire-response, are in fact tracking changes in height.

We used pitfall and bird survey data collected in Triodia scariosa vegetation over the Murray-Mallee region, south-eastern Australia.

Some species responded best to Triodia height, others to cover. Cover and height did not have the same fire-response. Where cover showed a unimodal response, Triodia height showed a bimodal response. Five out of eight fauna species showed a fire-response resembling Triodia height. Only one species showed a fire-response comparable with the Triodia cover fire-response.

Habitat requirements were dynamic for some species after 80 years-since-fire, with these species requiring less Triodia at the oldest fire-ages. Burning to regenerate habitat may be inappropriate, as Triodia height and fauna both recovered without fire.

Sensitivity Analysis to Configuration Option Settings in Eight Species Distribution Modelling Algorithms

Dr Willow Hallgren¹, Associate Professor Fabiana Santana², Associate Professor Sama Low-Choy¹, Ms Yuting Zhao², Professor Brendan Mackey¹
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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 061 - Dr Willow Hallgren gained a PhD from Monash University and then did a Postdoc at MIT. She is currently a global change and ecological modeller at Griffith University, and investigates the interactions between climate change, vegetation and land cover.

The sensitivity of eight well known SDM algorithms (MaxEnt, Artificial Neural Network (ANN), Classification tree analysis (CTA), Flexible Discriminant Analysis (FDA), Generalized Linear Model (GLM), Generalized Additive Model (GAM), Surface Range Envelope (SRE), and Multivariate Adaptive Regression Splines (MARS)) was comprehensively tested to variation in their configuration options settings.
A range of appropriate test values which were used in the sensitivity testing were derived from a process of expert elicitation for each configurable option for each algorithm. The species which we chose for our sensitivity analysis was the Koala (Phascolartos cinereus), since it has a well-known distribution.

We then compared the distribution from each sensitivity test (i.e. altered-settings) SDM for differences compared to the control SDM (i.e. default settings), using the visualization tools of the Biodiversity and Climate Change Virtual Laboratory, and we also analysed the AUC.

Our results indicate that all of algorithms tested showed sensitivity to alternate values for some of their settings, and this confirms that the choice of configuration option settings in these SDM algorithms can have a significant impact on the resulting projected distribution, which has significant implications for decision making and policy outcomes wherever SDMs are used to inform species and biodiversity management plans and policy settings. Our study suggests that assigning suitable values for SDM configuration settings is a very important consideration and as such should be always published along with the model, and indeed is necessary in order to increase the scientific robustness of species distribution modelling.

Microhabitat use of aquatic predatory insects reveals indirect herbicide effects on the predators

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 50 - Koya Hashimoto completed his Ph.D. in June 2018, since when he has worked as a Ph.D. researcher in KINDAI University working on the ecological impacts of pesticides. In his Ph.D. he studied plant-mediated interactions between butterflies in Kyoto University.

Indirect effects of pesticides on organisms via biotic interactions should be recognized as a major component of their ecological impacts on biological communities. However, knowledge in predicting such indirect effects of pesticides is still limited. Here, we argue that functional traits of organisms which characterize biotic interactions can predict interaction-mediated indirect effects of agrochemicals. We conducted a mesocosm experiment to test whether indirect effects of an herbicide (pentoxazone) on aquatic predatory insects in rice paddies depend on microhabitat use of the predators. Our hypothesis is that phytophilous predators which clasp aquatic macrophytes would be more subject to negative indirect effects of the herbicide through a decrease in aquatic macrophytes than benthic, pelagic, and neustonic predators. We also mixed an insecticide (fipronil) with herbicide-treated paddies to verify whether indirect effects of the herbicide to the predators depend on the presence/absence of the insecticide. Aquatic macrophytes significantly decreased their coverages after herbicide application. However, herbicide application did not consistently decrease phytoplankton abundance, and there were no negative impacts of the herbicide on zooplankton and prey insects. Meanwhile, phytophilous predators were more likely decreased by herbicide application than benthic, pelagic, and neustonic predators as expected. Some benthic and pelagic predators increased their abundances in the presence of the herbicide. However, the indirect herbicide effects were eliminated when the insecticide was applied, seemingly due to its high lethal toxicity. Our study highlights the importance of species traits such as microhabitat use which mediate biotic interactions for predicting indirect effects of agrochemicals on biological communities.
Habitat complexity affects floral resource discovery time of insects in urban landscapes

Mr Manuel Lequerica¹, Dr Caragh Threlfall¹, Dr Tanya Latty¹, Dr. Dieter Hochuli¹
¹University Of Sydney, The University Of Sydney, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 103 - Manuel is a doctoral candidate in the Integrative Ecology lab at Sydney University. He is interested in insect plant interactions, especially pollination, in urban environments.

Understanding how biotic communities are affected by urban growth is important for biodiversity conservation. Habitat structural complexity is reduced in urban areas as a consequence of gardening and landscaping. Changes in habitat complexity affect animals’ ability to forage and use available resources. The aim of this study was to assess if floral resource discovery time for insects was associated with habitat structural complexity.

We used an array of artificial flowers to attract floral visitors to sites in a gradient of habitat structural complexity, and recorded the time taken by floral visitors to discover the flowers. An innovative automatic camera monitoring system was used to record the identity of the visitors, allowing increasing the sample size while reducing human monitoring effort and error.

Floral discoverability was associated with habitat complexity, suggesting that environmental structure is associated with foraging activities in anthophilous insects. The ability of hoverflies, native bees, and the introduced honey bee, Apis mellifera to use floral resources increased as habitat complexity decreased, as hypothesised; this variation in foraging characteristics could have further implications for urban insect conservation and biodiversity.

Artificial focal plants are a useful way of sampling floral visitors and automatic cameras are powerful wildlife monitoring tools that deliver quality information at low cost and sampling effort. Our results suggest that environmental complexity is associated with the ability of insects to use floral resources. The implications of this change in foraging activity remain to be studied in depth, giving more details on the consequences of urbanisation on wildlife.

What’s a river without water? Citizen science and perceptions to improve ecosystem research and management

Dr Catherine Leigh¹,², Dr Kate Boersma³, Dr Núria Bonada⁴, Dr Thibault Datry⁵, Dr Mark Galatowitsch⁶, Dr Bernard Hugueny⁷, Dr Tory Milner⁸, Dr Hervé Pella⁹, Dr Rachel Stubbington⁹
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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM
Intermittent rivers support both aquatic and terrestrial biodiversity. Increasingly prevalent, these ecosystems are often under-protected, overlooked and held in low esteem, due to inadequate understanding of their ecology and value. We provide 3 examples of how citizens and scientists can collaborate to address these issues. First, surveys we’ve conducted of student citizens in Australia, the UK and USA indicate that even when perceptions of these rivers are positive, perennially-flowing rivers are valued more highly, especially when intermittent rivers stop flowing and regarding their aesthetic and recreational provisioning. Such insight has potential to inform management for better and more successful outcomes. Second, citizen scientists in Western France concerned with the impact of river drying on their recreational fishing activity rigorously collect observational data on river flow states (flowing, non-flowing, dry) each summer. Our landscape-ecology analyses of these data indicate non-flowing and dry patches can represent up to 80% of channel length by summer’s end and that small fish are particularly vulnerable to the resultant habitat fragmentation, confirming the fishers’ concerns. The program En Quête D’Eau now extends across France. Such observational datasets can help fill gaps in monitoring networks at low cost, guide management, and provide strong social and scientific benefits. This is exemplified by our third example, the RiuNet app to evaluate ecological status of intermittent rivers, which engages citizens directly with their environment and informs large-scale ecosystem assessments. All these initiatives help to provide public awareness and education around river ecosystems to improve their management and conservation.

Using virtual reality to estimate the beauty of the Great Barrier Reef

Dr Julie Vercelloni

Global Change Institute, The University Of Queensland, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Aesthetic value, or beauty of the Great Barrier Reef, is fundamental socioeconomic attribute of conservation alongside other ecosystem services. However, beauty is difficult to quantify and is not estimated well using traditional approaches to monitoring coral-reef aesthetic. To improve the estimation of ecosystem aesthetic values, we developed and implemented a novel framework used to quantify features of ecosystem aesthetics based on people’s perceptions of beauty. Three observer groups (Citizens, Experienced Divers, and Marine Scientists) were virtually immersed into the Australian’s Great Barrier Reef from which we elicited their perceptions of beauty and used their observations to assess the relative importance of eight potential attributes of aesthetic value. Among these, heterogeneity, defined by structural complexity and colour diversity, was positively associated with reef aesthetic values. There were no group-level differences in the way the groups perceived reef aesthetics suggesting that the sense of beauty does not necessarily depend of the past experiences and/or scientific knowledge of an observer with coral-reefs. The framework developed here provides a generic tool to help identify indicators of aesthetic value applicable to a wide variety of natural systems. The ability to measure aesthetic value in a robust way adds an important dimension to the holistic conservation efforts in the Great Barrier Reef, coral reefs worldwide, and other natural ecosystems.

Direct and indirect community effects of an invasive plant pathogen (Austropuccinia psidii) in eastern Australian rainforests
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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 035

In 2010, the invasive fungal pathogen Austropuccinia psidii (myrtle rust), which infects Myrtaceae plant species, was detected in Australia. In this study, we assessed the community-level impacts of A. psidii resulting from the infection of two highly susceptible rainforest species, Rhodamnia rubescens and Rhodomyrtus psidioides, using a disease exclusion experiment (three sites/species). For R. rubescens, 20 plots each containing an adult tree were established per site and designated one of four treatments: fungicide treated understorey only, canopy only, both or none (control). For R. psidioides, 30 plots containing seedlings were established per site and designated one of two treatments: fungicide treated understorey or control. Richness and abundance of understorey species was assessed every four months for a 24-month period, and for R. rubescens plots changes in canopy transparency were also assessed. We found that the R. rubescens control canopy plots had greater canopy transparency which resulted in richness and abundance reductions of understorey species. For treated canopy plots, abundance increased in treated understorey plots while richness did not change. For R. psidioides plots, understorey species richness and abundance did not differ between treatments. However, treated plots had significantly greater abundance of R. rubescens and R. psidioides seedlings. Finally, no R. rubescens trees produced viable seed during the study period irrespective of treatment. From these findings, we suggest that our study species will likely experience widespread local extinctions as a result of A. psidii, resulting in compositional and structural changes in the rainforest communities in which they occur.

Key-words: biodiversity; environmental impacts; forest pathogens; invasive species; Puccinia psidii

Does the gender with the reduced sex chromosome die earlier?

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
POSTER 027

Zoe is a student at UNSW who has recently completed her honours year. Her research focuses on how sex determination systems impact lifespan and body size across the tree of life.

Many taxa show substantial differences in lifespan between sexes. For example, female mammals tend to live longer, while male birds tend to live longer. One theory that might explain these differences is the ‘unguarded X’ hypothesis, which suggests that the reduced or absent chromosome in the heterogametic sex (e.g. the Y chromosome in mammals) exposes deleterious mutations on the other sex chromosome (e.g. the X chromosome in mammals). We compiled longevity data for females and males of 106 species from 25 orders across the tree of life to determine whether, on average, the heterogametic sex is shorter lived than its homogametic counterpart. Of the species analysed, invertebrates such as cockroaches (Blattodea), flies (Diptera) and dragonflies (Odonata), exhibited greater lifespan dimorphism than the reptiles (Reptilia), amphibians (Anura) and moths (Lepidoptera). Phylogenetic meta-analysis showed that the homogametic sex, on average, lives longer than the heterogametic sex (P < 0.01). These results are consistent with the predictions of the “unguarded X” hypothesis.
De novo RNA assembly of mangroves and transcriptomic responses to different natural habitats

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 076

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B.Sc. - Alzahra University 2005
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Postdoctoral Fellow. OIST, 2016 -

Mangroves are salt tolerant trees that grow in coastal saline water in tropics and subtropics and are adapted to harsh conditions with high salinity, extreme tides, strong winds, high temperatures, and anaerobic wetlands. Despite increasing awareness of mangrove’s ecological importance, the molecular mechanisms underlying their adaptation to extreme habitats remain elusive. Mangrove communities show gradual phenotypic changes in forest structure such as tree height and biomass that usually decrease due to increasing stress factors along the tidal gradients. We have set the study site in a mangrove forest located along the estuary of a river and coastal area of Pacific Ocean in Okinawa-Japan. This forest is consisted mainly of three mangrove species from the family Rhizophoraceae, and show highly developed morphological adaptations to extreme conditions. We are investigating how gene expression varies among individuals from different habitats in different level of stress, and how this variation is correlated with their morphological differences. A detailed de novo annotation of genes based on RNA sequencing data were done and gene expression analysis identified remarkable genomic characteristics that are conserved within each group but differ among them. Annotations of Gene Ontology also, revealed differences in the transcriptome profiles among the two populations. This study may contribute to a better understanding of the adaptive responses in plants and may help to evaluate the risk of plant species in fluctuations of the environmental conditions and can make a good model system for studying genetic mechanisms related to abiotic stress adaptation in tropical forest trees.

Reproductive plasticity in Tasmanian devils in response to devil facial tumour disease'

Dr Douglas Kerlin, Dr Konstans Wells, Dr Rodrigo Hamade, Prof Paul Hohenlohe, Prof Andrew Storfer, Prof Hamish McCallum, Dr Menna Jones

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
POSTER 093 - Douglas is a postdoctoral research fellow in the Griffith Wildlife Disease Ecology group. His research applies population ecology and spatial methods to study disease ecology of Australian marsupials, with a focus on Koalas and Tasmanian devil facial tumour disease.
Reproductive plasticity in wildlife can play a crucial role in the response of species to the adverse impacts of environmental hazards. Tasmanian devil facial tumour disease (DFTD), a transmissible and deadly cancer of Tasmanian devils (Sarcophilus harrisii), causes demographic shifts in devil population structure through the increased mortality of adult individuals. Precocial reproduction, defined as the early onset of breeding in subadult devils, has been suggested as a response to the loss of adult individuals from the populations, yet the underpinnings of changes in devil reproductive timing are not well understood. We analysed 18 years of longitudinal capture records from devil populations across Tasmania in a Bayesian dynamical state-space model to estimate the probability and timing of reproduction for devils in different age classes. This framework allowed model-based estimates of the timing of reproduction in different devil age groups, in addition to pouch young survival rates to help account for the underlying sampling bias. We demonstrate precocial breeding in certain devil populations congruent with the arrival of DFTD to the local area, however this phenomenon is not observed at all sampling locations. Disease-induced demographic shifts imposed by the selective removal of individuals from populations can cause life history changes in surviving individuals; the loss of adult devils may release subadult devils from density-dependent competition, with subsequent increased access to resources and reproductive plasticity manifesting in precocial reproduction.

The source of trait information affects ecological inference: a case study of plant invasiveness

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 064 - Esti is a PhD candidate in the Quantitative and Applied Ecology group. Her research interests include community assembly and invasion ecology. She aims to understand and generalise plant invasion mechanisms, mostly in Australia, using functional traits.

Trait-based approaches are commonly used to understand ecological processes, such as community assembly. Trait data are typically gathered by collecting specimens on-site or retrieving published records (e.g. online databases), but trait data are rarely available for all target species. The implications of trait source choice and methodology used to improve dataset coverage (e.g. imputation of missing values) are poorly understood for ecological studies. We aim to (1) assess the surrogacy of worldwide available trait records for regional values, and (2) test how different but commonly used approaches to build trait datasets may influence results of a trait-based invasiveness study. To answer these questions, we collected on-site (field) and off-site (TRY database) records of height and specific leaf area, SLA, for 82 plants exotic to Victoria, Australia. Then, using different combinations of field collected, downloaded and imputed data, we built 5 datasets for each trait.

Of the 57 and 43 species for which there was both on- and off-site height and SLA data available, respectively, we found a good match between their on-site and off-site trait mean values. However, when working with all 82 species (e.g. after imputation of missing values), the choice of data source and the methodological choices made to build the datasets influenced the rank of species trait means, and the relationships between traits and plant invasiveness metrics (relative cover and spread rate). Our results suggest that dataset compilation is a critical step on ecological studies and can affect the inference drawn from statistical findings.
Seed sourcing for plant restoration: performance of provenances along a climate gradient under water treatments.

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POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 060 - Bahram Mirfakhraei is a PhD candidate at the School of Biological Sciences-The University of Western Australia, Kings Park Science and The ARC Centre for Mine Site Restoration. His research interests are: seed sourcing, genecology and plant responses to changing environment.

Decisions on the source of seeds can have a major impact on the success of plant community restoration. Local provenancing has been widely implemented to deliver locally adapted seeds. However, a climate-adjusted method has been recently promoted to deliver seeds adapted to climate change. This method suggests to move in the direction of climate change and source some seeds from provenances with climatic conditions similar to expected future conditions, such as warmer and drier provenances. In this study, these seed sourcing methods were tested using Banksia menziesii, a key species in the restoration of Banksia woodland on the Swan Coastal Plain in Western Australia.

Response of seedlings from six provenances along a climate gradient to various water treatments was tested. Seedlings from provenances with low to high (443 to 813 mm) annual rainfall were exposed to low, medium and high water treatments to evaluate their plasticity and performance using plant physiological traits. This study will illustrate if seedlings of drier and wetter provenances perform better under low and high available water respectively and need to be considered as a seed source. The outcomes of this study will assist to improve seed sourcing guidelines for efficient and successful long-term plant community restoration.

Comparing fungal spore sources for establishing mycorrhizal associations in tuart tree seedlings

Miss Monique Smith1, Miss Natasha Tay1, Dr Amanda Kristancic1, Prof Giles Hardy1, Dr Patricia Fleming1
1School of Veterinary & Life Sciences, Murdoch University, Perth, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 73 - An ambitious biology student in her final year of study, with a passion for conservation, ecology and biochemistry. She is also a member of that rare, and strange group of people, that think statistical data analysis is fun.

Tuart (Eucalyptus gomphocephala) trees once dominated the Swan Coastal Plain in south-west Western Australia. Today, this species occupies a third of its former range, and tree numbers continue decline. Previous research has found a strong positive correlation between tuart crown health and mycorrhizal root associations (r² =0.75), and greater abundance of ectomycorrhizal fungi (ECM) associated with healthy trees. We investigated various sources of fungal spores as a means of improving the growth, health, and survival of tuart seedlings. Treatments (n = 80 seeds) were inoculated with either; 1. ectomycorrhizal spores from the field, 2. a commercial product containing mycorrhizae (TerraStart; Baileys), or 3. quenda scats (Isoodon fusciventer: a local mycophagous mammal, and natural disperser of mycorrhizal spores). Seedlings received all three inoculant sources, with two sources autoclaved before application. A fourth treatment had all three inoculants autoclaved, and a fifth received no inoculant (glasshouse control). Seedlings were grown in a glasshouse for seven months, before being
planted at a field site in Mandurah, where they will be monitored for a further two months. So far, the seedlings treated with the commercial product have the greatest growth rate, and the quenda scat seedlings are the healthiest. Our next step will be to determine whether the growth patterns recorded in the greenhouse translate into increased resilience when seedlings are planted out into the field. This study carries implications for tuart re-vegetation projects, and highlights the complex relationships between trees, mycorrhizae, and the mammals that move these fungi across the landscape.

High concentration of PM10 can impede honeybee navigation

Ms Yoori Cho

Seoul National University, Seoul, South Korea

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 012 - Yoori Cho is a PhD candidate at Seoul National University, studying pollination ecology.

Beijing was hit by a massive sandstorm, which is known as Asian dust or Yellow sand phenomenon (shāchénbào in Chinese, hwangsa in Korean), in April 2017. The city was enveloped by sand, and the reported visibility was less than 1 km. People could neither work outside nor drive. But can bees forage for their food in this sandy air? The hypothesis in this proposed study is as follows: honey bee's foraging activity is impeded when Asian dust is severe since bees cannot navigate to floral resources and to their nest as they normally do in a clear weather. This study was conducted with a honey bee colony in Beijing using RFID transponders carried by bees, which has a capability to record the time spent for foraging by the bees. Time taken for bees traveling between food resources and their nest was measured with reference to the real-time airborne PM concentration. The result was statistically significant: when the city was blanketed by the dust with a high PM concentration, the foraging time taken by the bees was longer.

Trapped in the hood: pollination in Pterostylis (Orchidaceae)

Mr Tobias Hayashi, Dr Ryan Phillips, Dr Noushka Reiter, Dr Bjorn Bohman, Prof Rod Peakall

The Australian National University, Canberra, Australia, La Trobe University, Melbourne, Australia, Royal Botanic Gardens Victoria, Cranbourne, Australia, University of Western Australia, Perth, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 069 - Tobias Hayashi is a PhD candidate in the Peakall lab at the ANU. He is passionate about orchids and is particularly interested in the interaction between the orchids and their pollinators.

Rewardless orchids are masters of deceit, using the visual and chemical language of pollinating insects to trick them into visiting flowers. Pollination by sexual deception, whereby orchid flowers mimic the sex pheromone of the female insect to attract the corresponding males as pollinators, is a prime example of rewardless pollination. This strategy is well known across several Australian wasp-pollinated orchid genera.

Pterostylis is a diverse and widespread orchid genus that occurs throughout temperate Australia and New Zealand. The flowers have a unique floral morphology with an intricate trap system designed to force dipteran visitors to remove pollen on escape from the flower. Recently, sexual deception of male fungus gnats has been confirmed in one species, raising the question: is pollination by sexual deception widespread within Pterostylis?

Here I present confirmation of highly specific pollination by sexual deception of male fungus gnats in six species of Pterostylis from all three sub-genera. Unusually, flowers of one species achieve long-distance attraction via sexual deception but appear to encourage floral visitors to enter the trap using a
combination of morphology and food reward. Despite this emerging evidence for widespread sexual deception across Pterostylis, other pollination strategies (not involving fungus gnats) also appear to be operating in this group.

Pterostylis offers promising new areas to investigate the ecology and evolution of pollination in Australian orchids. These results will also be important in the context of threatened Pterostylis, as effective orchid conservation requires an understanding of pollinators, particularly when pollination is highly specific.

Determining If Functional Traits Predict Plant Growth Rates Across Environmental Gradients

Ms Mimi McGirvan

1Queensland University of Technology, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 032 - My name is Mimi McGirvan. I am an Honours student at Queensland University of Technology and am interested in botany, ecology and community dynamics in rainforest ecosystems.

Measuring plant functional traits is often used as a method of investigating plant community dynamics, as they are assumed to provide a simple surrogate measure for function. The search for a set of easily measured functional traits has been described as the ‘holy grail’ of ecology, as it would provide a taxon independent currency for comparing ecosystems made up of different species, in terms of their function. This study aims to test this concept, by connecting population growth rates and interactions between traits and environmental conditions for one globally distributed herbaceous species, Plantago lanceolata. Using Plantpopnet, a global network that investigates the drivers of population performance of P. lanceolata, this study will analyse long-term trait data and demographic rates (such as specific leaf area, stem height, seed production, population density) from over 48 sites worldwide to provide a true assessment of phenotypic plasticity. Modelling fitness components such as population growth rates as functions of trait and environment interactions, has recently been recognised as a potentially more accurate method of determining the adaptive value of traits than using the correlation between community-weighted mean traits and environmental gradients. The functional trait and demographic data collected from sub-arctic to sub-tropic regions has been used to investigate the relationship between population growth rates and commonly measured traits dependent on environmental conditions, using a Boosted Regression Tree and Structural Equation Modelling (SEM). By incorporating survival rates such as population growth rates, the accuracy of determining the adaptive value of traits may be improved.

Multivariate drivers of diversity in temperate Australian native grasslands

Dr Jodi Price1, Dr Megan Good2, Dr Nick Schultz3, Dr Lydia Guja3, Dr John Morgan4

1Charles Sturt University, Albury, Australia, 2Federation University, Ballarat, Australia, 3Centre for Australian National Biodiversity Research, CSIRO, Canberra, Australia, 4LaTrobe University, Melbourne, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 051 - Jodi is a lecturer in vegetation ecology at Charles Sturt University

Disturbance (mostly fire) has been considered essential for maintaining biodiversity in temperate grassy ecosystems in Australia. This has been particularly well-demonstrated for inter-tussock plant species in
C4 Themeda-dominated grasslands in mesic environments. It is commonly thought that fire promotes regeneration indirectly—by removing biomass and providing gaps for recruitment—rather than directly stimulating germination. As such, much of the grassland literature has focused on the importance of biomass removal to promote diversity and has taken a univariate approach to the drivers of biodiversity—rainfall is seen as a key driver of biomass, and biomass then drives diversity, mediated by disturbance. We argue that this framework is too simplistic as many mechanisms impact on plant diversity. We propose a multivariate model for understanding drivers of diversity in temperate grasslands. Here, we focus on the multiple drivers of phytomass (live and dead plant material) accumulation and structure and how this structure effects regeneration opportunities and plant diversity. We suggest it is the accumulation and arrangement of phytomass that governs plant diversity rather than productivity per se. We review the literature on temperate grasslands in Australia to determine the relationship between phytomass structure and plant regeneration (focusing on germination cues). Understanding the conditions under which disturbance (and type of) is required to promote regeneration can be used in conservation management decision making (e.g. decisions on whether to re-introduce fire into long unburnt systems).

A Method for Large Scale Visual Navigation of Environmental Acoustic Data

Mr Benjamin Rowe¹
1Queensland University Of Technology, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 016 - Benjamin Rowe is currently an honours student at the Queensland University of Technology conducting research into interactive visualisation of environmental acoustic data

Audio recordings are playing an ever more important role in environmental conservation, however as many of these recordings can be thousands of hours long it becomes impossible for a human to listen to them (Towsey, Truskinger, & Roe, 2016). There already exist several methods of visualising this data, however each of these methods has advantages and disadvantages that makes it useful for its own niche, however reduce its usefulness in other contexts. Despite this there are very few visualisation methods which allow for navigation of audio data, and currently no methods that allow for navigation of an entire year of audio data on a single screen. Using Diel plots for large scale navigation and spectrograms to show fine detail allows for information to be presented clearly to users. This will allow for those involved in species conservation to more easily view large scale recordings and also easily verify conclusions that are made using this visual representation by navigating to the audio that corresponds to the visualisation.

Flirting with danger: do bolder northern quolls (Dasyurus hallucatus) gain more benefits from risky foraging?

Ms N.J. Freeman¹, Dr S.F. Cameron¹, Assoc Prof D.O. Fisher¹, Assoc Prof R.S. Wilson¹
¹University Of Queensland, St Lucia, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 022 - Natalie is a PhD candidate of the Wilson Performance Lab of University of Queensland, studying the personality and performance of northern quoll on Groote Eylandt, NT.
A daily challenge for any animal is balancing the necessities of foraging against the costs of detection by predators. Individuals consistently differ in their threshold of accepting predation risk versus resource gains - more risk-prone or 'bolder' individuals will spend more time foraging away from perceived cover, increasing their predation risk compared to more risk adverse or 'shyer' individuals. The trade-offs for these personality traits and the ultimate consequences for fitness (survival and reproductive success) are largely unexplored in the marsupial taxa. The northern quoll (Dasyurus hallucatus) population found on Groote Eylandt is one of the healthiest natural populations in Australia, yet little is known about the behaviour of these animals. We conducted giving-up density foraging trials on northern quolls from Groote Eylandt, NT to assess the bold-shy spectrum of individuals within this population. Foraging personality, metabolism, and growth rates were collected on the population over 2 years. These results will be presented here, with future investigations of their implications on survival and reproductive success to be undertaken. Understanding why some individuals are more risk-prone than others, and the consequences for the fitness of these individuals within a population is fundamental for future management of this endangered species.

Effects of habitat fragmentation on reproductive success of the endangered Conospermum undulatum (Proteaceae)

Mr Nicola Delnevo1, Prof William Stock1, Dr Eddie van Etten1
1Edith Cowan University, Perth, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 041 - Nicola Delnevo is a PhD candidate at ECU, Perth. After being focused on the effects of climate change on Arctic plants, he is now working on a challenging conservation project based on the ecology and genetics of an endemic species.

Anthropogenic loss and fragmentation of natural habitats has been increasing during the last 60 years and is now at unprecedented levels, making land use change one of the most important drivers affecting biodiversity. Conospermum undulatum is an endemic plant species of the Swan Coastal Plain, and the significant reduction in population size, connectivity and floral display of remnant patches are likely to constrain the reproduction of this species by altered plant-pollinator interactions and expression of inbreeding depression because of reduced gene flow between unrelated individuals. During 2017 flowering season we collected data from 210 individuals from 12 populations looking for differences in fruit and seed production, and seedling germination and mortality, among different populations. Results indicate that plant reproductive effort is not affected by any of the population variables. On the other hand, the proportion of seeds produced per inflorescence is positively and significantly related to population size, connectivity and floral display, indicating that habitat fragmentation is posing a threat to this endemic species. Interestingly, fruit production per inflorescence appears to be affected only by the population floral display, i.e. the potential of the population to attract pollinators. This result suggests that, besides pollen limitation, genetic factors that prevent the development of the embryo and result in empty fruits may be present in small and disconnected populations. The seed germination experiment is still running and will provide more insights into the reproductive success of the endemic Conospermum undulatum.
Race of the Northern Quoll & Black-footed Tree Rat

Loren Appleby, Emma Blacklock, Jo Davis, Renee Whitchurch, Miss Liz Fisher
1Eco Logical Australia, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 024 - Liz Fisher is an ecologist that works as a senior consultant at Eco Logical Australia. She has worked in the field of ecology as a consultant for over 10 years on large scale projects across Queensland.

The Northern Quoll (Dasyurus hallucatus) is an iconic species of Northern Australia that has undergone a significant decline in distribution. It is a species that has caught the attention of Sir David Attenborough, making it on the Attenborough Ark - top 10 endangered species to save. The Black-footed Tree Rat (Mesembriomys gouldii rattiodes) is also a recognised threatened species that has received recent media coverage after rediscoveries of populations thought to be wiped out across the Kimberley.

Whilst parts of Northern Australia remain a stronghold for both species, these remaining populations are still at risk to threatening processes and ongoing population decline. Further understanding of the species ecology, habitat requirements and responses to disturbance is therefore imperative to the conservation of the species.

This poster will present the results of baseline population surveys, including associated habitat composition and condition data of a population of Northern Quoll and Black-footed Tree Rat in an area on the Cape York Peninsular. This includes radio tracking results of both species, which provides insight into the species' denning and foraging habits. The results were found to be markedly different from each other - depicting the unique 'race' of survival for the Northern Quoll and Black-footed Tree Rat.

How the native and introduced dung beetles are faring along environmental gradients of NSW tablelands

Mr Min Raj Pokhrel, A/Prof Nigel Andrew, Dr Stuart Cairns
1The University of New England, Armidale, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 090 - The presenter is PhD scholar at UNE researching on biodiversity of introduced and native dung beetles and their adaptations to climate change. Mr Pokhrel is interested to resume his work on research/academics after completion of the degree.

Dung beetles are well known in Australia for controlling bush flies and livestock parasites along with efficient dung burial. To assess dung beetle assemblages along an altitudinal gradient, a seasonal dung beetle monitoring program was conducted in native and improved grassed paddocks at eight different locations along elevation gradients from 385 to 1357 masl in Northern NSW during the autumn, spring and summer seasons. Standard pitfall traps baited with cow, sheep and kangaroo dung were used to monitor the dung beetle assemblages. A total of 12,297 dung beetles and 23 different dung beetle species were collected: 8,951 (72.8 %) constituting 17 introduced species and 3,346 (27.2 %) constituting 6 native dung beetle species. The number of dung beetles trapped in cow dung bait was significantly higher (121.3±35.9 SE) than that in both sheep (105±29.6 SE) and kangaroo dung were used to monitor the dung beetle assemblages. A total of 12,297 dung beetles and 23 different dung beetle species were collected: 8,951 (72.8 %) constituting 17 introduced species and 3,346 (27.2 %) constituting 6 native dung beetle species. The number of dung beetles trapped in cow dung bait was significantly higher (121.3±35.9 SE) than that in both sheep (105±29.6 SE) and kangaroo dung baits (29.8± 8.72 SE). And in summer significantly higher (185.1±41.3 SE) dung beetles were attracted compared to that in spring (48.9±16.9 SE) and autumn (22.2±5.3 SE). Aphodius lividus (39.8 %) and Euoniticellus fulvus (10.8 %) were the most abundant introduced and Onthophagus australis (11.7 %) and Onthophagus granulatus (11.6 %) were the most abundant native species. The remaining 19 species comprised 26.1% of the total dung beetles. Community composition among seasons, elevations and
habitat shows how the introduced and native dung beetle species are structured. The higher species richness and abundance of introduced dung beetles elucidates their success in establishment and their potential in handling dung resources in the paddocks.

Using fire to shift the trajectory of a critically endangered wetland community: Fleurieu Swamps, SA

Mr Tim Vale¹, Ms Rebecca Duffield¹, Ms Lee Jeffery¹, Ms Tessa Roberts¹
¹CCSA, Adelaide, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 008 - Rebecca Duffield has been working in Fleurieu Swamps for nearly 20 years. Working closely with land managers she has developed guidelines for swamp restoration and explored the use of ecological burns to assist in restoring the Fleurieu Swamp ecological community.

The Fleurieu Swamps are critically endangered wetlands that persist as small disconnected patches within a modified landscape. The application of standard conservation practices can lead to a loss of biological diversity in these ecosystems. The vegetation community can shift from a dynamic and heterogeneous state to one dominated by a few competitive long-lived species.

A focus of this study is within Stipiturus Conservation Park, containing the critically endangered wetland community and many threatened flora and fauna species. Additional study sites occur on private property and have had different fire and grazing histories.

The use of ecological burns to shift homogenous and older age class vegetation to a dynamic and diverse community has been trialed. Similarly, the response to wildfire has also been monitored and evaluated. Initial work commenced 20 years ago and has been recently complemented by evaluating the response to a suite of prescribed burns and wildfire at different time periods.

A contentious issue for restoration practitioners, students and conservation managers is: ‘when is the best time to implement burns within Fleurieu Swamps?’ This study will provide initial results from both autumn and spring burns, and a combination of both at different times. Results suggest that the response of vegetation is co-determined by the dominant vegetation pre-burn and the physical setting. Repeat burns will result in quicker foliage but with fewer vegetation species.

This poster will deliver a précis of a) ecological disturbance work implemented b) results from monitoring c) technical and operational challenges, and d) future considerations

Photoperiod Sensitivity can explain delayed Flowering Time Advancement

Miss Karen Zeng¹
¹Unsw, Wentworth Point, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
POSTER 053 My name is Karen and I’m a honours student in the Big Ecology lab at UNSW. I like plants.

I examined the extent to which the presence of photoperiod sensitivity can predict whether a species does not advance their flowering time in response to climate change.
I looked at the phenological records of 56 species with known levels of photoperiod sensitivity from the literature between 1950 and 2016. I found that photoperiod insensitive species changed at a rate of 1.96 days per decade, significantly more than photoperiod sensitive species which changed only 1.15 days per decade (P < 0.001). I then tested whether photoperiod sensitivity could be predicted through phylogenetics or species traits. I found that photoperiod sensitivity was weakly phylogenetically conserved (D = 0.712). Finally, I found that a higher proportion of herbaceous species were photoperiod sensitive compared to woody species (χ² = 337.19, P < 0.001) and that a higher proportion of perennial species were photoperiod sensitive compared to annual species (χ² = 499.93, P < 0.001). These results provide the first empirical evidence that photoperiod sensitivity hinders flowering time advancement and explores ways in which we may predict it.

**Bulldozers, Backhoes and Chains: Ineffective regulation of environmental destruction in Australia**

*Ms Michelle Ward*¹

¹University Of Queensland, Diamond Valley, Australia

**POSTERS:** Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**

POSTER 009 Michelle has a Masters in Environmental Management and is now completing her Ph.D. at the University of Queensland. Her focus is on effective policy, action mapping for cumulative and interacting threats, understanding stewardship responsibilities, and prioritising management for threatened species.

Over the last 20 years, global forest loss has reached 129 million hectares. This substantial loss of habitat is contributing to desertification, the onset of a sixth mass extinction, the erosion of soil, increased salinity levels, changing global climatic systems and the reduction in vital ecosystem services upon which human lives depend. Despite decades of scientific research, numerous international treaties, national policies and sub-national tools, we continue to lose more than 7.6 million ha of forest per year. In Australia, we have many ways to mitigate this habitat loss, including the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999. The EPBC Act was hailed as a significant breakthrough in federal regulation of the environment. Since then, there have been 2047 approvals for destruction and 20 cases whereby companies or people have been fined for not seeking approval. This low figure is concerning due to the land clearing explosion in 2015-2016 under weakened state environmental policy. If the EPBC Act was in fact, effective, one would presume that either approved referrals or cases would be high during those years, not a mere 71 in total. There has been little quantitative assessment of the Act’s effectiveness of controlling significant environmental impacts. Using a combination of remote sensing techniques, we quantify and spatially locate the destruction of habitats for threatened species, threatened communities, and all other matters of national environmental significance. We then investigate the extent of unauthorised habitat destruction and identify the most impacted species within Australia over the last 20 years.
Adjusting ecological interactions to accelerate rainforest regeneration on former pasture: five years of Kickstart trials

Carla Catterall1, Kylie Freebody2, Amanda Freeman3, Luke Shoo4
1Griffith University, Nathan, Australia, 2Tablelands Regional Council, Malanda, Australia, 3School for Field Studie, Yungaburra, Australia, 4University of Queensland, Nathan, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 017 - Carla Catterall is Professor Emeritus in environmental sciences at Griffith University, Brisbane. For several decades her work has investigated forest clearing and restoration, and how to encourage a diverse wild flora and fauna to persist within landscapes used by people.

Retired grazing land provides significant opportunities for restoring rainforest cover, but natural regeneration is often limited by competition from pasture grasses, short lifespan and inadequate dispersal of most rainforest seeds, and predation by vertebrate herbivores. Kickstart trials were a five-year management experiment in catalysing regeneration processes on post-grazing tropical pasture. We used adaptively-timed repeat herbicide applications to suppress pasture growth, and studied the roles of scattered pasture trees, bird perches to attract seed dispersers, and herbivore exclosures. We monitored vegetation development, birds, initial seed rain beneath perches; and seedling recruitment and growth. After three years, rainforest-specialist bird species, including seed-dispersing frugivores, had started to use the emerging vegetation, and forest tree seeds had been deposited under perches. A range of native forest seedlings emerged, although browsing by native herbivores reduced seedling survival, especially near forest edges. Highest densities and diversity of both deposited seed and recruited forest seedlings occurred beneath pre-existing pasture trees. Away from them, most early recruits were non-native Solanum mauritianum, whose long-lived seeds accumulate in pasture, and whose rapid establishment was subsequently associated with increased recruitment of native forest seedlings. After five years most of the pasture grasses had been replaced by canopy-forming woody vegetation, compared with little change in matched control plots in ungrazed and grazed pasture. We conclude that suppressing pasture grasses could catalyse forest regeneration (especially if combined with tolerance of non-native pioneers), at about one-third the cost/ha of intensive tree-planting, although development was slower, and there was large spatial variability.

Indigenous Perspectives on Invasive Species Management

Ms Louise Gill1
1Griffith, Brisbane, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 048 - Louise Gill is currently completing a Bachelor of Science in Ecology and Conservation Biology at Griffith University, is part of the Riparian and Wetlands Lab, and will be completing Honours in 2019. Her research interest is in Environmental Anthropology.

Invasive species impact ecosystems all over the world, with many species thriving in their new conditions and outcompeting native species for resources. Peoples’ perspectives of invasive species can differ depending on their uses of the invasive species, and/or the ecosystem services they provide. Indigenous Peoples have lived with invasive species, and their knowledge and management strategies have adapted to cope with changing ecosystems through generations of cultural transmission. This systematic literature review examines Indigenous Peoples’ differing perceptions of exotic species. Primary peer reviewed research was selected using electronic databases, including all relevant literature. This initial research was then interrogated, producing a shortlist of papers relevant to the research questions. The shortlist was analysed according to the timing of publication, continent of
research, and the type of invasive species (fauna or flora). Through this analysis, it was found that Indigenous perspectives of invasive species changed depending on their modes of subsistence, specific uses of the invasive species, and aesthetic appeal of the species. Management of invasive species was most successful for Indigenous Peoples when their knowledge was taken into account by western scientists, and combining TEK with western knowledge provided better results. Gaps in the literature were found on a whole ecosystem level, as the majority of the papers reported on Indigenous Peoples perspectives on only a few individual species. Perceptions of novel and emerging ecosystems were not discussed in great depth. Further collaboration between TEK and western knowledge may provide more successful outcomes for ecosystem management practices in the Anthropocene.

Perennial streams as hubs for insectivorous bat activity across altered landscapes

Mr Bradley Clarke-wood1, Prof. Barbara Downes1, Prof. Mark Elgar2
1The School of Geography, The University of Melbourne, Parkville, Australia, 2The School of BioScience, The University of Melbourne, Parkville, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 014 - Bradley is a Ph.D. Candidate at the School of Geography, University of Melbourne. He has a broad interest in freshwater ecology and his current research area is resource exchange between perennial streams and riparian zones across agricultural gradients.

Land clearing and land-use for agriculture has reduced biodiversity the world over. Freshwater ecosystems such as perennial streams and their riparian counterparts are under particular stress due to the significant benefits they provide pastoralists. Insectivorous bats, as a highly diverse taxonomic group, depend heavily on these systems. Previous studies have identified inland waterways as important habitats for insectivorous bats and for some species, their distribution is determined by the availability of permanently flowing systems and the resources they provide. While recent research has identified complex community and in some cases, species-specific responses to anthropogenic alterations in vegetation structure of forests, few works have investigated how disturbance to freshwater and riparian ecosystems affect these insectivores. While clearing of riparian vegetation reduces the habitat potential of stream-riparian ecosystems by removing ‘hollow-bearing’ trees and reducing aquatic invertebrate emergence, the full impact of this has yet to be completely realised. In this study, we investigated the significant role of semi-arid perennial streams in subsidising insectivorous bat communities. We compared insectivorous bat and emergent aquatic invertebrate communities across an agricultural land-use gradient that incorporates potential longitudinal effects of streams. Specifically, we hypothesised that insectivorous bat community composition will lose clutter-tolerant species as riparian zones transition towards agricultural landscapes. Regardless of the intensity of agricultural land-use, we hypothesise also that perennial streams will be centres for insectivorous bat foraging activity.

Preserving Australia’s Ark - Safeguarding threatened species in the Dambimangari and Uunguu IPAs, North Kimberley

Annika Spiridis1, Dominika Ozies2, Cherylyn Ozies2, James Smith1, James Mansfield2, Ellie Boyle3
1Australian Wildlife Conservancy, Mornington Wildlife Sanctuary, Derby, Australia, 2Dambimangari Aboriginal Corporation, Derby, Australia, 3WWF-Australia, Ultimo, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 023 - Dominika Ozies and Cherylyn Ozies, rangers in the Dambimangari Ranger team, work on conservation programs to manage Dambimangari IPA.
Annika Spiridis is a Field ecologist for Australian Wildlife Conservancy working on projects to protect threatened species in the Kimberley Region.

The Wandjina-Woongudd homeland of the Kimberly region of W.A. is a national biodiversity hotspot, both for endemism and for critical weight range mammals, as the dramatic declines seen across the northern Australia for the majority of these species has not yet occurred. There are however some exceptions; the Brush-tailed Rabbit-rat is only known in W.A. from 2 small populations and the distribution of Golden Bandicoots (a once widespread species) and Nabarlek are unclear.

Inappropriate fire regimes, feral herbivores, predation by feral cats and the interactions between these threats have all been implicated as drivers of these declines. Controlling these threats has had demonstrable benefits for native wildlife across other areas of the Kimberley. In an effort to find further populations of these species, examine the threats limiting their distribution and modify our land management practices to benefit them, Indigenous Rangers are working with World Wildlife Fund and the Australian Wildlife Conservancy to survey and jointly manage the Dambimangari Indigenous Protected Area; an area of approximately 8,800 km².

The first surveys on the mainland and coastal islands have begun using remote sensor cameras, live trapping, scat collection and DNA analysis. Results from these surveys and preliminary implications will be presented.

This project is a collaboration between Dambimangari Aboriginal Corporation, Australian Wildlife Conservancy and World Wild Life Fund Australia.

It is supported by the Kimberley Ranger CWR mammal project, through funding from the Australian Government’s National Landcare Program and Lotterywest.

The Roots of Invasion: Belowground traits of native and non-native Australian grasses

**Erica Porter¹, Dr. Jennifer Firn¹, Dr. Susanne Schmidt², Dr. Amanda Rasmussen³, Dr. Anthony Clarke⁴

¹School of Earth, Environmental, and Biological Sciences, Queensland University Of Technology, Brisbane, Australia, ²School of Agricultural and Food Sciences, University of Queensland, Brisbane, Australia, ³School of Biosciences, University of Nottingham, Nottingham, United Kingdom.**

**POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM**

**Biography:**

Poster 063 - Erica Porter is currently a Master of Philosophy Candidate at Queensland University of Technology studying the belowground traits of Australian grasses and is broadly interested in plant ecosystem changes in light of anthropogenic interaction.

The mechanisms associated with the ability of non-native plant species to establish outside of their native range are still largely unknown across many environments. The low-nutrient grasslands of Australia are host to many non-native grasses from Africa that can have a detrimental impact ecologically and economically despite the fact that some of these grasses are still perceived as beneficial pasture grasses. Previous research suggests that these grasses may be better at nutrient use efficiency due to greater aboveground biomass. Nutrient use efficiency is directly linked to nutrient acquisition. This study examined several above and belowground traits of four African grasses introduced for pasture improvement with a similarly distributed native Australian congener to determine whether patterns expected aboveground hold true belowground and if these patterns suggest a greater capacity for nutrient use efficiency and nutrient uptake ability.

In our preliminary results, most belowground traits examined followed similar patterns as above suggesting that the non-native grasses may exhibit higher nutrient use efficiency and likely a higher rate
of nutrient acquisition. These results show a significant difference between natives and non-natives across multiple above and belowground traits. The most significant differences occurred in relation to the congener pairs Johnson Grass (Sorghum halepense) and Wild Sorghum (Sorghum leiocladum) as well as Rhodes Grass (Chloris gayana) and Windmill Grass (Chloris truncata). The clear differences found between native and non-native species in belowground traits suggest that these are important factors in understanding the mechanisms allowing some species to establish outside of their native range.

Quantifying and categorising the environmental impacts of alien birds

**Mr Thomas Evans**

1University College London, London, United Kingdom

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**

Poster 056 - Thomas Evans is currently undertaking a PhD at University College London (UCL). His research focuses on the identification and management of impacts associated with invasive alien species.

Despite the increasing numbers of alien species, and the damage they can cause, we lack comparable data on their impacts to allow us to determine the causes and consequences for different invasions, and the species we should worry about and why. Thus, an urgent challenge for invasion science is to develop measures to quantify and categorise the impacts of alien species.

The Environmental Impact Classification for Alien Taxa (EICAT) can be used to categorise alien species by the severity and type of their impacts. It will shortly be adopted by the IUCN, which aims to publish EICAT assessments for all known alien species world-wide by 2020. In this presentation, I will provide an overview of a recent set of studies that applied EICAT to quantify and categorise the environmental impacts of all alien bird species world-wide. I will show how this work has improved our understanding of the severity and type of impacts generated by different orders of alien birds, and of the factors that influence whether we have impact data for alien bird species, the severity of their impacts, and the spatial distribution of alien bird impacts.

Using large-scale ecological data to support taxonomic decisions in difficult species complexes in Ptilotus (Amaranthaceae)

**Timothy Hammer**

1School of Biological Sciences, The University Of Western Australia, Crawley, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

**Biography:**

Poster 071 - Tim Hammer is a PhD candidate and Forrest Scholar at the School of Biological Sciences, the University of Western Australia. He is studying the molecular phylogenetics, taxonomy, historical biogeography and ecological adaptations of the Australian genus Ptilotus (Amaranthaceae).

Ecological traits provide many characters that are not, or are only informally, evaluated in traditional taxonomy. Such traits may provide supporting evidence for lineage separation, particularly among closely related taxa, and help elucidate the role of natural selection on their populations and evolution. Ptilotus (Amaranthaceae) is a plant genus of ~120 species endemic to and distributed throughout Australia, with the centre of diversity in arid Western Australia. The genus is thought to have diverged from its closest relatives, distributed from Africa to S. Asia, after reaching Australia in the early Miocene, after which it underwent rapid adaptive radiation. Within Ptilotus are a series of species complexes that for many years have been difficult to resolve, leading to taxonomic instability and a history of 'splitting' and 'lumping'. Morphological taxonomic concepts of two such species complexes within Ptilotus were tested by using georeferenced specimen datasets from the Australasian Virtual Herbarium, coupled with
high-resolution environmental layers, and analysed with Maxent and CART modelling. In both cases, putative taxa delimited by morphological characters were found to have strong geographical and environmental partitioning, lending support to their recognition as separate species and providing examples of the reciprocity of ecology and morphology and the importance of ecological data in modern taxonomy. With the increasing availability of large, aggregated, online, georeferenced specimen datasets coupled with high-resolution environmental layers (e.g. those available on the Atlas of Living Australia), we expect the formal integration of ecology and morphology in taxonomic studies to become more common.

Pastures and Climate Extremes: the PACE of change in Australia’s pasture grasslands

Mrs. Kathryn Fuller¹, Dr. Sally Power¹
¹Western Sydney University, Richmond, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 099 - Kathryn Fuller is the Technical Officer for the Pastures and Climate Extremes project. She is from the United States where she was awarded a Masters degree in Biological Sciences from Auburn University and studied Environmental Biology as an undergraduate.

The livestock and dairy industries in Australia generate billions of dollars annually, supported by Australia’s vast areas of managed pastures and extensive grasslands. The well-established, strong relationship between climatic conditions and grassland species’ performance indicates that these environments are likely to be particularly sensitive to climate change. With climate models predicting increased frequency and severity of heatwaves and altered amounts and seasonality of rainfall, a clear understanding of grassland species’ responses to future, more extreme climates is essential for the sustainability of Australia’s prodigious livestock and dairy industries. The Pastures and Climate Extremes (PACE) project has been established to address industry concerns and scientific questions regarding the resistance and resilience of key grassland species to future climate scenarios. Ten species – including native and introduced grasses and legumes – are being exposed to elevated temperatures and reduced winter and spring rainfall in a novel field facility in Richmond, NSW. Research questions focus on the phenological, morphological and physiological mechanisms driving plant responses to more extreme temperatures and seasonal drought. Observations made using this approach will serve to increase the power of predictive models used to evaluate potential impacts of climate-driven stresses on pastures and grasslands in Australia and beyond.

Eating insects for the environment: yay or nay?

Dr Rocio Ponce-Reyes¹, Dr Rene Cerritos-Flores²
¹CSIRO, Brisbane, Australia, ²Facultad de Medicina, UNAM , Mexico

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 082 - Rocio is a research scientist with the Conservation Decisions Team -CSIRO. She is passionate about biodiversity conservation, from climate change impact on ecosystems distribution to prioritization of threat management and most recently in how eating insects can help saving biodiversity.

Protein is a critical macronutrient essential to health. Existing animal protein sources have high environmental impact: land clearing for agriculture and grazing threatens numerous species with extinction. Additionally many health issues arise from food overconsumption and poor diet. New foods that provide good nutrition are increasingly important.
Food web productivity and energy transfer varies with structural complexity in seagrass meadows

Ms Kristin Jinks1, Prof Rod Connolly1, Dr Chris Brown2, Dr Paul York3, Ms Abigail Scott3, Prof Marcus Sheaves4, Dr Michael Rasheed3

1Griffith University, Southport, Australia, 2Griffith University, Nathan, Australia, 3James Cook University, Cairns, Australia, 4James Cook University, Townsville, Australia

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Post 084 - Kristin is investigating factors that structure food webs (with a strong focus on seagrass habitats), how these factors relate to the ecological theory surrounding food webs, and the potential impacts on fisheries production.

The Great Barrier Reef World Heritage Area (GBR) contains around 35,000 km2 of seagrass, accounting for 10% of the GBR. Within the GBR, urban and industrial development poses one of the biggest threats to seagrasses. The fifteen seagrass species occurring in the GBR provide widely varying structural habitat for animals. Productivity and transfer of energy within these habitats are therefore likely to differ and we need to understand how these food webs might differ to decide where protection is needed most urgently. Key ecological theories about size spectrum and dietary contribution from basal sources assist in understanding the transfer of energy and productivity within food webs. Research from coral reefs and terrestrial environments show that food webs vary with structural complexity of a habitat, yet we know little about how structural complexity relates to food webs within seagrass meadows. We measured the biomass of invertebrates and fish, and their carbon, nitrogen and sulfur stable isotopes, to determine food web structure in 9 meadows across ~ 1000 km of the GBR coastline. The meadows represented five species in three genera, covering a range of structurally different seagrass types. We found that animal size spectra varied greatly among the meadows, indicating that some seagrass food webs rely on external subsidies. We also found that basal sources driving these food webs also differed with structural complexity, further supporting the theory about subsidised food webs. Our results are the first of their kind that address differences in productivity and energy transfer in seagrass.
Of turfs and trees: does moss trap more particulate matter than trees on urban roadsides?

Ms Alison Haynes¹, Dr Robert Popek², Senior Professor Sharon Robinson¹, Professor Kristine French¹

¹University Of Wollongong, Wollongong, Australia, ²Institute of Dendrology, Polish Academy of Sciences, Poland

POSTERS: Barbara Rice Memorial Poster Session, November 26, 2018, 6:00 PM - 7:30 PM

Biography:
Poster 104 - Alison Haynes is a second career scientist who took a degree in conservation biology after working in publishing. Her Honours was in conservation genetics, while her PhD is in plant stress physiology and ecology, with a focus on urban moss.

Urban air quality has impacts on plant and animal biodiversity as well as human health. One form of air pollution, particulate matter (pm), consists of minute solid and liquid particles that may increase plant stress as well as cause disease such as cancers in humans. Removal of pm by phytoremediation relies on plants' ability to trap pm on their leaves. This study compared accumulation of pm by roadside mosses with that of a local native tree, Pittosporum undulatum, to compare pm amounts and sizes as well as photosynthetic efficiency with degree of urbanisation. We collected moss turfs and leaves at nine sites in Wollongong, NSW, with three urban levels: high, medium and low. Pm was isolated in three sizes (10-100um; 2.5-10um; 0.2-2.5 um) by washing and filtration. Chlorophyll fluorescence measurements were taken, both in the field and after dark adaptation in the lab. Moss turfs trapped pm in increasing amounts with urbanisation, from total pm of 33.48mg per g dry weight in a highly industrialised area, to 5.60mg per g dry weight on a quiet road. Compared to the tree, moss pm amount was more closely coupled with urban level. Moss turfs also showed clear trends with increased urbanisation of greater wax deposition and decreased photosynthetic efficiency. This study raises the hypothesis that pm interferes with photosynthesis in urban moss and that wax deposition is a defence mechanism for moss in the urban environment. The role of moss in phytoremediation in the urban environment warrants further investigation.

Applied Forest Ecology Award Presentation

Ms Ana Bermudez

Presentation of the 2018 Applied Forest Ecology Award, Hall B, November 28, 2018, 9:50 AM - 10:05 AM

Efforts placed in active restoration have been increasing as a response to the high degradation caused on riparian ecosystems by anthropogenic impacts. In this context revegetation has been particularly important. However at some sites, revegetation has had limited success for reasons that cannot be attributed to poor plant material or site management, but, could be related to the role of soil biota. Soil mycorrhizal fungi enhance seedling establishment and plant growth as they provide plants with nutrients, water and other benefits in exchange for plant photosynthates. Transplanting nursery-grown stock may limit a plant’s ability to connect to the local soil mycorrhizal network, which could account for poor rates of plant establishment. In this study I compared the mycorrhizal community abundance and composition of tube-stock transplanted, direct seeded and naturally occurring established plants to answer the question: Can patterns in fungal communities explain revegetation success rates? The fungal communities found in the roots of tube-stock transplanted plants differed in species richness, diversity and composition when compared to the roots of naturally occurring plants; the former having the less diverse community and the lowest number for species richness. Findings point out towards a difference in the connection established with the local mycorrhizal network for the seeded plants where composition appears to be more closely related to the fungal community composition in naturally occurring plants. Thus, this research highlights the potential role of a more immediate and direct contact with the common mycorrhizal network for successful plant establishment in a restoration context.
Facilitating the use of Australian terrestrial ecological data: TERN and its Data Skills Development Program

Dr Bernardo Blanco-Martín1, Mr Biswajit Bala1, Mr Mosheh Eliyahu1, Mr Peter Isaac1, Mr Ravi Murukuti1, Mr Tom Saleeba1, Ms Tina Schroeder1, Mr Alvin Sebastian1, Mr Yi Sun1, Mr David Turner1, Dr Beryl Morris1, Dr Siddeswara Guru1

1Terrestrial Ecosystem Research Network (TERN), University of Queensland, St Lucia, Brisbane, Australia

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

Biography:
Currently, I am the Data Skills Development Officer at Terrestrial Ecosystem Research Network (TERN). Previously my research has dealt with aspects of the macro-ecology, biogeography, and macro-evolution of tropical reef corals and fishes.

The new millennium has brought an unprecedented volume and variety of ecological data at increasing velocity, largely due to significant investment in data collection by national and international research infrastructure initiatives. Open access to these data has created significant new opportunities for ecosystem science research. Since 2009, the Terrestrial Ecosystem Research Network (TERN) has: (1) collected, collated and integrated ecosystem data across broad spatial and temporal scales; and (2) build data infrastructure to store, archive, discover, access and analyze a broad spectrum of terrestrial ecosystems data.

However, often the skills required for practical use of a wide variety of data collections with different access methods, data descriptions and file formats limit the potential use of these data-sets. This, in turn, can hinder research progress and success in data-driven policy making. TERN strongly supports the “Collect Once, Use Many Times” paradigm, but it is aware that for this maxim to be accomplished for its data, many nontrivial skills are required from its users. Consequently, and after a consistent message from the community, TERN has embarked on the implementation of a Data Skills Development Program (DSDP). The DSDP aim is to facilitate the discovery, acquisition, understanding, integration and re-use of TERN’s data by its users. The DSDP will include online tutorials, lecture material for academia, and hands-on workshops on all TERN’s major data streams. The presentation will describe TERN’s DSDP in detail, including its vision, framework, conceptual model, current and future developments, and some examples of the work completed so far.

Why Near-Term Ecological Forecasting?

Professor Belinda Medlyn1, Dr Linda Beaumont2, Prof David Tissue3, A/Prof Brendan Choat1, Dr Chris Blackman1, Dr Martin De Kauwe3

1Western Sydney University, Penrith, Australia, 2Macquarie University, North Ryde, Australia, 3UNSW, Kensington, Australia

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

Biography:
Belinda Medlyn is an ecosystem modeller working to develop process-based models of forest and grassland responses to climate change. She works closely with experimental scientists studying elevated CO2, drought and warming to ensure a strong evidence base for models.

I started my scientific career attempting to predict the effects of a doubling of atmospheric CO2 on forest function, from 350 to 700 ppm. Whilst a challenging topic, it was also, to some extent, a safe one; my predictions would not be tested in my scientific lifetime. In restricting myself to untestable
predictions, I was in good company. Many ecologists have been wary of making forecasts because they’re likely to be badly wrong.

However, we should not be concerned about making incorrect forecasts. Getting forecasts wrong is an essential step towards developing the scientific understanding and technology needed to get forecasts, if not right, at least useful. Numerical weather prediction, for example, has made huge gains in recent decades, moving from being the butt of many jokes to being an essential and life-saving service, thanks to a repeated forecast / learning cycle.

Furthermore, the need for ecological forecasts on a testable timescale (days – years) is now becoming urgent. Climate change is no longer a thing of the future; it is happening all around us, and we now face a race against time to forecast the nature and speed of the changes we are likely to see.

In this talk I will discuss the changes in scientific practice needed to move towards short-term ecological forecasting, using our group’s attempts to forecast drought-related tree mortality as an example.

Evaluating the performance of biodiversity indicators with ecosystem models

**Dr Kate Watermeyer¹, Dr Emily Nicholson¹, Dr Beth Fulton², Dr Ben Collen³**

¹Deakin University, Burwood, Australia, ²CSIRO, Hobart, Australia, ³UCL, UK

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

**Biography:**
Emily Nicholson is a senior lecturer at Deakin University Melbourne. Her group undertakes research in conservation science, including ecosystem modelling and risk assessment, evaluating biodiversity indicators, ecosystem services and conservation planning.

https://conservationscience.org.au/

Biodiversity indicators provide vital information on the changing state of nature, and are used to measure progress towards global biodiversity targets, guide policy, and inform management interventions. Of the suite of indicators designated for such a role, few have been subjected to scrutiny on their ability to represent trends of interest, particularly in guiding policy choices. Here we combine model predictions of the impact of two broad fisheries policies to assess the performance of three biodiversity indicators in evaluating changes in multiple marine ecosystems. The three indicators, the Red List Index, the Living Planet Index and the Marine Trophic Index, are used to monitor progress towards the Aichi Targets of the Convention on Biological Diversity. We find that data bias in the indicators can compromise their ability to track change reliably. For example, taxonomic bias can have substantial effects on the Red List Index and Living Planet Index, although this varies by region. The Marine Trophic Index is rendered unreliable due its dependence on catch or landings, as found by previous studies. To better guide policy choices, we recommend indicators are designed specifically to inform environmental management, in particular by examining impacts of data gaps and biases, and how systematic and structural biases can be overcome. With these modifications, indicators have the potential to tell us how we can best conserve biodiversity, not simply that we are failing to do so.
Forecasting forest flammability

**Dr Matthias Boer**¹², Dr Víctor Resco De Dios³, Dr Rachael Nolan¹², Dr Francesca Di Guiseppe⁴, Dr Hamish Clarke¹²⁵, Prof Ross Bradstock¹²

¹Hawkesbury Institute for the Environment, Western Sydney University, Richmond, Australia, ²NSW Bushfire Risk Management Research Hub, , , ³Department of Crop and Forest Sciences, AGROTECNIO Center, Universitat de Lleida, Lleida, Spain, ⁴Forecast Department, European Centre for Medium Range Weather Forecasting, Reading, United Kingdom, ⁵Centre for Environmental Risk Management of Bushfire, University of Wollongong, Wollongong, Australia

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

**Biography:**

Matthias' research interests focus on the biophysical processes and relationships underlying continental fire regimes, and on the landscape ecology and management of fire-prone environments.

Most forests are inherently flammable and can burn whenever the fine dead surface fuels dry out to ignitable levels, which has been shown to only take a few weeks of dry warm weather conditions in Southeast Australian eucalypt forests. At the landscape scale, potential for large fires strongly increases with the spatial connectivity of dry fuel areas. Early warning of where and when forested landscapes are primed for catastrophic fire therefore requires: (1) reliable, spatially continuous predictions of daily variation in fine dead fuel moisture content, and (2) objective identification of critical fuel moisture thresholds for major landscape fire events.

We have previously developed a physically-based model for prediction of fine dead fuel moisture from gridded daily vapour pressure deficit data plus an objective methodology for the identification of critical fuel moisture thresholds from historical fire and weather records. Combining these two components with medium range weather forecasts opens the way for forecasting forest flammability at operationally significant resolutions over large territories. We demonstrate the potential of this approach with examples from Southeast Australia and Mediterranean Europe.

Medium range forecasts of where and when forested landscapes are approaching critical fuel moisture thresholds could help fire management and emergency agencies to more strategically deploy resources to high risk areas and prepare for potential evacuations or other risk mitigation measures.

Understanding the past to predict the future: synergism of climate and land-use on landscape connectivity

**Dr Mirela Tulbure**¹

¹University Of New South Wales, 2052, Australia

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

**Biography:**

Mirela is a Senior Lecturer in Geospatial Science and Remote Sensing of Environment at the University of New South Wales. You can find her on-line athttp://www.mirela-tulbure.com/

Understanding the past to predict the future: the impact of climate and land-use on landscape connectivity and surface water dynamics

Climate and land-use change act synergistically to affect surface-water dynamics and landscape connectivity, important for species persistence in dynamic dryland environments. Remotely-sensed time series and other geospatial data represent a promising and increasingly available resource for quantifying and disentangling ‘natural’ system dynamics vs. climate and land-use change in a spatially explicit and temporally dynamic way. Focusing on an ecologically relevant and internationally important
dryland area, Australia’s Murray-Darling Basin, in this talk I will present results (1) quantifying the impact of hydro-climatic drivers and historical land-use on surface water dynamics (2) assessing how changing hydroclimatic variability and land use change affected available habitat and opportunity for movement of aquatic organisms between surface water habitats (based on the combined use of graph theory network analysis with Landsat-derived, seasonally continuous 25-year surface-water time-series and circuit theory to assign landscape features with ‘resistance’ costs that indicate their resistance to ecological movement), and (3) highlighting current efforts to model future landscape connectivity as the synergistic effect of future land-use scenarios and global climate model-predicted rainfall.

Big Data in Australian research: Issues, challenges and opportunities

**Associate Professor Jane Elith¹**

¹The University Of Melbourne, Melbourne, Australia

Quantitative Ecology Showcase - future of quantitative ecology in Australia, Meeting Room 7, November 29, 2018, 3:30 PM - 5:30 PM

**Biography:**

Jane specialises in species distribution models. She has tested methods and explored their uncertainties, helped to develop and extend methods appropriate for typical data types, and worked on a broad range of practical applications.

I am part of an ARC “Learned academies” project on Big Data in Australian Research (https://www.science.org.au/support/analysis/decadal-plans-science/big-data-australian-research-issues-challenges-and). I will briefly describe the project, then hope to gather insights and ideas from you on issues, challenges and opportunities regarding current and future use of big data in ecology. We want to think over the horizon about what might be possible and what is needed to achieve our aspirations. I’ll have a clear structure to make best use of the minutes available. I’m hoping that with a room full of quantitative people, we’ll be able to generate good insights and vision for big data in Australian ecology that will serve us well into the future. If you can’t come to the session but are keen to contribute, please email me.

Cyclic coexistence dynamics: the potential for coexistence when plant population dynamics vary through time

**Professor Margie Mayfield¹, Associate Professor Daniel Stouffer²**

¹The University of Queensland, St. Lucia, Australia, ²The University of Canterbury, Christchurch, New Zealand

Quantitative Ecology Showcase – modelling global biodiversity patterns and dynamics, Meeting Room 7, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**

Prof. Mayfield is a plant community ecologist. She is interested in understanding how environmental heterogeneity and change drive patterns of diversity. She studies plant-plant interactions, coexistence dynamics and the impacts of global change on plant and animal communities.

Coexistence dynamics among plants are usually modeled under the assumption of fixed-point population dynamics. Many plant species are known, however, to have cyclic population dynamics through time or space. Thus, determining whether and how stable coexistence can occur between species that do not have fixed point population dynamics is important for understanding community diversity in the natural world. Though well-studied in predator-prey systems, the importance of cyclic population dynamics have been less well-studied in competitive systems. I will explore the potential for density-dependent, cyclic population dynamics to drive stable coexistence using an annual plant population model. I will show how density-dependent population cycles impact mutual invasibility and stable coexistence between pairs of four annual plant species that commonly co-occur in SW Western...
Australia. Results from our empirically-parameterized model suggest that monocultures of all four focal species can have cyclic solutions with periodicity greater than 1. These cyclic patterns can drive variation in annual abundance patterns, and result in a number of stable solutions for persistent monocultures and invasibility. We found evidence for mutual invasibility in the face of cyclic population dynamics for one species pair, a result that indicates that cyclic population dynamics can drive stable coexistence. Results further suggest that cyclic population dynamics may be common and important for coexistence in some communities. In such cases, the exploration of stable coexistence should include consideration of cyclic as well as fixed-point equilibria for maximal accuracy.

Guidelines for incorporating population processes in species distribution modelling

Dr Matthew Holden1, Dr Natalie Briscoe2, Dr Gurutzeta Guillera-Arroita2, José Lahoz-Monfort2, Dr Roberto Salguero-Gómez3, A/Prof Peter Vesk2, Dr Jian Yen2
1University of Queensland, St Lucia, Australia, 2University of Melbourne, Melbourne, Australia, 3University of Oxford, Oxford, United Kingdom

Quantitative Ecology Showcase – modelling global biodiversity patterns and dynamics, Meeting Room 7, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Holden is a research fellow and lecturer at the Centre for Applications in Natural Resource Mathematics. He specializes in dynamic modelling and optimisation to improve ecological theory and conservation decisions.

Information on how vital rates (e.g. survival, growth, and reproduction) of a species varies through space may improve projections of species distributions into the future. Unfortunately, we show that newly developed methods for doing this, demographic distribution models (DDMs), do not always improve predictions over standard correlative species distribution models (SDMs). DDMs are built using demographic data, measured in the field, and link environmental variables to long-term population growth rate, $\lambda$, through effects on vital rates. Species are assumed to be present at sites if their long-term population growth rates are greater than or equal to one, and absent elsewhere. We show that predictions from DDMs can be especially inaccurate if data comes from locations where the population is abundant, an aspect that is characteristic of most demographic surveys. The problem is that density dependence causes computed $\lambda$ to be near or below one when population density is high. Therefore, DDMs can over predict absences if the species experiences density-dependent growth, reproduction, or survival. Using a combination of simulations and a simple analytic approximation, we provide a rule of thumb for the critical population density after which density dependence starts to interfere with accurate spatial projections of species occurrence. The formula for this critical density can be used as a guideline for when to use linear DDMs in a density-dependent world.
Entropy unifies molecules and ecosystems, for monitoring and forecasting diversity

Professor William (Bill) Sherwin1
1UNSW Sydney, Sydney, Australia

Biography:
Sherwin has devised new approaches to forecasting and measuring biodiversity, at all levels from molecules to ecosystems, which is underpinned by molecular work on endangered, pest, and harvested wildlife in his lab and taken up by others.

At all scales from molecules to ecosystems, we measure biodiversity to indicate outcomes of natural or artificial processes, to compare with forecasts under various management schemes. Every biodiversity level has four basic processes – dispersal, adaptation, random change, and generation of novel variants (eg, ecosystems, species, alleles) – so approaches are often strikingly similar.

How can we exploit this similarity? Entropy is an obvious choice, being a general forecasting and measurement tool throughout science. It is also a simple transform of many common biodiversity measures, which are based on: Richness; Gini-Simpson; and Shannon. Macroecologists use Shannon for measurement (more than Simpson), and for forecasts use ‘maximum (Shannon) entropy’ and Simpson. In contrast, molecular ecologists have many measures and forecasts for richness and Simpson (heterozygosity, Fst etc), but have only recently begun to measure and forecast molecular Shannon diversity within and between areas (Sherwin et al 2017). Examples and simulations show that Shannon approaches outperform others in some tasks, such as genetic estimates of dispersal for input to metapopulation models, and tracing rangeshift or invasion.

Thus the stage is set to unify our monitoring and forecasting of these four processes that are common across all biodiversity levels, using a complete diversity profile that encompasses richness, Shannon and Simpson. This will integrate well with the many entropic methods in chemico-physical studies.

The role for mechanistic biodiversity models in informing conservation decisions

Dr Karel Mokany1
1CSIRO, Canberra, Australia

Biography:
My research focuses on developing and applying new macroecological modelling techniques to improve our understanding of current patterns of diversity, and how these are likely to change into the future, under alternative scenarios of management and environmental change.

Mechanistic models of biodiversity dynamics have advanced dramatically over the past decade, enhancing our capacity to explicitly incorporate key ecological processes in projecting biodiversity outcomes. Despite the improved predictive capacity these mechanistic models enable, many biodiversity policy, planning and management decisions still rely on information from simple statistical models or rules-of-thumb. To chart a path for increased utilisation of mechanistic biodiversity models in conservation decision making, I provide a snapshot of the current state-of-play in mechanistic biodiversity models, and how these are being used to inform conservation decisions. As a case-study, I
then focus on the development and application of the M-SET metacommunity model, which incorporates dispersal, niche-based community assembly, physiological tolerances and genetic adaptation in projecting outcomes for all species in a taxonomic group (thousands of species) at fine resolution across large regions. Drawing from applications of M-SET in Tasmania and the Wet Tropics, I highlight the potential importance of accounting for ecological processes in determining the likely consequences of management actions on biodiversity. Finally, I propose five key steps to advance the broader use of mechanistic biodiversity models in decision making, including model development, refinement, validation, demonstration and communication.

Macroecology of community structure in the marine biosphere

Professor Sean Connolly1,2, Professor Terry Hughes2, Professor David Bellwood1,2, Dr Hugh Sweatman3, Mr Cheng-Han Tsai1

1College of Science and Engineering, James Cook University, Townsville, Australia, 2ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia, 3Australian Institute of Marine Science, Townsville, Australia

Quantitative Ecology Showcase – modelling global biodiversity patterns and dynamics, Meeting Room 7, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Sean Connolly is Professor of Marine Biology at James Cook University and Program Leader in the ARC Centre of Excellence for Coral Reef Studies. He combines theoretical and statistical modelling with empirical work to understand marine biodiversity.

Abundance patterns in ecological communities have important implications for biodiversity maintenance and ecosystem functioning. However, ecological theory has been largely unsuccessful at capturing multiple macroecological abundance patterns simultaneously. In this talk, we present two parsimonious models to capture spatial and temporal structure in the patterns of commonness and rarity among species, and apply them to understand the structure of coral reef metacommunities. We test the spatial model against reef fish and reef-building coral abundance data from a 10,000-km transect across the Indo-Pacific. This model simultaneously captures extremely well local species abundance distributions, inter-specific variation in the strength of spatial aggregation, patterns of community similarity, and regional species richness, performing far better than alternative models proposed in previous work on coral reefs. We then turn to temporal dynamics, using a model of stochastic community dynamics that can be used to partition the variance in species abundances into “niche” and “neutral” components. By applying this to a highly replicated time series of reef fish community data, we identify strong links between volatility in coral cover and the degree of niche structuring in fish assemblages.

We need to talk about ecosystem models

Associate Professor Michael Bode1

1Queensland University Of Technology, Brisbane, Australia

Quantitative Ecology Showcase – modelling global biodiversity patterns and dynamics, Meeting Room 7, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
I am a mathematical ecologist with a focus on ecological decision theory and coral reef ecology.

Ecosystem models are important elements of ecological theory, and they are used to sustainably manage valuable natural resources and to predict the ecosystem-wide consequences of eradicating invasive species or translocating threatened species. They are the mathematical manifestation of Ecosystem-Based Management – quantitative models of entire ecosystems, which recognise the full
suite of species and interactions that make ecology so interesting, and ecological management so
difficult.

Ecosystem models are generally based on dynamical systems theory, constructed from first ecological
principles (e.g., who eats who), and then parameterised using a combination of empirical data,
allometric assumptions, and expert judgement. The resulting models look sophisticated, make specific
and detailed predictions, and exhibit complex and surprising behaviour and variation. They are also
wrong, and worse, they are not useful. Using quantitative analyses and a set of case-studies from
applied ecology, I will demonstrate that ecosystem models cannot answer the applied ecological
problems that they are commonly used to solve. More importantly, I will explain why this flaw is
fundamental to the models themselves, and why it therefore cannot be solved by better analyses or
additional research and data. These limitations cast a shadow on our current application of ecosystem
models to answer questions in ecological theory and management, and demand a set of new
approaches and techniques to understand the dynamics and future of ecological systems.

A robust species richness estimator

Dr John Alroy1

1Macquarie University, Macquarie University, Australia

Quantitative Ecology Showcase – modelling global biodiversity patterns and dynamics, Meeting Room 7,
November 28, 2018, 11:00 AM - 1:00 PM

Biography:

John Alroy is interested in large-scale patterns of biodiversity and extinction, and the processes that
govern them. He currently focuses on a compilation of ecological inventories called the Ecological Register.
His most recent work focuses on species richness estimation.

Estimating the number of species in a community by extrapolation remains a hard problem, and it has
not been solved by equations such as the first- and second-order jackknife (which are sometimes
upward biased) or Chao 1 (which is downward biased when abundance distributions are uneven). Here I
introduce a new richness extrapolator called squares. Unlike anything else, it considers the sum of
squares of abundances in addition to the number of species and the number of species sampled once
(the singletons). Simulations and direct computations show that squares always yields a lower bound
estimate when distributions are Poisson log-normal or uniform. The Poisson log-normal is important
because other distributions are highly unrealistic (geometric series, broken stick), do not have defined
species richness parameters (log series, Zipf), or are similar to the log-normal (double geometric).
Squares estimates are lower than those yielded by Chao 1, but not that low, when distributions are
highly even and poorly sampled. Otherwise, squares consistently yields similar or higher estimates. This
difference is particularly marked for highly uneven distributions that are still realistic. Squares also yields
consistently higher estimates when applied to empirical samples for trees and many animal groups
drawn from the Ecological Register. Furthermore, squares asymptotes more quickly as the number of
individuals drawn from a sample increases. In other words, the method tends to yield stable and high
estimates even when samples are small. Higher is better when dealing with a lower-bound estimator, so
squares should be favoured over Chao 1.
Using all available data to predict population and community dynamics

Dr Jian Yen1, Mr Zeb Tonkin2, Dr Jarod Lyon2, Mr Adrian Kitchingman2, A/Prof Peter Vesk1
1The University Of Melbourne, Parkville, Australia, 2Arthur Rylah Institute for Environmental Research, Melbourne, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Jian Yen is a McKenzie Fellow at The University of Melbourne. His research focuses on developing statistical methods for available data rather than idealised data. This includes working with incomplete data and with emerging data types.

Accurate predictions of population and community dynamics are critical to the management of natural resources and can be used to inform sustainable harvest policies, to control invasive species, and to guide conservation actions for threatened species. However, accurate predictions of population dynamics require extensive data, which are not always available. Recent statistical methods overcome data shortages by piecing together diverse data types in a single, “integrated” analysis. Integrated models make full use of available data and link different data types directly to the underlying ecological processes. We developed an integrated model to estimate size-dependent survival and fecundity of Murray cod (Maccullochella peelii) from a combination of size-abundance data, mark-recapture data, and individual growth trajectories. We used Hamiltonian Monte Carlo, implemented in the greta R package, to generate fully Bayesian parameter estimates, typically assumed to be computationally prohibitive in large integrated models. The integrated model fitted observed size-abundance data closely and generated plausible estimates of vital rates, including fecundity estimates very similar to existing estimates in the literature. Our integrated modelling approach could be used to predict future size-abundance distributions and could be extended to include information on local environmental conditions, individual movement, and interspecific interactions.

Weighing the costs and benefits of small versus big data for monitoring ecological change

Dr Ayesha Tulloch1,4, Dr Nathalie Pettorelli3, Assoc. Prof James Watson4, Dr Iadine Chades2
1University of Sydney, Sydney, Australia, 2CSIRO, Brisbane, Australia, 3Zoological Society of London, London, United Kingdom, 4University of Queensland, Brisbane, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Ayesha Tulloch is an applied ecologist and ARC DECRA Fellow at the University of Sydney. Ayesha works with NGOs, academia and governments to develop solutions to conservation problems such as threatened species monitoring, ecosystem condition assessment and management prioritisation.

In ecology, population sizes and detectability are often too low to create big data sets. In these cases, we often resort to surrogate information that is cheaper or easier to collect. Earth observation data are one such source providing big data to inform ecological and management questions. Satellite-derived maps of environmental dynamics help track ecosystem change over time – and this monitoring can be used to inform management decisions as well as progress towards national and international biodiversity goals such as the Aichi Targets. However, big data are not a panacea to all management and monitoring problems. We explore for an Australian case study how small and big data inform different goals linked to Aichi Biodiversity Targets, such as preventing species extinctions (Target 12), or reducing loss of natural habitats and degradation (Target 5). Managers and governments must make decisions about how to invest in monitoring of ecosystems and recovery actions, which must account for
availability and accessibility of existing data, its reliability and surrogacy, as well as the costs of collecting new data. Readily available satellite data on the extent of natural habitats has high return on investment for assessing progress towards Aichi Target 5, but low benefits for informing on the conservation status of threatened species, which is best-informed by trends in species’ populations over time. We show how governments and land management agencies tasked with tracking environmental change can calculate costs and benefits of data collation and collection to ensure investment in informative, efficient monitoring programs.

Virtual Reef Diver: Integrating data from multiple sources to monitor the Great Barrier Reef

Dr Erin Peterson¹, Dr Edgar Santos-Fernandez¹, Dr Julie Vercelloni³, Mr Alan Pearse¹, Dr Ross Brown¹, Dr Jennifer Loder⁴, Dr Manuel Gonzales-Rivero⁵, Dr Chris Roelfsema³, Dr Julian Caley⁵, Dr Ken Anthony², D. Prof Kerrie Mengersen¹

¹Queensland University Of Technology, Brisbane, Australia, ²Australian Institute of Marine Science, Townsville, Australia, ³The University of Queensland, Brisbane, Australia, ⁴Reef Check Australia and the Reef Citizen Science Alliance, Brisbane, Australia, ⁵ARC Centre of Excellence in Mathematical and Statistical Frontiers, Brisbane, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Erin is a Principle Research Fellow at the Queensland University of Technology, within the Institute for Future Environments. She is a quantitative spatial ecologist who works at the interface of landscape ecology, geographic information science, and environmental statistics.

Enormous effort is invested in monitoring the Great Barrier Reef (GBR), but data collection is currently fragmented over dozens of publicly and privately funded organisations, with data collected using different methods and for different purposes. Nevertheless, monitoring data are relatively sparse given the size of the GBR. The aims of the Virtual Reef Diver project are to 1) tap into the power of citizen scientists to significantly increase the spatio-temporal coverage of monitoring data, and 2) integrate professional and non-professional data sources, with various levels of uncertainty, to generate predictive maps of coral cover across the GBR. The web-based Virtual Reef Diver platform allows imagery taken by recreational and professional divers to be uploaded and geo-located within an existing digital map. Online classification modules allow regular citizens to classify benthic habitat in the images. These data are combined with existing monitoring data in a weighted Bayesian spatio-temporal modelling framework, which is used to generate predictions with estimates of uncertainty across the GBR based on the most up-to-date data available. Predictive maps are displayed online and can be downloaded by managers to gain a better understanding of the ecosystem, inform spatially explicit management decisions, and coordinate future data collection across multiple organisations. Although the Virtual Reef Diver project focusses on the Great Barrier Reef, the web-based modelling infrastructure is generally applicable to other citizen-science based monitoring efforts in the terrestrial, freshwater, or marine environments.
2001: A spatial odyssey revisited. Range size as an indicator of risks to biodiversity

Prof David Keith1,2, Prof Resit Akcakaya3, Dr Nick Murray1
1UNSW Centre For Ecosystem Science, Sydney, Australia, 2NSW Office of Environment & Heritage, Hurstville, Australia, 3Stony Brook University, New York, USA

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
David is an ecologist who undertakes research to inform biodiversity conservation. He is a collaborator in the development of IUCN Red List criteria for species and ecosystems and in 2017 edited the 3rd edition of 'Australian Vegetation'.

Range size has long been recognized as a useful and easily measured indicator of risks to biodiversity. For that reason it has a central place in IUCN Red List criteria for assessing both risks of species extinction and risks of ecosystem collapse, which use standardized metrics for range-size measurement. One of these, area of occupancy (AOO), is sensitive to measurement scale, prompting proposals to measure it at high resolution or at different scales based on the shape of the distribution or ecological characteristics of the biota. Despite its dominant role in red-list assessments for decades, appropriate spatial scales of AOO for predicting risks of species' extinction or ecosystem collapse remain untested and contentious. There are no quantitative evaluations of the scale-sensitivity of AOO as a predictor of risks, the relationship between optimal AOO scale and threat scale, or the effect of grid uncertainty. We used stochastic simulation models to explore risks to ecosystems and species with clustered, dispersed and linear distribution patterns subject to regimes of threat events with different frequency and spatial extent. We found that AOO is an accurate predictor of risk (0.81<|r|<0.98) and performed optimally when measured with grid cells 0.1–1.0 times the area of the largest plausible area threatened by an event. Contrary to previous assertions, estimates of AOO at these relatively coarse scales were better predictors of risk than finer-scale estimates of AOO. The optimal measurement scale depended on the spatial scales of threats more than the shape or size of biotic distributions.

Fast methods for fitting models to presence-only data

Professor David Warton1, Mr Elliot Dovers1, Dr Gordana Popovic1, Dr Wesley Brooks1, Dr Ian Renner2
1UNSW Sydney, Sydney, Australia, 2University of Newcastle, Newcastle, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Elliot Dovers is a PhD student in the Eco-Stats Research Group at UNSW, supervised by David Warton and Gordana Popovic, focusing on fast methods for fitting methods to presence-only data, and related topics.

Presence-only data are a potentially important source of information about species' distributions, although difficult to model because of uncontrolled sources of variation, and when trying to supplement it with additional information. Each of these issues is difficult to deal with effectively, but log-Gaussian Cox processes offer a way forward, as a type of extension of generalised linear mixed models (GLMM's) to handle presence-only data. The random effects terms in the model have the capacity to deal with unmodelled sources of clustering, and to deal with correlation across different species (in a multi-species model) or across different data sources (when combining data across species). There are key computational challenges however and this talk will outline some new methods we have been developing to address these issues.
Rainfall predictability and plant range boundaries

**Dr Rachael Gallagher**¹

¹Macquarie University, North Ryde, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Rachael is a plant ecologist interested in the factors that shape species range boundaries.

Ecological modelling is often dependent on digitised occurrence data derived from natural history collections. Expectations about the information embedded in these ‘dots on a map’ are often unreasonably high. This talk aims to calibrate what you can expect when dealing with occurrence data, using examples from a recent project modelling the influence of rainfall predictability on range boundaries in Australian plant species. Using insights gained from range mapping ~12,000 plants I will demonstrate principles and methods for assessing sampling completeness, cleaning and preparing occurrence data, and delimiting species range boundaries. Through sharing these new range maps for the Australian flora I hope to stimulate discussion about model improvement, and potential applications for quantitative plant ecology.

Statistical ecology for massive datasets with greta

**Dr Nick Golding**¹

¹University Of Melbourne, Parkville, Australia

Quantitative Ecology Showcase - predicting global biodiversity patterns and dynamics, Meeting Room 7, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Nick develops statistical methods and software for modelling the distributions of species and diseases.

General purpose MCMC software packages like WinBUGS, JAGS, and STAN enable users to define and fit almost any statistical model without having to worry about implementation details. These tools have enabled significant progress in applied ecological modelling, and underpin several other software packages for statistical ecology. However these existing tools are largely unable to make use of recent advances in hardware and software for high performance computing, meaning they scale poorly to large datasets. The need to specify models using a compiled, software-specific language is a significant hurdle to potential users make it very hard for anyone other than the core developers to extend or build upon them.

greta is a new software package for flexible statistical modelling that aims to overcome these limitations. greta uses Google’s TensorFlow high-performance automatic differentiation library, so it scales well to massive data sets (millions of observations), can run across many CPUs or on GPUs, and can use efficient gradient-based MCMC samplers like Hamiltonian Monte Carlo, or approximate inference methods like variational Bayes. greta models are written directly and interactively in R, so greta is easy to learn and simple to extended with new modules or use as a backend for more specific software.

I will demonstrate greta, and provide some examples of the bigger and better ecological models it allows us to fit; such as inference of population dynamics from spatial occurrence data and fitting joint species distribution models to massive datasets. If you want to know more now, see the website: https://goldingn.github.io/greta
Competition and the exploration of adaptive landscapes during evolutionary radiations

Russell Dinnage1, Marcel Cardillo1
1Australian National University, Canberra, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Poster 107 - Russell Dinnage is postdoctoral research at the Australian National University, where he studies a wide range of ecological questions using quantitative methods. Current interests include incorporating phylogeny and biogeography in species distribution models, and the interface between ecology and macroevolution.

Competition is hypothesized to play an important role during evolutionary radiations into unoccupied niche space, but the details of its effects are still debated. Theoretically, competition may suppress diversity during radiations because heavy competition can limit coexistence, leading to a smaller maximum diversity in a system. Or, competition can promote diversity because competition drives divergent selection, allowing species to move down fitness gradients and more effectively explore a fitness landscape. To explore these possibilities, we created a simulation framework that includes speciation and adaptive dynamics of a competing set of species, which are evolving on a complex multi-peak fitness landscape. Using this simulation, we discover that equilibrium species richness in an adaptive radiation is maximized at intermediate competition strength. When competition is too strong, a small number of species spread out thinly in the available niche space, but when it is too weak, a small number of species cluster on a single adaptive peak, never finding empty niche space represented by alternative peaks. At an intermediate competition strength, the adaptive landscape is effectively explored, but species do not limit each other too strongly, leading to a high diversity of coexisting species. Additionally, we explore patterns of trait and phylogenetic diversity generated by the model, using machine learning to discover which of a myriad of diversity indexes are most sensitive to variation in the model’s parameters. We present the simulation software as an R package, and discuss its potential for answering a wide range of questions in evolutionary biology and ecology.

How confident are ecological model predictions really? Data-model calibration using Bayesian inference

Dr Matthew Adams1
1The University Of Queensland, St Lucia, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Matthew is a Research Fellow based at UQ. He uses data-driven models to investigate the risk to ecosystems posed by species translocations, as well as other ecological problems where accounting for the uncertainty in model-data calibration is of critical importance.

Data-driven models in ecology have the potential to provide greater information than the data alone. However, due to the high variability in ecological dynamics and/or sparsity in measured data, models that do not explicitly account for uncertainty can yield precise but inaccurate predictions. In this talk I explain how Bayesian inference can be used in the data-model calibration process to create ecological model predictions that explicitly include uncertainty based on the available data. Within this inference framework, it is also possible to identify what is the next piece of data that is useful to measure.
provide ecological examples of applying this framework, to show how it can be used to address various problems broadly within ecology and conservation.

Century-scale ecology: Prediction of stem density and canopy cover dynamics in natural Eucalyptus regnans forests

Mr Sean Walsh1, Dr Raphaël Trouvé2, A/Prof Peter Vesk2, Dr Craig Nitschke1
1School of Ecosystem and Forest Sciences, University Of Melbourne, Burnley, Australia, 2School of Biosciences, University of Melbourne, Parkville, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Sean is a PhD student at the University of Melbourne, researching the interaction of climate, fire and seed banks in natural ecosystems. His background includes mathematical modelling, environmental science, fire behaviour and scientific software development.

Effective management of long-lived plant species requires a detailed understanding of growth and population dynamics over time scales which may extend to many centuries. Predictive models can enhance our knowledge and support decision-making, but model credibility is often constrained by a lack of data. Past studies can be an important source of relevant data if some care is taken with interpretation, context and terminology.

In this study the work of the late Dr David Ashton on the long-lived species Eucalyptus regnans is re-examined, to support the parameterisation of a mechanistic model of long-term E. regnans population dynamics in response to fire and climate. The focus here is on the temporal changes in stem density and canopy cover in pure unthinned stands.

A reanalysis of the data in Ashton’s 1976 paper “The development of even-aged stands of Eucalyptus regnans F. Muell. in central Victoria” resulted in new parameters for Reineke’s self-thinning rule for this species (slope=-1.596 and stand density index=865). We also found that the extent of canopy closure during the self-thinning process can be predicted using only the self-thinning slope and a power-law allometric relating crown diameter to stem diameter. A simple model is presented for canopy cover, showing good agreement with Ashton’s measurements over a 215-year chronosequence.

Results are discussed in the context of other studies of E. regnans forests, and in terms of the broader challenge of preparing robust models capable of handling both specific site dynamics and also the natural variation in behaviour across a species’ range.
Accounting for landscape structure effects to preserve species richness and functional diversity in fragmented landscapes

Mr Felipe Suárez-Castro¹, Dr Matt Mitchell³, Prof Margaret Mayfield², Dr Martine Maron², Dr Jonathan Rhodes²
¹Centre for Biodiversity and Conservation Science, The University of Queensland, Brisbane, Australia, ²School of Biological Sciences, The University of Queensland, Brisbane, Australia, ³Institute for Resources, Environment & Sustainability, University of British Columbia, Vancouver, Canada

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Spatial ecologist interested in using the knowledge on ecological functioning in conservation and environmental management planning. I have explored diverse research interests such as what drives species distribution patterns and the effect of landscape change on biodiversity and ecosystem services.

Promoting the conservation of multiple aspects of biodiversity in transformed landscapes is a fundamental challenge. As fragmented landscapes become more common, we need to understand not only how landscape structure (both landscape composition and configuration) affects the number of species that coexist in an area, but also the distribution of functional traits (i.e. functional diversity) that determine the relationship between species diversity and ecosystem functioning. We present a spatially explicit metacommunity model to evaluate how landscape configuration drives the relationship between species richness and functional diversity as habitat is lost. In addition, we show how we are testing the hypotheses generated in our model using empirical data for different functional groups of urban birds and tropical plants. Our model indicates that effects of landscape structure on species richness are relatively consistent among different functional groups, whereas patterns of functional diversity are more complex. We show that habitat fragments should be protected in clusters rather than as randomly scattered fragments to maximize the conservation of both species richness and functional diversity. In addition, we provide examples of how a focus on conserving species with particular traits at the local scale may be ineffective if attributes of landscape structure are ignored. Testing our model across a broader range of real landscapes and communities in different regions would simplify forecasting of effects of fragmentation on multiple components of biodiversity.

Using Markov Random Fields to identify changing co-occurrence or co-abundance associations

Dr Nicholas Clark¹
¹University Of Queensland, School Of Veterinary Science, Red Hill, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I am a disease ecologist exploring new ways to (1) understand how natural communities are formed and (2) predict how they will change over time. I use phylogenetic and network tools to study how host-parasite interactions change across urbanisation gradients.

Inferring interactions between co-occurring species is key to identify processes governing community assembly. Incorporating interspecific interactions in predictive models is common in ecology, yet most methods do not adequately account for indirect interactions (where an interaction between two species is masked by their shared interactions with a third) and assume interactions do not vary along environmental gradients. Markov Random Fields (MRF) overcome these limitations by estimating interspecific interactions, while controlling for indirect interactions, from multispecies occurrence data.
will illustrate the utility of MRFs for tackling a range of common ecological questions, and will demonstrate how covariates can be included (a set of models known as Conditional Random Fields, CRF) to infer how interactions vary along environmental gradients. In this hands-on session, I will explain steps needed to (1) fit MRF and CRF models using multispecies presence–absence data; (2) identify how co-occurrence probabilities change across environmental gradients; and (3) use model outputs to predict variation in species interaction networks. I will showcase all the tools needed for building CRFs and plotting/interpreting results using an open-source R package (MRFcov; available at https://github.com/nicholasjclark/MRFcov).

Collaborative approaches to process-based modelling

**Rafael Schouten**, Assoc Prof Peter Vesk, Assoc Prof Michael Kearney

1School of BioSciences, University Of Melbourne, Parkville, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

Rafael Schouten is a masters student in Biosciences at the University of Melbourne, developing process-based models of plant species distribution, and general techniques for process-based modelling.

We now take R packages for granted. But they are developed by thousands of dedicated researchers working collaboratively, and provide an amazing breadth of tools for statistics.

Process-based (AKA mechanistic) modelling has great potential in ecology, but the requisite tools are less organised and integrated than those for statistical modelling. Process-based modelling needs to adopt the open, collaborative strategies that have been so productive for developing statistical package in the R software ecosystem. But these strategies also present technical problems.

In this talk we explore ways to improve the social and technical aspects of collaborative process-based modelling, using plant growth models as an example. This includes both recognition of code as a legitimate product of research, and programming techniques required to enable collaboration. The monolithic designs common in process-based models will be contrasted with modular approaches, where components can be flexibly combined into custom models.

We will also discuss how modern scientific programming languages like Julia can facilitate this modularity, while simplifying code and connecting researchers to networks of numerical tools. This can be achieved without losing the performance of traditional Fortran and C models.

Ultimately, these approaches can improve our models, reduce development time, and facilitate more effective research in ecology and environmental sciences.
Spatial dynamics of plant coexistence: Adding spatial context to complex interactions in annual plant communities

Trace Martyn
1 The University Of Queensland, St Lucia, Australia

Quantitative Ecology Showcase - speed talks and posters, Meeting Room 7, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I am a PhD candidate exploring plant species interactions within the highly diverse annual plant communities of Western Australia. My research focuses on increasing our understanding higher-order and direct plant interactions in the framework for modern coexistence theory.

While the spatial arrangement of individuals within plant communities has been shown to affect the outcome of competition on focal individuals and species, many theoretical studies still assume random, well-mixed communities. Of those spatially explicit studies of species interactions, most focus entirely on direct, competitive interactions, without testing for indirect or higher-order interactions (HOIs) which can mediate both competition and facilitation.

- Here we introduce HOIs into models of species interactions while accounting for the spatial arrangement of local neighbours. Specifically, we aim to answer the following questions: Do spatially explicit models of species interactions improve model fit in individual fitness models? What is the spatial extent of interactions in which neighbours have detectable direct and higher-order interactions? Does this distance change with the identity of the focal individual?

- We address these questions by mapping the spatial arrangement and seed set for over 12,000 individual plants in the annual understory of York gum-Jam woodlands of Western Australia. The spatial and seed data were used to estimate the rate of decay of species interactions over space between species.

- We found that including space within these individual fitness models increases model fit as well as reflect complexity observed in natural systems in the models. Interaction decay rates varied for each species and species-pair. We conclude that including spatial weights increases our ability to predict coexistence within local 50cm interaction neighbourhoods. Models that don’t include space are likely to underestimate species interactions at small spatial scales and overestimate them at large spatial scales.
A brief overview of Dynamic Energy Budget theory and its relevance to quantitative ecology

Dr Michael Kearney


Biography:
My research focuses on physical constraints on the behaviour, life history, abundance and distribution of organisms as dictated by the processes of energy and mass exchange. I use field and lab observations and computer simulations to mechanistically model species' niches.

Dynamic Energy Budget (DEB) theory is a formal metabolic theory that captures how organisms take up energy and matter from their environment and allocate it to maintenance, growth, maturation and reproduction. It has much to offer quantitative ecologists but, for reasons I will speculate upon, has been largely ignored by ecologists. I will give a brief overview of the assumptions and logic of the theory, particularly the concepts of the synthesising unit, reserve dynamics, and macrochemical equations. I will also put it into context with 'the' Metabolic Theory of Ecology. I will then give a summary of the different ways it can be used in quantitative ecology, including its application to understanding life histories, nutritional ecology, ecological stoichiometry, isotope dynamics, population dynamics, symbioses and distribution limits. I will also briefly cover the efforts currently underway to develop a database of DEB parameters (currently >1100 species) and its relevance to other efforts in trait-based ecology.

New theory on how functional traits influence plant growth and shade tolerance across the life cycle

Dr Daniel Falster


Biography:
ARC future fellow at UNSW Sydney. Passionate about plants, modelling, open data, reproducible research, teaching biologists to code.

Plant species differ in many functional traits that drive differences in rates of photosynthesis, biomass allocation, and tissue turnover. However, it remains unclear how—and even if—such traits influence whole-plant growth, with the simple linear relationships predicted by existing theory often lacking empirical support. Here, we present a theoretical framework for understanding the effect of diverse functional traits on plant growth and shade tolerance by extending a widely used model, linking growth rate in seedlings with a single leaf trait, to explicitly include influences of size, light environment, and five prominent traits: seed mass, height at maturation, leaf mass per unit leaf area, leaf nitrogen per unit leaf area, and wood density. Based on biomass growth and allocation, this framework explains why the influence of traits on growth rate and shade tolerance often varies with plant size and why the impact of size on growth varies among traits. Specifically, we demonstrate why for height growth the influence of: (i) leaf mass per unit leaf area is strong in small plants but weakens with size; (ii) leaf nitrogen per unit leaf area does not change with size; (iii) wood density is present across sizes; (iv) height at maturation strengthens with size; and (v) seed mass decreases with size. Moreover, we show how traits moderate plant responses to light environment and also determine shade tolerance, supporting diverse empirical results.
Predicting impacts of climate change on size-structured marine ecosystems globally

Dr Julia Blanchard
Institute for Marine and Antarctic Studies, University Of Tasmania, Hobart, Australia


Biography:
Julia Blanchard is an Associate Professor in Ecology & Fisheries at the Institute for Marine and Antarctic Studies. Her research focusses on understanding and predicting human impacts on marine ecosystems, food webs and their links to society.

Predicting the consequences of human and environmental impacts on ecosystems requires models that accurately capture changes in abundance, biomass and function through time. Over the past decade, there has been an explosion of dynamical size spectrum models that focus on how individual processes shape and change ecosystem structure and function. These approaches are being used to tackle a wide range of questions including the impacts of fishing and climate change globally, through integration with satellite, climate and fisheries data. I will highlight recent advances in these models, including capabilities for predicting global patterns and changes in abundance and body size through time and their potential use for understanding ecological limits. I will outline key research needs for tackling key uncertainties and gaps in knowledge needed to improve models and future projections.

Is bigger always better? Influence of restoration planting size on woodland bird breeding activity

Ms Donna Belder, Dr Jennifer Pearson, Dr Karen Ikin, Dr Wade Blanchard, Dr Martin Westgate, Dr Mason Crane, Prof David Lindenmayer
1Fenner School of Environment and Society, The Australian National University, Canberra, Australia, 2National Environmental Science Program Threatened Species Recovery Hub, The Australian National University, Canberra, Australia, 3ACT Parks and Conservation, Canberra, Australia, 4Sustainable Farms, The Australian National University, Canberra, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Donna Belder is an ecologist with a passion for wildlife and conservation biology. Her PhD research focuses on using mechanistic indicators of habitat quality to assess whether restoration plantings can support resident, breeding populations of woodland birds.

Restoration plantings are an increasingly common way to address habitat loss in agricultural landscapes. Native fauna, including birds, may readily occupy planted areas of vegetation. However, unless restoration plantings support breeding populations, their effectiveness as a conservation strategy may be limited. We assessed breeding activity of woodland birds in restoration plantings in the South-west Slopes bioregion of New South Wales, Australia. We compared breeding activity in plantings of different size (small and large) and shape (linear and block-shaped), and in remnant woodland sites. Contrary to expectations, we found that for the woodland bird assemblage, breeding activity increased with decreasing patch size. We found no effect of patch type or shape. Breeding activity increased with decreasing patch size for dome-nesters, but not cup-nesters. For species of conservation concern, there was no effect of patch type, size, or shape on breeding activity. Our results highlight the value of small habitat patches in fragmented agricultural landscapes, and indicate that restoration plantings are as valuable as remnant woodland patches for supporting woodland bird breeding activity. We also
demonstrate the importance of conducting bird breeding studies to assess the conservation value of restoration plantings and other habitat patches for avifauna.

How well is genetic diversity captured in revegetation plantings?

**Dr Rebecca Jordan**, Dr Martin Breed, Prof Ary Hoffmann, Dr Adam Miller, Dr Suzanne Prober

CSIRO, Sandy Bay, Australia, University of Adelaide, Adelaide, Australia, Bio21 Institute, University of Melbourne, Parkville, Australia, Deakin University, Warrnambool, Australia, CSIRO, Floreat, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Rebecca is interested in how we can use genomic tools to help inform conservation management. She uses landscape genomic approaches to explore genetic diversity and adaption across species’ distributions, aiming to understand potential adaptability to environmental change.

Genetic diversity is essential for creating adaptable, self-sustaining revegetation populations under environmental change. Whilst revegetation may be expected to have lower genetic diversity due to the founder effects of seed sourcing, this is not always the case. Determining how well genetic diversity is captured in revegetation and the management choices that influence this could help improve resilience and adaptability of future revegetation plantings. Here we review the published studies that report genetic diversity in natural and revegetated plant populations to determine, how genetic diversity in revegetation compares to natural populations, and what factors influence this. A literature search identified 49 studies from around the world, including 7 from Australia, representing 22 plant families. Preliminary findings demonstrate restoration plantings can have as much, and sometimes greater, genetic diversity than natural sites. This, however varies widely between plantings. One key finding is a clear lack of metadata on the details of seed collection and revegetation plantings, which is crucial information to improving management actions. Metadata on seed sourcing approaches, including the number of seed mothers and source populations, was rarely reported and in some cases, stated as unknown. These results highlight not only the heterogeneity of how well revegetation captures source genetic diversity, but also the importance of metadata and monitoring to provide feedback and improve revegetation decisions.

Contrasting effects of woody plant removal on ecosystem structure, function and composition

**Ms Jingyi Ding**, Prof David Eldridge

University Of New South Wales, Sydney, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

PhD candidate, Biological Science, University of New South Wales (2017-present)
MSc, Land use management, University of Beijing Normal University, China (2017)

BSc, Geography Science, University of Yanbian University, China (2014)

In drylands, the encroachment of woody plants into grasslands over the past few decades has caused considerable concern to land managers due to increased competition with forage plants. Removal of woody plants is therefore being used increasingly by managers to encourage the growth of forage plants for livestock, but the effectiveness and ecosystem impacts of different removal practices has rarely been evaluated. We used a global meta-analysis to explore the net effect of woody plant removal on ecosystems. Our analyses of 163 ecosystem attributes from 267 studies worldwide showed that: (1) the
overall effect of removal varied among ecosystem response variables, with increases in composition, reductions in structure, but equivocal effects on function; (2) effects of removal depended heavily on the traits of individual woody plants, with clear trait differences between above- and below-ground attributes; (3) woody plant removal has short-term efficacy, and generally negative legacy effects on ecosystems. Our results explain the wide disparity in results of studies where woody plants have been removed and reinforce the notion that the impact of woody plant removal is strongly context dependent and environmentally deleterious in the long term. Removal of woody plants to attain ecosystem goals should be targeted to specific environmental conditions and species with specific traits.

Achieving multiple benefits in ecological restoration for biodiversity conservation and carbon sequestration

Ms Valerie Hagger1,4, Dr Jacqui England3, Dr John Dwyer1,2, Prof Kerrie Wilson1,4
1The University Of Queensland, Brisbane, Australia, 2CSIRO, Dutton Park, Australia, 3CSIRO, Melbourne, Australia, 4ARC Centre of Excellence in Environmental Decisions, Brisbane, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Valerie is a PhD candidate with UQ and CSIRO. She has research interests in conservation of natural ecosystems and biodiversity through ecological restoration, the role of ecosystem services in achieving restoration goals, and improving restoration through better decision making.

The potential for revegetation to deliver biodiversity co-benefits alongside carbon abatement has been a focus of recent work however better assessments of the biodiversity values of revegetation, in particular for native fauna, and the potential synergies and trade-offs with carbon sequestration are required to inform decision making on where and how to invest in revegetation in order to maximize outcomes for both biodiversity conservation and carbon sequestration.

We undertook field surveys of revegetation sites across south-east Queensland to identify the diversity of woodland dependent birds, the above ground biomass in woody plants, and the floristic diversity and structural attributes of vegetation. Topsoil sampling was also undertaken and analysed for soil texture, macro-nutrients and organic carbon. Sites of different planting ages, sizes and landscape context were selected. We are analyzing this data to explore (1) the relationship between productivity (above ground biomass) and biodiversity value (woodland bird diversity), (2) the influence of plant diversity and vegetation structure, and soil and climatic variables on productivity, and (3) the influence of landscape-level variables (age, size, landscape context and connectivity) on biodiversity value.

We hypothesize that plantings with more complex vegetation structure and higher floristic diversity will support a greater diversity of woodland dependent birds and have the capacity to store more carbon. In this talk, I will present initial results and describe implications for improving restoration approaches. Delivering greater shared ecological and social-economic benefits will be important if we are to scale up restoration efforts to meet International commitments.
How are insect seedling predation patterns altered during rainforest restoration on disused pastures?

Mrs Marisa Stone1, Dr Luke Shoo2, Prof Nigel Stork1, Prof Carla Catterall1
1Griffith University, Brisbane, Australia, 2University of Queensland, Brisbane, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
My name is Marisa Stone and I am a PhD candidate at Griffith University. My research interests include ecosystem functioning, restoration, rainforests and invertebrates.

Converting rainforest to pasture can have large impacts on ecosystem functioning. It could be expected that vegetation restoration should induce recovery of many ecological functions. However, evidence to test this proposition is scarce. Seedling predation by insects can play an important role in regulating dominant plant species and increasing plant diversity. To investigate this process we experimentally quantified herbivory by insects as the proportion of leaf areas loss/damage and damage type on tagged leaves of planted seedlings over seven months. Two species of seedlings common in the area were planted in 25 sites, with replicate sites representing different stages of vegetation degradation and recovery: old growth forest, grazed pasture, unassisted regrowth (aged five years to several decades since livestock removal from former pasture), and assisted regeneration of similar regrowth 1-10 years after intervention. We found that seedling predation was greatest when rainforest had been converted to pasture, but that seedling predation had reduced within a few years following commencement of both unassisted and assisted restoration. We used leaf damage types to associate different herbivore groups such as chewers and leaf miners or rollers. This showed that the greatest seedling predation in pasture was caused predominantly by just one damage type caused by leaf miners, whereas a range of damage types were observed on leaves within a few years following commencement of both unassisted and assisted restoration. To conclude, we consider the practical application our insect seedling predation experiment could have for rainforest recovery within the context of restoration and conservation.

The role of damping-off on the survival of seedlings in conspecific and heterospecific soils

Mr Christopher Shaw1, Professor Giles Hardy1, Associate Professor Treena Burgess1
1Murdoch University, Murdoch, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Christopher is currently completing his third year of PhD studies. His work focuses on the various oomycete pathogens found on the sand-plains north of Perth, Western Australia, and their impact on the native and rehabilitated plant communities of the region.

An experiment was designed to explore if pathogenic mechanisms help drive the high diversity of the kwongan heath in South West Australia. Five common plant species with different nutrient acquisition traits were selected for a glasshouse seedling trial. The emergence and survival of seedlings was recorded when seeds were sown alone and with a second plant species in conspecific and heterospecific soils. Soils and root material were sourced from beneath 15 mature individuals of each plant species at a single site in Mt Lesueur National Park. The preliminary results indicate the source of some soils impacted the emergence of several plant species. The addition of a secondary plant species generally reduced the impact of soil source on seedling emergence. The seedling survival response was varied for
all plant species and was not consistent with the emergence data. However, the second plant species did appear to have a greater effect on the seedling survival response. Previous studies into this field of research have not taken into account the effect of damping-off and the presence of other plant species. We discuss the implications of these findings with regards to previous experiment designs and the possible impacts on species diversity in the kwongan plant community.

**Seedling growth responses to species, neighborhood and landscape scale effects during tropical forest restoration.**

**Dr Lachlan Charles**, Dr John Dwyer, Dr Tobias Smith, Ms Sophie Connors, Professor Petra Marschner, Professor Margaret Mayfield

1School of Biological Sciences, University Of Queensland, Brisbane, Australia, 2CSIRO Land and Water, Brisbane, Australia, 3School of Agriculture, Food & Wine, University of Adelaide, Adelaide, Australia, 4School of Biological Sciences, University of Adelaide, Adelaide, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Lachlan Charles is a research technician at the University of Queensland. His research focuses on tropical forest restoration, community assembly and successional processes in fragmented tropical countryside landscapes.

Central to the success of restoration plantings within abandoned pastures is the appropriate selection of species that can establish and grow rapidly to form canopies to suppress grasses. However, species selection can be difficult, largely due to combinations of biotic and abiotic factors operating across multiple spatial scales that can affect seedling growth rates. Using a large replicated restoration experiment in Australia’s Wet Tropics, we evaluated seedling growth rates of 24 native rainforest species commonly used in local restoration efforts over the first 31 months post planting. We investigated the influence of landscape, site and planting conditions on early-stage seedling growth and whether functional traits and surrounding neighborhood density and composition explain variation in seedling growth rates. Seedling growth rates were influenced by numerous stem-, species-, plot- and climate-level factors, with the strength of these effects strongly dependent on the size of the seedling. Specifically, species with low wood densities, larger seeds grew faster. In response to plot-scale and climate factors, larger seedlings consistently displayed faster growth, demonstrating the benefits of initial seedling size for seedling success. Our study highlights that early-stage seedling growth can be influenced by many factors, operating across multiple spatial scales. Importantly, we demonstrate that planting larger seedlings may improve seedling growth and that developing strategies to increase the survival of fast growing low wood density species is crucial for ensuring that plantings can achieve canopy closure quickly, improving early to mid-term trajectories of tropical forest recovery.
Different soil types vary considerably in their inherent microbial potential to degrade nucleic acids.

Mrs Manisha Kunadiya
1Murdoch University, Perth, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
POSTER 034 - She is Molecular Plant Pathologist at Murdoch University working on Phytophthora dieback project. The major focus of her work is on the developing robust molecular tools for the plant pathogen P. cinnamomi. did master degree in Microbiology and Medical Technology.

Diagnostics based on the detection of DNA of a given organism has revolutionised plant pathology and biosecurity. However, these tests cannot distinguish between signals originated from viable cells and DNA released from dead cells, increased the risk of false-positive results. An alternative is to use an RNA based approach, as RNA is only produced by living organisms. But the question remains; how long do nucleic acids remain detectable in different substrates such as soil? Both DNA and RNA are degraded in the soil by nuclease producing microorganisms. The activity of these microorganisms will depend upon soil type, temperature and moisture availability. P. cinnamomi is soil-borne plant pathogen to which many Australian plants are susceptible. Eradication studies are underway, but a limiting factor is to detect surviving propagules in the soil. This study aimed to determine the persistence of P. cinnamomi DNA and RNA in five different soil types in wet and dry conditions. Naked DNA and RNA of a known concentration was applied to the soils. The persistence of RNA was determined after time intervals of 0, 1, 3, and 7 days and DNA after intervals of 0, 3, 7, 14, 90, 241, and 378 days. This study showed, P. cinnamomi RNA was no longer detected after 1 day, while DNA can be detected in dry soil condition up to days 241. It confirms RNA degrades very quickly, while DNA can be remarkably stable in some environment, and could lead to false positive result in a DNA based disease diagnosis.

Recruitment and dispersal limitations in a chronosequence of secondary forests in tropical Australia

Dr Ana Palma
1James Cook University, Cairns, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Ana Palma is a tropical ecologist interested in animal behaviour and forest ecology. Ana did her PhD in a chronosequence of secondary forests in tropical Australia to understand their recovery after human disturbance.

Increasing awareness of the repercussions of forest lost and its implications on human-well being and ecosystems health make forest restoration a key area for current and future research, policy-making and environmental management. Results from our study in tropical North Queensland show a delayed recovery in tropical secondary forests and the absence of key functional plant groups (e.g. large-seeded trees) even in 40 year-old forests. This finding makes restoration efforts necessary if we want to preserve local biodiversity and enhance the conservation value of these forests. Restoration efforts seeking to accelerate biodiversity recovery and the protection of the local flora should include species limited by seed dispersal. When possible, these initiatives should include multiple species and various seed sizes. Further, the inclusion of species with higher tolerance to drier conditions could improve restoration outcomes and prepare the region for future climatic scenarios.
Environmental watering enhances recovery of fish and vegetation communities in the Wimmera River system

Mrs Joanne Sharley1, Mr Zeb Tonkin1, Dr Chris Jones1, Mr Greg Fletcher1, Ms Renae Ayres1, Dr Scott Raymond1, Mr Graeme Hackett1

1Arthur Rylah Institute, Heidelberg, Australia, 2Wimmera Catchment Management Authority, Horsham, Australia

Restoring ecosystems: successes, failures and recommendations for where to next, Meeting Rooms 4-5, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Joanne Sharley is an aquatic scientist at the Arthur Rylah Institute for Environmental Research. Her area of expertise is fish habitat restoration in freshwater ecosystems. Joanne also has a special interest in threatened species ecology, monitoring and conservation.

Water delivery for environmental benefits is increasing in river management practices across southeastern Australia to address the effects of altered river stream flow regimes and associated impacts on ecosystems. The Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) was established by the Victorian Government during 2005 to monitor and assess ecosystem responses to environmental watering in priority Victorian rivers. The tributaries of the Wimmera River (including the MacKenzie River, Burnt Creek and lower Mount William Creek) are highly modified, flow stressed systems. During the Millennium Drought, these waterbodies were subject to extensive cease to flow periods and with the exception of some refuge pools, complete drying. This had catastrophic impacts on native fish populations and important vegetation assets. Fortunately, widespread flooding in 2010-2011 resulted in the reconnection of refugia and headwater source populations. Since this time, environmental water has been used to maintain refugia and connectivity in the upper reaches of these tributaries.

This project presents a unique case study in the VEFMAP Program to assess the role of environmental flows in the Wimmera River system in governing both short (seasonal) and long-term (decadal) outcomes for both fish and vegetation communities. Fish communities as well as riparian and instream vegetation were assessed at multiple sites within five unique reaches of the MacKenzie River, Burnt Creek and Mt William Creek which varied significantly in their flow regimes since 2010.

Our results clearly show the important role environmental water has played in the recovery and maintenance of native fish and vegetation communities.

Belowground plant functional ecology: novel frontiers and targets for the next decade

Dr Gianluigi Ottaviani1, Dr Jana Martínková1, Prof Jitka Klimešová1,2

1Czech Academy of Sciences, Institute of Botany, Department of Functional Ecology, Trebon, Czech Republic, 2Charles University, Faculty of Science, Department of Botany, Prague, Czech Republic

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 074 - Dr Gianluigi Ottaviani, PostDoc position at CAS, Institute of Botany, Třeboň, Czech Republic. My research focuses on whole-plant ecology, functional biogeography and refugia

Recently, ecologists have rediscovered the importance of belowground plant strategies for ecosystem functioning. However, most of the attention concentrates on acquisition, fine-root traits and mycorrhizal associations. Other, non-absorptive functions (e.g., those related to resprouting and clonal
growth abilities exerted by rhizomes and lignotubers) remain greatly unexplored. We propose a compartment-based approach, built on biomass allocation into different functions, tailored to studying belowground plant ecology comprehensively. Two compartments are identified, namely acquisitive and non-acquisitive. The former includes organs and traits referring to plant capacity to acquire resources. The latter involves functions such as space occupancy, on-spot persistence, resource storage and sharing, resprouting after disturbance, carbon sequestration. For example, longevity of belowground organs can be used as a reliable trait for i) understanding plant demography, ii) studying plant responses across environmental gradients, and iii) improving estimates of carbon sequestration, a key ecosystem service. Although, methodological challenges related to assessing biomass partitioning and turnover across plant ontogeny and growth forms occur, e.g., associated with biomass decay of belowground organs. Finally, we identify four main areas for next-future research: i) biomass scaling, ii) clonality vs resource acquisition relations, iii) resprouting vs changing environments linkages, and iv) belowground carbon sequestration. Standardized procedures for collecting traits informative on these less studied functions are urgent. Gathering such trait-data from different biomes in a comparable way will facilitate the inclusion of key, yet poorly studied functions and traits into global syntheses. This will advance the understanding of plant functioning and ecosystem services provided by different belowground plant compartments.

Species traits, climate and competitive interactions determine tree growth in Australian tropical rainforests

Dr John Dwyer1,2, Dr Dan Metcalfe2
1The University of Queensland, St Lucia, Australia, 2CSIRO Land & Water, Brisbane, Australia

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
I'm a plant ecologist and lecturer based in Brisbane. I am interested in plant communities – how they form, the processes maintaining them, their capacity to recover from disturbance and their invasibility.

Tree species are well known to vary in their growth responses to environmental variation and competition. The phenotypic traits that underpin these differences are beginning to emerge but empirical research is required to test theoretical predictions of trait-mediated trade-offs. We analysed diameter increment data from CSIRO's rainforest permanent plots in north Queensland. The 20 x 0.5 ha plots were measured 10-16 times over 33-40 year periods spanning considerable interannual climate variation. Counter to results of recent global analyses, our preliminary models show that growth is unrelated to wood density in these forests, but is positively and strongly related to species' maximum heights. Consistent with previous research and theoretical predictions, metrics of intra- and interspecific competition had negative relationships with growth, and were stronger for intraspecific competition. Moisture availability, average maximum temperatures and the occurrence of cyclones explained substantial growth differences between plots, and also temporal variation within plots. Interactions indicated that the positive effect of moisture availability was especially pronounced for taller-growing species, while the effects of intra- and interspecific competition did not vary with climate. In addition to reporting these results, we will present other analyses examining the role of trait differences in driving competitive interactions within these globally important rainforests.
Quantitative variation in floral and foliar chemical defence, cyanogenesis, in populations of Telopea speciosissima

Ms Edita Ritmejeryte1,2, Dr Berin Boughton2,3, Dr Michael Bayly2, Dr Rebecca Miller1
1School of Ecosystem and Forest Sciences, The University Of Melbourne, Richmond, Australia, 2School of Biosciences, The University of Melbourne, Parkville, Australia, 3Metabolomics Australia, The University of Melbourne, Parkville, Australia

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
I am a PhD candidate at the University of Melbourne researching floral chemical defence in Proteaceae. My competencies range from fieldwork, through glasshouse experiments, to analytical chemistry, specifically LC-MS and novel metabolite imaging (MALDI-MSI).

Floral chemical defence strategies remain little tested with respect to the large body of plant chemical defence theory, despite the significance of flowers to plant fitness, the sizeable investment of resources in flowers, and the potential impact of florivory. Optimal Allocation Theory (OAT) predicts that higher concentrations of defence metabolites will be allocated to the most vulnerable and valuable plant parts, including reproductive structures such as flowers. Relatively little is known, however, about resource allocation to floral chemical defence in plant populations, and whether levels of floral defence correlate with foliar defence and are influenced by environmental conditions.

We used seven Telopea speciosissima populations from three genetically and geographically distinct regions in NSW to quantitatively compare foliar and floral chemical defence investment. T. speciosissima tissues contain cyanogenic glycosides, nitrogen-based secondary metabolites that deter herbivores by releasing toxic HCN upon tissue damage. Floral and foliar tissues were analysed for cyanogenic glycosides and nitrogen and environmental parameters (climate, soil nutrients) were analysed for each site. Within-plant and within-inflorescence variation in cyanogenesis was also investigated.

We identified significant quantitative variation in both floral and foliar cyanogenic glycoside concentrations within all populations; floral and foliar cyanogenic glycoside concentrations were not correlated within populations. Inconsistent with OAT, floral cyanogenic glycoside concentrations were not higher than foliar concentrations. There were significant differences in mean floral cyanogenic glycoside concentrations between the three genetically and geographically separated populations. The differences between these three distinct groups will be discussed in relation to environmental variation and plant defence theories.
Using plant functional traits and rainfall-productivity relationships to predict grassland sensitivity to extreme rainfall events

Mr. Jeff Chieppa¹, Dr. Uffe Nielsen¹, Dr. David Tissue¹, Dr. Sally Power¹
¹Western Sydney University, Hawkesbury Institute for the Environment, Richmond, Australia

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Understanding the link between diversity and stability in plant communities remains a central tenant of ecology and will continue to be important as more communities are increasingly affected by humans and human-induced climate change. My PhD topic investigates grassland plant species’ responses to extreme rainfall events. I utilize seven field sites in eastern Australia which differ in historic rainfall amounts and variability. I have focused on plant functional traits (morphological, economic, life-history traits), which permits comparison across unique flora, to assist in understanding productivity patterns across the landscape. I’ve found both above- and belowground plant traits are useful predictors of grassland sensitivity to changes in rainfall. More specifically, community-weighting and considering intraspecific variation of traits are important for understanding and predicting changes in grassland productivity under altered rainfall amounts. My talk will focus on results from a mesic grassland in western Sydney which experienced 65% rainfall exclusion and phosphorus addition over five years. The overall goal of my work is to understand the role of plant functional traits in mediating the diversity-stability paradigm to improve predicting ecosystem sensitivity to climate change.

Relationship of fine roots to forest biomass of Chinese fir plantations in subtropical China

Dr Yingchun Liao¹, Prof Houbao Fan¹, Prof Xiaohua Wei², Prof Huimin Wang³
¹Nanchang Institute of Technology, Nanchang, China, ²University of British Columbia Okanagan, Kelowna, Canada, ³Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Yingchun Liao is an associate professor in forestry. Her research interests mainly include fine root biomass, root and mycorrhizal ecology, global change biology and plant physiology.

Background and aims: Fine roots play a prominent role in plants’ acquisition of nutrients and water from the soil, and their amounts and dynamics determine trees’ growth and adaptation to environmental stress. However, the relationship between fine tree roots (including absorptive roots and fine transport roots) and environmental stress (e.g., increased competition, poor soil quality) remains poorly understood, which was the main objective of this study.

Methods: We selected 20 plots in Chinese fir (Cunninghamia lanceolata) plantation forests of the similar ages (23 years old on average) along large environmental gradients with various levels of soil quality in subtropical China to assess the above-mentioned relationship. Forest biomass was used as a proxy for soil quality or condition.

Results: We found that all fine root biomass of trees and understory vegetation were significantly and negatively correlated with forest biomass. To our surprise, both total Chinese fir fine root biomass (absorptive roots and fine transport roots) and fine transport root biomass showed significant and positive correlations with understory fine root biomass. In spite of insignificance, absorptive root biomass also showed a positive relationship (P = 0.185) with understory fine root biomass.
Conclusions: These results clearly demonstrate that fine tree root biomass is significantly promoted and increased due to significant competition from understory vegetation or poor soil conditions where forest biomass is low.

Keywords: Fine tree root biomass • Absorptive roots • Fine transport roots • Understory vegetation fine roots • Forest biomass • Competition

Experimental approach of using biological traits to enhance functioning

Miss Navodha Dissanayake1, Miss Fiona Chong2, Dr Bryony Caswell1, Prof Chris Frid3

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Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
I am a marine benthic ecologist (PhD candidate at Griffith University) researching on macrobenthic fauna in intertidal soft sediment. At present I'm working on the functioning of mudflats by using biological traits as a proxy.

The adverse impacts of human population growth and coastal development are currently leading to the gradual transformation of intertidal flats and the alteration of ecosystem processes that underpin economically important ecosystem services. In this study we investigate, experimentally, the role of two large bioturbating taxa with contrasting traits, the crab (Macrophthalmus (Mareotis) setosus), and the mud whelk (Pyrazus ebeninus) in mudflat ecosystem functioning. The former is a burrower while the latter is a surface disturber. The study was conducted at McCoy’s creek, a site with limited human impact was selected. Five treatments (5 replicates of each) were applied in a random block design; Control – no cage and Cage Control; twice background density of crabs, twice background density of whelks and a combined treatment of 1.5 background density of crabs and whelks. After 14 days a box core (0.0625m2) for macrofaunal community analysis and surface sediment for chlorophyll a were retrieved from each treatment. The redox discontinuity layer depth was recorded for each box core. The recovered numbers of both crabs and whelks did not match the presumed starting density, so changes in ecosystem functioning and macrofaunal community composition are interpreted against the final observed densities. Initial results suggest that altered densities of the two macro-bioturbators did not impact on ecosystem functioning, suggesting some form of compensator mechanism possibly involving changes in multiple smaller taxa. Such functional resilience would be consistent with patterns of mudflat ecosystem functioning globally.
Hot and stinky: Floral trait and pollinator divergence in an endemic Australian Typhonium complex

Mr Thomas Sayers¹, Assoc Prof Martin Steinbauer², Dr Kevin Farnier²,³, Dr Rebecca Miller¹
¹School of Ecosystem and Forest Sciences, The University of Melbourne, Richmond, Australia, ²Department of Ecology, Environment and Evolution, La Trobe University, Bundoora, Australia, ³Department of Economic Development, Jobs, Transport and Resources, Agriculture Research Division, Melbourne, Australia, Bundoora, Australia

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Thomas Sayers completed a Bachelor of Science and Master of Environmental Management at the University of Tasmania, and is currently a PhD candidate at the University of Melbourne. Tom’s main research interest is the ecology and evolution of plant-pollinator interactions.

Typhonium brownii is the most widely distributed endemic Typhonium (Araceae) species within Australia, covering tropical to temperate latitudes along Australia’s eastern seaboard. However, the possibility of a species complex rather than high population diversity across this large distribution has not been investigated. The pollination systems of T. brownii populations in five different regions, in addition to the closely related and southern-most Australian species, T. eliosurum, were studied to test for species differentiation. Pollinators were identified, and floral traits such as floral morphology, trapping mechanisms, reflectance, floral thermogenesis, anthesis patterns, and floral scent compounds were characterised. The inflorescences of all T. brownii were highly thermogenic; however, there were distinct shifts in the timing of thermogenic activity and anthesis associated with pollinator attraction, effectively reproductively isolating certain taxa within the T. brownii complex. All floral odours were reminiscent of herbivore dung; reflected in the 101 scent compounds identified across all taxa, including the volatile organic compound skatole. The floral scent profiles of three T. brownii taxa were comparable, while two T. brownii taxa and T. eliosurum were significantly different from all taxa investigated. Interestingly, T. eliosurum captured exclusively dipteran fauna (Sphaeroceridae and Psychodidae) in contrast to Coleoptera (Staphylinidae and Scarabaeidae), the predominant pollinators of all T. brownii taxa investigated. Despite sharing similar pollinator assemblages, the divergence in several floral traits within the T. brownii complex is discussed. In addition to the significant differences in floral trapping features associated with a divergence to fly pollination observed in T. eliosurum.

What controls the distribution of south eastern Australian eucalypts? Lessons from trait-based species distribution models.

Dr Peter Vesk¹, Dr William Morris¹, Mr William Neal¹, Dr Karel Mokany², Dr Laura Pollock³
¹University Of Melbourne, Parkville, Australia, ²CSIRO Land & Water, Canberra, , ³University of Grenoble, Grenoble, France

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Peter is a quantitative ecologist interested in generalisation and in ecological management. Most work is with plants an with models or analysis. Particular interest are in how to make use of sparse data and the use of plant functional traits.

Trait-based, multi-species distribution models allow quantification of trait-environment relationships. They offer: a route to incorporate ecological mechanism into correlative statistical models and; potential to generalise across species. We have employed trait-based generalized linear mixed models to learn
about the role of plant functional traits in the distribution responses of species along environmental gradients. Submodels of species responses are linear functions of their traits. Formally, traits interact with site covariates.

We previously showed* that each of specific leaf area (SLA), seed mass and maximum height modulated occurrence responses along environmental gradients among 20 Eucalyptus species over ~ 450 plots across mountain ranges in an area ~ 10³ km². How are inferences and model performance influenced when we move to new and larger regions with different and sometimes greater numbers of species? In this talk, we report on models with a dataset of ~ 80 taxa, ~25000 plots across ~10⁵ km².

SLA modulated responses to temperature; higher SLA species had more positive responses to temperature. Some relations did not transfer from the Grampians to the SE Australian region. We found that implicit decisions about sampling design influenced coefficients. Design criteria include spatial arrangement of plots, spatial grain and record spatial precision extent and the trait distributions of species. These influence inferences drawn about how traits modulate species responses to environmental gradients. Thus, study design close attention if we are to contemplate predicting to new species and new situations.


**Relative controls on wood decay: plant traits, enviornment and microbial communities**

Amy Zanne1, Dr. Marissa Lee1, Amy Milo1, Brad Oberle2, Darcy Young3
1George Washington University, Washington, United States, 2New College Florida, Sarasota, United States, 3Sarasota Bay Estuary Program, Sarasota, United States

Revisiting the holy grail: do functional traits predict ecological processes?, Meeting Room 6, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**
Amy Zanne is an Associate Professor at George Washington University, USA. Her lab examines how various taxa, especially plants, microbes and termites are constructed, as well as how they interact under decay to release carbon back to the environment.

Woody plants are one of the largest aboveground terrestrial biotic stores of carbon. As they senesce and decay, they release carbon back to the environment. The rates at which they decompose are determined by the activity of the decay agents, such as microbes, insects, fire and ultraviolet light, as mediated by the wood traits and local environment. Here, I present results from a 7 year decay experiment in MO, USA in which we followed decay trajectories in “rot plots” located in drier ridges and wetter valleys for 21 species of woody plants, including both angiosperms and conifers, that varied in their anatomical, morphological and chemical construction. We also examined changes in the microbial communities found in the wood through time. Our findings suggest that location on the landscape had little influence on rates of decay. Initial wood traits, especially chemical composition had strong controls on rates of decay; however, these influences decreased through time as wood became increasingly decomposed. Similarly, microbial community compositions were more strongly shaped by wood species and traits at earlier stages of decay. These results suggest that at early stages of decay, different wood species may follow different initial trajectories but these differences decline through time. Finally, I will describe several new decay projects occurring in sites across Australia where other decay agents, such as termites, fire and ultraviolet light become important.
How does habitat alter predation risk? A modelling tool to inform conservation initiatives

Dr Rebecca Wheatley¹, Dr Theodore Pavlic², Dr Amanda Niehaus¹, Dr Ofir Levy³, A/Prof Robbie Wilson¹

¹University Of Queensland, St Lucia, Australia, ²Arizona State University, Tempe, USA, ³Tel Aviv University, Tel Aviv, Israel

Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Rebecca is a postdoctoral research fellow at the University of Queensland, investigating how habitat and predation interact to affect mortality in Australian mammals, including the endangered northern quoll. She has broad research interests in animal performance, biomechanics, behaviour and conservation.

Australia has the highest rate of mammalian extinction in the world, with declines being primarily driven by the joint forces of habitat loss and predation by cats and foxes. Despite mounting evidence that habitat loss exacerbates predation risk, we understand very little about which particular habitat features (or combinations of features) increase habitat “safety”. To address this question, we built a customisable agent-based model to predict prey survival in habitats with varying availability of cover, refuges, and obstacles. Our model predicts that these habitat features interact with the predator’s performance capabilities in how they affect predation risk. For example, in simple, open habitats, prey had the worst chance of escape against faster predators with relatively low agility. However, in complex habitats containing many obstacles, prey had the best chance of escape against these predators. We aim to use the model to determine the most important habitat features for predator evasion in the northern brown bandicoot and the endangered northern quoll. However, our model could also be used to inform conservation programs for a wide range of mammalian species, and to help identify important habitat features to include in revegetation initiatives.

The Melbourne Strategic Assessment after five years: What have we learned?

Dr Matt Bruce¹, Dr Steve Sinclair¹, Mr Dave Bryant¹, Dr Tracey Regan¹, Dr Kim Lowe¹, Ms Jessica Kovassy², Ms Renae Measom², Mr Ben Nam²

¹Arthur Rylah Institute, Department of Environment, Land, Water and Planning, Heidelberg, Australia, ²Regulatory Strategy and Design, Department of Environment, Land, Water and Planning, East Melbourne, Australia

Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Matt is a zoologist with research interests in animal behaviour and ecology. He is currently working on the implementation of the ecological program for the Melbourne Strategic Assessment.

The expansion of Melbourne’s urban growth boundary was one of the first strategic assessments in Australia; a landscape scale assessment process that considers cumulative impacts of similar activities on Matters of National Environmental Significance. This includes two threatened ecological communities, six threatened plants and four threatened animals. The ecological component of this program is centered on two large reserves; a 15,000 ha grassland reserve and a 1,200 ha grassy eucalypt woodland reserve, several smaller reserves and an area designated for Southern Brown Bandicoot management. The process has triggered a program of ecological monitoring, modelling and research aimed at tracking the status of species and communities though time and improving our management effectiveness. We’re coming up to the first five-year reporting period for ecological outcomes and it is a useful time to reflect on the progress we have made, the lessons learned and what we need to do in the
future. In this talk I will provide a background to the program, give an overview of the ecological work that is currently taking place and summarise where we see the program going over the next few years.

Extra-floral nectar as a driver of ant communities in seasonally dry Brazil

Prof Alan Andersen¹, Dr Laila Ribeiro², Dr Carlos Silva³
¹Charles Darwin University, Darwin, Australia, ²Universidade Federal de Viçosa, Viçosa, Brazil, ³Universidade Federal de Pernambuco, Recife, Brazil

Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Alan is a University Professorial Fellow with Charles Darwin University. His primary research interests are in the global ecology of ant communities, where he integrates community ecology, biogeography and systematics to gain a predictive understanding of ant community dynamics.

Carbon-rich plant exudates are key resources for arboreal ants, and in the Neotropics extra-floral nectaries (EFNs) are a major source of such exudates. Compared to plants without them, trees bearing EFNs often support a higher abundance and richness of ants. However, it remains unclear if effects on individual trees scale up to influence arboreal ant communities at the site scale. Moreover, many ground-nesting ants also feed on extra-floral nectar, but its role in structuring ground-nesting ant communities is also unclear. We will first describe a study in Brazilian savanna at Serra do Cipó NP, Minas Gerais, showing that not only do trees bearing EFNs have substantially higher richness than do trees without, but that the proportion of EFN-bearing trees is a strong predictor of ant richness at the site scale, independently of overall tree density and richness. Species composition also varied with the proportion of EFN-bearing trees. We will then describe a study in Brazilian caatinga in Catimbau NP, Pernambuco, that examines distances of soil nests of ants in relation to EFN-bearing trees. Nests of species that are heavy users of extra-floral nectar tended to be much closer (mean of 1.2 m) to the nearest EFN-bearing tree than were those of non-users (3.5 m), and those of occasional users (2.8 m) were intermediate. Our findings indicate that EFNs are an important factor structuring communities of arboreal ants at the site scale, and that they are also an important factor driving the spatial structure of ground-nesting communities.

Meta-analysis of tree decline impacts on fauna

Associate Professor Patricia A Fleming¹, Dr Shannon J Dundas¹,³, Dr Michael D Craig¹,², Dr Tracey K Kreplins¹,³, Dr Kobus J Wentzel³, Professor Giles E StJ Hardy¹
¹Murdoch University, Perth, Australia, ²The University of Western Australia, Perth, Australia, ³Department of Primary Industries, Orange, Australia

Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Trish Fleming is a Wildlife Biologist at Murdoch University. She has been studying the complex relationships between plants and animals. This talk represents a review of a decade of research into the links between tree declines and wildlife.

Although tree declines have received considerable scientific attention, surprisingly little is known about their impacts on fauna. This meta-analysis synthesises the results of 61 studies that have quantified the impact of tree declines on abundance responses of 33 arthropod families and 213 vertebrate species. We had insufficient data to make general comments for arthropod, reptile and mammal species. For 362 effect sizes representing 158 bird species, there were significant effects of primary diet, foraging
location, and nesting guild on bird responses to the impacts of tree decline. Woodpeckers and seed-eaters (especially those foraging on the ground) were most likely to show an increase in abundance as a result of tree decline. Nectarivores, canopy feeding birds and hawking/perch-feeding birds were most likely to show a decrease in abundance in the presence of tree decline. There were also significant differences in abundance responses between bird nesting guilds, with ground-nesting birds more likely to show an increase in abundance and canopy nesters a decrease in abundance in the presence of tree declines. These patterns indicate that the loss of canopy has significant impacts on birds in terms of lost food and nest resources, while opening up of the canopy associated with many tree declines and subsequent changes to understory vegetation may benefit ground-feeding species. These results indicate that tree declines have substantial effects on overall ecosystem function and potentially represent a significant threat to forest fauna.

How changing fishing practices can mitigate ecological and economic fisheries losses from fish depredation

Dr Maria Ching Villanueva1, Dr Lavinia Suberg1, Dr Paul Tixier2, Mr Nicolas Gasco3, Ms Anais Janc4, Mr Gaétan Richard2,4,5, Mr Patrice Pruvost3, Ms Charlotte Chazeau3, Prof Guy Duhamel3, Dr Cédric Cotté6, Dr Clara Peron3, Prof Christophe Guinet4

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Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
She uses quantitative models to simulate future ecosystem responses to changes (natural and anthropogenic) and build scenarios on possible management. She works on temperate and tropical freshwaters, brackish waters and marine ecosystems, as well as tropical terrestrial savannah.

Reports of direct and operational fisheries interactions with marine mammals are on the increase globally and poses conservation threats to some of these species. Close interactions of marine mammals with fisheries occur either as an active or passive behavior to depredate caught fish. Such operational encounters can lead to conservation and security threats of depredating marine mammals as well as the fisheries’ economic viability.

In the Kerguelen and Crozet Economic Exclusive zones, some marine mammals were observed to depredate mainly on Patagonian toothfish (Dissostichus eleginoides) caught using demersal longlines. Fish depredation by marine mammals seems to have serious consequences for demersal longline fisheries in the area, especially when they lose valuable catch and face other associated operational and regulatory challenges. Recent use of technological acoustic deterrent provided limited efficiency to reducing longline fisheries production loss. Thus, changes in some fishing strategies were quantified to evaluate their efficiencies in mitigating both bio-ecological and economic losses.

Results showed that depredation probability may be influenced by the season, depth and distance travelled to outrun depredating whale populations. Spatial modeling analyses showed that Patagonian toothfish distribution influenced marine mammal occurrence. Despite this later observation, isotopic analyses seem to indicate that this fish species was not the primary targeted prey of depredating marine mammals. Ecosystem-based approaches will be implemented to provide a holistic overview of ecosystem functioning and dynamics and facilitate implementation of adequate and efficient management plans.
Do florally diverse roadsides support diverse pollinator communities in rural landscapes?

Dr Mark Hall1,2, Dr Manu Saunders1, Dr Dale Nimmo3, Prof Andrew F. Bennett2,4
1University Of New England, Armidale, Australia, 2La Trobe University, Bundoora, Australia, 3Charles Sturt University, Albury, Australia, 4Arthur Rylah Institute, Heidelberg, Australia

Species interactions and the dynamics of ecological systems, Meeting Room 3, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Mark recently completed his PhD with the Centre for Future Landscapes at La Trobe University in Melbourne. His PhD investigated the role of remnant vegetation within agricultural landscapes—occurring along linear roadsides and streams or as scattered paddock trees—for biodiversity conservation.

Changes in land-use globally mean that many species must persist within modified landscapes. The distribution of pollinator species and the composition of assemblages in agricultural landscapes is thought to be driven largely by their ability to find suitable foraging and nesting resources. Here, we used a landscape-level natural experiment to investigate bee community responses to the presence, or loss, of three types of landscape element typical of productive farmland in Australia: streamside tree cover, roadside tree cover, and scattered paddock trees. We selected 24 landscapes (each 1 km diameter), stratified to represent four combinations of these landscape elements: a) landscapes with all three wooded elements present (n=6), b) landscapes lacking riparian trees (n=6), c) lacking roadside trees (n=6), and d) lacking scattered trees (n=6). We surveyed bees at multiple points across each landscape to calculate the impact of the loss of each type of landscape element on alpha, beta and gamma diversity. Alpha (site) diversity increased in landscapes lacking wooded vegetation along roadsides. This result led us to ask what characteristics of such landscape features might benefit pollinator communities. We then selected 32 treeless roadsides within a similar agricultural region and conducted timed searches to record all flower visitors. We recorded plant richness, abundance and diversity to test if these measures increased pollinator diversity within these features. With intensification of farming practices, landscape features that provide adequate foraging resources for bees outside of peak crop flowering periods are needed to sustain communities. Florally rich roadsides may provide these necessary resources.
Snippets of impact science from The Nature Conservancy

Dr Hugh Possingham
SPEEDNOTE PRESENTATIONS, Hall B, November 26, 2018, 2:00 PM - 2:45 PM

Biography:
Hugh is the Chief Scientist of The Nature Conservancy and a 20% Professor at The University of Queensland. His group has achieved outcomes all over the world, for example, Tun Mustapha marine park, the largest in Malaysia declared in May, was a joint project with WWF Malaysia and Sabah Parks. His interests include: conservation metrics, biodiversity offsetting, population modelling, sea-sharing and sea-sparing, prioritising actions, spatial zoning with Marxan and other tools, optimal monitoring and government policy. You can find his papers here https://scholar.google.com.au/citations?user=lSYOB3cAAAAJ&hl=en. Hugh was recently elected a Foreign Associate of the National Academy of Sciences (USA), is a fellow of the Australian Academy of Science and he has two honorary doctorates. He has a debilitating obsession with bird watching.

I will skim across a range of research projects carried out by scientists from The Nature Conservancy that are delivering impact on the ground and in the sea.

Harnessing the microbes associated with soil water repellency to enhance plant survival and growth

Dr Melissa Danks1, Dr Katinka Ruthrof2,3, Professor Graham O'Hara3, Mr Matthew Power4, Professor Michael Bunce5, Mr Sunil Misra5, Dr Paul Storer5, Dr Anna Hopkins1
1Edith Cowan University, Joondalup, Australia, 2Kings Park Science, Department of Biodiversity Conservation and Attractions, Kings Park, Australia, 3Murdoch University, Murdoch, Australia, 4Curtin University, Bentley, Australia, 5Troforte Innovations Pty Ltd, Wangara, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Dr Anna Hopkins is a lecturer in conservation biology and fungal ecology at Edith Cowan University. She has more than ten years experience working with soil microbes, plant-fungal-fauna interactions and fungal plant pathogens in Australasia and Scandinavia.

Soil water repellency (SWR) is one of the fundamental challenges to plant establishment and growth in production and restoration landscapes worldwide. Despite considerable research, it remains a recalcitrant problem for which few persistent, cost-effective alleviation technologies or solutions have been developed. Previous work focused on SWR as a problem to overcome. However, SWR may yield to a new approach that focuses on its potential ecological benefits. This project seeks to understand SWR so that we may temporarily overcome it to establish plants, and then preserve it to act as a “drought-proofing” tool for agricultural and forestry systems. The overarching aim of the project is to develop a mechanistic understanding linking the microbial properties of soils to SWR, and to create products to improve plant establishment and yield. In a pilot study, soil samples were collected from paired repellent and non-repellent soils at three sites and subjected to high throughput sequencing to find common microbial influences involved with SWR. Both fungal-specific (for ITS) and bacteria-specific primers (for 16S) were used to examine a wide range of potentially significant microbes. The findings of this pilot study will inform a larger-scale study to look for microbial patterns in water repellent soils. In collaboration with our industry partners, recommendations will be made for a range of plant and broadacre-scale products that facilitate and exploit SWR.
Unwelcome tenants or essential guests: Do weeds take their microbiomes with them?

**Dr Tracey Steinrucken**1,2, Dr Andrew Bissett1, Assoc Prof Jeff Powell2, Prof Matteo Garbelotto4, Dr Rieks van Klinken1

1CSIRO, Dutton Park, Australia, 2Hawkesbury Institute for the Environment, Western Sydney University, Richmond, Australia, 3CSIRO, Hobart, Australia, 4University of California Berkeley, Berkeley, USA

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**
Tracey uses microbial ecology to answer questions about the causes of plant disease. She is especially interested in biological control and diseases in invasive plants. Currently working for CSIRO, she completed her PhD with Western Sydney University in 2017.

What makes an exotic species more successful in the invaded range? In the native range, most plant species are controlled by abiotic conditions, co-evolved natural enemies, symbionts and competitors. However upon introduction to a new range, many of those mitigating elements are lost while factors that make a plant resilient and competitive remain. This is supported by the endophyte-enemy release hypothesis. Our study aims to characterise endophyte communities of the weed Parkinsonia aculeata to determine if they differ by geographic range and host species, and to identify potentially protective or pathogenic endophytes which influence invasion success. We sampled healthy *P. aculeata* from northern Australia and co-occurring *P. aculeata*, *P. florida* and *P. microphylla* in southern USA. Using MiSeq Illumina sequencing we characterised fungal and bacterial endophyte communities, compared these by range and host species, and identified individual endophyte taxa which influence the composition of these communities. We found significant variation in fungal endophyte community composition by host species and range, and identified a number of fungal species typical of each community. There were no observed host species effects on bacterial endophyte communities, but there was a significant range effect. Invasion success of *P. aculeata* in Australia could not be explained by the presence of potential beneficial endophytes, but the loss of the co-evolved endophytes means that *P. aculeata* is likely to be more susceptible to infection by relatively benign pathogens in Australia. This may explain why *P. aculeata* is affected by dieback here and not in the native range.

Formalising feedbacks: a framework for assessing the role of plant-soil feedbacks in structuring plant communities

**Dr Elizabeth M. Wandrag**1, Ms Sarah B. Bates1, Prof Richard P. Duncan1

1University Of Canberra, Bruce, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

**Biography:**
Lizzie’s research focuses on the role of biotic interactions in structuring plant communities. She has a particular interest in how these interactions might be affected by species loss through extinctions and species gain through invasion.

Feedbacks between plants and soil microbes are increasingly recognised to influence the ability of plant species to coexist and thereby structure plant communities. However, few consistent trends in the factors that might determine the strength and direction of plant-soil feedbacks have emerged. Consequently, we lack an ability to predict when and how plant-soil feedbacks might act to determine things such as invasion by exotic plant species and the success of restoration efforts.
Reasons it has been hard to identify patterns in plant-soil feedbacks are that: 1) there are a variety of ways in which to experimentally examine feedbacks and interpret the data generated; and 2) the role of plant-soil feedbacks in structuring plant communities will depend on their importance relative to other processes.

We demonstrate how existing theoretical models provide a framework to both design plant-soil feedback experiments and interpret the data generated in a way that is comparable among studies. We show how these models can be used to make predictions about the outcomes we expect to see in plant communities due to plant-soil feedbacks. Reanalysing data from the literature using this framework reveals that interpreting a role of plant-soil feedback in structuring plant communities based on the direction of feedbacks alone may be misleading. Moreover, it highlights how integrating results from plant-soil feedback experiments into this framework can allow us to test predictions of when and how plant-soil feedbacks might be important.

**Differential impacts of mycorrhizal fungal communities on plant growth and defences drive the performance of invertebrate herbivores**

**Dr Adam Frew**

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Arbuscular mycorrhizal (AM) fungi can be key drivers of soil health, plant productivity, diversity and community structure. Yet the influence of the AM symbiosis reaches far beyond their host plants. More than half of the world’s described insects feed on living plant material. The growth and fitness of these insect herbivores is largely determined by the quality of their host plants, most of which will form associations with AM fungi. Indeed, AM fungi do not only affect the nutrient status of their host, but also impact plant physiology and secondary chemistry which are significant components of plant resistance to herbivory.

Using a variety of glasshouse and controlled environment experiments on sugarcane (Saccharum spp. hybrids) and wheat (Triticum aestivum) we investigated how AM fungal communities impact plant productivity and secondary chemistry, and how this affects invertebrate herbivores. Combining results from these experiments suggests that inoculation with AM fungal communities can either promote or reduce herbivore performance. This is driven by different mycorrhizal-induced changes in plant growth, nutrient status and defence chemistry, which depend on the host plant species.

Considering the ubiquity of mycorrhizal-plant-invertebrate interactions, it is vital that mycorrhizal fungal communities are effectively incorporated into natural resource management strategies within agriculture, restoration and conservation. However, predicting the strength and direction of the effects of AM fungal communities on aspects of plant success and diversity is often challenged by the context specific nature of the outcomes.
Can soil mycorrhizal fungi help in ecological restoration?

Miss Vicky McGimpsey1, Dr Cristina Aponte1, Dr Rebecca Miller1, Dr Fiona Ede1
1University Of Melbourne, Melbourne, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
I am a PhD student at Melbourne University on the role of soil microbial communities on the success of woody revegetation in riparian ecosystems. I have a strong interest in genetics, evolutionary biology and investigating biological processes.

Restoration success is underpinned by soil communities and microorganisms as they influence plant growth, establishment and survival. Symbiotic mycorrhizal fungi promote plant growth, nutrient acquisition, plant defence, aid in water acquisition, buffer against toxic levels of trace elements in contaminated land and increase a plant’s ability to tolerate environmental stresses. Plant establishment and survival are closely related to mycorrhizal interactions which become increasingly important in disturbed or degraded environments. At this stage, few studies have focused on the changes in mycorrhizal communities with restoration and fewer still have included analysis of vegetation structure. My research shows how the diversity and composition of soil mycorrhizal communities in riparian ecosystems differ on a restoration trajectory and how these changes relate to abiotic soil properties and vegetation attributes. My results will improve our understanding of the role of plant-soil interactions in riparian systems and contribute to the development of evidence-based guidelines for restoration practices that could increase our capacity to efficiently preserve riparian ecosystems.

Arbuscular mycorrhizal fungi reduce nitrous oxide emissions: sterilization but not temperature matter

Dr. Haiyang Zhang1, Prof Sally Power1, Prof Ian Anderson1
1bHawkesbury Institute for the Environment, Western Sydney University, Richmond, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Haiyang Zhang is a biogeochemist. His research interests focus on plant–microbe interactions and below-ground ecology in order to understand the ecosystem functioning and global carbon and nutrient dynamics.

Emerging evidence shows that arbuscular mycorrhizal fungi (AMF), the symbiosis that associate with most (~80%) terrestrial plants species, has a controlling influence on greenhouse gas emissions including N2O fluxes. There are multiple possible mechanisms responsible for this effect including N competition between AMF and nitrifying bacteria or through direct alteration of the microbial community. Moreover, since N2O losses and AMF colonization are both expected to increase under warmer condition, we hypothesised that AMF-mediated reduction of N2O should be larger under warming scenarios. To test for a functional relationship between AMF and N2O emissions, we manipulated the abundance of AMF (adding inoculum or not) in sterilized and non-sterilized soil for a legume (Lucerne,) and non-legume species (Fescue) under ambient (aT, 26 °C) and elevated temperature (eT, 30 °C) in a glasshouse pot experiment. For sterilized soil, N2O emissions were significantly reduced when the AMF community was well-established compared to the microcosms without that community. Furthermore the reduction in emissions tended to be either consistent or even greater under eT, suggesting that AMF regulate N2O emissions both under aT and eT. Interestingly, these AMF mediated-effects were absent for non-sterilized soil. Further analysis will examine the
complete microbial community as well as the expression of selected genes responsible for N2O production (nirK) and consumption (nosZ). Our results suggest that the N2O-reduction effect of AMF symbiosis is maintained under warming climate conditions and the disruption of the AMF symbiosis through intensification of agricultural practices may further contribute to increased N2O emissions.

Drivers of mycorrhizal fungi and root pathogens in threatened woodlands of the Cumberland Plain

Jeff Powell1, Jennifer Walker1, Catriona Macdonald1, Ian Anderson1
1Western Sydney University, Penrith, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Jeff Powell is a Researcher in the Hawkesbury Institute for the Environment, where he works in the fields of plant, microbial and soil ecology.

In NSW, there is an ongoing effort to restore and rehabilitate native Cumberland Plain woodland (CPW) ecosystems, particularly those impacted by invasive species. Soil microbes likely play an important role in supporting growth of plants in these woodland soils due to their typically low nutrient availability. For instance, mycorrhizal fungi form associations with roots of many CPW plant species. These fungi are important drivers of ecosystem productivity and carbon storage, yet we lack an understanding of what drives their distributions beyond broad generalisations of their roles in particular biomes. In addition, root pathogens are candidate drivers of dieback in many forest and woodland systems in Australia, with oomycetes receiving a significant amount of recent attention.

Field experimentation, combined with microscopic measures and high-throughput sequencing of soil and roots reveals patterns of changing abundance and species composition in mycorrhizal fungal and oomycete communities in response to soil properties and as trees age. In addition, our evidence from the Eucalyptus Free-Air Carbon Enrichment experiment suggests that these changes may be exacerbated under future atmospheric carbon dioxide concentrations. More data are needed to identify the best-integrated approach to improve soil health and CPW restoration outcomes, particularly in the presence of additional threats associated with climate change and human activities.

Invasive plant-soil feedbacks: insights from Australian acacias in South Africa’s fynbos biome

Dr Johannes Le Roux1, Ms Staci Warrington2, Mr Jan-Hendrik Keet3, Prof Cang Hui4, Dr Allan Ellis3
1Department of Biological Sciences, Macquarie University, Sydney, Australia, 2Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa, 3Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa, 4Centre for Invasion Biology, Department of Mathematical Sciences, Stellenbosch University, Stellenbosch, South Africa

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Jaco Le Roux is an Associate Professor in the Department of Biological Sciences at Macquarie University. His research interests include invasion genetics, plant evolutionary biology, plant phylogeography, and the dynamics of plant-soil bacterial interactions.

Reassembly of biotic interactions by non-native plants play a key role in their establishment success following introduction into new areas. These plants can be co-introduced with their symbionts or form
novel associations in their new ranges. These two pathways can lead to positive feedbacks between interacting partners, but may differ in the rate of accrual, and extent of, subsequent invader impacts. We will illustrate that invasions by Australian acacias in South Africa’s hyper-diverse fynbos biome are often characterised by co-invasions with their nitrogen-fixing rhizobial symbionts. Next generation sequencing (NGS) and functional genomic data further revealed that acacias enrich and homogenise invaded soils for these mutualists. Subsequent positive feedbacks associated with overall soil changes, i.e. rhizobial X abiotic conditions, enhanced the performance of acacias. Despite this, effective nodulation by rhizobia seems more important to early growth performances of acacias when encountering novel soils compared to invaded soils. Homogenization of rhizobial communities in invaded areas was mimicked by most other bacterial taxa present in soils, i.e. whole soil microbiomes. NGS DNA barcoding illustrated that pristine (uninvaded) fynbos soils are characterised by high microbial community turnover, possibly reflecting high turnover in above-ground community components. This signal, however, was diluted by the presence of dense monotypic acacia infestations, even over large spatial scales. We will discuss the implications of our findings for the restoration of acacia-invaded fynbos regions.

Genome size and ecological strategies across bacteria and archaea

Mark Westoby
1Macquarie Uni, Sydney, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Westoby has been at Macquarie Uni since 1975. He has at different times worked on diet selection by herbivores, state-and-transition modeling for vegetation, mother-offspring relations in plants, and plant ecological strategies via measurable traits.

Genome size varies widely across bacteria and archaea. It reflects mainly the number of different genes present, more so than genes in multiple copies. Among culturable species, genome size varies largely independently from cell size (which strongly influences diffusive uptake of substrates into the cell) and from potential rate of increase (which strongly influences use of resource bursts). Recent reports indicate genomes tend to be larger in species from soils than from guts or thermal environments, with freshwater and marine environments intermediate. In the course of a collaborative project to develop ecological strategy schemes, we have synthesized as much trait information as possible from species worldwide and spanning all habitats including plant and animal hosts, soils and sediments, and marine and fresh waters. It appears that species using oxygen as electron acceptor tend to have larger genomes. Genome size differences between broad habitats can largely be understood as a by-product of this effect. The results are considered in relation to four different literature hypotheses about what circumstances or processes should favour larger genome size. We consider also what sorts of genes are more abundant in larger genomes (what COGs, clusters of orthologous groups), and how this evidence relates to the competing hypotheses.
Understanding substrate and microbial community effects on decomposition

A/Prof Will Cornwell1, A/Prof Amy Zanne2, Dr. Marissa Lee3, Dr Brad Oberle4, A/Prof Jeff Powell5
1UNSW Sydney, Sydney, Australia, 2George Washington University, Washington, USA, 3North Carolina State University, USA, 4North Central Florida University, USA, 5Western Sydney University, Richmond, Australia

SYMPOSIUM: Applying microbial communities to improve restoration and conservation outcomes, Meeting Rooms 1-2, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Into plants and fungi and ecosystems. Enjoys the subtleties of organic matter decomposition.

Ecosystem process rates are governed by a combination of the environment and the organisms involved as well as in interaction between the two. Priority effects are one potential mechanism through which the presence of particular species could slow (or speed) decomposition rates. These effects have been observed through experimental manipulation of decomposer communities but little is known about how endophytic fungi, present prior to initiation of the decay process, may contribute to priority effects. To test the relative magnitudes of the substrate and community we characterised endophytic fungal communities (ITS2 sequencing using Illumina MiSeq) and wood functional traits in stems sampled from 22 species of plants growing in woodlands near Richmond, NSW, Australia. We then let the wood decompose for 5 years with sequential harvests. Initial communities of wood dwelling fungi were very diverse, including an average of 165 taxa per sample. Differences in composition depended on both measured and phylogenetically structured wood traits with water content and carbon concentration were especially important in delineating fungal communities, as were putative facilitative interactions among fungal taxa. The wood traits were good predictors of decomposition rate but there was only very weak and context dependent power of the fungal community samples after wood traits were taken into account. This suggests that priority effects may be less consequential that previously shown, particularly in unmanipulated and diverse microbial communities established prior to the initiation of decay.

Effect of captivity on morphology: negligible changes in external morphology mask changes in internal morphology

Dr Stephanie Courtney Jones1, Dr Adam Munn2, Dr Phillip Byrne1
1Centre for Sustainable Ecosystem Solutions, University Of Wollongong, Wollongong, Australia, 2University of New South Wales, Kensington, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Stephanie is an applied ecologist with an interest in assisted evolution, translocations, conservation technology, community ecology and their applications for conservation biology. She specialises in using various behavioural and physiological techniques for conservation applications.

Captive breeding programmes are increasingly relied upon for threatened species management. Changes in morphology can occur in captivity, often with unknown consequences for reintroductions. Few studies have examined the morphological changes that occur in captive animals compared with wild animals. Further, the effect of multiple generations being maintained in captivity, and the potential effects of captivity on sexual dimorphism remain poorly understood. We compared external and internal morphology of captive and wild animals using house mouse (Mus musculus) as a model species. In addition, we looked at morphology across two captive generations, and compared morphology between sexes. We found no statistically significant differences in external morphology, but after one generation in captivity there was evidence for a shift in the internal morphology of captive-reared mice,
captive-reared mice (two generations bred) had lighter combined kidney and spleen masses compared with wild-caught mice. Sexual dimorphism was maintained in captivity. Our findings demonstrate that captive breeding can alter internal morphology. Given that these morphological changes may impact organismal functioning and viability following release, further investigation is warranted. If the morphological change is shown to be maladaptive, these changes would have significant implications for captive-source populations that are used for reintroduction including reduced survivorship.

Identifying climate refugia for threatened species in New South Wales

Dr Linda Beaumont1, Dr Manuel Esperon-Rodriguez1,2, Dr John Baumgartner1
1Macquarie University, North Ryde, Australia, 2Hawkesbury Institute for the Environment, Western Sydney University, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Linda Beaumont is a Senior Lecturer at Macquarie University. She researches responses of species and communities to climate change and implications for conservation, biosecurity and land management.

The identification of refugia for species from climate change is increasingly considered important for conservation. However, conservation decision-making may be impeded due to uncertainty arising from the use of alternative, yet plausible, climate scenarios. Here, we describe our approach for mapping different types of refugia across the spectrum of plausible future climates from now to 2070, for 319 species threatened in NSW, using the habitat suitability model Maxent. Importantly, this information can be used to identify appropriate management actions and prioritise populations for conservation. For each species, we identified areas that are climatically suitable now and under all climate scenarios until 2070. For these areas, we distinguished between locations that are also a) currently occupied or b) currently unoccupied, categorising these as internal refugia and potential translocation regions, respectively. We find that by 2070, 207 species are likely to have limited areas that are either internal refugia or potential translocation regions – the tolerance of these species to climate change needs to be urgently assessed. In contrast, 65 species are likely to retain both types of regions, and hence have lower exposure to climate change. For 25 species, regions for translocation are limited, meaning this action likely unviable; internal refugia for these species should be managed appropriately to maximise resilience. Twenty-two species have very limited internal refugia, however, since they have regions identified as potentially suitable for translocation, this option should be further explored. Finally, we highlight our approach to developing a website to communicate this information to end-users.
Addressing climate impacts on rare species when restoring critically endangered Lowland Subtropical Rainforest

Mr Paul Donatiu1
1Healthy Land And Water, New Farm, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Paul undertakes HLW restoration projects on the Gold Coast. Paul has worked for WWF, GAQ and NPAQ, and completed a Fellowship that examined how national agencies in Europe, USA and South Africa were dealing with climate impacts on protected areas.

The Gold Coast hinterland is a rich environment characterized by a diverse topography that includes some of the last relatively intact tracts of critically endangered lowland subtropical rainforest (LSR) in Southeast Queensland. Over a decade, a collaborative restoration program has improved the integrity of remnant LSR along Mudgeeraba Creek in the Austinville Valley near Springbrook, but recent extreme weather events have raised questions about the local persistence of rare species against the backdrop of a changing climate.

As the regional natural resource management body for Southeast Queensland, Healthy Land and Water (HLW) provides funding for restoration projects that conserve and protect habitat for threatened species. Part of this work is to build land manager interest in the projected climate impacts on these species, and their capacity to mitigate these impacts through practical on-ground actions.

This presentation will focus on the short (extreme weather such as tropical cyclone Debbie) and longer-term (drying and higher temperatures) impacts of climate change on select EPBC and QNCA listed species found within remnant LSR on the Gold Coast hinterland. It will describe how land managers are responding to these impacts on-ground (identifying changes in species composition, conserving refugia, and changing their restoration practice) as a basis for conserving lowland subtropical rainforest and its constituent threatened flora and fauna.

Assessing impacts of climate change on landscape sensitive threatened species

Dr Rajesh Thapa1, Dr Hanieh Saremi1, Ms Janeen Robb2, Mr Jamie Love2, Dr Michael Drielsma2
1University Of New England, Armidale, Australia, 2Office of Environment and Heritage, Armidale, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Hanieh Saremi is a postdoctoral researcher at University of New England. Her research includes; forestry, soil science and biodiversity assessment using spatial analysis tools (GIS/RS). Her recent research focuses on climate change impacts and biodiversity conservation using spatial modelling.

Over the past decades, several approaches and tools including species distribution models (SDMs) have been developed to predict the response of biodiversity to climate change. Here, we have used rapid evaluation of metapopulation persistence (REMP) approach to predict occupancy patterns and identify areas that provide habitat for the persistence of 30 threatened species under future climates of CSIRO (a warm/dry scenario) in NSW. REMP metapopulation modelling integrates cost-benefit approach (CBA) with existing analytical techniques and uses a small set of species ecological parameters including movement abilities. We modelled the distributions of the species, using SDMs (MaxEnt models based on
biodiversity database records), which were made for seven timeseries with decadal intervals (2010–2070) and three regional climate models (R1, R2 and R3). Four scenarios were tested, including pristine (pre-industrial), modified (extant vegetation and its condition), pristine coupled and modified coupled (in coupled scenarios, unlike the other scenarios, each time step is dependent on the previous time step). With our data, grey-headed flying-fox, little bentwing-bat and rose-crowned fruit-dove showed a significant increase in persistence by 2070, while little lorikeet and painted honeyeater showed no change in area of occupancy through the years. The rest of the species modelled (80%) are expected to lose substantial amounts of preferred habitat in 70-year period. Although SDMs are a fundamental tool for habitat distribution predictions; the use of REMP ensures that the resulting models are also fitted according to the adequacy of available habitat area, and the metapopulation dynamics of in the species.

An integrated assessment of biophysical and socio-economic climate change impacts on species habitat.

Mr Simon Kapitza1, Dr Pham Van Ha2, Ms Natasha Cadenhead1, Prof Brendan Wintle1, Dr Nicholas Golding1, Dr Payal Bal1, Prof Tom Kompas1,2
1School of Biosciences, University Of Melbourne, Parkville, Australia, 2Crawford School of Public Policy, Australian National University, Acton, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Simon Kapitza is interested in developing and implementing tools for assessments of biodiversity change in response to various direct and indirect drivers. His main focus is on computational implementation and meaningful integration of models from various disciplines.

How the dynamics of the world economy affect species and ecosystems is poorly understood. Variations in global commodity demand lead to changes in global land use, which in turn affects species habitat. Previous studies have focussed on only subsets of this system, but understanding how these drivers interact is critical to facilitate predictive trade and land-use policy analysis.

We developed a multidisciplinary analytical framework to integrate variations in commodity demand, land-use change and species distributions across large spatial scales. First, we use computable general equilibrium (CGE) models to simulate global commodity demand. Second, we link simulated commodity demand changes with a new spatially explicit fine-scale land-use model. Third, predicted land-use time series are linked with species distribution models. Our framework enables prediction of biodiversity outcomes under competing economic scenarios, whilst retaining information about habitat changes of individual species.

We applied this framework to explore the medium-term (~50 years) direct (biophysical) and indirect (via commodity demand and land use change) impacts of climate change on the habitat of 750 bird species in Vietnam and 650 bird species in Australia. This new research applies recent advances in CGE modelling by explicitly quantifying climate change impacts on the global economic equilibrium. Results show that overall, climate change strongly affects habitat directly and climate change mitigation remains a key priority. In Vietnam, climate change also affects human production systems with beneficial outcomes for species. In Australia, key habitat largely occurs in unused areas and the indirect impacts of climate change are small.
Innovative cloud-based tools for ecological modelling

Ms Sarah Richmond1, Dr Chantal Huijbers1, Mr Siddeswara Guru2

1Griffith University, Griffith University, Australia, 2TERN, University of Queensland, 4072

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Sarah Richmond is a Project Manager in eResearch at Griffith University. With a research background in ecology, she has a special interest in enhancing environmental research through digital solutions by building user-friendly cloud platforms for accessing data and analysis workflows.

Recent technologies have enabled consistent and continuous collection of ecological data at high resolutions across large spatial scales. The challenge remains, however, to bring these data together and expose them to methods and tools to analyse the interaction between biodiversity and the environment. These challenges are mostly associated with the accessibility, visibility and interoperability of data, and the technical computation needs to interpret the data. Here we present a suite of tools that provide easy access to data and analysis methods for both novice as well as expert ecological modellers. The Biodiversity and Climate Change Virtual Laboratory (BCCVL) is a point-and-click online platform for modelling species responses to environmental conditions, which provides an easy introduction into the scientific concepts of models without the need for the user to understand the code behind the models. For ecologists who write their own modelling scripts, we have now developed ecocloud: a new online environment that provides access to data connected with analysis tools like RStudio & Jupyter Notebooks and cloud-based virtual desktop environment using Australia’s national cloud computing infrastructure. ecocloud is built through collaborations among key facilities within the ecosciences domain, establishing a collective long-term vision of creating an ecosystem of infrastructure that provides capability to enable reliable prediction of future environmental outcomes. Underpinning these tools is an innovative training program, ecoEd, which provides cohesive training and skill development to university lecturers and researchers enabling them to combine theoretical concepts with real-world applications.

A toolbox for climate-ready revegetation: communicating science to end users

Dr. Nola Hancock1, Dr. Rebecca Harris2, Dr. Linda Broadhurst3, Pro Vice-Chancellor (Research Integrity and Development) Distinguished Professor of Biology Lesley Hughes1

1Macquarie University, North Ryde, Australia, 2Antarctic Climate & Ecosystems CRC, University of Tasmania, Hobart, Australia, 3CANBR/CSIRO NRCA, Canberra, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Dr. Nola Hancock is a researcher at Macquarie University (Biological Sciences). Nola has worked on a diverse range of climate change adaptation projects but her main research interest is to improve ecological restoration practices under climate change.

Accelerating climate change and the associated increase in the frequency and intensity of extreme weather events create substantial challenges for natural landscape management. The revegetation of degraded landscapes plays a key role in natural resource management (e.g. habitat for biodiversity conservation and carbon storage for CO2 emission abatment). Climate change presents a fundamental dilemma to revegetation practice because current vegetation assemblages may not exist in the decades to come. These changes raise the difficult question of ‘what species should be planted now?’ because species that are being planted under current conditions may not be sustainable in situ in the future.
This presentation introduces the publication 'Climate-ready revegetation. A guide for natural resource managers' and explains how complex science was developed into a tool box for planning. The Guide brings together online tools that can assist land managers / ecological restoration practitioners in revegetation decision making. The Guide consists of step-by-step instructions on where to find and how to use climate projections; how to use bioclimatic envelopes to assess the sustainability of plant species at a particular location; and presents a synopsis of the current thinking about seed provenance strategies. To make the Guide accessible to the end users, a 16-page booklet, an electronic version http://anpc.asn.au/resources/climate_ready_revegetation and a downloadable pdf were produced. Lessons learnt (or reinforced) include managing funding constraints, developing layout and content in consultation with stakeholders, and the value of workshops.

How can Government address climate change adaptation challenges in biodiversity conservation

Miss Polly Mitchell

1Nsw Office Of Environment And Heritage, Sydney, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Polly Mitchell is the Senior Team Leader in Climate Change Adaptation for the OEH. She is experienced in biodiversity conservation, strategic planning and climate change adaptation. She currently leads a program integrating adaptation solutions into urban and natural environmental management.

The NSW Office of Environment and Heritage has been implementing a program of work to integrate climate change adaptation into land management and biodiversity conservation. NSW National Parks and Wildlife Service (NPWS) has developed a strategy to operationalise climate change adaptation into the management of our National Parks. Through extensive engagement workshops with NPWS experts, adaptation pathways were developed for each of the functional responsibility of NPWS (e.g. biodiversity conservation, fire management, pest and weed management). The pathways identify what technological solutions and adaptation responses can be actioned, and what monitoring trigger is needed to identify the increasing impacts from climate change. The implementation of the pathways in both strategic planning and operational management ensures options for protection are identified, planned for and enacted prior to the loss of the assets. The NSW Adaptation Research Hub Biodiversity Node outputs deliver research that can be operationalised directly into the adaptation decision making of NPWS. The research such as revegetation guides, projected changes in wildlife pathogens and disease spread and climate refugia for future suitable sites provide practical tools to inform adaptation planning in biodiversity conservation management.
Incorporating habitat suitability in to community modelling: ants in the Australian Wet Tropics

Dr Somayeh Nowrouzi

James Cook University, Cairns, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (1), Hall A, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Somayeh Nowrouzi came from Iran to Australia in 2011 as a visiting scientist collaborating with CSIRO Ecosystem Science, Darwin. She received a PhD scholarship from James Cook University on macroecology of ants. She is now working on YCA in Cairns.

Understanding how species’ diversity and distributions respond to climate change is a major focus of ecology and conservation biology. However, forecasting climate change impacts on certain species is often challenging because of a) a lack of comprehensive species-level data, especially in tropical regions, and b) influences from indirect impacts of climate change such as altered habitat condition. Here we use a community-level approach, Generalised Dissimilarity Modelling, to assess the impacts of climate change on rainforest ant communities in the World Heritage-listed Australian Wet Tropics (AWT). Major gradients of turnover in ant composition were modelled using records for ~300 ant species sampled at 150 sites across six mountains. Through calculating the predicted compositional dissimilarity among sites, we determined the current effective area of similar ecological environments (SEE) for classes of ant community and subsequently, the expected change in species occurrences under two future climate projections for the years 2035, 2055 and 2085. Our models indicated that current rainforest ant communities will lose effective area of SEE under both climate change scenarios. The highest risk of reduction in area of SEE is projected in drier inland areas of the AWT and therefore we expect major compositional turnover in such locations due to substantial changes in rainforest habitat, in addition to the direct effects of a changing climate. These findings emphasise the importance of incorporating habitat suitability into future projections of species turnover, particularly for tropical rainforest communities where the vegetation is projected to transition to savanna and therefore drive significant compositional changes.

Leaf traits with water use efficiency with drought mortality of two native Australian acacia species

Dr. Rumana Yeasmin, A/Prof Stephen Bonser

UnSW, Sydney, Australia, Belmore, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
My research focus on the area seeking new insight into the plant ecophysiology as well as their interaction with their environment both above-ground and below-ground, plant and leaf level physiological responses associated with future climate change and extreme weather events

Drought-induced events of massive tree mortality appear to be increasing worldwide. We examined growth pattern, multiple leaf-scale traits, including foliar isotopic composition (13 C), rates of photosynthesis and their relationships with pre-dawn leaf water potential (as an index of soil water availability) of two acacia species; Acacia deanei (A. deanei) issued from an arid zone and Acacia longifolia (A. longifolia) from mesic zone of Australia in combination with a drought period. Saplings were subjected to well-watered (control) and drought treatments under greenhouse condition until drought induced mortality. Low soil water content can limit photosynthesis by reducing stomatal
conductance. Decreased growth, coupled with a sharper increase in foliar 13 C during extreme drought in dead saplings, indicate a more conservative water use strategy for A.deanii. The different physiological behavior of the two-acacia species in response to drought (further supported by data from surviving saplings) may have influenced mortality rates, which contributed to greater survival for A. deanei over the lifespan of the saplings. Overall, our findings show that A. longifolia experienced more difficulty in adapting under drought conditions, where, A. deanei is a promising drought-resistant plant species for rehabilitation of dry areas.

The effects of tropical cyclones on forest structure and composition of tropical and subtropical forests

Gunnar Keppel1, Thomas Ibanez2
1University of South Australia, Adelaide, Australia, 2Institut Agronomique néo-Calédonien, Noumea, New Caledonia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Gunnar is an associate professor at the University of South Australia. His research focuses on the ecology and biogeography of islands, and the role of refugia and refuges in moderating the effects of climate change.

Tropical cyclones are large-scale disturbances that regularly impact tropical forests, and their intensity and position are predicted to change as a result of global warming. Here we show, using a pantropical dataset (438 plots ≥ 0.1 ha, pooled into 250 1 x 1-degree grid cells) that cyclones are impacting the structure and composition of tropical and subtropical forests in the long-term. We computed maps of cyclone frequency and energy released by cyclones per unit area (power dissipation index, PDI) using a high-resolution historical database of TCs trajectories and intensities. We then related PDI to forest structural features, controlling for climate and human disturbance. Forests subject to frequent cyclones and high PDI exhibited higher stem density and basal area, and lower canopy heights. Furthermore, using a dataset of 45 large (1 ha) plots and species abundance distributions (SADs), we show that cyclones reduce the number of rare species in forests. Our results provide the first evidence that TCs have a long-term impact on the structure and composition of tropical and subtropical forests in a globally consistent way. The projected increase in intensity and poleward extension of TCs due to anthropogenic climate change may therefore have important and lasting impacts on the structure and dynamics of forests in the future.

Impacts of climate change on the Biodiversity of the Alpine region

Dr Rajesh Thapa1, Mr Jamie Love2, Dr Michael Drielsma2, Ms Janeen Robb2, Dr Michael Reid1
1University Of New England, Armidale, Australia, 2New South Wales Office of Environment and Heritage, Armidale, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Postdoctoral researcher spatial at the University of New England and his PhD assessed Australian native vegetation productivity-response to wetting and drying. Research interest includes application of GIS remote sensing in understanding change, biodiversity, land use, floodplain, vulnerability, resilience and climate-change.

Alpine regions are important biodiversity hotspots with high levels of endemism. As is the case worldwide, biodiversity in the Australian Alpine regions is now under threat. This study assesses the direct influence of near and far future climate change on species composition and the expected impacts
on the biodiversity of Alpine regions in NSW and ACT and their surrounding region. Methods include forward projecting generalised dissimilarity models of species composition and integrating these projections with habitat condition and connectivity models in a biodiversity assessment framework. The most immediate impacts of climate change within the greater study area are expected outside of alpine areas, in productive lower-altitude lands between Wagga Wagga and Griffith. Biodiversity in alpine areas is expected to change at a slower rate with the greatest change in species composition predicted along the south eastern, south western and northern parts of Kosciuszko National Park and its surrounds. Projected shifts in species composition are multidirectional, with majority of migrations towards higher altitudes. Mountain tops at the edge of climate gradients, lack migration options as temperatures increase, and as colder, high-elevation climate envelopes contract. The patterns of response were found to be varied, as some species have greater tolerances to changed environmental conditions than others. Over time, the persistence of an increasing proportion of continental biodiversity is expected to rely on the Alpine region, increasing competition for space, and necessitating tough management decisions.

Modelling the current and future relationship between vegetation greenness, climatic water balance and habitat resources

Prof Brendan Mackey, Dr Sandy Berry
Griffith University, Southport, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Brendan Mackey has a PhD in tropical forest ecology and is Director of the Climate Change Response Program at Griffith University. He is coordinating Lead Author for Chapter 11 Australasia, Working Group II Contribution to the IPCC Sixth Assessment Report.

Here we report on recent research into identifying a biologically meaningful climate variable that capture water-energy availability and which is suitable for high resolution (250 m × 250 m) dynamic spatial modelling of the mean fraction of photosynthetically active radiation (fpar) intercepted by the sunlit canopy; a major variable in modelling of ecosystem primary productivity. Mean annual water availability indices yielded strong linear relationships, opening the way to project how future climate might impact on ecosystem productivity. Whilst empirical, these relationships are robust as they are founded in well established eco-physiological principles. Invoking Southwood’s habitat templet theory, we can use the relationship between fpar and climatic wetness to model current and future habitat productivity regimes, thereby providing additional data to support models of species distributions and ecosystem dynamics in response to a rapidly changing climate. This approach is illustrated using the Australian continent as a case study and MODIS-based fpar time series data.
Magnitude, pattern, pace of change in the distribution of Australia’s threatened species under climate change

Dr Ramona Maggini1,2, Dr Heini Kujala3, Prof Hugh P. Possingham1,4, Prof Brendan A. Wintle3, Dr Martina Di Fonzo1, Dr Martin F.J. Taylor5, Prof Richard A. Fuller1

1ARC Centre of Excellence for Environmental Decisions (CEED) & Centre for Biodiversity and Conservation Science, School of Biological Sciences, The University of Queensland, Brisbane, Australia, 2School of Earth, Environmental and Biological Sciences, Queensland University of Technology (QUT), Brisbane, Australia, 3ARC Centre of Excellence for Environmental Decisions (CEED), School of Botany, University of Melbourne, Melbourne, Australia, 4The Nature Conservancy (TNC), Brisbane, Australia, 5WWF-Australia, Brisbane, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Ramona is an ecologist with expertise in geographic information systems, spatial analyses and species distribution modelling that she uses to inform decision-making and spatial planning for biodiversity conservation, in particular in the face of climate change.

Palaeo and future climate shifts in koala browse species

Dr Farzin Shabani1, Dr Mohsen Ahmadi2, Dr Frédérik Saltré1, Dr Katharina J. Peters1, Prof Simon Haberle3, Prof CJA Bradshaw1

1Global Ecology, College of Science and Engineering, Flinders University and ARC Centre of Excellence for Australian Biodiversity and Heritage, GPO Box 2100, Adelaide, Australia, 2Swiss Federal Research Institute WSL, Dynamic Macroeconomy Group, Birmensdorf, Switzerland, 3Department of Archaeology and Natural History, College of Asia and the Pacific, The Australian National University, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM
Biography:
I am an Associate Investigator in palaeo-ecological vegetation modeling for the new ARC Centre of Excellence for Australian Biodiversity and Heritage. I am working with Professor Corey Bradshaw and Dr Frédérik Saltré at Flinders University.

Koala distribution is currently restricted to eastern and south-eastern Australia but there are evidences (fossil records) of koala presence from as late as 70 ± 4 ka from regions of southwestern Australia and the Nullarbor Plain. We hypothesised that (i) koala population extinctions, at least since the Last Interglacial, resulted from the eastward retraction of primary browse species in response to changing climatic conditions and (ii) further general reduction in the distribution of primary koala browse trees in the near future would be caused by the rapid pace of ongoing climate change. We identified eleven primary koala browse species and constructed species distribution models for five time periods: Last Interglacial, Last Glacial Maximum, Mid-Holocene, the present, and 2070. We generated an ensemble model of habitat suitability using five correlative models based on five hindcasts and a forecast climatic variables, and topsoil clay fraction that we compared with 17 koala fossil reliable dated specimens (from the FosSahul database). We show that primary browse species were at their greatest extent of suitability during the Last Glacial Maximum, with the greatest loss of koala habitat occurring between the Mid-Holocene and the present. We predict a similar loss of habitat between the present and 2070. The spatial patterns of habitat change of tree species support our hypothesis that koala extinctions resulted from the eastward retraction of primary forests in response to long-term climate changes. Future climate patterns are also likely to increase the extinction risk of koalas in their remaining eastern ranges.

Are Australian plants adapting to climate change?

Mrs Susan Everingham¹, Prof Angela Moles², Dr Cathy Offord²
¹UNSW, Narrabeen, Australia; ²The Australian Botanic Garden, Mount Annan, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (2), Hall A, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Susan is a PhD student at UNSW. Her research focuses on broad scale patterns in plant adaptation and evolution, particularly the effects of climate change on plant species. She also applies these concepts to practical outcomes in conservation.

Indisputable evidence for global climate change has sparked a mass of research about the responses of species and ecosystems to altered climate conditions. Plants are unlikely to be able to migrate fast enough to keep pace with predicted rates of climate change. If plants are to avoid extinction, they may need to adapt in situ to mitigate the dramatic effects of climate change. Our research aims to determine if plants have already adapted to recent climate change in traits such as height, seed mass, photosynthetic rate, water use efficiency, LMA. Using old seeds, banked in seed banks across Australia, we compare these individuals to modern seeds collected in fieldwork. We hypothesise that in regions where the climate has changed more dramatically in temperature and precipitation, plants will have changed more in their traits.
Phenotypic plasticity to heat and cold: mapping trait responses across temperatures in an alpine herb

**Alexandra Catling¹, Dr Pieter Arnold¹, Prof Loeske Kruuk¹, Prof Adrienne Nicotra¹**

¹Australian National University, Canberra, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
I am an Honours student involved in the ARC-funded project ‘Multi-trait plasticity in response to a changing climate’ supervised by Adrienne Nicotra, Loeske Kruuk and Pieter Arnold. My research interests are ecophysiology and genetics in both natural and agricultural systems.

Climate change threatens the persistence of Australian alpine plants due to increasing frequency of exposure to extreme events such as aseasonal frosts and heatwaves. The ability of plants to alter their phenotype in response to environmental variation, known as phenotypic plasticity, may be a crucial pathway in enabling the persistence of plant species under novel conditions. The typical approach to assessing phenotypic plasticity involves generating linear reaction norms from traits measured in two different environments. This simplifying assumption of linearity may mask complexity in the shape of the response which a high-resolution reaction norm would otherwise reveal. To map reaction norms of plant traits in response to temperature, I grew Australian alpine waxy bluebells (Wahlenbergia ceracea) across a gradient of 12 temperatures and measured the response of germination, leaf number, leaf mass per unit area (LMA), and chlorophyll content. Thermal tolerance was assessed as the temperature at which 50% damage to photosynthetic machinery occurs (LT50) under heat and cold stress. I employed random regression mixed models to quantify non-linear trait responses and compare phenotypic plasticity of different traits. I assessed the effect of thermal acclimation on characteristics of thermal physiology and investigated whether thermal acclimation broadens the thermal tolerance range or shifts it such that tolerance to one extreme temperature is gained at the cost of the other. My findings demonstrate that assessing plant phenotypic plasticity over many temperatures allows us to map reaction norms more accurately and will improve our inference of plant responses to novel conditions.

Phenotypic plasticity in a changing climate: a multispecies, multi-site investigation into plant functional traits

**Miss Sonya Geange¹, Prof. Fernando Valladares², Prof. Mark van Kleunen³, Assoc. Prof. Christina Richards⁴, Dr Silvia Matesanz², Ms Nicola Aitken¹, Dr Meisha-Marika Holloway-Phillips¹, Prof. Adrienne Nicotra¹**

¹Division of Ecology and Evolution, Australian National University, Canberra, Australia, ²Museo Nacional de Ciencias Naturales, CSIC, Madrid, Spain, ³University of Konstanz, Konstanz, Germany, ⁴University of South Florida, USA

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
Sonya Geange, PhD Candidate at ANU, conducts comparative ecological studies on phenotypic plasticity in plant water use traits. She also researches Australian alpine plant ecology, in particular responses to climate change along elevation gradients.
Current predictions of environmental change threaten to out-pace developmental, genetic and demographic capacities of plants. Phenotypic plasticity is a mechanism by which plants may persist under rapidly changing environments. However, many crucial questions remain, including: (1) what functional traits exhibit plasticity? (2) does the degree of plasticity differ within and between species? and, most importantly, (3) does phenotypic plasticity in plant functional traits correlate with plant fitness? To try to answer these questions, phenotypic plasticity in key functional traits was estimated for 36 species spanning semi-arid, alpine and coastal habitats. Each of the three habitats were represented within Australia, six species per habitat, and once within each of the overseas countries; Spain - semi-arid, Germany - alpine, and the US - coastal, with six species each. Two years of observational data revealed plasticity in traits such as SLA and leaf area to stem mass ratio varied highly among species, with substantial seasonal variation occurring within some species. Preliminary analysis also indicates that increased plasticity in traits such as SLA is associated with fitness, measured as higher growth rates. Trait variation has important implications for current sampling efforts to build trait-based models to improve the predictive power of vegetation and bioclimatic models. We discuss these issues with regards to the contrasting patterns of variation in plasticity observed within and across species as a function of habitat, growth form, species and season and provide some guidance as to the approaches that can be taken in order to capture and understand this variation.

Thermal tolerance of land plants: A systematic review

Professor Adrienne Nicotra, for The Thermal Tolerance Team

1Australian National University, Acton, Australia, 2University of Technology, Sydney, Sydney, Australia, 3Deakin University, Melbourne, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Adrienne Nicotra is a plant evolutionary ecologist with an interest in phenotypic plasticity and climate change, particularly thermal ecology and water relations.

Researchers seek to understand patterns of thermal tolerance of plant species in order to breed crops for a growing population, to predict responses of native species to a changing climate, and to gain fundamental insight into evolutionary and ecological process. Heat and cold tolerance are of interest, particularly in those areas where plants may experience both these extremes. But after over 100 years of plant thermal tolerance research there are remarkable gaps in our knowledge. We conducted a systematic review to describe the range of research techniques used and their distribution across systems, biomes and life forms. The vast majority of thermal tolerance studies focus on frost tolerance of agricultural species and only a trivial percentage considered both heat and cold tolerance. Our understanding of heat tolerance is rudimentary; worrying in a warmer world with increasingly frequent heat waves. In terms of experimental approach we show that many studies take advantage of chance events and post hoc interpretation, rather than testing the impacts of exposure to defined temperature events a priori. While valuable, these opportunistic studies do not lend themselves to determination of critical temperatures or to comparison across studies because the methods are not standardised. Indeed, only a relatively small portion of studies report a thermal metric that can be compared across work. We advocate for increased research attention on heat tolerance, adoption of standardised methods, and further consideration of the underlying mechanisms of thermal response.
Cool Old Plants, Warm New World: Assessing Climate Change Induced Phenophase Shifts in Alpine Plants

Ms Casey Gibson1, Prof David Keith1,2, Assoc. Prof Will Cornwell1, Dr Susanna Venn3
1University of New South Wales, Kensington, Australia, 2Office of Environment & Heritage, Hurstville, Australia, 3Deakin University, Melbourne, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Casey is a second year PhD student at UNSW in the Centre for Ecosystem Science and the Evolution & Ecology Research Centre, researching response traits in alpine plants under recent and future climatic change.

Since the botanical pioneering of Ferdinand von Mueller during the 1850s, flora of the Australian Alps has been extensively sampled and stored in herbarium collections. Increasingly, non-conventional data sources such as herbarium records are being drawn upon to make inference about how species may be responding to global environmental change. While there are broad-scale studies of alpine flowering phenology based on digitised voucher labels, qualitative assessments of phenological traits from entire herbarium specimens are lacking. My first-order goal in this project is to use digital images of herbarium specimens to assess whether phenological change has occurred in Australian alpine plant species over time, corresponding to increases in temperature and decreases in snow cover. My second-order goals are to (1) determine if collection altitude is a useful predictor in assessing the velocity and magnitude of reproductive trait shifts; (2) classify the phenological status (phenophase) of herbarium specimens to determine if the timing and intensity of phenophases is changing through time; and (3) determine if phenological trait shifts are phylogenetically conserved among the alpine flora. The study is representative of the mainland alpine flora and includes all growth forms (tree, shrub, herb, rosette, graminoid, cushion) and eighty-eight species from fifty genera representing twenty four families. In focusing on annually replaced reproductive structures of long-lived alpine plants, the wide temporal range offered by herbarium records provides a rare opportunity to identify meaningful response trends through time.

Can a critically endangered alpine plant community recover from bushfire in a warming world?

Mr Brodie Verrall1, Prof Catherine Pickering1
1Environmental Futures Research Institute, School of Environment and Science, Griffith University, Southport, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Brodie Verrall has recently completed a BSc(Hons) at Griffith University majoring in ecology and conservation biology, and intends to continue undertaking research in the Australian Alps, including further examining human impacts on alpine ecosystems including climate change.

In January-February 2003, bushfires burnt 1.75 million hectares of the Australian Alps, including some areas of alpine vegetation. We assessed the recovery of a critically endangered alpine community, Windswept Feldmark, which is restricted to the highest ridges of the Australian Alps. In Feldmark, the dominant prostate shrub, Epacris microphylla, facilitates the growth of other less stress-tolerant plants potentially by sheltering them from abrasive winds and low temperatures. We compared permanent plots of burnt and unburnt Feldmark 15 years post-fire to assess recovery including if the new Epacris...
shubs in burnt areas facilitate other plants. Differences in alpha and beta diversity, vegetation cover and composition were assessed in and out of shrub canopies, along with shrub size. In unburnt Feldmark, the shrubs enriched alpha and beta diversity resulting in greater gamma diversity for the community as a whole, with several species associated with the shrub, but rare outside its canopy (p>0.001). In contrast, in burnt areas graminoid (p=0.006), herb (p=0.045) and weed cover (p=0.024) were all higher, but not total vegetation cover (p=0.489), compared to unburnt Feldmark. Also shrubs where were taller but less spread out than in unburnt Feldmark. Finally, there were few species in the shrubs canopy, but more outside (p>0.001) in burnt Feldmark. It seems that the facilitation capacity of Epacris shrubs in burnt areas has not recovered and may actually be excluding, rather than facilitating, other species. Therefore, the ecology and composition of Feldmark may be changing in a warmer and more fire prone Alps.

Do the metabolic responses of meat ants exposed to thermal stress vary across populations?

Nirosha Ranawaka1, A/Prof Nigel Andrew1
1University Of New England, Armidale, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
I am a PhD student in the Insect Ecology Lab at University of New England. My research is about population genetics, thermal tolerance and aggression behaviour of meat ants around New England table lands.

Critical temperature maximum (CTmax) and metabolic rate (as the rate of CO2 release) are used to assess thermal tolerance of insects to thermal stress. To minimize physiological cost insects show limited phenotypic plasticity in their CTmax and is said to be evolutionary hard wired. However when insects are exposed to ramping temperatures when assessing metabolic rates and CTmax, using a technique called thermolimit respirometry, the ramping rate can potentially produce variable results and question thermal stress endpoints. In this study we carried out thermolimit respirometry on meat ants collected from seven different meat ant nests in Armidale using three different ramping rates (0.25°C/minute, 0.5°C/minute and 1°C/minute). Then 0.25°C/minute ramping rate was used to assess thermolimit respirometry of six different meat ant populations in NSW: Wollomombi, Tamworth, Armidale, Warrumbungles, Western Sydney and West Wyalong. Both CTmax and metabolic rate were significantly different among the three ramping rates for the Armadale ants. CTmax was significantly different across populations in NSW: Warrumbungles and West Wyalong populations exhibited the biggest differences. Overall metabolic rates were not significantly different across populations. These results suggest that CTmax and metabolic rate have less variation across different populations in NSW.

Thermal trait variation in three species of closely related lizard across an elevation gradient

Ms Anna Senior1, Nick Clemann2,3, Associate Professor Michael Gardner4,5, Dr Geoffrey While6,7, Associate Professor Bob Wong1, Associate Professor David Chapple1
1Monash University, Clayton, Australia, 2Arthur Rylah Institute for Environmental Research, Heidelberg, Australia, 3Museum Victoria, Carlton, Australia, 4Flinders University of South Australia, Adelaide, Australia, 5South Australian Museum, Adelaide, Australia, 6University of Oxford, Oxford, UK, 7University of Tasmania, Hobart, Australia

SYMPOSIUM: Assessing impacts and facilitating adaptation of biodiversity to climate change (3), Hall A, November 27, 2018, 4:00 PM - 6:00 PM
Biography:
Anna is completing a PhD studying the ecology of three threatened skink species: Lissolepis converyti, Liopholis montana and Liopholis guthega. Her aim is to enhance conservation management of the species by collecting data on distribution, thermal biology and population genetics.

The impacts of climate change are expected to be significant in ectotherms from mountainous regions, and predicting the winners and losers is a complex challenge. Physiological and ecological interactions will invariably play a role, particularly in species experiencing increased competition under distributional shifts. Intra-and interspecific differences in thermal and ecological trait variation may allow us to identify spatial patterns of vulnerability. We examined distribution and habitat, and compared critical thermal minimum (CTmin), critical thermal maximum (CTmin), and thermal sensitivity of sprint speed, in populations of skink from the genus Liopholis occurring along an elevation gradient from 920 - 1860 m asl. The species included alpine specialist, L. guthega; subalpine/montane L. montana and widespread species L. whitii. Habitat attributes were similar between the species, suggesting a capacity for competition particularly between L. guthega and L. montana which occurred in closest proximity. CTmax was similar for all species and populations, except for L. whitii from high elevations suggesting an extreme thermal environment at this site. Liopholis guthega were able to run faster at lower temperatures, however CTmin did not differ between the majority of species and populations, suggesting Liopholis share a similar thermal niche throughout much of the study area. Liopholis guthega sampled from 1890 m did exhibit a significantly lower CTmin compared to other Liopholis and to L. guthega from a lower elevation. This study reveals a complex pattern of thermal tolerance with elevation, highlighting the importance of both intra- and interspecific comparisons in predicting vulnerability, both between species and populations.

Marine ecosystem functioning: Lessons from decadal and deep time.

Professor Chris Frid 1,2, Dr Bryony Caswell 3, Dr David Clare 4
1Griffith University, Southport, Australia, 2Dove Marine Laboratory, University of Newcastle upon Tyne, Newcastle upon Tyne, UK, 3University of Hull, Hull, UK, 4Centre for Environment, Fisheries & Aquaculture Science, Lowestoft, UK

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Chris Frid is a marine ecologist whose research has focused on the dynamics of coastal seas. He has regularly provided advice to industry, government and international organisations on the impacts of human activities on the marine environment and their management.

Understanding the ability of the biosphere to continue to deliver ecosystem services in the face of biodiversity loss and environmental change is a major challenge. Monitoring of two North Sea benthic communities over the last 40 years has shown major decadal scale changes in taxonomic composition. Ecological functioning (trait composition) was found to be statistically indistinguishable across these periods. A temporary alteration to functioning was, however, inferred at both sampling stations; coinciding with the 1986 North Sea regime shift. Trait composition recovered after 1 year at the station located inside the grounds of a trawl fishery, whereas the station outside the main area of fishing activity underwent a six-year period of significantly altered, and temporally unstable, trait composition. The rate at which ecological functioning stabilizes and recovers appears to be dependent on environmental context; e.g. disturbance regime. In order to extend the temporal horizon, we used data on benthic palaeocommunities covering 4,000,000 years in the Late Jurassic when temperate coastal seas in NW Europe experienced fluctuations in oxygenation and species composition. The calculated rates for the supply of food to higher predators was remarkably constant during the 4,000,000 years, suggesting that redundancy amongst species in the assemblage drives the biodiversity-ecosystem function (BEF) relationship. By contrast, the provision of biogenic habitat varied with the occurrence of a relatively few taxa, a pattern consistent with a rivet type model of BEF. For nutrient regeneration,
carbon sequestration and food-web dynamics the patterns were complex and suggestive of an idiosyncratic model of BEF.

**Drawing a longbow? From monitoring to adaptive management of environmental water for vegetation diversity outcomes**

**Dr Samantha Capon**
1Griffith University, Nathan, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**
Samantha Capon is a Senior Lecturer in the Griffith University School of Environment and Science and the Australian Rivers Institute where she teaches courses in community, urban and freshwater ecology and conservation and leads several large research projects.

Australian governments currently manage significant environmental water holdings which can be delivered to achieve a range of ecological outcomes, including those associated with vegetation diversity. Planning and prioritising environmental watering actions has therefore become a considerable challenge, both at local wetland scales as well as at larger catchment and basin scales, especially given the high levels of spatial and temporal variability inherent in our inland wetlands. Accordingly, monitoring and evaluation (M&E) of interventions has become critical to the effective adaptive management of environmental water. It is not always straightforward, however, to identify appropriate touchpoints for M&E to inform adaptive management or to interpret monitoring data in light of management questions. Here, I will discuss the approach and findings of the Commonwealth Environmental Water Holder’s Long-Term Intervention Monitoring programme, which has been running for the past four years, with a particular focus on the vegetation diversity theme. I will explore how monitoring data can be evaluated to inform environmental water management across a range of scales and through different phases of the adaptive management loop, as well as highlighting key lessons for adaptive management which have emerged from this project to date.

**The long and the short of riparian monitoring**

**Dr Chris Jones**
1Arthur Rylah Institute For Environmental Research, Heidelberg, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**
Chris Jones works at The Arthur Rylah Institute. He spends a lot of time thinking about long-term monitoring programs and a lot of time on rivers collecting data about plants and how they respond to environmental flows.

Long term monitoring is required to evaluate long term ecological processes and the cumulative effects of repeated actions. Long term change is typically a compilation of short term events, responses and processes. Sampling intervals that are too long may be able to show long term trends but not the path or events that were crucial in reaching that outcome. Riparian systems are dynamic and are constantly nudged by changes in climate, flow regulation, and physical manipulation. To effectively manage these systems, we must know the impacts of individual events and the cumulative effects of regimes over time. We use data from a long term environmental flows monitoring program to demonstrate the importance of the appropriate combination of short and long term monitoring to understand system
responses and guide management. Long term data with large monitoring intervals show broad trends over many years, spanning processes of drought, flow regulation regimes and vegetation dynamics. Short term data with small intervals show the immediate impacts of individual flow events and seasonal variation. While some individual flow events or seasonal changes have little impact on the overall trends, others can have major influences. Indeed, a single event (e.g. flood) can be the primary driver of an observed long term trend. Understanding how short term impacts accumulate to drive long term change is the key to managing these systems.


Ms Fiona Dickson, Dr Veronica Doerr, Mr Micah Davies, Dr Erik Doerr, Dr Suzanne Prober, Dr Helen Murphy, Dr Heather McGuiness, Dr Ben Hoffman, Liz Turner, Emma Norman

1Department Of The Environment And Energy, Canberra, Australia, 2The Commonwealth Scientific and Industrial Research Organisation, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Fiona Dickson manages a suite of research projects for the Department of the Environment and Energy, including the collaborative CSIRO-DoEE Biodiversity Knowledge Projects, and monitoring and evaluation of the Environmental Stewardship Program.

Funding for Natural Resource Management (NRM) is scarce, so it is vital to direct investment towards on-ground actions that are most likely to be effective, and towards monitoring and research that builds understanding of the effectiveness of both existing and innovative NRM interventions. To this end, the Department of the Environment and Energy commissioned CSIRO to build "A Knowledge Bank of Management Effectiveness". This project aimed to build a living, searchable resource containing evidence about the effectiveness of NRM interventions. The bank was intended to help mobilise and improve accessibility to existing science, build an understanding of the confidence we can have in interventions and reveal knowledge gaps. Through an extensive systematic mapping process, 15,653 studies were initially identified. On closer review only 308 studies across 37 commonly undertaken NRM actions qualified as empirical evidence. For some NRM actions, there were no qualifying studies. Even for actions with a volume of evidence, the studies were not sufficient to discern a clear picture of effectiveness. Although this finding was not surprising on the basis of previous reviews of NRM programs, there has been little holistic analysis of the scientific, institutional and capability barriers driving this failure within our NRM system. Given the pressing need to improve our environmental management capability in a climate changing world, we have explored options and innovations to overcome barriers, accelerate learning and generate the systems-change required to build a robust evidence-base. We hope the synthesis and recommendations presented here can provide a catalyst for reform.
Tracking inundation regimes from space: long-term knowledge informing environmental flow management

Ms Rachael Thomas1,2, Prof Richard Kingsford2, Dr Gilad Bino2, Dr Jessica Heath1
1Water and Wetlands Team, Science Division, NSW Office of Environment and Heritage, Sydney South, Australia, 2Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Rachael Thomas, Senior Environmental Scientist. My research focuses on understanding the influence of flooding regime dynamics on the floodplain wetlands of inland NSW, through remote sensing and spatio-temporal analyses, to support adaptive management of NSW environmental water.

Floodplain wetlands are highly productive and biodiverse ecosystems, yet many are lost, degraded and threatened over large parts of the world, including the Murray-Darling Basin (MDB) where river regulation has altered flooding regimes, requiring intervention with environmental water. Increasingly, environmental flow managers rely on inundation to produce environmental outcomes on floodplains, but with relatively poor understanding of inundation regimes over large spatial and long temporal scales. We used Landsat satellite derived inundation maps to track inundation regime change before (1988-2008) and after (2008-2013) the breaking of the Millennium Drought, in the vegetation of the Macquarie Marshes, an expansive Ramsar-listed floodplain wetland in the MDB. From the inundation extents of 30 floods (1988-2013) we quantified frequency for 5-year and 20-year temporal windows. To track change, we calculated the proportional inundation frequency difference between the 20-year (1988-2008) and each 5-year window. Inundation extent was highly variable ranging from 3,112 ha to 218,805 ha with significant differences in extents among the 5 year windows (KW(4,n=30)=10.61, p=0.03). We revealed a weak but significant linear drying trend in the inundation frequency difference for non-woody wetland vegetation (Adj.R2=0.427, p<0.001) between 1988 and 2008. Post-Millennium Drought there was evidence of inundation frequency increase in these vegetation communities which received environmental water. Our results highlight the importance of environmental water management during droughts, projected to become more frequent and protracted in the MDB. For effective management inundation regime monitoring using remote sensing needs to be frequent enough to capture temporal variability and over long-time periods (decades).

Evaluating ecological responses to environmental watering in the Macquarie Marshes Ramsar site

Dr Gary Palmer1, Dr Samantha Capon1, Dr Mischa Turschwell1, Dr Catherine Leigh1
1Griffith University, Brisbane, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
I am an ecologist at Griffith University in Brisbane. My research interests focus on the ecology of vegetation communities and landscapes. I also have an interest in practical conservation research, and how this research can influence management and policy decisions.

The Macquarie Marshes Ramsar site in northern New South Wales supports a wide range of ecological, cultural and socioeconomic values. In 2009, a notification was submitted reporting ‘likely change’ in the site’s ecological character, citing declining health and extent of wetland vegetation communities and reductions in waterbird abundance, diversity and breeding. Changes were attributed primarily to flow
alteration resulting from river regulation and drought. A Response Strategy was subsequently prepared by the NSW government, outlining restoration objectives and actions over the short- to long-term aimed at halting the decline and improving the condition of the site. We recently conducted a review, on behalf the Australian government, of monitoring data to evaluate ecological outcomes of environmental watering of the Ramsar site since 2009. A range of datasets were available concerning inundation patterns, wetland vegetation and other key ecological components (i.e. fish and waterbirds) during this period. We assessed these in relation to environmental watering and restoration objectives. Overall, environmental water contributed to inundation of considerable areas of key wetland vegetation communities, reflected by significant responses in their extent and condition, although clear attribution was difficult to infer. Given the inherent dynamism of Australia’s dryland wetland ecosystems, we recommend development of restoration objectives that account for high levels of spatial and temporal variability across multiple spatial scales. Furthermore, we recommend monitoring is clearly underpinned by appropriate management objectives to enable their evaluation and to ultimately inform effective adaptive management.

Designing long-term monitoring frameworks to deliver robust evaluation platforms: the Regional Land Partnerships program

Dr Guy Castley1, Dr Simon Linke2, Ms Ruth O’Connor2, Dr Gary Palmer1, Dr Dan Schmidt1, Dr Samantha Capon1
1School of Environment and Science, Griffith University, Gold Coast, Australia, 2Australian Rivers Institute, Griffith University, Nathan, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (1), Meeting Rooms 4-5, November 26, 2018, 11:00 AM - 1:00 PM

Biography: 
Guy’s research interests focus on the transdisciplinary nature of contemporary conservation practice drawing on his background in conservation biology, protected area management, long-term monitoring & landscape and urban ecology to address novel mechanisms for conservation action.

The Regional Land Partnerships (RLP) program led by the Australian Government is the next phase in the National Landcare Program. Conservation objectives of the program focus on maintaining and enhancing the condition and value of priority threatened species, threatened ecological communities, Ramsar sites and World Heritage areas. To achieve these objectives and provide a platform for evaluation, we developed a long-term monitoring framework (LTMF) that considered the variable scales at which the program might be evaluated to inform future decision making. The proposed RLP LTMF has a hierarchical structure (i.e. RLP project level, conservation asset level, regional / state level, Program or national level), underpinned by an ecological conceptual model drawing on elements of the drivers, pressures, states, impacts and responses model. A key consideration in the development of the LTMF was ensuring that monitoring efforts were completed in a standardised manner to facilitate evaluation across all hierarchy levels. The key structural components of the proposed LTMF are i) interventions, ii) pressures, iii) targets and iv) habitats. We compiled a library of monitoring indicators that captured essential ‘extent’, ‘magnitude’ and ‘condition’ metrics. These indicators were also linked to the program hierarchy, structural components as well as RLP core conservation objectives. Additional elements of the LTMF include recommendations for data collection and management, data analysis and interpretation, evaluation and adaptive management as well as program governance requirements.
Overkill or industrial best practise? Monitoring bird and bat impacts at wind farms

Emma Bennett1,2
1Monash University, Red Lion, Australia, 2Elmoby Ecology, Clunes, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (2), Meeting Rooms 4-5, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Emma has worked at windfarms since 2005 undertaking impact monitoring. She has a history working in private consulting, the state government, not for profit sector and is currently doing a PhD with Monash University.

Impact monitoring at wind farms, in Victoria at least, results in a minimum of 4 years of bird point count surveys and roaming surveys (collectively called bird utilisation) in addition to 2 years of impact monitoring. Additional to this, flight path modelling for threatened species is often undertaken, and several years of acoustic recording for bat activity is collected. However the evidence suggests that wind farms are low on the list of anthropogenic causes of bird mortality, so are we monitoring for monitoring sake or does all this data collection actually improve bird and bat survival rates? In my presentation I will argue that the funding and resources spent in monitoring could be reallocated to direct action such as habitat improvements or threat abatement elsewhere which is more likely to have a net positive impact on species survival than the current planning requirement imposed on wind farms. I will also show how disconnections between researchers, government and industry can be seen as a bigger threat and hurdle for threatened species and how the community and not for profit sector could provide solutions that are not currently considered.

Dynamics, habitat use and extinction risk of the kowari are revealed by long-term monitoring

Dr Aaron Greenville1,2, Robert Brandle1-3, Peter Canty4, Prof Chris Dickman1,2
1University Of Sydney, Sydney, Australia, 2National Environmental Science Program Threatened Species Recovery Hub, Sydney, Australia, 3Natural Resources SA Arid Lands, Department for Environment and Water, Port Augusta, Australia, 4State Herbarium, Department for Environment and Water, Adelaide, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (2), Meeting Rooms 4-5, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Aaron Greenville is a Post-doctoral Research Associate with the Desert Ecology Research Group, University of Sydney. He uses a combination of population biology and trophic ecology to predict how ecosystems respond to climate change and the introduction of exotic species.

Animals in hot desert environments often show marked fluctuations in population size, persisting in low numbers in refuge habitats during dry periods and expanding after rain when resources increase. Understanding drought-wet cycle dynamics is important for managing arid ecosystems, particularly if populations of threatened species are present. Such species may face increased risks of extinction if all populations decrease synchronously toward zero during low-resource periods, and if key refuge habitats needed during these periods are disturbed or unavailable. We describe the dynamics and habitat requirements of two sub-populations of the kowari, Dasyuroidea byrnei, during long-term sampling (2000–2015) that encompassed multiple drought-wet cycles. This species is listed currently as Vulnerable on the IUCN Red List. We found that the study region contains favourable habitat, with kowari occurring on hard stony (gibber) pavements in association with coverage of sand that may facilitate construction of burrows. Both sub-populations of kowari declined over the study period.
irrespective of climatic conditions, despite some evidence that both body condition and reproductive output increased after rain. We suggest that the studied sub-populations are under stress from extrinsic rather than intrinsic factors, with livestock grazing and introduced predators perhaps having the most negative effects. If similar demographic trends are apparent elsewhere in the species' geographical range, the species would be eligible for listing on the IUCN Red List as Endangered. Urgent research is required to quantify and mitigate the extrinsic threats to kowari populations. Proactive measures such as captive breeding to act as insurance populations would be prudent.

Environmental flow success? Vegetation response to flooding regimes in a floodplain wetland.

Mr Joel Honeysett¹, Ms Rachael Thomas¹²
¹Water and Wetlands Team, Science Division, Office of Environment and Heritage, Sydney, Australia, ²Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (2), Meeting Rooms 4-5, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
My name is Joel Honeysett and I am working as a Wetland Scientist for the Office of Environment and Heritage. My research interests include how environmental water impacts wetland ecology as well as remote sensing and environmental statistics.

Environmental flows are managed to Murray-Darling Basin (MDB) floodplain wetlands by mimicking natural flow regimes to maintain and restore ecosystems impacted by river regulation. A critical ecosystem component is vegetation but our understanding of vegetation responses to flooding regimes remains poor. The Macquarie Marshes, a large Ramsar listed floodplain wetland in the MDB, is a complex mosaic of different vegetation communities providing important fauna habitat. Currently, environmental water delivery to the Macquarie Marshes has been planned as a flow regime over a three water-year period (2017-2018 to 2019-2020). We assessed differences in vegetation communities from the first water-year in response to the recent (2 year) inundation regime. Extant vegetation was quantified during Autumn 2017 within 78 20m quadrats. We classified plant species and substrate into four functional groups based on moisture affinity (amphibious, terrestrial) and substrate cover (bare-ground/litter, Eleocharis plana litter). Inundation regime was classified according to inundation frequency (sites inundated by two inundation events: Spring 2016-2017 and 2017-2018) and duration (survey inundation status). More inundation favoured a significant increase in amphibious plant cover ($r^2=0.36$, $p=0.0001$) and species richness ($r^2=0.43$, $p=0.0004$). Where flooding was frequent but brief, terrestrial plants were more species rich despite having less cover which suggests communities were dominated by a few amphibious perennials when wet but when drying there were more competing terrestrial species. Our findings highlight the interplay between flood frequency and duration influenced vegetation composition, important for environmental flow management during extended dry periods, projected to increase in the MDB.
Conserving threatened species needs effective monitoring, but where are the gaps and how to improve?

**Dr Natasha Robinson**1,4, Dr Ben Scheele1,4, Assoc Prof Sarah Legge1,4, Prof John Woinarski2,4, Prof Stephen Garnett2,4, Assoc Prof Mark Lintermans3, Prof David Lindenmayer1,4

1The Australian National University, Canberra, Australia, 2Charles Darwin University, Darwin, Australia, 3University of Canberra, Canberra, Australia, 4National Environmental Science Programme Threatened Species Recovery Hub, Australia

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (2), Meeting Rooms 4-5, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Natasha Robinson is a Research Fellow at the Australian National University and former fire ecologist with the Victorian State Government. Her research interests include threatened species monitoring and management, mammal reintroductions and fire ecology.

Monitoring is essential for effective conservation management of threatened species. However, more often than not, monitoring is undervalued, inadequately resourced and implemented, and thus its potential to contribute to threatened species recovery is reduced. In this talk, we highlight the gaps in monitoring for threatened species in Australia and outline how we can improve monitoring effectiveness to ensure better conservation outcomes. First, we evaluated monitoring with a framework of nine metrics to assess the extent and quality of monitoring for threatened Australian terrestrial and freshwater vertebrates. We found that monitoring is woefully inadequate: about one quarter of threatened taxa are not monitored. In taxa that are monitored, monitoring quality was generally low. Higher quality monitoring occurred mostly for species with recovery plans and species at greatest risk of extinction. Proportionally more mammals, and then birds, were monitored than other taxonomic classes, with the quality of monitoring scoring highest for birds. Second, we drew on the combined wisdom of 26 conservation managers and scientists from across the country to develop key principles to improve the effectiveness of threatened species monitoring. These principles are: 1) Integrate monitoring with management; 2) Design fit-for-purpose monitoring programs; 3) Engage people and organisations; 4) Ensure good data management; and 5) Communicate the value of monitoring. Conservation of our threatened biodiversity can only be realised when actions and decisions are underpinned by good processes and knowledge.

What should we plant to maximise the supply of multiple ecosystem services in the long-term?

**Mr Sebastian Fiedler**1, Dr José Monteiro1, Dr Michael P. Perring2,3, Prof Dr Britta Tietjen1

1Freie Universität Berlin, Berlin, Germany, 2The University of Western Australia, Crawley, Australia, 3Ghent University, Ghent, Belgium

SYMPOSIUM: Beyond monitoring: Long-term ecological knowledge to support biodiversity and ecosystem management (2), Meeting Rooms 4-5, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Mr Sebastian Fiedler, a doctoral student in the research group “Biodiversity/Theoretical Ecology” at the Freie Universität Berlin in Germany, is applying simulation modelling and empirical approaches to assist restoration of degraded ecosystems people and animals rely on for their well-being.

The delivery of ecosystem services (ES) that people rely on for their well-being is declining world-wide which is likely to continue in the light of multiple global changes. Ecological restoration can assist ecosystems in a way that improves their long-term supply of ES and makes them resilient to future threats, especially in biodiversity hotspots such as Mediterranean-type ecosystems (MTEs). Successful
realisation of such a strategy requires a fundamental understanding of the link between ecosystem composition, related ecosystem functions and ES, and influencing environmental factors. Measurable plant traits have been recognised as such a link. Until now, however, trait-based research that addresses trade-offs among multiple ES under the impact of multiple environmental factors to reliably support restoration in MTEs is missing.

We started closing this gap by integrating empirical research and process-based simulation modelling. We developed an eco-hydrological simulation model complementing an ongoing large-scale restoration project in Western Australia (the Ridgefield experiment). For a given vegetation composition and other properties of the ecosystem processes for vegetation, nutrient and water dynamics are calculated and the delivery of ES are quantified. In a full factorial design of different plant trait compositions and influencing environmental factors, trade-offs among ES are assessed, and the resilience of the ecosystem towards multiple factors of global change are tested. Preliminary results show that there are assemblages of plant traits that minimise trade-offs among ES under global change. These findings will aid in improving restoration towards the long-term supply of multiple ecosystem services in MTEs in Australia and globally.

**Short-term monitoring data leads to inaccurate conjecture of species recovery**

Ms Marilyn Connell, Mr Andrew McDougall, Dr Hamish Campbell

1 Charles Darwin University, Darwin, Australia, 2 Tiaro & District Landcare Group, Tiaro, Australia, 3 Department Natural Resources, Mines & Energy, Bundaberg, Australia

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

Marilyn Connell is a Masters research student at Charles Darwin University and Leader of Tiaro Landcare’s Mary River turtle conservation program. Her research interest focuses on the conservation and recovery of threatened freshwater turtles.

Against the tide of species loss, enormous efforts are occurring worldwide to recover species from the brink of extinction.

Here we examine if monitoring the hatching success rate (annual) of a threatened turtle conservation program is an effective indicator of population recovery (long-term). Since 2001, the local community has implemented a conservation program for the Mary River turtle, Elusor macrurus. By the late 1990s, it was estimated that the nesting population was functioning at 5% capacity when compared to the 1960s anecdotal harvest data. The goal of the conservation program was to recover the population through reducing predation of turtle nests. Annual monitoring of hatching success indicated the program achieved a survival rate of 0.64 significantly greater than the international average of 0.22.

A population study was conducted to determine if this increased recruitment had transferred to the population. It was hypothesized that the river reach where the nest protection program occurred would have a greater proportion of immature turtles. A mark-recapture study was undertaken at four study reaches with sampling repeated identically every six months. Two hundred and sixty-eight Elusor macrurus were captured and marked, with 29 recaptured. No immature turtles were captured in the stretch of river where the nest protection program took place. This suggests that monitoring the hatching success is an appropriate indicator to measure the effectiveness of the intervention measures. In contrast, the population demographic study calls into question the effectiveness of nest protection as a stand-alone measure for the recovery of this species.
Novel approaches to inform extinction risk assessment of one of Australia’s longest living fish species

Dr David Roberts¹, Mr Tom Espinoza², Mr Andrew McDougall², Dr Stewart Fallon³, Dr Nick Bond⁴, Dr Jane Hughes⁵, Dr Daniel Schmidt⁵, Dr Mark Kennard⁶, Mr Steven Brooks⁶, Dr Peter Kind⁶

¹Seqwater, Ipswich, Australia, ²Department of Natural Resources and Mines, Bundaberg, Australia, ³Research School of Earth Sciences, The Australian National University, Canberra, Australia, ⁴La Trobe University, Wodonga, Australia, ⁵Australian Rivers Institute, Griffith University, Brisbane, Australia, ⁶Department of Agriculture and Fisheries, Brisbane, Australia

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Roberts is a aquatic ecologist specialising in fish ecology and limnology. David completed a PhD at Griffith University investigating food web dynamics and impacts of drought in a large impoundment and has worked on protected species and fish migration.

Australian lungfish (Neoceratodus forsteri) present many challenges for ecologists researching population and life history characteristics to inform conservation actions. Even after 100 years of study, the age and genetic diversity of lungfish populations are poorly understood. Their protected status, unique anatomy, morphology, and physiology mean traditional approaches used in fish ecology are unsuitable. Recent breakthroughs in techniques to fill these knowledge gaps in age and genetic diversity for lungfish came about through a combination of non-destructive measurements of scale radiocarbon and next-generation DNA sequencing of the large lungfish genome. Lungfish possess large cosmoid scales that are retained and continue to grow over their lifespan. The radiocarbon content of these scales measured at the origin, and progressively to the outer edge, reveals patterns that correlate with historical atmospheric concentrations, providing timestamps in the scale and enabling the estimation of birth year and age. The maximum age recorded of wild sampled lungfish was 77 years and showed variable age frequency patterns across the three catchments studied. Age frequencies revealed periods of low and high recruitment, enabling the assessment of environmental variables that may correlate with recruitment patterns. Combining the age results with the power of 15,201 single nucleotide polymorphic (SNP) loci from 92 individuals ranging in age from 2 to 77 years old, enabled us to assess the risk of genetic erosion over an extended period. This new information will assist in assessing extinction risk and potential conservation management options for this species.

How much long-term data are required to effectively manage a widespread freshwater turtle?

Dr Ricky Spencer¹

¹Western Sydney University, Penrith, Australia

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Ecologist, whose passion is to develop innovative conservation solutions for long-lived organisms. Associate Professor at Western Sydney University

Freshwater turtle populations are globally threatened by many factors. Complicating matters, their longevity requires long-term monitoring on the scale of decades to assess changes in population size, yet few long-term studies exist. Documenting population estimates and trends is essential for identifying and conserving imperilled populations, however, the impacts of many current threats may render populations endangered well before declines become apparent. By that stage, population
recovery may not be possible, thus assessing population level impacts of potential threats may provide a direct measure of risks of population extinction. Australian turtles face major threats of mortality from invasive species, vehicles, disease and declining water quality. Even Australia’s most abundant and widespread species has declined by up to 91% in some populations. Here I use population models to assess the impacts of threats to multiple life history stages of an Australia turtle. I provide practical solutions where citizen science can be enabled to provide accurate broad-scale management options.

Can standardized and participatory research build the baseline for the conservation of the Dugong?

Dr Christina Shaw¹
¹Vanuatu Environmental Science Society, Port Vila, Vanuatu

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Christina Shaw is a veterinary surgeon based in Vanuatu. She founded the Vanuatu Environmental Science Society (VESS) in 2014. Christina works to conserve threatened species, including dugongs and flying foxes, and strengthen the use of science in conservation in Vanuatu.

The GEF Dugong and Seagrass Conservation Project is the first global initiative for the protection of the dugong (Dugong dugon) and their seagrass habitats. Dugongs are not only long lived but also migrate across national boards. The Project spans across eight dugong range states in Africa, Asia and the Pacific.

Starting in 2015, this four-year project has set an ambitious objective to improve the effectiveness of the conservation efforts towards the dugong and their habitats. More than 30 organizations worked together towards the global project objective, stepping on four building blocks: Research; Incentives; Policy; and Awareness and Education.

Being implemented in developing and least developed countries, the project faced multiple challenges, such as lack of baseline conservation and socio-economic information, lack of awareness of the importance of seagrasses and dugongs, misperception of the role of conservation for livelihoods and local development, lack of policy frameworks and capacity for policy enforcement, to mention a few.

For the research component, the project adopted a participatory research approach using standardized species-specific tools to help the partners address these challenges. Giving the project partners access to expert technical advice and tools, such as the CMS Duong questionnaire, has allowed research questions to be answered during the short timeframe of the project. Results of this research can be also collated across the range of this migratory species.

We will share the lessons learned from the use of these providing in-depth information about the experience from two of the project countries, Vanuatu and the Solomon Islands.
Turtles as canaries in coal mines: co-opting ecotoxicology to justify population monitoring

Dr James Van Dyke¹
¹Charles Sturt University, Albury, Australia

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I’m an integrative biologist who uses ecological and physiological approaches to improve conservation for endangered vertebrates. I am especially interested in unifying reproductive biology, population ecology, and ecotoxicology in this endeavour, and focus primarily on threatened reptiles.

Turtles are among the world’s most threatened vertebrate taxa; more than 50% of all species are listed as threatened or worse. Designing effective conservation plans for turtles is difficult because they are long-lived, relatively slow to mature, and usually have very low survival rates prior to maturity. Thus, detecting improvements in population size as a result of conservation management can take decades, and simpler metrics like population demographics and nesting or hatching success are often used instead. Still, developing long-term funding for these efforts can be difficult. I propose ecotoxicological studies as a justification for long-term monitoring of turtle populations, using integrative and noninvasive approaches. Reptiles are generally underrepresented in ecotoxicological studies, but turtles are particularly useful model systems. Many of the most important contaminants of environmental systems exist in the biotic environment rather than the abiotic, and turtles are susceptible to bioaccumulating (and biomagnifying) these because of their longevity and their ecological roles as carnivores, scavengers, herbivores, and omnivores. Compared to other model vertebrates in aquatic systems, like birds and fish, turtles are also relatively sedentary and may be chronically exposed to contaminants. Finally, some turtles are relatively robust to some contaminants, like mercury, which may allow long-term tracking of environmental contaminant concentrations within individual animals. Together, these traits make turtles useful models for investigating ecotoxicological impacts on aquatic systems. Long-term non-invasive monitoring of contaminant loads in turtles would thus facilitate sampling for population studies, and could provide a funding stream for independent long-term assessments of population dynamics.

Isotopic evidence for multi-decadal shifts in trophic ecology of the long-lived Australian lungfish

A/Prof Mark Kennard¹, A/Prof Stewart Fallon², Dr David Roberts³, Ms Tom Espinoza⁴, Prof Julian Olden⁵
¹Australian Rivers Institute, Griffith University, Brisbane, Australia, ²Research School of Earth Sciences, The Australian National University, Canberra, Australia, ³Seqwater, Ipswich, Australia, ⁴Queensland Department of Natural Resources, Mines and Energy, Bundaberg, Australia, ⁵School of Aquatic and Fishery Sciences, University of Washington, Seattle, USA

SYMPOSIUM: Challenge: How to investigate long-lived organisms within 3-year funding cycles, Hall A, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Mark is a freshwater ecologist with a keen interest in the conservation and management of freshwater ecosystems and biodiversity in Australia and around the world.

Meeting the conservation challenges of long-lived species ideally requires ecological assessments encompassing appropriately long time scales. The use of dietary proxies, such as ratios of stable isotopes occurring in animal tissues that demonstrate progressive growth, has shown considerable promise to reconstruct the ecological histories of long-lived organisms. Here, we combine innovative
radiocarbon scale-aging techniques with cross-sectional stable isotope analysis of carbon and nitrogen to reconstruct dietary histories for the vulnerable Australian lungfish (Neoceratodus forsteri) in the core of its remaining global distribution. Over a 65-year period, we found pronounced temporal shifts in the dominant energy sources assimilated by lungfish that coincided with a period of hydrological modification by dams and agricultural land-use intensification. In the Brisbane and Burnett Rivers, whose hydrology is substantially regulated by large dams, lungfish showed consistent trends of δ13C depletion and δ15N enrichment over time. This suggests that seston being exported downstream via regulated releases from impoundments may represent a carbon source of increased availability, and has shifted the lungfish diet from benthic-dominated primary production typical of unmodified river systems, to pelagic carbon sources. By contrast, δ13C values of lungfish in the unregulated Mary River were more stable through time, whereas δ15N increased corresponding with the expansion of the dairy industry and increased nitrogen fertilization usage. In conclusion, we demonstrate how human activities have altered natural patterns in benthic vs. pelagic energy resources supporting Australian lungfish and demonstrate how detectable trophic signals in fish scales can reveal historical anthropogenic changes in riverine ecosystems.

Gauging attitudes of residents living close to flying-fox camps to inform conflict management

Dr Pia Lentini1, Ms Kaye Currey2, Dr Kylie Soanes2, Dr Dave Kendal3, A/Prof Kathryn Williams2
1School of BioSciences, The University of Melbourne, Parkville, Australia, 2School of Ecosystem and Forest Sciences, The University of Melbourne, Parkville, Australia, 3School of Technology, Environments and Design, The University of Tasmania, Hobart, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Pia is an applied ecologist and part of the Quantitative and Applied Ecology Group at the University of Melbourne. Her research focuses on conservation in highly modified, human-dominated landscapes.

Australian flying-foxes are becoming increasingly urbanised, and camps (roosts) are a source of mounting tensions with human communities. Agencies manage camps in response to complaints from residents, but acknowledge that it is difficult to capture the full range of views that are present in their communities. We conducted 49 semi-structured interviews with residents living close to one of nine camps across south-east Australia. Interviews covered perceived impacts of camps, resident’s values around nature and wildlife, and their perceptions of local management agencies. We found that sensory impacts and fear of diseases were the key concerns for residents. Some perceived flying-foxes to be destructive and messy, and felt they impacted on their quality of life. Yet, positive associations were also common, such as appreciation of the ecological role that flying-foxes play, and a sense of awe and wonder in experiencing flying-fox camps. Almost everyone stated that they loved wildlife, but in some cases this did not extend to the bats. Residents with strong opinions were divided between those that felt the rights of humans should take precedence, versus those who thought humans had to learn to live in harmony with wildlife. Many acknowledged that long-term dispersals of flying foxes are costly and associated with substantial risks, but education-only approaches that don’t directly mitigate perceived impacts may increase resentment towards managers if people feel that they are not being listened to. Management of contentious flying-fox camps in ways that satisfy community concerns is likely to remain a difficult and complex task.
Using crocodile attacks to save people’s lives: the CrocBITE project

Dr Adam Britton1,2, Mr Brandon Sideleau3
1Charles Darwin University, Darwin, Australia, 2Big Gecko Crocodilian Research, McMinns Lagoon, Australia, 3Not applicable, Thousand Oaks, United States

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Zoologist and crocodile specialist based in Darwin, focusing on population ecology, human-crocodile conflict, conservation management of crocodiles, education and training. Active in Australia and SE Asia. Runs the consultancy Big Gecko, and holds an adjunct position at Charles Darwin University.

Crocodiles are considered a valuable economic, ecological, social and cultural asset for Australia, but they carry the obvious negative value of being potentially dangerous towards people. Globally, successful conservation of crocodiles which leads to recovering populations adds both positive and negative values to those populations, and learning how to deal with these effects has become a major conservation issue for this group. Throughout their range, recorded saltwater crocodile attack incidents number in their hundreds each year, yet these provide the best clues on how to save people’s lives in the future. In 2012 we established the CrocBITE project to collate and analyse thousands of incidents to help inform mitigation efforts including those in Australia. The results show both common trends between countries (eg. access to and use of water resources, vulnerable age groups) and differences (recreational versus subsistence access to water), and they highlight that the risk of attack from increasing crocodile – and people – densities can be counteracted more effectively through changes in behaviour brought about by management and education programs. The data also reveal useful insights into how saltwater crocodiles recolonise former habitat across their historical range, including in Australia.

Too cute to cull? Comparing expert and public opinions on culling koalas, kangaroos and brumbies

Margreet Drijfhout1, Dr Dave Kendal2, Dr Pete Green1
1La Trobe University, Bundoora, Australia, 2University of Tasmania, Hobart, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
I’m in the final year of my PhD, studying both ecological and social issues regarding overabundant koala populations in Victoria.

Managing species based on ecological knowledge is one thing; aligning this knowledge with public opinions is another. Empirical evidence on public opinion is rarely part of decision-making in conservation management. This is particularly true for the management of charismatic species, where policy and management are often based on anecdotal evidence of public opinion that may not be aligned with expert scientific advice. Yet, there are robust tools available to measure a variety of dimensions of public opinion. We tested the public’s acceptability of alternative management strategies for managing overabundant koalas, kangaroos and brumbies, using a nationwide survey (n=1,148). We also tested managers’ acceptability of the same management strategies used in managing overabundant koalas (n= 154). We found that managers tend to have significantly different opinions about the acceptability of lethal control methods. Opposing opinions were found in the acceptability of both culling and indigenous hunting of koalas. While managers found these to be socially acceptable for koalas, the public did not, revealing a mismatch between these groups and a potential source of conflict towards wildlife management. Different views were apparent between species, as lethal control of
koalas was less acceptable than for kangaroos or brumbies. This diversity of results underlines the need for policy which is not directed towards a one-size-fits-all approach, as people respond differently in different situations. Empirical evidence of public opinion will aid managers in engaging the public on this topic and could reduce conflict, leading to better conservation outcomes.

The Transformation of Human-Wildlife Conflict: Is Law a Viable Tool or a Social Barrier?

Katie Woolaston1, Dr Leah Burns1, Dr Steven White1, Emily Flower1, Julia Van Velden1
1Griffith University, Nathan, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Katie Woolaston is an inter-disciplinary researcher and doctoral candidate in the Griffith Law School. Her current projects include the formation of a collaborative framework for wildlife management in Australia, and the improvement of the human-wildlife relationship using eco-feminist ontological theory.

Human-wildlife and conservation conflicts have been the topic of biodiversity literature for some time, and are known to result in biodiversity loss and decreased human security. Madden and McQuinn (2014) proposed the need for a transformation of how these conflicts are perceived and managed, in order to make real progress in solving them. This transformation involves an analysis of, and amendment to, attitudes towards wildlife, and how they are institutionalized in society. To date, there has been very little attempt to begin this conflict transformation, especially in Australia.

The aim of this research is to understand the link between law as a societal institution and human-wildlife conflicts, by undertaking a systematic quantitative review of wildlife management literature to ascertain how conservation laws shape attitudes, values and behaviour towards and concerning wildlife. We collected English-language publications from nine different databases across different jurisdictions, to discover whether there is an evidentiary link between law and human-wildlife conflict. Preliminary findings suggest that not only is there a lack of ‘human dimensions of wildlife’ research in Australia, there is also a lack of any acknowledgment of the link between our societal institutions and individual attitudes and value towards wildlife. The findings from this timely review enable us to understand the role of law in resolving human-wildlife conflict, and contribute evidentiary scrutiny to the ideas of Madden and McQuinn (2014), thus beginning the process of conflict transformation at an institutional level.
Cull or conserve: landholder perceptions of wombats and their management

Casey O’Brien¹, Dr Elisa Sparrow², Dr David Taggart¹
¹The University of Adelaide, Adelaide, Australia, ²Department of Environment and Water South Australia, Adelaide, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Casey O’Brien is a PhD Candidate at the University of Adelaide studying human-wildlife conflict

Wombats are a much loved iconic Australian animal, but they are also considered an agricultural pest throughout much of their range. The damage caused by their burrowing behaviour often results in substantial financial costs and decreased production. Lethal controls, monitored under a permit system are used to reduce damages, but its impacts are poorly understood making it ineffective for conflict management and conservation. Landholder frustration with the permit system and its failure to resolve conflicts can lead to indiscriminate culling. Culling raises ethical and conservation concerns for wombats and there is increasing public pressure to implement non-lethal controls. Consequently, conflicts arise between stakeholders over how to best manage wombats. An integrative management approach encompassing the social and ecological aspects of the situation is needed to reduce conflicts, but the scientific data required to make informed and effective management decisions is lacking. This study examined the perceptions of landholders living throughout the southern hairy-nosed wombats (Lasiorhinus latifrons) range to ascertain attitudes towards the species and its management. Qualitative surveys revealed 81% of respondents with L. latifrons on their property experienced damage. Despite this, the majority (86%) of respondents supported L. latifrons conservation. Respondents who experienced damage and/or were financially dependent on their properties were more likely to use culling to reduce damages. To improve L. latifrons management, the largest portion (39%) of respondents suggested the development of non-lethal management options. These results highlight the need for new management strategies that reduce property damages and enhance co-existence between L. latifrons and landholders.

Quendas: Pet, pest or plague? Residential attitudes towards quenda, pet management and gardening practices

Mr Joseph Caspersz-Loney¹, Dr Amanda Kristancic, Dr Catherine Baudains
¹Murdoch University, Subiaco, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Poster 010 - Joseph has completed a Bachelor of Science, majoring in Conservation Biology and Law and Society, and is currently doing his Honours at Murdoch University in urban conservation of quenda.

The rapid urbanisation of the Swan Coastal Plain as part the Perth Metropolitan Region has resulted in widespread displacement of native wildlife. However, quenda (Isoodon fusciventer), are maintaining populations within this urban matrix, frequently interacting with human residents. Significant interactions occur between quendas and human residents on private property, areas often heavily modified to suit human interests, but with potential to provide critical resources for quenda. The possible relationships between residents’ attitudes and beliefs towards quenda, and residents’ attitudes towards pet management and garden practices concerning quendas is unknown, however exploring these relationships could be integral to maintaining these populations. This study is interviewing 60
participating residents in the City of Mandurah on their attitudes and beliefs concerning quenda, and quenda in relation to pet management and garden practices. A preliminary analysis of the data will be presented, however it is anticipated that themes will emerge between quenda presence and resident attitude, pet management and garden practices. These relationships can then be quantitatively tested in future studies to assist in developing an integrated framework, encompassing the interplay between urban conservation and human and social requirements. These frameworks would aim to create guidelines that can be promulgated by local government and concerned bodies to educate and assist residents in establishing ‘quenda-friendly’ gardens and public spaces. Such frameworks would assist in maintaining urban quenda populations and have the potential to apply to other native urban fauna, such as water rats and possums.

Human-wildlife conflict in Australia: Are we missing the bigger picture by focusing on the impacts?

Ms Kaye Currey1, Dr Pia Lentini2, Dr Dave Kendal2

1University Of Melbourne, Parkville, Australia, 2University of Tasmania, Hobart, Australia

SYMPOSIUM: Coexistence and conflict between Australians and wildlife, Hall B, November 27, 2018, 10:45 AM - 12:45 PM

Biography:

Kaye is a PhD candidate in BioSciences at the University of Melbourne. Her research interest is in human-wildlife conflict.

Human-wildlife conflict is a significant issue in many parts of the world due primarily to increased competition for space and resources as the human population expands. Conflict mitigation strategies often attempt to address the direct impacts of wildlife on humans by managing the wildlife (e.g. culling, fencing), but there is now widespread acceptance that effective management requires equal consideration of the human dimensions of the conflict. To disentangle the complexity of human-wildlife conflict we propose a framework which highlights that relationships between individuals within communities and the relationships between communities and wildlife managers can also be major drivers of conflict. A wide range of species are implicated in human-wildlife conflict in Australia and a review was undertaken in part to identify what species are involved, the type, frequency and intensity of impacts, and what management strategies are being implemented to mitigate impacts. Overseas research suggests that increased engagement with stakeholders can be an integral element of conflict mitigation, so a major focus of the review was to explore the extent to which the human dimensions of conflict are being considered. Initial results suggest there is a relative paucity of this type of research, and that many wildlife management plans are still primarily focusing on the impacts and ecological solutions, rather than on stakeholders and the community.
Metaphorical ecologies

Dr Amanda Niehaus¹
¹University Of Queensland, St Lucia, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Amanda Niehaus is a biologist and writer who uses science as metaphor to inspire new ways of thinking about the human-nature interface. Her first novel, The Breeding Season, will be published by Allen & Unwin in 2019.

Most of the science we do is communicated to the world via academic journals, nonfiction or journalism. These modes are effective at transmitting information to our colleagues and to particular members of the community, but we miss a large number of people—those without access to these materials or who, if you asked them, aren’t “into” science or non-fiction or would never buy a New Scientist or Cosmos.

Over the last five years, I’ve begun to experiment with new forms of science communication that use narrative and metaphor to convey information to readers. Alongside my reasonably sterile scientific papers, I write fiction and personal essays that set science right up against the things most people care about—love, health, family, respect, legacy. The field of ecology has so much potential to connect in this way to readers that might be otherwise lost. In this talk, I will highlight some of the ways we as scientists can cultivate curiosity and wonder in a more diverse readership.

Communicating the importance of insects in urban environments to policymakers and the general public

Dr Luis Mata¹
¹RMIT University, Melbourne, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Luis Mata is a Research Fellow at RMIT University, working as part of the Clean Air and Urban Landscapes Hub. He is an ecologist with an interest in plant-insect interactions, conservation of urban biodiversity and citizen science.

Scientists are increasingly relied upon to make their findings accessible, particularly those that can inform policy decision-making and raise awareness of controversial public issues. Traditionally trained scientists however are frequently ill prepared to communicate their findings outside academia. Whereas the motivation for most scientists is to address knowledge gaps in novel ways, policymakers and the public are much more interested in understanding how research outcomes can be applied to improve people’s lives. I argue that science communication has the potential to overcome this challenge and help researchers meaningfully impact the world around them.

I draw on the outreach outputs from The Little Things that Run the City project to showcase how my collaborators and I have communicated the importance of insects in urban environments to policymakers and the public. I highlight the creative tools we have used to communicate our findings in an aesthetically pleasing way, including photography and illustrations, and share examples where merging science and art has benefited the communication of our outputs. I then discuss insights into the pathways that have contributed to the success of the project’s science communication strategy, including the benefits of collaboration between industry and academic partners in co-creating the
Communicating uncertain science from complex systems: Should ecologists use questions in paper titles?

A/Prof Dieter Hochuli¹, Mr Trevor Drees¹, Mr Ryan Leonard¹

¹School of Life and Environmental Sciences, The University Of Sydney, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Dieter Hochuli heads the integrative ecology research group at the University of Sydney. His recent work in urban ecosystems examines how human activities affect ecosystem health, and conversely how human wellbeing is affected by the nature we interact with.

Asking and answering questions is fundamental to doing science. We examined the practice of ecologists asking questions in the titles of scientific papers to identify how common it was, and whether the papers framed that way conformed to Betteridge’s Law. This law, derived from journalism, states that “Any headline that ends in a question mark can be answered by the word no.” It is seen as a hallmark of lazy communication and essentially a version of clickbait, where the curiosity of media consumers is valued over accuracy and veracity. We surveyed 8 generalist ecology journals, assessing 3-yearly outputs spanning 3 decades. Examining over 10000 papers, we identified how often questions were asked, the types of questions asked, and whether Betteridge’s Law held. We found that the propensity to ask questions was remarkably consistent across decade, journal, and system studied. Just over 5% of all papers asked questions in their titles, with a majority of these asking simple yes/no questions. Of these, one in three answered “no” while almost half of them answered “yes”, suggesting that Betteridge’s Law could not be applied to ecological research. Our findings highlighted several key issues for linking primary scientific research to effective scientific communication. In the emerging era of open science, our work is increasingly accessible to a wider audience that is both sophisticated and sceptical. The simple step of using succinct, precise descriptive titles in primary research papers is an important first step in communicating our science to this diverse audience.

Loving our waterways too much? Monitoring waterway condition and social benefits in South East Queensland

Dr Emily Saeck¹², Dr Kim Johnston³, Dr Paul Maxwell¹, Prof Helen Ross⁴

¹Health Land And Water, Brisbane, Australia, ²Griffith University, Brisbane, Australia, ³Queensland University of Technology, Brisbane, Australia, ⁴The University of Queensland, Brisbane, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Emily is a Senior Scientist at Healthy Land and Water and a manager of the social and environmental condition monitoring program (EHMP) for South East Queensland’s annual waterways Report Card.

People move and travel to coastal regions seeking out beautiful natural waterways to live near and recreate on. However this creates a paradoxical effect, where increasing development to accommodate increasing population is associated with land clearing, which increases pollutant loads and pressure on our river and coastal water quality and the ecosystems they support. The South East Queensland
Waterways Report Card has been monitoring changes in local waterway condition for 15 years and importantly communicates this to the public every year. But knowing there is a problem is only the first step. Residents need to be strong stewards for waterway protection. Educational psychology theory suggests that for people to behave in ways that support the protection of waterways, they need to be both cognitively engaged (i.e. have enough information) and emotionally engaged (i.e. care enough). Surveying more than 3200 residents across SEQ each year, this monitoring program has found that residents’ emotional engagement varies across the regions, with local estuarine water quality as a strong predictor of engagement. This raises the issue of a negative feedback loop. If we are to protect and restore waterways into future, we need to find approaches to improve stewardship in the face of increasing population pressure and associated declines in water quality.

Urban noise – what’s a dove to do?

Dr Kirsten Parris, Dr Dominique Potvin, Mr Roy Erickson
1The University of Melbourne, Parkville, Australia, 2University of the Sunshine Coast, Hervey Bay, Australia, 3Arizona State University, Tempe, USA

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Kirsten Parris is an Associate Professor of Urban Ecology at the University of Melbourne, and the Leader of the Clean Air and Urban Landscapes Hub of the National Environmental Science Program (CAUL).

Urban noise hinders acoustic communication between animals, and presents a particular challenge for species that vocalise using low-pitched signals. The acoustic adaptation hypothesis proposes that the acoustic properties of a given habitat will exert selection pressure on the vocal signals of animals in that habitat. Many species of songbirds change their vocalisations in noisy urban habitats, but less is known about the response of non-passerines such as doves and pigeons (family Columbidae) to urban noise. While their calls are subject to substantial acoustic interference in cities, these birds may be less capable of changing their vocalisations. We recorded the calls of Inca doves (Columbina inca) and mourning doves (Zenaida macroura) at 24 neighbourhood parks in Phoenix, Arizona, and analysed call properties as a function of ambient noise. Using linear mixed models in a Bayesian framework, we found that both our study species used longer notes in noisier conditions. For example, note duration in the call of the Inca dove increased by a predicted 166% between the quietest and noisiest parks in our study, at a rate of 12% per dB(A) of noise. However, we found no evidence that either species of dove increased the pitch of their calls in urban noise. These results demonstrate that doves can respond to urban noise by changing certain properties of their calls; next steps for this work are to assess the effect of this strategy on population processes.
**Being mistaken for the enemy; increasing community engagement with quenda for the ‘right’ reasons**

**Dr Amanda Kristancic**, Dr Catherine Baudains, Prof Giles Hardy, A/Prof Patricia Fleming

1*Murdoch University, Murdoch, Australia*

**SYMPOSIUM:** Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Amanda Kristancic is a postdoc at Murdoch University, studying urban ecology of quenda.

Engaging the local community is crucial to the success of urban conservation projects. In Western Australia, we are lucky to share our urban areas with quenda (Isoodon fusciventer). These native bandicoots use remnant bushland as well as private residential gardens. Unfortunately, anecdotal evidence suggests that these marsupials are often mistaken for a feral rat, and quenda suffer consequences such as poison baiting and trapping/removal. Far from being a pest, quenda are considered ecosystem engineers, and play a pivotal role in maintaining the health of urban bushland (e.g. through dispersal of fungi spores and positive impacts on soil health). Efforts to conserve quenda in urban areas may be sabotaged by members of the public accidentally harming quenda when attempting to get rid of the “rats” on their property. If this misconception is widespread, community education regarding correct identification of quenda will be an important tool for management of quenda in urban areas. We have developed a range of novel methods to communicate quenda ecology, and the importance of conserving quenda, to the general public. Methods include traditional school visits and community talks, through to quenda games, truffle hunts and collector cards, which we hoped would be fun ways to deliver a conservation message. This presentation will describe the engagement tools we have developed, where they have been used, and feedback from stakeholders and community members regarding their experience with the tools. It is hoped this may serve as inspiration to other ecologists looking to engage the community in novel ways.

**The longest-lived spider: mygalomorphs dig deep, and persevere**

**Miss Leanda Mason**, Prof Grant Wardell-Johnson, Prof Barbara York Main

1*Curtin University, Bentley, Australia, 2University of Western Australia, Crawley, Australia*

**SYMPOSIUM:** Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Poster 015 - A concerned Perth resident that advocates for conservation on behalf of the downtrodden (and often trodden on) spiders. More specifically, trapdoor spiders. Curtin University PhD candidate and teach Science Communication at University of Western Australia.

We report the longest-lived spider documented to date. A 43-year-old, female Gaius villosus Rainbow, 1914 (Mygalomorphae: Idiopidae) has recently died during a long-term population study. This study was initiated by Barbara York Main at North Bungulla Reserve near Tammin, south-western Australia, in 1974. Annual monitoring of this species of burrowing, sedentary mygalomorph spider yielded not only this record-breaking discovery but also invaluable information for high-priority conservation taxa within a global biodiversity hotspot. We suggest that the life-styles of short-range endemics provide lessons for humanity and sustainable living in old stable landscapes.
Capturing imaginations and prey: using carnivorous plants to communicate botanical and ecological sciences

Ms Laura Skates¹
¹University Of Western Australia, Crawley, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 011 - Laura Skates is a PhD candidate researching the nutrition and ecology of carnivorous plants. She communicates with people about botany and conservation at events, schools, botanic gardens, in print, and online. You can find her on Twitter & Instagram @floraskates

Carnivorous plants are an ecologically defined group, characterised by their ability to capture and digest prey using specially modified leaf traps. Ever since Charles Darwin provided the first evidence of this unusual nutritional strategy, the carnivorous plants of the world have become a source of fascination for scientists, horticulturalists, gardeners, artists, and entertainers. In popular culture, carnivorous plants are often associated with both beauty and horror, portrayed either as wonders of the natural world or as man-eating monsters.

In reality, they are an incredibly charismatic and diverse group of plants, found naturally all over the world, with significant ecological, socio-cultural, and economic value. Unfortunately, carnivorous plants are threatened by humans through the loss and disturbance of their natural habitat and through the illegal collection of wild plants. With people and the fate of carnivorous plants so intertwined, there is a clear need for open and effective communication between ecologists, conservationists, cultivators, collectors, and the wider public.

Through my PhD research on the nutrition and ecology of carnivorous plants, I have had several opportunities to engage with a variety of audiences at events, schools, botanic gardens, in print, and online. I have found that carnivorous plants can spark curiosity in the Plant Kingdom, opening up conversations on broader scientific topics including botany, ecology, human impacts, conservation, and the intrinsic value of native species. In this presentation, I will discuss some of the public engagement activities I have undertaken using carnivorous plants, and outline opportunities for future research in this space.

The story of a citizenless citizen science project: what we’ve learned

Dr Megan Good¹, Dr Nick Schultz¹, Dr Birgita Hansen¹
¹Federation University Australia, Mount Helen, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Megan has been developing her ecological comedy routine through a hilarious combination of stay-at-home-parenting and innumerable short-term academic contracts. She wants to be a ground-breaking researcher, but until then, she gets the laughs.

This is the story of a failed citizen science project. Let’s start at the beginning. Many trees in the agricultural landscapes of south-east South Australia are dead or dying. Our literature review revealed many different causes of paddock and roadside tree death, but the distribution and occurrence of different symptoms was poorly understood. We needed some data and a map. We had been really successful engaging landholders, local government and land managers, all of whom were concerned about their beloved paddock and roadside trees. These people knew where the sick trees were located,
the management histories, and many other useful tidbits that we did not know. Are you thinking what we were thinking? Let’s build an online crowd-sourcing tool to extract this vital information from their brains! Citizen science to the rescue! They say ‘if you build it, they will come’. Spoiler alert: they never came. The website was designed to be simple, easy to navigate and informative. People were excited. There was a launch event. We visited local communities and ran demonstrations. We had the recipe for success. But it failed—possibly because we didn’t spend enough time with face-to-face engagement immediately after the launch (due to the inconvenient birth of my second kid), or possibly because no one actually cared about the trees in the first place. Citizen science is becoming a popular tool for research and outreach but we rarely hear about the failures. Let us be your cautionary tale.

**Conservation Crossroads: Is podcasting a good way to communicate your research?**

Ms Carla Archibald, Ms Rachel Friedman  
1The University Of Queensland, Brisbane, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Carla is interested in why landholders adopt private land conservation, and whether different motivations may influence the impact that private land conservation can make towards conservation goals. She also hosts the conservation podcast Conservation Crossroads along with Rachel Friedman.

Conservation science is at crossroads, species are declining at rapid rates and ecosystems are being thrown out of balance! Conservation Crossroads was born out of a desire to improve communication between scientists studying the environment and people in the community that may want to learn more about environmental issues. Throughout the podcast, we explore and share the most up-to-date thinking in conservation science and environmental problem-solving. We are trying to highlight conservation issues that are timely and resonate with more than just academics - for example, citizen science, crowdfunding for conservation, research in Antarctica or plastic pollution. Science should be accessible to a broad set of people, and connecting members of the scientific community, policymakers, and the general public is something that we are both motivated to achieve through the Conservation Crossroads podcast.

**Welcome to the Anthropocene: from concept to making it real**

Dr Simon Torok, Mr Paul Holper  
1Scientell, Melbourne, Australia

SYMPOSIUM: Communicating ecology in the Anthropocene, Meeting Rooms 1-2, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Simon is Director of Scientell (www.scientell.com.au), a science communication business specialising in environmental and climate change communication. We distil technical information for non-scientific audiences to communicate the importance of science in our lives and its role in understanding the environment.

Our species’ whole recorded history has taken place in the Holocene – the brief interval stretching back 10,000 years. But our collective actions have brought us into uncharted territory – humanity is now influencing every aspect of the Earth on a scale akin to the forces of nature. If our descendants look back in thousands of years’ time, they’ll see the evidence of our actions written everywhere in the rocks. We’ve entered a new geological epoch – the Anthropocene, a term first used by Nobel Laureate Paul Crutzen in February 2000.
Welcome to the Anthropocene is a website and short film designed to improve our collective understanding of humanity’s impact on Earth. It combines insights from some of the leading scientific research institutions on global sustainability with powerful imagery and a video flight over the Earth’s surface to help visualise and better understand humanity’s geographic imprint in recent time.

We are at a crossroad in environmental communication where the science is clear, the data are available, the visualisation tools are affordable, and the diffusion networks are global and free. Advances in visualisation tools, increases in global internet access, and the proliferation of social media have created new opportunities for communicating science in general – and environmental science in particular. This paper will provide guidelines for achieving impact through visualisation by explaining the communication activities that led from the initial Anthropocene website concept to the use of the film by United Nations to open the Rio+20 Conference in Brazil.

Using DNA meta-barcoding techniques to assess the impacts of mass-flowering crops on pollinator floral fidelity

Ms Victoria Reynolds1,2, Dr Karen Bell2,3, Prof Margaret Mayfield1, Dr Berry Brosi4
1University Of Queensland, Brisbane, Australia, 2CSIRO Land & Water, Floreat, Australia, 3University of Western Australia, Crawley, Australia, 4Emory University, Atlanta, USA

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Victoria Reynolds is a PhD student with the School of Biological Sciences at the University of Queensland and CSIRO Land & Water. She has recently completed a nine-month Fulbright Scholarship at Emory University in Atlanta, Georgia, USA.

Plant-pollinator networks have typically been created from insect visitation data that may not accurately depict true pollination events. Recently, there has been an increase in the number of networks created via insect pollen load samples. However, these networks are often determined through light microscopy identification, which requires specialised knowledge and reference collections, and even with these, lower levels of identification can be hard to achieve. Recently, next-generation sequencing technology has been used as an alternative to identifying species-specific pollen samples from honey, hives and insects. However, this novel approach has not yet been used to test ecologically driven questions, like how varying landscape factors may be altering resource collection patterns and floral fidelity in pollinating insects. We use DNA meta-barcoding and the DADA2 pipeline to assess the impacts of a mass-flowering crop, Brassica napus, on the floral fidelity of pollinating insects in wildflower communities adjacent to these fields. We collected 120 pollinating insects from remnant patches of York Gum-Jam woodland wildflower communities in SW Western Australia with varying distances from flowering canola fields. Using DNA meta-barcoding and next generation sequencing, we identified the species composition of these pollen loads and created network and pollen load analyses to determine how increased proximity to canola crops alters pollen load consistency. With this research, we highlight the practical applications of using this technique and the potential for its use in ensuring improved accuracy for plant-pollinator network analyses and pollen load analyses that will be a valuable resource for answering ecologically driven questions.
Detection Dogs for Conservation

Dr Celine Frere¹, Mr Russell Miller¹, Dr Romane Cristescu¹
¹University Of Sunshine Coast, Sippy Downs, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Frere’s research strength lies her ability to combine the fields of genetics, behaviour and ecology to study evolutionary processes in natural and human impacted landscapes using longitudinal datasets.

Australia’s unique and diverse fauna are threatened by habitat loss, introduced species and disease with an estimated $526 million spent each year on wildlife conservation nationwide. Certain basic information about a species is needed to ensure that management strategies are effective; for example, accurate data on presence/absence, spatial distribution, genetic diversity, and disease for fauna species is fundamental to conservation biology. Despite this, acquiring such critical data can often be time consuming, laborious and costly, all of which can be exacerbated for fauna species characterised by low densities, large home ranges and cryptic or elusive behaviour. For such species indirect methods are often relied upon, the most common being surveys of faecal pellets (scats). Scat surveys, are however, not without their difficulties; they often contain high false negative rate and age of scat greatly influence molecular typing for genetic diversity and disease detection. Using experimental and field-based trials, we will present data to show the extent to which detection dogs can be applied to tackle some of the major challenges associated with koala conservation through scat surveys.

Improving urban biodiversity habitat and conservation using green roofs

Assoc. Prof. Nicholas Williams¹, Ms Jacinda Dromgold¹, Dr Caragh Threlfall¹, Dr Briony Norton², Dr Claire Farell¹, Prof Jeremy Lundholm³, Mr John Delpratt¹
¹The University of Melbourne, , Australia, ²University of Derby, Derby, United Kingdom, ³St Marys University, Halifax, Canada

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Nick is an ecologist who works predominantly in urban areas. He co-leads the Green Infrastructure Research Group (GIRG) at The University of Melbourne which aims to develop and evaluate the benefits of green infrastructure for Australian cities.

Green roofs are becoming increasingly common in the world’s cities. Over the past decade we have developed green roofs suitable for Australian cities and quantified their hydrology, energy and human well-being benefits. While these are substantial, green roofs could also provide new opportunities for plant conservation in urban areas and habitat and resources for a range of mobile fauna species. We discuss the characteristics of plant species that may benefit from conservation on green roofs and reports on trials to establish a native grassland community on a green roof in inner Melbourne. This was planted with 29 species from the critically endangered Victorian Volcanic Plains and their survival and recruitment monitored over three years. In a separate project, we sampled the invertebrate community on six green roofs in Melbourne planted with either native grassland or succulent species. We compared their invertebrate communities to communities on ground-level sites close by, and sites with similar vegetation. The only significant differences between invertebrate communities on green roofs and ground-level habitats was total abundance and fly family richness, which were both higher in ground-level sites. The percent cover of green space surrounding each site was consistently important in predicting invertebrate richness and abundance, while roof height, site age and size were influential for
some taxa. Our results suggest that establishing low cost biodiversity green roofs is feasible in Australian cities but their effectiveness as habitat will be highly dependent on their location and the horizontal and vertical connection to other habitats.

Project AIRSHIP: Spotting sharks using blimp-mounted cameras for conservation and human safety

Mr Kye Adams¹, Dr Leah Gibbs², Ms Allison Broad¹, Dr Nathan Knott³, Mr Martin Hing¹, Prof Andy Davis¹
¹University Of Wollongong, Wollongong, Australia, ²Department of Primary Industries, Huskisson, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
My current research is focused on managing the ecological impact of fisheries, especially on vulnerable species caught as by-catch. I founded project AIRSHIP; an initiative developing a new approach for mitigating shark-human interactions at our Australian beaches.

Managing shark-human interactions is a key social and environmental challenge that needs resolving if we are to maintain shark populations and ecosystem function. Shallow coastal marine environments such are known to provide nursery habitats for many shark and ray species. These shallow nearshore areas are also areas where recreational activities such as swimming and surfing are concentrated. Here we develop a novel active tracking approach using blimp-mounted cameras to continuously track the presence and movement of sharks, rays and other species. The blimp provides a means for assessing the shallow water space-use and beach visitation rates of large marine animals, providing continuous 8-hour coverage. A “spotting” trial was conducted to determine the reliability of this method in different weather conditions and water depths. Mobile shark analogues were deployed daily at two depths. Footage was later shown to lifeguards who identify whether a shark analogue was presence or absence from the footage. During the field trials, the movement behaviour of numerous sharks, rays, fish and seals was also recorded. This technique has relevance to scientists interested in monitoring animal movements with minimal disturbance. The project addresses the key management objective of preventing unwanted shark-human interactions; providing safer beaches whilst conserving marine life.

The Fire Research and Modelling Environment (FRaME)

Dr Philip Zylstra¹
¹University Of Wollongong, Wollongong, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Dr Zylstra models fire behaviour from plant traits, and constructs mechanistic frameworks that show how these interact with climatic and management influences to drive the influence of fire in the environment.

Fire is a key disturbance mechanism for many terrestrial ecosystems. Understanding these ecosystems requires knowledge of the fire regime and its influence on component species. Fire behaviour modelling has however been inadequate for the prediction of species effects on flammability and has not captured species feedbacks on fire regimes.

The Fire Research and Modelling Environment (FRaME) uses biophysical, mechanistic modelling to determine the drivers and effects of flammability on ecosystems. The core of FRaME is the Forest Flammability Model (Zylstra et al., 2016), the first peer-reviewed forest fire behaviour model for SE Australia, and a global first in its ability to quantitatively model the influence of species composition on fire behaviour. Current work is adding to this a comprehensive series of tools for modelling fire effects,
ranging from soil heating to crown scorch, and the impact of specific fires and regimes on a species of animal. These models will inform bushfire risk planning for significant fauna in NSW through the Office of Environment and Heritage.

FRaME is being developed within the R Statistical Environment as a modular platform capable of integrating new science as it is developed. Validation of modelled flame heights demonstrated high levels of accuracy across a wide range of forests and conditions, and further work is underway to validate predictions of fire impacts on wildlife population dynamics for a range of well-documented species.

Using LiDAR for landscape-scale mapping of potential habitat for the critically endangered Leadbeater's Possum

Ms Ruizhu Jiang¹, Dr Craig Nitschke¹, Professor Patrick Baker¹, Dr Raphael Trouve¹, Dr Linda Lumsden²
¹University Of Melbourne, Richmond, Australia; ²Arthur Rylah Institute, Heidelberg, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Ruizhu "Jane" Jiang is a PhD student in the School of Ecosystem and Forest Sciences at the University of Melbourne.

Identifying areas of potential current and future habitat is central to conservation planning. For forest-dependent species with specific structural requirements, such as the critically endangered Leadbeater's Possum, this presents a challenge because it requires data that is both high-resolution and spatially extensive. LiDAR provides an efficient mechanism for obtaining such data. Here we describe new algorithms to detect the specific habitat features required by Leadbeater's Possum using recently acquired LiDAR data from Victoria's Central Highlands. We then applied machine-learning tools to a large dataset of Leadbeater's Possum survey plots to develop statistical models that related LiDAR-derived structural features of the forest to the probability of Leadbeater's Possum presence. This allowed us to develop the first high-resolution mapping of potential Leadbeater's Possum habitat across >400,000ha of the Central Highlands. The results of this work will provide new insights into the distribution of current habitat, the empirical foundations for modelling future habitat, and a landscape-scale context for conservation planning and forest management.

Securing a long-term future for coral reefs: the 50 reefs challenge

Dr Emma Kennedy¹, Dr Hawthorne Beyer¹, Prof Ove Hoegh-Guldberg¹
¹University Of Queensland, St Lucia, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Dr Emma Kennedy is a marine ecologist specialising in coral reef ecosystems. She currently works at University of Queensland, where she coordinates a large-scale reef monitoring program that combines AI and camera technology to scale up reef monitoring efforts.

Coral reefs have experienced severe degradation in recent decades, driven by a range of processes from overfishing to pollution and climate change. Ocean warming is expected to have further severe impacts on these ecosystems unless global warming is restrained well below 2°C (the goals of the Paris Agreement). Even then, it’s expected that 70-90% of reef areas will be experiencing conditions unsuitable for coral growth by mid-century. Not all reefs are equally at risk from climate change, suggesting potential to identify those that are less vulnerable to climate change and that may help
replenish other degraded reefs in the future. Here we apply Modern Portfolio Theory, a tool borrowed from financial theory, to conservation planning to identify a global portfolio of coral reefs that meet these criteria, while allowing for our own uncertainty of projected climate impacts. The proposed global strategy and actions add to the existing conservation efforts for coral reefs as we face the long-term consequences of deepening climate change.

Evaluating the efficacy and optimal deployment of unmanned aircraft systems for wildlife monitoring

Ms Elizabeth Brunton¹, Dr Scott Burnett¹, Dr Javier Leon¹
¹University Of The Sunshine Coast, Sippy Downs, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 019 - Beth is a wildlife ecologist with broad research interests including urban wildlife, wildlife conservation, citizen science and conservation physiology. Her current research focuses on the effects of urbanisation on eastern grey kangaroos.

While unmanned aircraft systems (UAS), commonly known as drones, are viewed as a less intrusive method of monitoring large wildlife there is little research to support this contention, or to confirm the efficiency of wildlife monitoring using UASs. This research therefore tested the feasibility and potential impacts of monitoring kangaroos in urban and peri-urban environments using drone-based thermal imagery. We conducted 46 drone deployments over a 9 month period to investigate optimal drone flight altitude and optimal environmental and temporal conditions for detection of kangaroos. In this study, drone-mounted thermal imagery coupled with manual image interpretation, achieved an overall 84% detection success rate of known kangaroos. Results of linear modelling showed that successful detection of kangaroos was influenced by the height of the drone, the time of day that drone deployment took place, and the type of vegetation present. These results lead us to conclude that in grassy or open forest, early morning drone flights at a height from 60 - 100m above ground level will deliver high rates of kangaroo detection. Surveys conducted at other times of day, at lower altitudes and in areas with shrub or forest cover, are likely to be less successful in detecting kangaroos and may impact upon kangaroo behaviour.

Identifying drivers of decline in freshwater species: a landscape-level approach using environmental DNA detection methods

Emily McColl-Gausden¹, Dr Reid Tingley¹, Dr Andrew Weeks¹,²
¹School of BioSciences, The University of Melbourne, Parkville, Australia, ²cesar, Parkville, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 020 - I am a PhD student in the Quantitative and Applied Ecology group at The University of Melbourne. I am examining how environmental DNA can be used to gather landscape level data and am interested in the effectiveness of novel technologies.

Freshwater biodiversity is impacted by many ongoing threats. To untangle how these threats are impacting freshwater species, we need to be able to accurately detect spatial and temporal changes in species distributions. Conducting accurate surveys is often costly and time intensive, reducing the number of sites that can be visited for a given survey budget. Environmental DNA (eDNA) sampling, which involves the detection of extracellular DNA in the environment, has the potential to improve survey cost efficiency for a wide range of freshwater taxa. I will use single-species and multi-species
eDNA methods to elucidate the processes threatening several freshwater vertebrate taxa, with a particular focus on the platypus. I will achieve this aim by correlating threat intensity with the persistence or extirpation of species at historically-occupied sites. I have developed a stratified sampling regime to ensure all combinations of threats and platypus occupancy status are sampled. I will visit ~500 sub-catchments over two years within Victoria and New South Wales to estimate the current distribution of platypuses in Australia’s most regulated rivers. The multi-species detection method used will allow me to determine the presence/absence of other species such as invasive and threatened fish. This study represents an extensive multi-species survey across iconic and threatened species using a novel technique.

Animal Call Recognition Using Acoustic Indices

Mr. Hongxiao Gan1, Dr. Jinglan Zhang1, Prof Paul Roe1
1Queensland University of Technology, Brisbane, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 018 - Mr. Hongxiao Gan is a Ph.D. candidate at Queensland University of Technology, Brisbane, Australia. His research interests lie in machine learning and animal call classification with acoustic data.

The aim of this research is to provide ecologists with an efficient method to identify species in long duration recordings. Although listening to environmental sound can be an efficient way to monitoring biodiversity, rapid advances in recording technology and storage make it possible to accumulate thousands of hours of recordings, of which, ecologists can only listen to a small fraction. Animal call recognition systems help ecologists identify species in long duration recordings. However, current recognizers require designing specific features for each species. It is time-consuming to find feature sets that best benefit building efficient recognizers. There is a high demand on generic recognizers that work well on multiple species.

Acoustic indices are global measures of the acoustic output of the community. They are developed to summarize some aspects of the structure and distribution of acoustic energy and information in acoustic recordings. Since the use of acoustic indices is not restricted to a specific species, they may be used as a generic feature set for recognizers on multiple species. Therefore, acoustic indices can simplify the procedure of building animal call recognizers. This research proposes new recognizers with acoustic indices as generic features to represent animal calls and avoid the repetitive work of feature design. The experiments show that our recognizers with acoustic indices works well on Little Spotted Kiwi except very faint calls. The preliminary result of an undergoing experiment on Common Sedgefrogs and Wallum Sedgefrogs is inspiring.

Automated detection of koalas in thermal imaging derived from UAVs

Miss Evangeline Corcoran1, Dr Simon Denman1, Dr Grant Hamilton1
1Queensland University Of Technology, Brisbane, Australia

SYMPOSIUM: Conservation technology: Innovative applications for ecology, Hall B, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Evangeline Corcoran is a Master of Philosophy Candidate at Queensland University of Technology researching advanced detection techniques for monitoring threatened populations of Koalas utilizing technologies such as UAVs, thermal imaging, machine learning and LiDAR.
Koalas are an iconic Australian species that are listed as threatened throughout most of their range. Obtaining reliable and regular estimates of abundance is critical for management of koalas in an area, however, their cryptic nature and wide dispersion have presented significant challenges to developing a robust and efficient monitoring method for the species. Although thermal imaging from UAVs has been suggested as an ideal solution to abundance estimation for many species, UAVs have not yet been used for making accurate quantitative estimates of arboreal wildlife in Australia. The development of new approaches to imaging the species and the environment have been required, together with deep-learning algorithms to carry out image analysis automatically. In this presentation, we will discuss the guidelines that have been developed for the best use of UAVs for Koala abundance estimation, the use of thermal imaging and machine learning for more accurate analysis, and the application of the data collected towards the establishment of probability of detection and development of occupancy models. The takeaway lessons from this study have broad application to a variety of species of conservation concern, as well as invasive species.

The need to better include and recognise Aboriginal Rangers in threatened species management processes and research

**Dr Malcolm Lindsay¹, Dr Vanessa Westcott², Ms Cissy Gore-Birch³, Mr Albert Wiggan³, Dr Alexander Watson⁴**

¹Environs Kimberley, , , , ²Bush Heritage Australia, , , , ³Nyul Nyul Rangers, , , , ⁴WWF – Australia, ,

SYMPOSIUM: Conserving Northern Australia’s Culturally Important Species and Ecosystems, Hall B, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**

Dr. Malcolm Lindsay is the Ecological Projects Coordinator for Environs Kimberley, a regional NGO, whose collaborative projects with Aboriginal Rangers work to manage and document ecologically and culturally important species and ecosystems in the Kimberley.

Aboriginal Rangers have become the largest conservation work force in Australia and have cultural and tenured land management responsibility for a significant portion of the land and sea, and by extension, a significant portion of the remaining ranges of many threatened species and ecosystems. Despite Rangers and their communities’ long history of land management, custodial responsibilities, cultural connections, traditional ecological knowledge, land management capacity and tenure ownership around threatened species and ecosystems, they have been poorly included or recognised by formal threatened species management processes (e.g. National Recovery Teams) or research. Here we document the extent and patterns of this poor inclusion for Kimberley and Desert Ranger groups through interviews and meta-analysis of recovery plans and research papers, and make recommendations on how to improve the current situation. We show that this is far more than simply an issue of respect for Aboriginal rights and culture, but that it also impacts the effective and informed management of Australia’s threatened species.

Bush tucker and biodiversity: weed management on the floodplains of Kakadu National Park.

**Professor Michael Douglas¹,², Dr Vanessa Adams²,³, Professor Sue Jackson³,⁴, Dr Kelly Scheepers, Dr Johnathan Kool⁵, Associate Professor Samantha Setterfield¹,⁴**

¹University Of Western Australia, Crawley, Australia, ²University of Tasmania, Hobart, Australia, ³Griffith University, Nathan, Australia, ⁴NESP Northern Australia Environmental Resources Hub, Darwin, Australia, ⁵Private Consultant, Queanbeyan, Australia

SYMPOSIUM: Conserving Northern Australia’s Culturally Important Species and Ecosystems, Hall B, November 28, 2018, 11:00 AM - 1:00 PM
Biography:
Michael Douglas is the Leader of the NESP Northern Australia Hub and a Professor of Ecology at the University of Western Australia. He is a freshwater ecologist but collaborates actively with researchers from other disciplines, government agencies and Indigenous land managers.

Invasive alien species are a major driver of global biodiversity loss. Constrained conservation budgets demand that threat abatement strategies must take into account the heterogeneity of areas in need of protection, such as significant ecological and cultural sites, as well as the competing values, preferences and objectives of stakeholders. We used an interdisciplinary team to assess the threat that invasive alien grasses pose to both environmental and Indigenous cultural values on the floodplains of Kakadu; a co-managed, World Heritage-inscribed national park. We evaluated costed management scenarios that sought to simultaneously conserve biodiversity and bush tucker. We found that there was a greater initial cost to protect both bush tucker and biodiversity sites compared with just protecting biodiversity, but the ongoing costs were similar. This was the first study to apply strategic foresight to weed management planning in a realistic, culturally complex setting and it provides Traditional Owners and park managers with a basis for improved floodplain weed management.

Balanggarra “Right Way Fire” in the Conservation Management of Threatened Gouldian Finches

Dr Ian Radford1, Mr James (Birdy) Gallagher2, Dr Anna Weier3, Mr Richard Fairman1, Mr Wes Alberts2, Mr Phil Mitchell2, Mr Quinten Gall2
1Department Of Biodiversity, Conservation And Attractions, Kununurra, Australia, 2Balanggarra Land and Sea Management Unit, Kimberley Land Council, Wyndham, Australia, 3Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia

SYMPOSIUM: Conserving Northern Australia’s Culturally Important Species and Ecosystems, Hall B, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Ian is a Fire Ecologist whose research includes the effects of fire regimes, and other threatening processes, on threatened savanna biodiversity. James (Birdy) Gallagher is a Balanggarra Ranger engaged in burning for carbon and conservation management across the East Kimberley.

Current fire regimes are implicated in declines of many species including the threatened Gouldian Finch of northern Australian savannas. This is despite the main Gouldian finch food source, annual Sorghum grass seeds, thought to be more abundant under current fire regimes. This paradox has been partly addressed during recent research and “right way fire” management by the Balanggarra Rangers and researchers from Charles Darwin University and WA Parks and Wildlife. Rather than responding negatively to all fire as originally thought, this study found that finches benefitted from “right way fire” approaches to burning. Breeding finches preferred recently burnt areas (from last year) as long as they were in many small patches (fine-scale mosaic 10-100 m across) rather than few larger (high intensity) fires. Finches preferred areas burnt infrequently (<1 in 4 years). Recent, infrequent and patchy fires (right way fire) resulted in higher seed production and higher seed nutritional value for breeding finches compared to areas burnt in larger, more intense wildfires during the mid to late dry season (Jun to Oct). Active fire management to achieve patchy mosaics during the wet-dry transition (Mar-May) prevented later wildfires from damaging finch habitat both in terms of grass seed quality and availability, and in terms of destruction of large hollow-bearing trees used by breeding finches. The challenges of implementing fine grain fire mosaics during the hottest and most humid time of the year in the hottest part of Australia is discussed from an aboriginal ranger’s and a researcher’s perspective.
First citizen-science population estimates for green sea turtles foraging in the northern Great Barrier Reef

Ms Christine Hof¹, Mr Edward Smallwood²
¹WWF-Australia, Brisbane, Australia, ²Gudjuda Aboriginal Reference Group (Senior, Bindal Elder), Ayr, Australia

SYMPOSIUM: Conserving Northern Australia’s Culturally Important Species and Ecosystems, Hall B, November 28, 2018, 11:00 AM - 1:00 PM

Biography: biography to be advised

Embayments and coastal reefs of Queensland have supported some of the highest densities of green sea turtle (Chelonia mydas) foraging aggregations in the western Pacific. Since industrialization, many cumulative threats have negatively impacted these turtles with some Aboriginal communities concerned about notable reductions in local abundance and possible end to their customary hunting practice. Guided by collaborators, population trends, survivorship and somatic growth were monitored at a broadly representative inshore site in Edgecumbe Bay, Queensland using a local citizen science approach. The 12-year time series of 1316 tagged turtles from 2003-2014 was analysed using Capture Mark Recapture and Bayesian growth models. Models indicated the population comprised of 4392 individuals in 2014 and is rebuilding at 8.3% pa. Overall survival (0.90 apparent survival pa) and growth rate (1.20 cm/yr) were high compared to other green turtle populations globally. This study represents the first population modelling of green turtles foraging in inshore waters of the Great Barrier Reef and north east Australia. Rangers from Gudjuda Aboriginal Reference Group are now well placed to continue population monitoring studies and take sole responsibility for data collection and decision making contributing to the future management of Sea Country, whereby the Gudjuda Aboriginal people have instituted a permit system to manage turtle take for traditional ceremonial purposes only. Although scientist collaboration will be required for CMR analysis, this study provides a good example of collaboration with use of a citizen science approach which could be replicated and modelled in other dedicated communities in Australia and worldwide.

A multi-scale analysis of large herbivore distribution in the north Kimberley, Western Australia

Miss Angela Reid¹, Dr Brett Murphy², Dr Tom Vigilante³, Wunambal Gaambera Aboriginal Corporation⁴, Prof David Bowman¹
¹University Of Tasmania, Hobart, Australia, ²Charles Darwin University, Darwin, Australia, ³Bush Heritage Australia, Melbourne, Australia, ⁴Wunambal Gaambera Aboriginal Corporation, Kalumburu, Australia

SYMPOSIUM: Conserving Northern Australia’s Culturally Important Species and Ecosystems, Hall B, November 28, 2018, 11:00 AM - 1:00 PM

Biography: Angela M. Reid is currently a PhD Candidate at the University of Tasmania researching interactions between fire, forage and large native and introduced herbivores on lands under Aboriginal management. She will be completing her program in mid-2019.

Fire and herbivory are integral processes for the maintenance and management of tropical savannas. Anecdotal evidence suggests that in parts of northern Australia macropod species have declined where introduced herbivores are well-established and fire regimes have been altered. We utilized a combination of multi-scale methods in the north Kimberley, WA to examine the diversity and distribution of native and exotic large herbivores (macropods and cattle): 1) scat counts, 2) road transects, 3) aerial transects and 4) aerial photography. We developed species distribution models to identify the drivers of the distribution of large herbivores in the study region. Scat counts showed that
seasonal dryness and time since fire were important predictors of habitat use by cattle and macropods. Macropods were only detected once during the road transects (n = 35); in contrast, cattle were abundant with a mean density of 0.10 per ha. Aerial transects provided corrected (for perception bias) population estimates (± SE) for macropods (3,845 ± 1,343) and cattle (6,096 ± 1,603) on the approximately 7,800 km² study area. Both aerial transects and aerial photography showed strong distribution patterns. Cattle and cattle tracks were found on fertile savannas 1.5x more than expected while macropods were found 0.3x as often as expected. Conversely, macropods were found on infertile savannas 1.2x more often than expected and cattle and cattle tracks 0.8x. Our findings confirm a low density of macropods in northern Australian savannas and provide insights into how native and introduced herbivores utilize and interact across the savanna landscape.

Co-authors: Dr Brett Murphy (Charles Darwin University), Dr Tom Vivilante (Bush Heritage Australia), in collaboration with Wunambal Gaambera Aboriginal Corporation

**Team Sawfish: Indigenous Rangers and Researchers protecting sawfishes in the Fitzroy River, Kimberley and beyond**

Assoc. Prof. David Morgan, Dr. Adrian Gleiss, Ms Karissa Lear

*Murdoch University, Murdoch, Australia; Walalakoo Aboriginal Corporation, Derby, Australia*

**Biography:**
David Morgan has been researching fishes in Western Australia for the last 26 years. Since 2005 he has lead Team Sawfish; a collaboration with people of the Kimberley focused on protecting sawfish populations, such as the Freshwater Sawfish.

It is only relatively recently that the global significance of the Freshwater Sawfish population in the Fitzroy River, Kimberley, has been revealed. The species, which has a juvenile freshwater phase, has declined globally and is now listed by the IUCN as Critically Endangered. In 2005, scientists from Murdoch University teamed up with the Nykina-Mangala Rangers to help protect the sawfish in the Fitzroy River, and became known as Team Sawfish. This collaboration, through national and international media and scientific publications has led to greater understanding (globally) of the importance of the Kimberley to sawfish conservation; noting that 4 of the world’s 5 species are found here. These culturally and morphologically iconic species have proved to be an important flagship species for the conservation of the Fitzroy River. Team Sawfish have tagged almost 1000 sawfish in recent years, the collaboration unraveling the mysteries of these enigmatic rays. This is the longest running fish monitoring project in Western Australian inland waters and has highlighted the importance of long-term studies in large river systems, particularly where recruitment is linked river discharge and may fail during poor wet seasons. Here we will present scientific, cultural and internationally important findings in relation this iconic species.

**Predictive modelling of Spectacled Hare-Wallabies informs management of the Yawuru Indigenous Protected Area**

Dr Michael Wysong, Mr Johani Mamid, Mr Pious Gregory, Mr J Smith, Mr E Maher, Mr V Lee, Dr Alexander Watson

*WWF-Aus, Broome, Australia; Nyamba Buru Yawuru, Broome, Australia*

**Biography:**
Michael Wysong is an animal ecologist with expertise in population modeling. With a focus on the conservation of the spectacled hare-wallaby, he has conducted research in the Kimberley region of Australia. His work involves developing predictive models to inform conservation strategies, particularly in the context of Indigenous Protected Areas. Wysong’s research has contributed significantly to understanding the habitat preferences and population dynamics of this critically endangered species.
Mr Johani Mamid is the Head Ranger of the Yawuru Country Managers managed by Nyamba Buru Yawuru. They work with local community to manage the Yawuru Indigenous Protected Area that surrounds Broome.

The spectacled hare-wallaby (Lagorchestes conspicillatus) is a medium-sized macropodid whose range formally occupied half of the Australian continent. Today, however, the distribution of L. conspicillatus is extremely patchy and has suffered a substantial decline where it is now considered very rare in regions including the Kimberley. As a specialist of dense tussock grasslands, L. conspicillatus is likely threatened by altered fire regimes and grazing by introduced livestock as well as by introduced predators such as foxes and feral cats. Between 2014 - 2018, indigenous Country Managers with the Nyamba Buru Yawuru (NBY) Land and Sea program together with WWF-Australia researchers conducted surveys for L. conspicillatus both within the recently dedicated Yawuru Indigenous Protected Area (IPA) and surrounding country. Prior to these surveys, L. conspicillatus had not been recorded for 9 years, with speculation they had become locally extinct. Our initial surveys confirmed the presence of L. conspicillatus on the IPA at multiple locations. A more intensive survey in 2017/2018, undertaken with the support of Nyikina Mangala and Karrajarri rangers, used occupancy modelling to determine which environmental features best explain the occurrence of L. conspicillatus in the landscape and then used maxent GIS modelling to produce a predictive map for L. conspicillatus occurrence across the IPA. We found that diversity of fire age was the strongest factor for predicting SHW occurrence and this information is now utilised by Country Managers and Roebuck Plains Pastoral Station to protect and recover populations of L. conspicillatus on the Yawuru IPA and surrounds.

Co-authors: Dr Michael Wysong (Yawuru IPA Manager, WWF Australia), Mr Pious Gregory*, Mr J Smith*, Mr E Maher*, Mr V Lee*, Dr Alexander Watson (Kimberley Program Manager, WWF Australia)

* Yawuru Country Ranger, Nyamba Buru Yawuru

Movement ecology on land: knowledge gaps and new technologies to help fill them

Professor Don Driscoll1, Dr Tim Doherty1, Associate Professor Euan Ritchie1, Professor Ran Nathan2, Professor Abbas Kouzani3, Professor Sivan Toledo3, Dr Thanh Nguyen1

1Deakin University, Burwood, Australia, 2Hebrew University of Jerusalem, Jerusalem, Israel, 3Tel-Aviv University, Tel-Aviv, Israel

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Don Driscoll is Professor of Terrestrial Ecology, President of the Ecological Society of Australia, Director of the Centre for Integrative Ecology and the TechnEcology Research Network at Deakin University. Much of his research focuses on animal movement in fragmented landscapes.

Habitat modification, loss, fragmentation and introduced predators can disrupt animal movement, elevating extinction risks. However, the specific human-related mechanisms that disrupt movement are poorly understood because most species are too small to track. Further, most commonly used methods to study movement provide only course insights. Consequently, there is limited capacity to understand the chain of mechanisms by which human meddling can alter movement and subsequently species’ persistence. In this presentation on recent directions in movement ecology on land, I will argue that to understand impacts of human-meddling on movement, we need to evaluate how movement is influenced by environmental variation, interactions with other species and individual personality. Achieving this knowledge requires detailed tracking data. Although detailed tracks can be collected using GPS for large animals, GPS applications for small animals remain very limited. However, new
approaches to tracking and analysis are already moving towards revolutionising the field of movement ecology for small animals. These include automated tracking methods, and incorporating machine-learning into managing big-data.

Emerging directions in the study of organism movement: Opportunities and challenges for the ecological community

Dr Hamish Campbell
Charles Darwin University, Ellengowan Drive, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Hamish Campbell is a RIEL Senior Research Fellow and leader of the Movement and Landscape Ecology laboratory (MLE-Lab) at Charles Darwin University (CDU). His research studies the spatiotemporal relationship between animals and their environment.

Movement is fundamental to ecological processes. Measures of animal movement, e.g. dispersal, residence time, home range size and overlap forms the basis of fundamental ecology theories and are essential for managing threatened species, reducing the spread of invasive species, and predicting rates of disease spread. Consequently, the study of organism movement has pervaded all fields of ecology. In this talk I will provide an overview of the ‘Movement Ecology' paradigm. Demonstrating how new technologies and analysis techniques are assisting us to better understand the causes and consequences of organism movement, and what opportunities and challenges that lie ahead for the field.

Emerging directions in movement ecology in the marine environment

Dr. Vinay Udyawer
Australian Institute of Marine Science, Darwin, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Vinay Udyawer is currently a post-doctoral fellow based at the Australian Institute of Marine Science, based in Darwin. His area of research is within the fields of movement and spatial ecology, animal behaviour, comparative physiology and data science.

Studying individual-level animal movements is hard enough without the added challenges of working in marine environments. With the ruggedization and miniaturisation of tracking technology and animal-borne sensors, more and more high-resolution information can now be gathered about marine animals in their natural environment. Analogously, the advancement of analytical and data visualisation techniques in this field, driven by increased computer processing power have allowed us to understand complex biotic and abiotic drivers of movement, physiologies, and social interactions. Although primarily used to obtain fundamental ecological and biological information on marine animals, the field has now rapidly grown to provide critical information needed to better inform fisheries management planning and marine conservation efforts. In this talk we will discuss the range of field techniques that have been used to track individual animal movements in the marine environment, and some promising new technology that is being developed to enhance future data collection efforts. We will also cover some of the emerging methodological techniques being used to analyse these complex data streams and the how these data are being used to provide critical information needed to better design management strategies, and direct marine conservation efforts.
Resource availability drives variation in a marsupial glider’s home range.

Ms Alyson Stobo-Wilson1, Dr Teigan Cremona1, Dr Brett Murphy1, Dr Shaun Levick1, Prof Susan Carthew1
1Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
My main research interest is in the population ecology and conservation management of Australia’s unique mammal fauna. However, my research experience spans movement ecology, predator ecology and landscape ecology.

Home range and movement patterns are key aspects of a species' ecology and strongly influence conservation requirements. Home range can vary significantly both between and within species. Body mass, diet, social structure and resource availability are considered the primary drivers of variation in home range size. We have investigated the importance of these drivers on the home range of a marsupial glider, Petaurus ariel, in the tropical savannas of northern Australia. P. ariel occurs across a strong rainfall gradient with associated variation in both habitat structure and resource availability. Over 2016-2017, we radio-tracked two P. ariel populations at either end of the species' geographic range (high vs. low rainfall), to determine home range and den use within each population. We used field surveys and terrestrial LiDAR to investigate and compare fine-scale habitat use by P. ariel between sites. We found an almost 10-fold increase in mean home range size between the two study areas (high rainfall: 6 ha; low rainfall: 58 ha). Compared to other terrestrial, omnivorous mammals globally, P. ariel is in the top 2.5% of home range size relative to body mass. Our findings demonstrate that the disproportionately large home range of P. ariel is driven by low resource availability within the species' geographic range.

Management populations of moving animals in a complex resource landscape

Dr. Florian Schwarzmueller1, Dr. Katharina Merkel2, Andrew Hulthen1, Dr. Hazel Parry1
1CSIRO Agriculture&Food, Dutton Park, Australia, 2School of Earth, Environmental and Biological Sciences, Queensland University of Technology (QUT), Brisbane, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
I am an ecological modeller interested in theoretical and applied aspects of population dynamics in complex environments. My current projects focus on the management of populations and their ecosystem services in a heterogeneous socio-ecological setting.

Moving animals provide their ecosystem services across various parts of a landscape. However, their movement patterns are often determined and restricted by their resource needs and the distribution of these in the landscape. The emerging field of movement ecology equips us with tools to understand the mechanisms behind these patterns which allows us to predict animal movement in a changing environment. This valuable information can then, for example, be incorporated into ecosystem models which inform population level management strategies.

Here we show an example of an ecological model for the Queensland Fruit Fly (Bactrocera tryoni) where we identified critical unknowns in the movement ecology of this species and the resulting consequences for predicting population patterns. These theoretical findings motivated a field study to test the
underlying model assumptions. Finally, the model was used to inform strategies for an area-wide population management.

We show that:

1) resource continuity and movement strategy interactively influence population patterns
2) the success of management strategies is highly landscape specific
3) the right timing of management actions can lead to a more efficient outcome

Ecological research is at the heart of understanding these systems, but combining it with ecological modelling can inform decision making and increase the buy-in into management strategies. General models, like the one presented can be fairly easily tailored for specific regions, adapted to other species or used to get a general understanding of the management of populations and their ecosystem services or disservices.

Using weather surveillance radar to map changes in the distribution of Magpie Geese

Ms Rebecca Lehrke¹, Dr Hamish Campbell¹, Dr. Shaun Levick¹, Dr Charlotte Wainwright²
¹Charles Darwin University, Darwin, Australia, ²University of Oklahoma, Norman, United States of America

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Rebecca is a New Zealander currently living in Darwin, studying the movement of Magpie Geese using weather radar. She is particularly interested in movement and spatial ecology, science communication and using technology to enhance wildlife management.

Ecologists have been using weather surveillance radar (also known as rain radars) to track the movements of birds, bats and insects since the 1970s. Here in Australia, despite having a network of over 60 operation weather radars, very little research has been done using them to track wildlife. Many of these radars have been collecting data at 8-10 minute intervals continuously for decades. This is an extremely detailed history of animal movement and distributions in Australia that almost no one is using. For this research I have been identifying distribution patterns of Magpie Geese, a large waterfowl species, using the weather radar in Darwin. These patterns will be ground-truthed using known locations of Magpie Geese, including annual population surveys, GPS tracking data for individual birds and field surveys. Weather radar data will then be used to investigate how and why the distribution of Magpie Geese may have changed over the last eight years in the Darwin region in response to environmental change. With changes in climate and human modification, the need for high resolution and long-term datasets of animal distributions is crucial to managing populations and reducing negative impacts. Weather radar is a proven source of such data internationally that is currently extremely under-utilised in Australia and through my research, I hope to provide a guideline for using this tool to study and manage Australia’s aerofauna.
Connectivity and divergence in aquatic insects with contrasting life history strategies in arid central Australia

Dr Emma Razeng1, Dr Ashley Murphy1, Dr Alexandra Pavlova1, Dr Jayne Brim Box2, Dr Phil Suter3, Dr Alan Lemmon4, Dr Emily Moriarty Lemmon4, Prof Ross Thompson5, Prof Jenny Davis6, Prof Paul Sunnucks1

1Monash University, Clayton, Australia, 2Department of Land Resource Management, Alice Springs, Australia, 3La Trobe University, Wodonga, Australia, 4Florida State University, Tallahassee, USA, 5University of Canberra, Canberra, Australia, 6Charles Darwin University, Darwin, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Emma Razeng has recently completed her PhD project, where she investigated metacommunity and genetic connectivity among aquatic insect populations in the Australian arid zone. Her current work involves scoping how genetic diversity considerations can be applied to biodiversity conservation planning.

Dispersal potential and the ability to tolerate a range of heterogeneous environments influence a species’ ability to maintain gene flow over short-term and evolutionary timescales. Freshwater habitats in arid ecosystems form a naturally fragmented network, and aquatic insects that live in these habitats rely on a variety of life history strategies to persist, each of which can influence genetic connectivity among populations. When populations are unable to exchange genes for long periods, they become more genetically distinct and may eventually form distinct species. We used five aquatic insect taxa with different life history strategies to investigate genetic connectivity among populations in arid central Australia. Up to 728 anonymous nuclear loci were sequenced for individual insects, and the resulting datasets were used to identify cryptic species and examine population connectivity within species. We detected evidence of speciation in weak-dispersing mayflies, both recent (Atalophlebia, three species, 3.5-55 ka) and ancient (Cloeon, three species, 1.8-10.2 Ma). Mayfly species showed similar levels of genetic differentiation among sites, but the more environmentally tolerant Cloeon fluviatile showed higher genetic diversity. Dragonfly and whirligig beetle species (strong-dispersers) showed low genetic differentiation among populations, with high genetic diversity, although the environmentally tolerant dragonflies showed higher genetic diversity than the relatively sensitive beetle. These findings illustrate the importance of dispersal for maintaining population connectivity in fragmented habitats over multiple timescales. They also indicate that species with a narrow range of environmental tolerance may be more vulnerable to events that reduce genetic diversity, even if they are strong dispersers.

Biotelemetry Reveals Ontogenetic Shifts in the Nesting Behaviour of Female Crocodiles

Mr Cameron Baker1, Prof Craig Franklin1, Dr Hamish Campbell2, Dr Terri Irwin3, Dr Ross Dwyer1

1The University Of Queensland, St Lucia, Australia, 2Charles Darwin University, Darwin, Australia, 3Australia Zoo, Beerwah, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Cameron is a PhD student at the University of Queensland. His research is primarily centred around animal ecology, with a particular focus on understanding how both intrinsic and extrinsic factors influence the movement and behaviour of animals.

Reproductive investment has been shown in birds and mammals to increase with age and maternal experience. While this has been well described within these taxa, little is known about how age influences reproductive decisions in other vertebrate groups. To examine this the movements and
nesting behaviour of 57 female estuarine crocodiles Crocodylus porosus were monitored over a 10-year period throughout 180 km of river using a combination of externally mounted satellite tags, implanted acoustic transmitters and a network of submerged acoustic receivers. We examined the timing, extent and frequency of movements to nesting grounds, how these varied with body length (a proxy for animal age) and if there were extrinsic factors influencing nesting decisions. We found that female C. porosus routinely undertook large-scale (up to 84 km) annual migrations from dry season territories to wet season nest sites. Hidden Markov models revealed these movements could be split into four distinct states. During migration events, larger females migrated further and remained away from dry season territories for longer periods than smaller individuals. Furthermore, not only were migratory movements stimulated by increases in rainfall, larger females migrated to nest sites at lower rainfall thresholds than smaller females. Only by integrating high precision satellite telemetry with long term passive monitoring were we able to examine how age influences nesting behaviour in a wild crocodylian, with shifts likely resulting from an increased willingness to invest in nest protection among older and more experienced females.

Animal movement in farming landscapes: effects of habitat configuration on bearded dragon space use

Dr Tim Doherty¹, Charlie Fist¹, Prof Don Driscoll¹
¹Deakin University, Centre For Integrative Ecology, Burwood, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Tim Doherty is a quantitative wildlife ecologist specialising in disturbance and predator-prey ecology. A primary theme of his current research relates to the drivers and consequences of altered animal movement in human-dominated landscapes.

Movement is fundamental to animal survival and ecosystem function, but can be disrupted by habitat loss and fragmentation caused by humans. Here, we studied the movement ecology of the eastern bearded dragon in a farming landscape containing remnant mallee woodlands in south-central New South Wales. We radio-tracked animals living in either linear remnants of varying widths or a large rectangular nature reserve to assess if their movement behaviour varied according to habitat configuration. Home range size and daily movement rate increased with body size, but did not vary according to habitat configuration (proportional tree cover), nor did monthly displacement distance. Home range linearity increased as tree cover decreased (i.e. home ranges were more linear in linear remnants). Animals living in linear remnants regularly made forays into the matrix to access paddock trees and other small remnants. The eastern bearded dragon may be relatively insensitive to changes in habitat configuration due to its generalist nature and evolutionary exposure to a range of habitat types across its broad distribution.
Influence of thermodynamic constraints on daily movement behaviour and habitat use of brolgas (Antigone rubicunda)

Ms Inka Veltheim1,2, Dr Natalie Briscoe2, Dr Megan Fitzpatrick3, Associate Professor Michael Kearney2, Professor Warren Porter1, Dr Simon Cook1, Professor Michael McCarthy2
1Federation University Australia, School of Science, Information Technology and Engineering, Mt Helen, Australia, 2University of Melbourne, School of BioSciences, Parkville, Australia, 3University of Wisconsin, Department of Integrative Biology, Madison, United States of America

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Inka Veltheim is a PhD student at Federation University Australia and University of Melbourne. Her research interests are movement ecology, animal behaviour, conservation biology and landscape ecology. She is particularly interested in applying animal movement studies to conservation planning.

To cope with high heat loads, birds may increase their body temperature, increase evaporative cooling, or move to habitats with lower metabolic costs and reduced water loss. Brolgas forage in open fields in the morning and move to wetland roosts in the middle of the day. Foraging brolgas are thus potentially exposed to environmental conditions that can result in individuals experiencing high heat loads. Foraging field and wetland habitat have different thermal properties and wetlands are likely to provide opportunities to lose heat, reduce overall heat stress and compensate for any water loss experienced during foraging. We tested the hypothesis that daily movements and habitat choice are driven by thermoregulatory constraints, using an approach that can simultaneously account for other possible behavioural and physiological responses. We used a correlative statistical model to predict timing of movements using weather (solar radiation, temperature, wind speed and humidity) and behavioural data. To further understand drivers of daily movement behaviour, we used a mechanistic biophysical model to investigate physiological responses to microclimate. Behavioural data was used to evaluate the model results to assess if brolgas departed foraging fields due to heat stress. The results suggest that brolgas tolerate a range of weather conditions before shifting habitats to reduce the effects of high heat loads. Modelling suggests that brolgas may increase their core temperature, in order to extend time available for foraging. Wetlands are likely to provide habitat for bringing body temperature back down, and their proximity to foraging fields is likely to be important.

Where do Quenda rest their heads? Application of movement ecology data for urban bush management

Ms Janine Kuehs1, Dr Amanda Kristancic1, A/Prof Patricia Fleming1
1Murdoch University, Murdoch, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Janine is a PhD student at Murdoch University using novel technology (GPS and accelerometry data-loggers) to study the movement ecology of urban bandicoots; where they nest and forage, and how they travel and survive in the increasingly fragmented landscape.

Quenda (Isoodon fusciventer) are threatened by urban expansion through loss of habitat, predation by cats and foxes, and increased risk of vehicle strike as individuals move between habitat patches and across the urban matrix. Understanding their habitat requirements can therefore improve conservation management to ensure retention of this iconic bandicoot species across increasingly fragmented urban reserves. Tracking bandicoots has always been difficult; their small size limits the weight of tracking equipment that can be attached to individuals. However, the introduction of GPS and accelerometry data-loggers has allowed for the study of their movement ecology in the wild. Tracking data has been used to investigate movements of Quenda within and across urban landscapes, providing insights into their habitat use and movement patterns. Understanding these patterns can inform conservation strategies to protect Quenda populations in urban areas.
equipment that can be attached while their neck shape restricts collar attachment. New miniature GPS and accelerometry devices are opening up new possibilities. High resolution spatial and temporal data were collected from quenda around Mandurah, Western Australia, using glue-on data-loggers. Devices fell off after 2-5 days but recorded high resolution data for this period. The GPS data revealed fine-scale habitat use, and path analysis showed route choices, as well as the frequency and distance that excursions were made from remnant reserves, including quenda traveling substantial distances to novel food sources in residential backyards. Accelerometry data in conjunction with GPS highlighted activity patterns and behaviours that enabled the identification of forage and nest locations. We have identified plant species and habitat structure used by quenda for diurnal nest sites and foraging. Such details identify how quenda utilise the urban landscape and assist local councils with management of urban bushland reserves. In particular, activities such as weed management and native vegetation planting, as well as slashing or burning can benefit from detailed knowledge of quenda habitat choices within the urban landscape.

Solitary sociality? Spatial and social structure in a wild koala population

Mr Anthony Schultz¹, Dr Kylie Scales¹, Dr Kasha Strickland¹, Dr Romane Cristescu¹, Dr Jon Hanger², Dr Deidre de Villiers², Dr Celine Frere¹

¹University Of The Sunshine Coast, Sippy Downs, Australia, ²Endeavour Veterinary Ecology, Toorbul, Australia

SYMPOSIUM: Emerging directions in movement ecology, Meeting Rooms 1-2, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Anthony is a PhD candidate in his final year. He uses spatial tracking data and non-invasive genetic sampling to quantify koala space use and social structure.

For many animal species, living in proximity to conspecifics comes with both benefits and costs. This is true for species that exhibit highly complex social structures, as well as those with solitary life histories.

Animals living in stable groups often benefit from reduced predation risk, but may suffer increased within-group resource competition, as well as increased parasite and disease load. Solitary animals, on the other hand, risk increased predation, and reduced access to mates. These costs and benefits will differ for different populations across different habitats, and optimal social structure will vary across a spectrum, between stable group living and solitary living.

The spatial and social structure of wild koalas sits somewhere in the midst of this spectrum, with individuals leading solitary lifestyles within a complex matrix large, highly overlapping home ranges.

Using a VHF tracking database of wild koalas, we apply methods from spatial ecology and social behaviour studies to quantify the spatial and social structure of a wild koala population, and examine how they maintain their solitary lifestyles while surrounded by conspecifics.

Conserving Antarctic biodiversity in the face of multiple threats

Jasmine Lee¹

¹University of Queensland, St Lucia, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Jasmine is a PhD candidate at the Centre for Biodiversity Conservation Science at the University of Queensland. She is an Antarctic conservation scientist and her research interests include spatial analysis, modelling, climate change and conservation prioritisation.
Like many corners of the globe, Antarctica is subject to multiple threatening processes, including climate change, invasive species and an expanding human footprint. Prioritising management actions in the face of these multiple threats is a challenging, yet essential goal for progressing biodiversity conservation in the region. One method of prioritising management actions for taxonomic groups or regions is using a Priority Threat Management (PTM) approach, which was pioneered by scientists at CSIRO in Australia. PTM relies on expert elicitation to derive a cost-efficient outcome and is especially relevant in the Antarctic as the region is heavily deficient in empirical data, lacking even standard biodiversity surveys. We applied the PTM approach to terrestrial Antarctic biodiversity in an international workshop that brought together over twenty-five biodiversity experts, logistics managers and policymakers in Belgium, in July 2017. Here I will present the results from this workshop, including the identification of management strategies and priority actions to be employed across the Antarctic region. This work represents a substantial leap for conservation planning in the region and will be of great use to future management decisions.

Integrating expert elicitation, cost-benefit analysis and spatial prioritisation to inform multi-species and multi-action conservation

Lucy Rose

University Of Melbourne, Parkville, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
A PhD candidate in the Quantitative and Applied Ecology group at University of Melbourne, researching prioritisation tools for biodiversity conservation of wetlands. Interested in improving the quality of decisions about biodiversity conservation when faced with uncertainty, multiple species and actions.

Decisions in biodiversity conservation and waterway management often need to be made when supporting data is incomplete. Managers and agencies regularly develop strategies and plans for cost-effective biodiversity conservation. However, this requires knowledge on the effect of various actions on multiple species, which is patchy.

Aims of this study included: 1) to build on approaches that support prioritisation of conservation actions at wetlands, and 2) to identify a portfolio of conservation action-areas that maximise persistence for multiple species in my study area. For my case on frogs in Port Phillip & Westernport Catchment area (Victoria), expert elicitation was integrated with species distribution modelling, cost-benefit analysis and spatial prioritisation to help inform a multi-species multi-action conservation strategy.

We applied the IDEA (Investigate, Discuss, Estimate and Aggregate) protocol to elicit expert judgements on the change in probability of occupancy of seven frog species under candidate action scenarios.

The information elicited allowed us to develop generalized linear models for each species and make predictions about benefit to each species under alternative scenarios at each wetland in the study area. Among other findings, we found that benefit varied depending on the starting occupancy, where wetlands with a higher starting occupancy did not benefit as much as wetlands with a lower starting occupancy, suggesting that it is more efficient to act at the latter category.

Application of this approach to my case study demonstrated how expert elicitation can be integrated with other decision-making tools to develop robust and transparent catchment management strategies.
Improving quantitative judgements with the IDEA protocol

Miss Victoria Hemming1
1The Centre of Excellence for Biosecurity Risk Analysis, The University of Melbourne, Melbourne, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Victoria’s PhD focuses on “Improving expert judgement within conservation”. She reviewed current practice in conservation, prepared guidelines for structured expert elicitation using the IDEA protocol, tested the protocol and explored the benefits of Cooke’s performance weighting of experts.

In this talk, I present an accumulation of research from my PhD. I discuss the basis of structured elicitation protocols which have been developed from research spanning mathematics, psychology, and judgement and decision-making. I then outline the IDEA protocol for structured expert judgement which combines principles from these protocols.

The IDEA protocol stands for key steps “Investigate”, “Discuss”, “Estimate”, and “Aggregate”. The protocol was developed initially to inform biosecurity decisions, but its ability to elicit quantitative estimates with relative ease and low cost whilst improving the accuracy and calibration of such judgements has led to global recognition of the protocol.

In 2016 and 2017, I began to test the protocol to determine whether improvements obtained by individual steps were achieved when combined into a single protocol and could be repeated across diverse domains. I also began to explore methods to improve the final aggregations of the protocol through performance weighting.

The results of these studies found that the IDEA protocol does improve judgements. Furthermore, such judgements can be gained from as few as 5-9 individuals and via remote elicitation. I will discuss other advantages and insights that I found along the way. The results clearly demonstrate that the IDEA protocol provides a practical approach to the elicitation of expert judgement in conservation.

Spatially-explicit predictions of species responses to management: can experts fill the data void?

Dr Jim Thomson1, Dr Tracey Regan1, Dr Matt White1, Dr Canran Liu1, Dr Tracey Hollings1
1Arthur Rylah Institute For Environmental Research, Heidelberg, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Dr. Jim Thomson is a Senior Scientist in the Ecological Analysis and Synthesis group at the Arthur Rylah Institute for Environmental Research. His research interests include ecological modelling and statistics, conservation planning, landscape and aquatic ecology, and making shiny apps.

Biodiversity managers need to understand the likely impacts of alternative management actions on diverse species and ecosystems. For the vast majority of species and possible management actions, there is little or no empirical data on which to base predictions of management effectiveness, meaning that expert judgement may be the only alternative. We developed a web application to elicit expert judgments about the expected responses of native species to 20 generic management actions under wide range of environmental and geographic contexts across the state of Victoria, Australia. Experts collectively estimated species persistence probabilities under tens of thousands of unique scenarios (combinations of species, geographic and environmental contexts, and management actions). Trait-
based response models were used to generalize experts’ assessments to all native vertebrate fauna and vascular plants in Victoria, and these models were coupled with species distributions models to map the expected benefits of each management action to each species across the state. The resulting maps of expected benefit are used to inform decisions about biodiversity management in Victoria. Here we discuss the benefits and challenges of eliciting - and projecting - species’ responses to management actions, and explore the collective wisdom of dozens of ecologists about the prospects of Victoria’s biodiversity.

Expert prediction of changes in vegetation condition and implications for biodiversity offset design

Dr Josh Dorrough1, Dr Ian Oliver3, Dr Steve Sinclair2
1NSW Office Of Environment And Heritage, Merimbula, Australia, 2Arthur Rylah Institute, DELWP, Heidelberg, Australia, 3NSW Office Of Environment And Heritage, Gosford, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Josh Dorrough is a conservation biologist and restoration ecologist within the Ecosystem Management Science branch of the NSW Office of Environment and Heritage's Science Division.

Expert opinion is commonly employed to inform policies or management decisions when comprehensive empirical data are lacking. Biodiversity offsetting, the balancing of a known loss of biodiversity with an equivalent but uncertain improvement elsewhere, relies heavily on expert opinion, particularly in relation to estimates of future biodiversity outcomes with and without offsets. However, methods for collecting these data are often ad-hoc, unreplicated or not reported. Here, we present the outcomes of a structured elicitation with 25 field ecologists, practitioners, research scientists and ecological consultants to quantify their opinions about changes in vegetation composition, structure and function resulting from adoption of conservation management at offset sites. On average, experts predicted only modest improvements at offset sites, relative to a business-as-usual counterfactual, although variation within and among experts was large. While there were cases where experts predicted that conservation management at offset sites would result in positive outcomes, in a substantial number of circumstances experts predicted no improvement, despite management of key threats and pressures. This highlights the need to understand and clearly articulate when, and for which components of biodiversity, conservation benefits are most likely to be obtained. Our results suggest that there are opportunities to refine offset schemes to identify those sites with greater potential for positive outcomes but also highlight important design considerations for monitoring and evaluation. Expert elicitation is a useful method for developing initial hypotheses to guide offset design and the results presented here are informing aspects of the NSW Biodiversity Assessment Method and associated offsets scheme.
A novel approach to developing a view of national ecological condition using expert elicitation

Dr Rebecca Pirzl, Dr Matt White, Dr Kristen J Williams, Ms Fiona Dickson, Mr Peter Lyon, Ms Nat Raisbeck-Brown, Ms Amy Warnick, Dr Steve Sinclair

1CSIRO, Canberra, Australia, 2Department of the Environment and Energy, Canberra, Australia, 3Arthur Rylar Institute, Heidelberg, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Rebecca Pirzl is an ecologist at CSIRO where she leads initiatives and projects in biodiversity and environmental assessment and prediction, digital biodiversity platforms and Indigenous spheres.

A continental view of ecological condition is fundamental for the design of sound national environmental policy. However, the road to assessing and reporting on ecological condition nationally is just beginning.

Although the measurement of bio-physical attributes can build an empirical view of the structure and composition of the environment, the interpretation of this data to generate an assessment of ecological condition is a more theoretical and subjective exercise. The condition metrics employed by most states and territories reflect this subjectivity. For example, most condition metrics rely on comparing suites of attributes against benchmarks, however the way benchmarks are conceived is highly variable. In addition, although the attribute information collected by different state and territory methods is often similar, there are critical differences in detail of measurement approaches. Such differences make it challenging to reconcile and aggregate existing state and territory condition datasets to provide a consistent continental view.

We are piloting a national approach to condition assessment which collects expert ‘interpretations’ of condition, rather than attempting to sort through the complexity manifest by these conceptual and methodological differences. The approach, which is being trialled in 2018, acknowledges that subjectivity is an inalienable feature of condition assessment. The method explores innovative approaches to calibrating and providing insight into subjectivity. It is hoped that the outcomes of this pilot will go on to inform future debate about how to build a national ecological condition assessment system.

Eliciting conceptual models for estimating species response to management

Dr Helen Mayfield, Associate Professor Jonathan Rhodes, Dr Megan Evans, Mr James Brazill-Boast

1The University of Queensland, School of Earth and Environmental Sciences, Brisbane, Australia, 2Centre for Biodiversity Conservation Science, Brisbane, Australia, 3Conservation Programs Branch, NSW Office of Environment and Heritage, Sydney, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 026 - Helen Mayfield is a post doctoral research fellow in the UQ Centre for Biodiversity and Conservation Science. She has a strong interest in data modelling for both conservation and eco-epidemiology research.
Threatened species management is often carried out with limited resources and imperfect ecological knowledge. However, regardless of the context, monitoring and evaluation of the species response to management actions is crucial to establish whether interventions are having the desired effect, and whether this is sufficient to secure the species at a the site and the effects on the overall population viability of the species. The New South Wales Office of Environment and Heritage Saving our Species (SoS) programme aims to secure as many threatened species in the wild as possible in NSW for the next 100 years. Monitoring and evaluation is a key requirement of the program, including situations where little is known about the species and its environment.

We developed guidelines to assist species managers in creating process models of the relationships between a threatened species, the threats it faces and the management actions designed to assist it. These models can then be used to select suitable indicators and facilitate estimates of target values for these indicators for both baseline and managed scenarios. The guidelines were refined through a series of stakeholder workshops involving species coordinators and external experts. The final guidelines are adaptable for data rich or data poor situations and are demonstrated with examples from 12 threatened species managed under the SoS program.

Planned extensions include examining their applications to managing species across the wider landscape and evaluating how effective management at a single site needs to be in order to secure a species in the wild.

Eliciting significant impact thresholds for threatened species

Dr Tracey Regan1, Dr Josephine Machunter2, Dr Peter Griffioen1

1The Arthur Rylah Institute for Environmental Research, Heidelberg, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:

Tracey Regan is a senior scientist at the Arthur Rylah Institute for Environmental Research. Her research focuses on applied ecology and conservation biology, specialising in ecological modelling and decision theory for informing and improving decision making.

Governments around the world are responsible for protecting and managing threatened species and often impose restrictions on human activities that are likely to significantly impact listed species. However vague terms and definitions of what constitutes a significant impact can result in different interpretations where assessments of impact lack transparency and can lead to inconsistencies across species and assessors.

Significant impact is a value judgement representing an unacceptable impact to a threatened species given a specific human activity. In this study we developed a structured process for eliciting quantitative decision rules for assessing significant impact of human activities on threatened species. We elicited rules given a specific activity, fuel reduction burning, however the process can be used for any type of human activity that impacts threatened species.

Twenty-three participants considered 120 possible scenarios of impact from fuel reduction burning on different fauna species ranging in conservation status from Least Concern to Critically Endangered. Participants individually assessed each scenario as either a significant impact or not. Impact was measured as a percentage change in abundance from fuel reduction burning. We also elicited risk tolerances given various levels of impact and conservation status.

Models of best fit across all judgements suggest significant impact depends on current conservation status with Critically Endangered species having more precautionary thresholds than Least Concern or Vulnerable species. Similarly, risk tolerance declined as conservation status increased. This study
provides an approach for interpreting significant impact guidance to improve transparency and consistency in decision making for threatened species.

Using expert elicitation to improve biodiversity offsetting

Dr Megan Evans1,2, Zoe Stone1, Victoria Hemming3, Assoc. Prof. Martine Maron1
1The University Of Queensland, Brisbane, Australia, 2The Land Restoration Fund, Department of Environment & Science, Queensland Government, Brisbane, Australia, 3University of Melbourne, Melbourne, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Zoe Stone is a Postdoctoral fellow at the University of Queensland interested in threatened species conservation. She is currently working on conservation of the critically endangered Northern Eastern Bristlebird recovery & developing effective offsets for threatened species.

Biodiversity offsets are routinely prescribed as conditions of approval for which impact on threatened species and ecological communities. Offset decisions are often made quickly, and decisions makers rely on easily accessible data on the costs and benefits of on-ground conservation management actions. However, these data are generally hard to obtain at short notice, and are dependent on long-term, resource dependent studies to provide reliable information on the effectiveness of different conservation actions. For offsets to result in real biodiversity gains, knowing the most effective actions for offsetting a given species or community is key. Formal elicitation processes are becomingly increasingly used to fill in knowledge gaps and can provide a relatively inexpensive and rapid source of information that better informs offset decision making. Offset policies can often focus on single management actions like habitat protection, however for many species, other actions will be more effective for their conservation. Our research utilises expert elicitation using the IDEA Protocol (Investigate, Discuss, Estimate, Aggregate) to identify the best offset strategies for a range of threatened species and ecological communities listed under the EPBC Act, specifically those 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. Here we outline our research and present preliminary findings on our first rounds of expert elicitation surveys and discuss future directions of the research and identify other key species and communities that will be included.

A structured expert elicitation to inform the adaptive capacity of alpine animals

Dr Anca Hanea1, Dr Kate Umbers2, Dr Rachel Slatyer3, Prof Adrienne Nicotra3
1University Of Melbourne, Parkville, Australia, 2Western Sydney University, Richmond, Australia, 3Australian National University, Canberra, Australia

SYMPOSIUM: Expert elicitation in ecology and conservation: techniques, examples, problems and successes, Meeting Room 6, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Anca Hanea is a senior research fellow at CEBRA and a research associate at CEER. Anca is an applied mathematician focused on risk analysis, decision theory, Bayesian Networks, and structured expert judgement.

Australia’s alpine environments are changing rapidly and are predicted to shrink substantially over the coming decades. This raises two questions: 1) how are Australia’s unique mountain animals responding to new climate conditions? and 2) how might they respond in the future?
We are aiming to quantify the adaptive capacity of alpine animals to future climate scenarios. Adaptive capacity describes the ability of species to cope with environmental change by persisting in situ or by moving to more suitable habitats. While the underlying factors determining adaptive capacity are somewhat understood, little is known about which species reliably have high adaptive capacity, how to quantify it, how it varies within and across species, or how to manage populations to maximise it. Nonetheless, increasingly conservation and management practitioners are required to make decisions about allocation of resources based on vulnerability assessments that incorporate exposure risk and adaptive capacity. In addition to adaptive capacity, the relative importance of the organism to an ecosystem function must be considered for resources to be effectively allocated.

We will facilitate a rigorous expert elicitation of the current state and future responses of Australia’s alpine animals – both vertebrate and invertebrate – to climate change. A panel of experts will provide estimates, which together with the existing data will enable building a predictive model for adaptive capacity of alpine animals. We will use the IDEA protocol for structured expert judgement and complement a matching expert elicitation which was recently completed for 75 of Australia’s alpine plant species.

State of our rangelands: achieving change in a policy backwater

Dr Margaret Friedel1
2CSIRO Land & Water and Charles Darwin University, Alice Springs, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Marg joined CSIRO Alice Springs in 1974 to research the ecology and management of grazed arid rangelands, eventually including community-based decision-making and policy development. Post retirement, she is writing about invasive plants, fire management and birds (much to her surprise).

More than 75% of Australia is rangelands and yet they receive little attention from Australia’s largely urban population – there is a policy ‘hole in the heartlands’. Pressure for policy development rarely comes from urban electorates, and rangelands populations are too sparse to have much direct political influence in federal and state parliaments.

Perhaps because resident populations are low, rangelands are in a relatively unmodified state despite over a century of European land-use. Current pressures include mining, pastoralism, invasive species, declining water supply and climate change. Mining is the only industry subject to urban pressure for policy oversight. In other areas, policy makers will not lead, so the drivers must come from elsewhere.

Encouragingly, some of the most important trends in rangelands are evolving, not as a consequence of new policy, but as initiatives from the grass roots. These initiatives have grown to attract philanthropic and industry support and, in the process, government funding too. The Aboriginal ranger program started small but is now a major employer on-country of Aboriginal people, including women, complemented by Indigenous Protected Areas. Pastoral properties of conservation value have been purchased by Bush Heritage Australia and Australian Wildlife Conservancy with extensive public funding. The Ten Deserts Project receives significant funding from the BHP Billiton Foundation, and the Pew Charitable Trusts support multiple projects through ‘Outback to Oceans Australia’. Long-term partnerships amongst all such players is resulting in increasing efforts on rangelands to manage fire, feral animals and weeds, recovery of native fauna and landscape repair.
Burning issue: forest fire regimes

A/Prof. Alan York¹
¹University Of Melbourne, Creswick, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Alan leads the Fire Ecology and Biodiversity research program within the School of Ecosystem and Forest Sciences at the University of Melbourne. His research group investigates the response of plants and animals to fire-induced patterns in the landscape.

There is widespread consensus that we are entering a period of unprecedented global change. One significant consequence of global change concerns fire regimes, particularly in forest-dominated biomes. There are two likely scenarios. Firstly, through increased extreme fire weather and higher ignition rates, a warmer climate may cause an increase in the average frequency and intensity of wildfires in temperate forests of southern Australia. With shorter inter-fire intervals we could see greater tree mortality, with frequent fires threatening the persistence of ‘fire sensitive’ obligate seeder eucalypt forests, which could in turn facilitate a shift to a non-forest state. There is also the potential for structural changes in ‘fire tolerant’ resprouter forests. Secondly, because high intensity fires can result in substantial loss of human life and property, a likely management response will be more frequent low-intensity prescribed fires to enhance suppression capability. More prescribed burning will necessitate fires outside the season and inter-fire interval of ecological experience. Fire frequency as a driver of assemblage composition has previously been reported for a wide range of plant communities in temperate Australia, with subsequent impacts on fauna habitat. Less is known about altered seasonality of fire, although it has the potential to negatively interact with plant and animal life histories. With ongoing urgent calls for a substantial increase in the use of prescribed fire, never has there been a more important time to increase our understanding of the impact of altered fire regimes in these ecosystems.

How to successfully coexist with sharks: a review and policy recommendations

Associate Professor Euan Ritchie¹, Dr Jacquomo Monk², Dr Christopher Neff³, Dr Fredrik Christiansen², Associate Professor Laurie Laurenson²
¹Deakin University, Burwood, Australia, ²Deakin University, Warrnambool, Australia, ³University of Sydney, Sydney, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
I apply ecological theory with good doses of field work to seek solutions to the challenges of conserving biodiversity.

More at:
https://euanritchie.org/
https://www.facebook.com/DrEuanRitchie/
@EuanRitchie1

Few apex predators instill fear in humans like large sharks do, due to the potential for serious harm or in some cases lethal encounters. Interactions between sharks and people can stimulate media frenzies, trigger emotive political and public debate, and result in negative perceptions about sharks. In response, in some regions of the world governments actively promote policies and management actions aimed at achieving the exclusion or lethal control of sharks. However, large shark species also perform critical ecological roles, including helping to mitigate climate change, and have substantial economic value (e.g.
tourism and the diving industry), and hence the loss and decline of many shark species from marine environments globally is of great concern. Despite the likelihood of negative and potentially cascading ecological effects on ecosystems resulting from shark control programs, their efficacy in achieving human safety is typically poorly known, if assessed at all. With reference to sixty years of time series data on shark control and shark attacks on humans, from coastal South Africa and Australia, we show that there is no statistically significant evidence that killing sharks makes people safer. Further, our scenario modelling showed that to reliably achieve increased human safety would essentially require the eradication of sharks from extensive regions. With this in mind we finish with a review of what non-lethal methods and approaches are available and should be supported by governments in order to achieve successful human-shark coexistence.

Working together better: changing how we research invasive plant species to assist control efforts

**Associate Professor Jennifer Firn**

*Qut, Coorparoo, Australia*

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**

Jennifer’s research is dedicated to finding better ways to conserve biodiversity and key ecosystem services in production landscapes, including solutions to weed control, multi-use forest restoration, and challenging land management decisions. Jennifer is EiC of the journal Ecology and Evolution.

Globally the prevalence and impact of invasive non-native species is increasing rapidly; while, experimentally based research aimed at adequately responding and supporting management is limited in its ability to keep up with this pace, given the complex drivers associated with successful invasion and control strategies. In contrast landholders are in unique positions to witness biodiversity turnover in grasslands, adapt management practices in response, and learn from successes and failures. This local knowledge could be crucial for identifying feasible solutions to land degradation, and ecological restoration, but local knowledge is rarely explicitly embedded in ecological research. In this talk, I will discuss three projects where we have or are collaborating with local farmers, Traditional Owners and local governments in three vastly different ecosystems across Australia. I will demonstrate how local knowledge coupled with scientific methods can act in tandem as a highly efficient method for developing management recommendations. This approach effectively identifies local perceptions that are not substantiated by scientific data to halt potentially harmful practices, and observations that are insightful predictions about the dynamics and impacts of introduced species that require long-term experiments to corroborate scientifically.

Coastal freshwater wetland vegetation response to altered hydrology and salinity

**Rebekah Grieger**¹, Dr Samantha Capon¹,², Dr Wade Hadwen¹,²,³

*Griffith University, Nathan, Australia, Australian Rivers Institute, Nathan, Australia, Griffith Climate Change Response Program, Gold Coast, Australia*

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**

Poster 075 - Rebekah is a PhD candidate at Griffith University investigating the resilience of coastal freshwater wetland vegetation to climate change. She also completed her Bsc with honours at Griffith University in Ecology, Conservation, and Biology.
Coastal freshwater wetlands are highly vulnerable to climate change and the alteration of hydrology and salinity that is predicted with sea level rise. Investigating the response and resilience of wetland vegetation to predicted changes is important for understanding the threat that climate change poses and to help predict the potential impacts on wetland systems. Yandina Creek Wetlands, on the Sunshine Coast, is an ex-sugarcane farm that, over the last 12 years, has been regenerated into a coastal freshwater wetland. However, due to management decisions, tidal floodgates have been removed from creek boundaries, allowing tidal inundation to penetrate the wetland, creating a more saline environment that is frequently inundated. This research will look at the effects of altered hydrology and salinity through investigating the responses of major wetland vegetation communities. Three permanent plots have each been established in Casuarina swamp, Melaleuca swamp, Salt Pan, and Riparian zone vegetation communities. Within these plots, surveying of vegetation composition, structure, and condition will be conducted every six months to determine the response over time. A baseline survey was conducted prior to the opening and removal of floodgates. Initial results show that groundcover species richness is greater in Riparian and Melaleuca swamp sites, however Melaleuca and Casuarina swamp sites are relatively similar in groundcover composition. This study will show an in-situ response of coastal freshwater wetland vegetation communities to altered hydrology and increased salinity through time, as is predicted with climate change and rising sea levels, providing information for future management actions.

**Novel food resource use facilitates range expansion into urban areas by threatened forest red-tailed black-cockatoos**

Erika Roper, Prof Richard Hobbs, Dr Michael Craig

*The University Of Western Australia, Crawley, Australia*

**SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM**

**Biography:**

*Poster 052 - Erika Roper is a PhD student at UWA. Her research interests include animal behaviour, urban ecology, conservation, and birds, especially parrots. Recent projects include the foraging ecology and vocalisations of parrots.*

Urbanisation affects a large proportion of wildlife worldwide. Despite the focus of previous research on the negative impacts of urbanisation on wildlife, adaptable species can benefit from exploiting the changed environment. One of the main attractants of wildlife to urban areas is an increased novel food supply. Using the threatened forest red-tailed black-cockatoo (Calyptorhynchus banksii naso) as a case study we show that wildlife eat novel foods for several reasons: availability, processing time, and nutrition. The traditional habitat of C. b. naso is the Jarrah forest of south-western Australia. Since 2000, C. b. naso has occurred with increasing frequency in heavily urbanised Perth city, and there are now several resident urban populations. The traditional food of C. b. naso is Jarrah (Eucalyptus marginata) and Marri (Corymbia calophylla) seeds. In urban areas C. b. naso eats many novel food sources, especially exotic Cape Lilac (Melia azedarach), a common street tree, which provides food year-round. Behavioural video analysis was used to determine processing times for food species in urban and forest areas. We show that many exotic foods are faster for C. b. naso to process than traditional foods (e.g Cape Lilac is approx. 10 times faster to process than Marri), resulting in higher foraging efficiency. Testing of the nutritional composition of traditional and novel foods is underway. As novel food use becomes more prevalent in urban areas it is important to investigate why urban wildlife, especially threatened species, are choosing novel foods.
Inbreeding and outbreeding depression in *Stylidium hispidum*: implications for mixing seed sources for ecological restoration

**Dr Siegy Krauss**1, Dr Kristina Hufford3, Dr Erik Veneklaas2

1Kings Park Science, West Perth, Australia, 2University of Western Australia, Crawley, Australia, 3University of Wyoming, Laramie, USA

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**

Siegy Krauss is a Senior Research Scientist at Kings Park in Perth, Western Australia, where he leads the conservation genetics program. Here, genetics tools and thinking are underpinning practical outcomes in plant conservation and ecological restoration.

The benefits of composite rather than local seed provenances for ecological restoration have recently been argued, largely on the basis of maximising evolutionary potential. However, these arguments have downplayed the potentially negative consequences of outbreeding depression once mixed provenances interbreed. In this study, we compared intraspecific F1 hybrid performance for four populations of *Stylidium hispidum*, a species endemic to south Western Australia. To test for outbreeding depression, we conducted controlled pollinations and assessed germination and survival to 6 months for three cross categories (within population crosses, short- and long-distance F1 hybrids) for paired sites (3-10km apart) distributed within two genetically and climatically differentiated regions (120km apart). Fully reciprocal transplant trials with F1 progeny were established in 2011 within initial source populations to further assess outbreeding depression through survival, growth, flowering and ultimately life-time reproductive success through fruit and seed production for all plants for each of 5 years. For germination and survival, we found strong evidence for outbreeding depression in long-distance crosses, and inbreeding depression for within population crosses, relative to short distance crosses. For in situ survival and growth, we found evidence for a long-distance cross advantage over both short-distance and within-population crosses. Final fruit and seed production results will be presented. Cumulative results that identify an intermediate outcrossing distance (here, equivalent to 10km) in this species are considered in light of the evolutionary consequences of mixing seed sources for biodiversity restoration.

Achieving Effective Mine Closure

**A/Prof Glen Corder**1

1Centre for Mined Land Rehabilitation, University of Queensland, Brisbane, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

**Biography:**

Glen is the Environment Centres Acting Director at the Sustainable Minerals Institute, at The University of Queensland. His research interests include industrial ecology, the circular economy and sustainability risk management frameworks in the mining and minerals industry.

An increasing number of mines are approaching the end of their life and facing the environmental and economic challenges of successful mine closure. To achieve outcomes that will satisfy a wide range of stakeholders, including industry, government, local community and broader society, a combination of innovative ecological approaches and post-mining land uses need to be implemented in an effective and practical manner. These approaches and uses will vary, potentially considerably, depending on the surrounding environment and context of the mine site. Furthermore, planning for mine closure has historically not been sufficiently considered at the development stages of a mine, and has been often left late in the mine life, therefore limiting the ability to progress suitable mine closure initiatives. This presentation will discuss some of the key issues related to current mine closure that will help identify areas of relevant ecological research which would help inform policymakers and the wider public.
Hot Topics in Ecology

Dr Rachel Standish
1Murdoch University, Murdoch, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Rachel is a Senior Lecturer in Ecology at Murdoch University in Western Australia, and the Chief Editor of the Ecological Society of Australia Hot Topics.

The role of the ESA is to promote ecological science, and by doing so assist nature conservation, advise environmental policy and educate the public. The Hot Topic (HT) Initiative helps to achieve these goals by delivering timely, factual overviews (www.ecolsoc.org.au). We, the editors of the HT Initiative, propose to launch the inaugural Hot Topics in Ecology Symposium at ESA 2018. Our objectives are to provide an overview of current hot topics in ecology in Australia and to encourage HT contributions. We have structured the session into six themes reflecting key issues of the Anthropocene. To introduce the symposium, I will provide a synopsis of the HT initiative and a brief account of its success to date. Ultimately, our goal is to establish ESA Hot Topics as a dynamic repository of ecological knowledge for guiding decision makers and informing the public and environmental discourse.

Winners and losers of coral bleaching in the subtropics

Mr. Sun Kim1, Dr. Eugenia Sampayo1, Ms. Carrie Sims1, Dr. K-le Gomez1, Dr. Maria Beger1, Dr. Brigitte Sommer1, Dr. Hamish Malcolm1, Dr. Scott Heron1, Ms. Nicole Kyriacou1, Dr. Steve Dalton1, Dr. Renata Legorreta1, Dr. Will Figueira3, Prof. John Pandolfi1
1Australian Research Council Centre Of Excellence For Coral Reef Studies, The University Of Queensland, St.Lucia, Australia, 2University of Leeds, Leeds, United Kingdom, 3University of Sydney, Sydney, Australia, 4National Oceanic and Atmospheric Administration, Townsville, Australia, 5Department of Primary Industries, Coffs Harbour, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
I'm a PhD student at the University of Queensland, interested in the ecology and evolution of coral range dynamics.

Coral reefs are under critical threat as detrimental environmental anomalies recur more frequently at more locations. One of the most conspicuous biological responses of corals to environmental anomalies is coral bleaching. Corals and their endosymbiotic dinoflagellates relinquish their relationship under acute environmental stress, rendering the coral host to lose its colour and symbionts. These decoloured, or bleached corals suffer nutritional deficiency, causing an eventual mortality under prolonged bleaching. Past studies have reported an asymmetry in bleaching responses among coral taxa, and resultant short and long-term changes in coral community structure. Unfortunately, recent bleaching surveys document that such asymmetry wanes with greater environmental stress. This implies that recent environmental anomalies have exceeded thresholds for both bleaching resilient winners and vulnerable losers. Whilst the gravity of ecological and conservation implications of recurrent coral bleaching events is uncontroversial, research efforts are heavily concentrated on the tropical coral communities, and coral bleaching among subtropical coral communities remain far less explored. Here, we report the patterns of coral bleaching along the subtropical east coast of Australia during the peak of heat stress in 2016. In particular, we identify winners and losers during the 2016 bleaching event across the subtropical east coast of Australia. Our findings indicate that oversimplified bivariate associations between environmental factors and bleaching responses cannot fully account for coral bleaching in the subtropics. In addition, our results also highlight that the gap in bleaching responses between winners and losers may drive a change in coral community structure under current climatic conditions.
Where do species belong? Exploring definitions of plant nativeness to inform greenspace policy and practice

Miss Katherine Berthon¹, Dr Freya Thomas¹, Dr Luis Mata¹, Professor Sarah Bekessy¹
¹ICONScience, RMIT, Brunswick, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Katherine is a PhD candidate investigating drivers of biodiversity change and function in urban landscapes. Her passion for conservation and curiosity for understanding natural phenomena has led to a diverse research background in animal behaviour, invasion biology and ecological theory.

The classification of species as native or non-native has important ramifications for how they are treated within urban greenspace policy and practice. Native-only planting strategies are becoming standard practice, under the assumption that native species will deliver a wider range of biodiversity benefits. Despite many attempts at refining terminology and fervent debates of the value of non-native species, there remains ambiguity regarding appropriate spatial and temporal scales, and a lack of ecological reasoning for why we expect native or non-native species to perform better.

We synthesise current knowledge to propose a non-binary framework for defining plant nativeness that includes temporal, geographic and biotic dimensions. We then examine the underpinning processes driving ‘nativeness’. Acknowledging that evolutionary context is constantly shifting, we propose that a species which is considered native is one that ‘belongs’ to a particular co-evolutionary or cultural context. That is, nativeness definitions are based on a cultural bias towards a particular time period or set of co-occurring species. Ultimately, we show that any given plant can be considered native or non-native in different contexts. For example, Lophostemon confertus, a species that is often planted in Metropolitan Melbourne, is native to the continent (Australia) but is not native to the local area. We finish by exploring how shifting definitions of plant nativeness can influence the interpretation of comparisons of native and non-native species performance using a case study of City of Melbourne’s greenspaces. We envision that our more nuanced approach can substantially contribute to better inform greenspace policy and decision-making.

The impacts of wind farms on birds – good, bad, acceptable?

Mr Chris Sims¹
¹Woolnorth Wind Farm Holding, Launceston, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Chris is an experienced safety and environment professional who has worked in the wind industry for over 10 years. Managing a range of safety and environmental issues from flora and fauna to wind turbine evacuation and everything in between.

Bluff Point Wind Farm at Woolnorth in Tasmania’s north-west was one of the first large scale wind farms in Australia (2002). It was at this wind farm where extensive site-based studies of bird impacts and interactions were first undertaken in Australia. Key studies included bird mortality surveys (surveys to monitor ‘direct’ collision impacts), bird utilisation surveys (surveys to assess ‘barrier’ and ‘alienation’ effects) and avoidance studies (attempting to quantify avoidance behaviours and characteristics). Since the development of Bluff Point Wind Farm, two other large scale wind farms have been established in Tasmania and the same suite of studies have been conducted to evaluate the same fundamentals – direct impacts, barrier and alienation effects and avoidance behaviours. Through these three wind farm developments, the results of the studies have yielded many common findings. Through comparison and
assessment of similar studies conducted elsewhere, there appears to be nothing unique about the findings of the studies from these three Tasmanian wind farms.

1. Low numbers of bird and bat mortalities are observed
2. Not all birds and bats are collision prone, many species observed at a wind farm do not appear in collision records
3. The clear majority of mortalities are species with no conservation status
4. Barrier effects are not observed, that is birds do not demonstrate behaviour indicating they see wind farm infrastructure as a barrier
5. Operating wind turbines do not cause alienation or prevent birds from using adjacent habitat/s
6. Avoidance rates vary from species to species

Ecological impacts of extreme climate events

Dr Katinka Ruthrof
Kings Park Science, Perth, Australia

Symposium: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Katinka is a research scientist with the Department of Biodiversity, Conservation and Attractions (DBCA) and Kings Park Science. Her interests include fire return intervals, climate change impacts on forest health, plant-animal interactions; and, improving rehabilitation success of degraded ecosystems.

Extreme climatic events have profoundly impacted biota globally over the past decade. A heat wave in southwestern Australia in 2011, for example, affected both marine and terrestrial ecosystems at a subcontinental scale, impacting larger areas and a greater taxonomic breadth than previously envisioned. Chronic and acute drought events have also had landscape scale impact on terrestrial ecosystems. And surprisingly, large-scale frost events have also occurred in southwestern Australia, affecting the dominant forest ecosystem. Using climatic and multi-species data collected from the region, we show that extreme events have triggered abrupt, and multi-trophic ecological disruptions, including mortality, demographic shifts and altered species distributions. Our research shows that a broad range of taxa are being affected by extreme climatic events, implying that the extent of ecological vulnerability to projected increases in extreme events is underestimated.

The success of terrestrial vertebrate conservation translocations worldwide: are we getting better at moving species?

Mr Shane D Morris, Prof Chris N Johnson, Dr Katherine E Moseby, Prof Barry W Brook
University Of Tasmania, Sandy Bay, Australia, University of New South Wales, Sydney, Australia

Symposium: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Shane is part of the Dynamics of Eco-Evolutionary Patterns (DEEP) research group at the University of Tasmania. His research, using ecological modelling, focuses on the potential of conservation translocations in combating our current rate of biodiversity loss.

Conservation translocation – the deliberate movement of an organism from one area to another with a measurable conservation benefit— has become increasingly important as an active response to the current biodiversity crisis we are experiencing in the Anthropocene. We analysed success and failure in conservation translocations of terrestrial vertebrates over the last 120 years and tested whether success has improved through time. We undertook a systematic quantitative literature review using a Boolean string of relevant terms applied to publications listed on the Web of Knowledge, with data extracted and
combined with information from the six IUCN “Global Re-introduction Perspectives” reports. This process resulted in 514 data points. We found high success rates overall, with clear improvements over time. The number of animals released had a strong influence on the probability of success while reintroductions were the most prevalent type of translocation and had a high success rate.

Geographically, there was a relatively high failure rate of translocations in Oceania. However, given that criteria for success are not universally accepted, we also evaluate the effect of reporting and post-release assessment biases. This talk will briefly focus on our own region, Oceania, as it carries out the most translocations globally and faces problems on a scale not seen anywhere else in the world, particularly regarding introduced predators.

How much can a koala bear? Habitat loss, translocation and half-truths

Dr Oisín Sweeney
1National Parks Association of NSW, Pyrmont, Australia

SYMPOSIUM: Hot topics in ecology, Meeting Room 7, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Oisín is Senior Ecologist for the National Parks Association of NSW (NPA), an environmental non-governmental organisation committed to the expansion of the protected area network. His primary role is to use his scientific training to ensure NPA’s advocacy is evidence-based.

Few animals highlight the conservation problems that face wildlife in the Anthropocene as well as koalas. Once abundant in Queensland and New South Wales, with historic accounts of millions of pelts being exported, almost all populations are now in decline. Victoria and South Australia, where koala translocations have taken place, buck this trend. For these states, koalas are likely persisting because of an abundance of food in translocated habitats (either remnant native vegetation or timber plantations). Yet this is not necessarily positive as starving koalas have had to be euthanased. The causes of koala decline in the eastern states are well understood: habitat loss and degradation reduce population sizes and force koalas to the ground where they face increased risk of vehicle strike, dog attack and disease. Climate change is rendering inland areas increasingly inhospitable to koalas with their range predicted to shift east. These threats must all be addressed if koala populations are to recover. Protection of remaining habitat is a priority due to the time and expense of restoring habitat and the need to provide connectivity to help koalas respond to climate change. New South Wales provides a case study as to how current policy settings fail to address the challenges faced by koalas. Conservation groups have proposed reserves that have been ignored by government in favour of sub-optimal koala habitat that avoids land-use conflict. Fundamental changes to land clearing and forestry legislation, coupled with a failure to effectively manage urban development, will hasten population declines in NSW.

Saving the Bilby on Birriliburu country

Briohny Jackson, Lena Long, Rita Cutter, Leonie Anderson, Dr Vanessa Westcott
1Mungarlu Ngurrarongkatja Rirraunkaja Aboriginal Corporation, Wiluna, Australia, 2Bush Heritage Australia, Crawley, Australia

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Lena Long is a Birriliburu Elder and Ranger and Briohny Jackman is a Birriliburu Ranger. Birriliburu country belongs to the Birriliburu Traditional Owners. Their connection with country has been woven over many thousands of years and continues to this day.

The Bilby is an iconic threatened species that continues to retract in its range. It is a species of cultural significance to the Birriliburu Traditional Owners and one of the last remaining mammals of that size left
on country. The Birriliburu Rangers are working to protect Muntargnaku by sharing stories, passing
down knowledge, monitoring burrows, tracking feral predators and managing fire. They are also working
with other Indigenous ranger groups across the desert and Kimberley to coordinate efforts. After the
first ever Indigenous Bilby Festival held at Kiwirrkurra in 2016 it has become clear that the vast majority
of the area where bilbies are left in the wild is aboriginal owned and managed land.

Ngura Dharug, (place, people). The ancient roots of knowledge

Professor Liz Cameron

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM -
12:45 PM

Biography:
Professor Liz Cameron is of Dharug Aboriginal decent from the Hawkesbury River area in NSW. Liz
completed Post Graduate studies in Indigenous Social Health at Macquarie University (2008), and a PhD in

This paper discusses and illustrates Aboriginal Traditional Ecological Knowledge (TEK); an evolving, cyclic,
sustainable, accumulating and transformative interconnection between people and place. This
knowledge contains elements of ‘other’ as it is inclusive to all relationships between people, plants,
animals and natural seasonal occurrences. Whilst often discarded and suppressed as mythical nonsense
from past Western Enlightenment ideals and contemporary sciences, TEK is argued to be an accumulated
body of transgenerational knowledges, practices and beliefs systems that are ever evolving and adaptive
to meet our changing environment. Such knowledge is expressed through visual and verbal dialect
through an interplay of cultural exchange. Transgenerational knowledge is argued to encapturale the
Sacred and is thus associated to holistic perceptions based on spiritual belief systems within human
connectivity. It is within these realms that this discussion will draw on how the ancient roots of
knowledge within Aboriginal Dharug spiritual philosophies of the seven senses in connectivity can
increase the capacity of understanding towards harmonious biodiversity and human well-being in a
social-ecological context. In considering traditional knowledge systems, ancient ways continue to
provide strength in identifying, analysing and acting upon philosophies based on “Healthy
Country/healthy people”, inclusive to all living things. It is through the deep learning in comprehending
holistic ancient concepts of humanism centered on seven sensces - sight, touch, taste, hearing and smell
along with Aboriginal Dharug philosophies that include imagination (Nganga) and intuition (Oolgna) that
we can restore and prosper in keeping Country healthy and strong.

Can Aboriginal Ecological Knowledge offer solutions in addressing our
biodiversity crisis associated with human activity.

Professor Liz Cameron

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM -
12:45 PM

Biography:
Professor Liz Cameron is of Dharug decent (NSW), PhD in Indigenous Knowledges and is a practicing artist.
Liz’s research includes Indigenous land/ sea management and traditional healing practices. Liz is the
Director of the Institute of Koorie Education, Deakin University.

This paper discusses and illustrates Aboriginal Traditional Ecological Knowledge (TEK); an evolving, cyclic,
sustainable, accumulating and transformative interconnection between people and place. This
knowledge contains elements of ‘other’ as it is inclusive to all relationships between people, plants,
animals and natural seasonal occurrences. Whilst often discarded and suppressed as mythical nonsense
from past Western Enlightenment ideals and contemporary sciences, TEK is argued to be an accumulated body of transgenerational knowledges, practices and beliefs systems that are ever evolving and adaptive to meet our changing environment. Such knowledge is expressed through visual and verbal dialect through an interplay of cultural exchange. Transgenerational knowledge is argued to encapsulate the Sacred and is thus associated to holistic perceptions based on spiritual belief systems within human connectivity. It is within these realms that this discussion will draw on how the ancient roots of knowledge within Aboriginal Dharug spiritual philosophies of the seven senses in connectivity can increase the capacity of understanding towards harmonious biodiversity and human well-being in a social-ecological context. In considering traditional knowledge systems, ancient ways continue to provide strength in identifying, analysing and acting upon philosophies based on “Healthy Country/healthy people”, inclusive to all living things. It is through the deep learning in comprehending holistic ancient concepts of humanism centered on seven senses - sight, touch, taste, hearing and smell along with Aboriginal Dharug philosophies that include imagination (Nganga) and intuition (Oolgna) that we can restore and prosper in keeping Country healthy and strong.

Identification of Australian edible insects: applying bio-informatics and ethno-entomological knowledge

Mr Conrad Bilney. Dr Susan Lawler1, Dr Michael Shackleton1, Dr Alan Yen (dec’d)
1Department of Ecology, Environment & Evolution, La Trobe University, Melbourne, Australia

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Conrad Bilney is a PhD candidate with an interest in insects and ethno-entomological knowledge.

Entomophagy describes humans eating insects. In Australia, the iconic ‘witchetty’ and ‘bardi’ grub are synonymous with white, fat, wriggly grubs Aborigines ate from roots and trees. The ‘witchetty’ grub, Endoxyla leucomochla, is the single classified insect specimen in Australia, but informal interviews and an extensive literature review suggest otherwise.

Evidentiary material gleaned from the literature and Aboriginal narratives indicated the figure might be ‘upward of thirty’. We recorded 24 edible insect species and nineteen host trees from six designated collection sites around Australia.

Insect larva insect larvae are part of the food chain; co-evolving with flowering plants and predators, building networks of trophic relationships between autotrophs and heterotrophs. Phylogenetic trees mapped the evolution of grub and host trees and signalling closeness of was done by creating phylogenetic trees and mapping connections between each species which was identified using Bioinformatics at Latrobe University.

Primary evidence included journals, reports, newspapers and narratives from TOs. Diaries, notebooks, journals and newspaper clippings found during desk-top research added to primary sources used in this research. Over 60 articles referred to entomophagy without entomological and/or classificatory methodology.

Insects form part of the dietary intake for people living in over 100 nations. Entomophagy offers nutritious relief to malnourished people in producing nations as well as a developing economy of tourism, restaurant and inquisitiveness from ‘western’ nations, including Australia. The considerable challenge will be how to minimise environmental and cultural damage from an expected growth in tourism and eating places. High-protein sources will supplement human diets containing fat, vitamins and minerals comparable with farmed livestock. Many insects contain high levels of protein, fat, vitamins, and minerals compared to edible livestock.
With 2 billion people consuming over 2,000 insects, the challenge is how to feed the anticipated growth in the human population. We highlighted the historical significance of insect research to date, paying attention to research gaps. The United Nations Food and Agricultural Office (FAO) has recommended entomophagy as a resolution to the shortage of future world food supplies (van Huis 2013).

Nest predation of Alwal (golden-shouldered parrot Psephotellus chrysopterygius) on Olkola Country, Cape York Peninsula, Australia

_Teghan Collingwood, Olkola Aboriginal Land Managers, Dr Allana Brown, Terry Mahney, Susan Shephard, Stephen Kearney, Prof Stephen Garnett, Prof James Watson, Dr Alex Kutt, School of Earth and Environmental Sciences, University Of Queensland, Brisbane, Australia, Olkola Aboriginal Corporation, Cairns, Australia, Bush Heritage Australia, Golden-shouldered Parrot Recovery Team, Charles Darwin University, Darwin,

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

_Biography:_
Teghan graduated with Bachelor of Environmental Management (Hons I) with a major in Natural Systems and Wildlife in 2018. Throughout her studies Teghan developed a passion for arid zone ecology and working with Indigenous groups to achieve conservation outcomes.

Nest predation is hypothesised to be an important threat to the Endangered Alwal (golden-shouldered parrot Psephotellus chrysopterygius), which is endemic to Queensland. Varanus spp. and pied butcherbirds (Cracticus nigrogularis) are considered the primary predators and feral cats (Felis catus) can also take nestlings. Vegetation thickening due to changed land management is thought to increase the success of pied butcherbirds predating Alwal nests. Remote-triggered cameras installed at 28 Alwal nests across two breeding seasons (2016, 2017) in two habitat refuges (Killarney, Old Dixie) were used to resolve nest predator identity and importance. Bird surveys and vegetation assessments were undertaken to determine whether butcherbirds were more abundant in areas with denser vegetation due to increased hunting success. Of the 76 nests located, 16 (21.1%) failed, with 10 due to predation. Predator activity was significantly (P=0.03) higher at fledging time and predated nests were more likely to fail (P=0.03). The yellow-spotted monitor (V. panoptes) was the only predator to cause an observed nest failure. Pied butcherbirds went undetected at nests, while black-backed butcherbirds (C. mentalis) were a novel predator. Despite high detection rates, feral cats were implicated in one successful predation event. Ariel predation events occurred in more open vegetation (P=0.02), despite butcherbirds having significantly (P=0.02) higher activity levels within dense vegetation. This study highlights the complexity involved in understanding and managing Alwal nest predation. To secure the future of Alwal improved monitoring techniques are clearly needed, including robust census data of Alwal and nest predators to determine trends in predation levels.

Bilby monitoring with Martu: bringing together Indigenous knowledge and western science

_Dr Anja Skroblin, KJ Martu Rangers, Ms Tracy Carboon, Dr Eddie Game, Prof Brendan Wintle, University Of Melbourne, Parkville, Australia, Kanyirninpa Jukurrpa, Newman, Australia, The Nature Conservancy, South Brisbane, Australia,

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

_Biography:_
Anja Skroblin is a research fellow in the NESP TSR Hub. Much of her work bridges strategic research and on-ground conservation management that protects and enhances ecosystems. A current focus is collaborative design of monitoring programs on Indigenous lands.
The bilby is the last of the desert bandicoots. Its stronghold is in the Indigenous lands that cover the deserts of Western Australia and Northern Territory, which includes Martu country. It is a serious task for Martu and other Indigenous groups to learn, record and apply their Knowledge along with western science practices to care for and manage the bilby populations that remain on country, and to prevent a decline of this species. It’s not just the bilby that is threatened, but also the Aboriginal knowledge to care for them, which is being lost as people pass away and knowledge disappears with them. There are challenges in assessing how threatened species are faring when the animals are rare, the area to search is huge, access is difficult and previous records are limited. We have combining expert knowledge from Martu who understand the habits and occurrence of bilbies on their country, with western science approaches to analysis and design to develop a monitoring program that can track the status of bilbies on Martu country. We will give examples of Martu knowledge of bilbies (such as spatial location data, environmental factors that influence distribution, and fine-scale habitat associations), and outline how this information can be integrated into designing a monitoring program and survey method that is tailored to Martu rangers who are caring for their country. This project provides a case study for combining Indigenous knowledge with western science to enhance monitoring and conservation practices.

Marine macrofaunal communities of First Nations' clam gardens

**Mrs. Morgan Black**1, Dr. Francis Juanes1, Dr. Sarah Dudas1,2

1University Of Victoria, Victoria, Canada, 2Department of Fisheries and Oceans, Nanaimo, Canada

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

**Biography:**
Returning to academic life with a renewed vigour, Morgan is a Hakai Scholar and NSERC funded PhD student at the University of Victoria, British Columbia. She is passionate about ocean conservation and supports innovative and collaborative efforts with that goal.

Ancient First Nations’ clam gardens on the west coast of North America provide a unique example of a very long-standing anthropogenic habitat modification in the nearshore marine environment. Clam gardens are a rock wall piled in the low intertidal zone which creates a terrace that changes the beach slope, sediment composition, increases structural complexity, and buffers wave action. These beaches were designed to support clam populations; however, their effects on other organisms have not yet been studied. We hypothesize that the biological communities of clam gardens and reference sites are significantly different. To assess these effects, we are sampling fish and invertebrates at clam gardens and reference sites. This research serves to expand our understanding of drivers of diversity, informs on the potential restoration of modified coastlines, and supports harmony between indigenous peoples’ land use rights and conservation goals.

Rediscovering biodiversity in East Arnhem Land; a cross-cultural approach

**Mr Ben Kitchener**

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

In the recent past, the use of Indigenous cultural knowledge as a tool to better understand our environment has begun to gain traction in Western science. This is particularly true in areas of Northern Australia where local Indigenous communities maintain a strong understanding and connection with their country. This project uses a cross-cultural approach to record the biodiversity of the Laynhapuy and South-East Arnhem Land Indigenous protected areas in remote Northern Territory. It aims to increase our understanding of the fauna of the region by conducting surveys in various locations using a
modified Northern Territory Standard survey method. The surveys also record Indigenous cultural knowledge of country to provide further information about species distributions and histories. This citizen-science based project extends on 3 years of collaboration between Eastern Arnhem Land’s Indigenous Protected Areas (IPA’s), Macquarie University, The Atlas of Living Australia, and local schools and communities. Surveys have been conducted at 8 locations during 2018, with a further 8 locations to be survey in 2019. Over 120 survey participants from local communities, ranger groups, schools and youth groups have been involved to date, assisting in data collection and analyses. The surveys have seen more than 1000 individuals recorded, alongside invaluable cultural recordings describing the uses, distributions and roles of these species within their environment. This serves to not only provide a more comprehensive ecological understanding of the region, but also to ensure traditional stories and knowledge are maintained for future generations and empower local communities to protect their environment.

Bringing Alwal Home: A two-tool box approach for recovering the endangered Golden-shouldered Parrot

Ashaley Ross1, Allana Brown2, Olkola Rangers, Elders and Knowledge Holders1
1Olkola Aboriginal Corporation, COOKTOWN, Australia, 2Bush Heritage Australia, COOKTOWN, Australia

SYMPOSIUM: Indigenous Ecological Knowledge, Meeting Rooms 1-2, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Poster 081 - Ashaley Ross is an Olkola Ranger and Traditional Owner for the traditional lands and waters of the Olkola People, south-central Cape York Peninsula. He is the Olkola project manager for the ‘Bringing Alwal Home’ Project.

The Golden-shouldered Parrot (Psephotus chrysopterygius), or Alwal in Olkola language, is a totem species for the Olkola People of south-central Cape York. Since the return of 766,270 ha of country in December 2014 the Olkola People have been undertaking recovery actions to halt the contraction of range and further decline of this iconic and endangered species. Western scientific understanding of the reasons behind Alwal’s decline have been well documented thanks to research undertaken in the early 1990s. With the return of Olkola lands to the Olkola people, conservation efforts for Alwal now have the benefits of a genuine two-tool box approach. The Western scientific perspective is one lens and Olkola’s cultural understanding, knowledge and obligation to care for their Totem is another lens through which Olkola Traditional Owners view Alwal. Bringing these two lenses together provides a clearer and more truthful view through which we can better understand the threats impacting this endangered species; and how to protect it forever. Ashaley Ross speaks about this two-tool box approach and how it has been embedded in a landscape-scale habitat improvement project for Alwal in partnership with Bush Heritage Australia. Ashaley demonstrates these concepts through a conceptual diagram he developed that illustrates both Olkola and Western scientific understanding.
The Australia-New Zealand Drought Atlas: 500 years of hydroclimatic context for ecological systems

Dr Jonathan Palmer2, Dr Kathy Allen1, Dr Edward Cook3, Dr Chris Turney2, Professor Patrick Baker1
1University Of Melbourne, Richmond, Australia; 2University of New South Wales, Sydney, Australia; 3Lamont-Doherty Earth Observatory, Columbia University, Palisades, USA

SYMPOSIUM: Lessons from the Past – The application of palaeoecology and archaeobotany to ecological science, Meeting Rooms 1-2, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Jonathan Palmer is a research scientist at the UNSW Climate Change Research Centre and the ARC Centre of Excellence for Australian Biodiversity and Heritage (CABAH).

Australian ecosystems are shaped by spatial and temporal patterns of water availability. Instrumental records of hydroclimatic variability are relatively short, spatially sparse, and biased in their distribution towards established population centres. Long-term records of hydroclimatic variability from remote areas would provide unique historical context for better understanding contemporary ecosystems. We used a network of 177 drought-sensitive tree-ring and coral proxy records to reconstruct the summer (Dec-Feb) Palmer Drought Severity Index (PDSI) across eastern Australia and New Zealand. Here we present the Australia-New Zealand Drought Atlas (ANZDA), a spatially gridded PDSI reconstruction at 0.5 degree grid resolution that covers the past 500 years (1500-2012). The ANZDA accurately reproduces known historical droughts associated with early European settlement, identifies several intense decadal-scale droughts prior to European settlement, and highlights the extraordinary spatial and temporal complexity of summer drought conditions across eastern Australia and New Zealand. The ANZDA provides a unique historical hydroclimatic context for better understanding ecological systems in this region. In particular, the ANZDA provides a direct estimate of the distribution of drought conditions and extremes that ecosystems have experienced in recent centuries and a long historical baseline for understanding future directional changes in hydroclimatic conditions.

The Australian savanna: ecological biome or degraded woodland?

Ms Susanna Bryceson1, Dr John Morgan1
1La Trobe University, Bundoora, Australia

SYMPOSIUM: Lessons from the Past – The application of palaeoecology and archaeobotany to ecological science, Meeting Rooms 1-2, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Susanna Bryceson is combining low-tech ecological experiments with high-tech data collection to explore the processes that influence the biogeography of Australian ecosystems. She has started from a botanical perspective, but also enjoys any conversation about Australian critters and ancient patterns.

Since 2004, the Tropical Ecology Branch of the CSIRO in Darwin has been conducting one of Australia’s few long-term savanna studies, in an experiment on 20 hectares south of Darwin, Northern Territory. This long-term experiment applies a systematic burning program to designated sites within a previously long unburned patch of vegetation, providing rare data on the effects of fire regimes in tropical woodlands. The experiment has enabled wide ranging research into plants, animals and invertebrates, and while it aims to inform land management, the findings have the potential to revolutionise current burning practices. This presentation uses an uncommon paleobotanic perspective to interpret the ecological patterns that have emerged over the 15 years of these fire regimes. It investigates transformations in the suite of woodland plant species, tipping points and points-of-no-return. We look at what it takes to create a savanna and the ecological costs entailed.
Unravelling forest encroachment into the treeless plains of north-west Tasmania using multi-proxy palaeoecological data.

Miss Judith Vink1, Associate Professor Patrick Moss1, Mr Peter McIntosh2, Mr Adrian Slee3, Miss Amirah Farrell1
1The University Of Queensland, St Lucia, Australia, 2Forestry Practices Authority, Hobart, Australia

SYMPOSIUM: Lessons from the Past – The application of palaeoecology and archaeobotany to ecological science, Meeting Rooms 1-2, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
This will be the first time the results of my thesis will be presented. Currently enrolled in a degree in Bachelor of Environmental Management at UQ, my main interest is how palaeoecological data can assist land managers to conserve ecosystems.

A high-resolution reconstruction of the past environments of Surrey Hills, north-west Tasmania for the Last Interglacial Glacial Transition (LIGT ~14.7 - 11.5 ky BP) and early Holocene (11.5 - ~8 ky BP) is needed to inform the current debates on forest encroachment into treeless plains. The mid-altitudinal plateau of Surrey Hills has puzzled ecologists for decades with its matrix of vegetation types that exist independent of altitude (Onfray 2002) and soil properties (Bowman 2003). Expanding on a previous study by Watson (2013), this research aims to reconstruct Surrey Hills using multiple proxies; pollen, charcoal and sedimentology. This research is intended to assist current managers Forico Pty Ltd to understand past environments and to inform the ongoing conservation of these biologically diverse ecosystems. The results of this multi-proxy palaeoecological study will be discussed.

Bowman, D, Wood, S, Neyland, D, Sanders, G & Prior, L 2013, 'Contracting Tasmanian montane grasslands within a forest matrix is consistent with cessation of Aboriginal fire management', Austral Ecology, vol. 38, no. 6, pp. 627-38.


Tree rings reveal a conservation conundrum for the critically endangered Leadbeater’s Possum

Prof Patrick Baker1, Dr Craig Nitschke1, Mr Tim Willersdorf1, Dr Raphael Trouve1
1University Of Melbourne, Richmond, Australia

SYMPOSIUM: Lessons from the Past – The application of palaeoecology and archaeobotany to ecological science, Meeting Rooms 1-2, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
Prof Patrick Baker studies how forests change over time, how disturbances impact forests, and how this knowledge can be used to develop new approaches to managing forests in the face of global change.

Leadbeater’s Possum is a critically endangered arboreal marsupial that inhabits tall eucalypt forests in a small area of southeastern Australia. In recent decades Leadbeater’s Possum has been the focus of intense controversy because the forests that are its preferred habitat are also highly valuable for commercial timber production. Leadbeater’s Possum requires two key habitat features: 1) large, hollow-
bearing trees for nesting and 2) a dense, connected understorey of Acacia and other understory species for foraging and movement. To date, most research has focused on hollow-bearing trees with the assumption that the understorey element is always present. We used dendroecology to reconstruct the historical dynamics of the forest understorey and demonstrate that the Acacia species preferred by Leadbeater’s possum are an ephemeral component of the forest. In addition, we show that the abundance, growth, and vigour of the Acacia are negatively correlated with the amount of Eucalyptus in the stand. Our tree-ring analyses demonstrate decadal scale dynamics in which the understorey and overstorey typically decouple several decades after the stand-initiating disturbance. These findings have important implications for conservation strategies aimed at maintaining or increasing current Leadbeater’s Possum habitat.

Australian Coastal Wetlands - Sea Level, Peat and Fire

A/Prof Patrick Moss
1The University of Queensland, Brisbane, Australia

SYMPOSIUM: Lessons from the Past – The application of palaeoecology and archaeobotany to ecological science, Meeting Rooms 1-2, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Patrick Moss is located at the School of Earth & Environmental Sciences at The University of Queensland. His research is related to an improved understanding of how Australian and SE Asian landscapes have responded to climatic alterations and human impacts.

Australia is regarded as the driest inhabited continent in the world and has such many of its wetlands are underappreciated at a global scale. This presentation will focus on the extensive areas of coastal wetlands that are located across eastern Australia, particularly their relevance to global carbon budgets. In particular, two wetland systems will be examined in more detail, the extensive areas of Wire Rush (Empodisma minus) that occur from the tropics to southern Tasmania and temperate salt marsh communities. In particular, E. minus wetlands are associated with a unique wetland type, patterned fens, which are the only known subtropical wetland system of this type in the world. In addition, fire appears to play a key role in the maintenance of these wetlands that has important management implications. Furthermore, temperate salt marsh systems are highly sensitive to alterations in sea-levels, as well as providing important information about human impacts on coastal landscapes. This presentation will highlight the importance that palaeoecological information can provide about the ecology and management of these unique wetland systems.
Developmental constraints and their temporal variability in an intertidal fish with a complex life-cycle

Mr. Joshua Thia1, A/prof. Cynthia Riginos1, Dr. Libby Liggins2, A/prof Will Figueira3, Dr. Katrina McGuigan1
1The University Of Queensland, Brisbane, Australia, 2Massey University, Auckland, New Zealand, 3University of Sydney, Sydney, Australia

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
I am an evolutionary biologist. My recent research, as part of my PhD at The University of Queensland, has focused on processes that influence spatiotemporal variability in the distribution of genetic and phenotypic variation in marine fish with complex life-cycles.

Complex life-cycles are predicted, under evolutionary theory, to decouple trait variation across different developmental phases in an organism’s lifetime; however, developmental constraints might limit the degree to which this occurs. In marine organisms with complex life-cycles, much attention has been given to understanding how early developmental experiences influence survival later in life. However, we know very little about developmental constraints among life-history traits in wild populations. We address these knowledge gaps by studying life-history trait relationships in juvenile Bathygobius cocosensis, an intertidal fish. We found significant and temporally consistent associations among traits within the larval phase, but mixed support for the expectation that larval traits are dissociated from post-metamorphic juvenile traits, suggesting a trade-off in developmental processes across life-stages.

Extinction Risk in Novel Communities

Professor John Pandolfi1, Dr Timothy Staples1, Professor Wolfgang Kiessling2
1The University Of Queensland, St Lucia, Australia, 2Universität Erlangen-Nürnberg, Erlangen, Germany

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
John Pandolfi is a Professor in the School of Biological Sciences, The University of Queensland. He has research interests in marine palaeoecology, especially the effects of anthropogenic impacts and climate change on the recent past history of modern coral reefs.

Local and global changes cause many ecosystems to be transformed into new configurations through taxonomic turnover and species-abundance changes. This transformation is resulting in what many refer to as ‘novel communities’ - communities with no historical precedence in the ecosystem. But a fundamental gap exists in the comparative analysis of ecosystems as community novelty remains an ill-defined, ill-quantified concept, often lacking a pre-historical context. Here, we develop a robust methodology for the identification of novel communities that allows for investigation of their frequency, causes, and consequences over long temporal scales. We distinguish between instantaneous novelty, in which a community is significantly different from its previous state, and cumulative novelty, in which a community is significantly unprecedented in all previous times. We identify novel communities only when instantaneous and cumulative novelty converge. Applying our approach to time series data from Cenozoic marine pelagic and Quaternary terrestrial plant communities, we find the mean frequency of novel communities varied from 1.5% to 3.2%. We address the role of local extinction and local origination in: 1) generating novel communities, and 2) communities that follow novel communities. We found that extinction helps drive novelty in Cenozoic pelagic but not Quaternary plant communities; however, origination helps drive novelty in both systems. Though novelty is largely driven by taxonomic turnover, novel communities do not give rise to more or less extinction-resistant communities nor those
Can ecosystem functioning be maintained despite climate-driven shifts in species composition? Insights from marine forests

Mr. Albert Pessarrodona Silvestre\textsuperscript{1,2,3}, Dr. Dan Smale\textsuperscript{2}, Dr. Andrew Foggo\textsuperscript{3}
\textsuperscript{1}University of Western Australia, Perth, Australia, \textsuperscript{2}The Marine Biological Association of the UK, Plymouth, United Kingdom, \textsuperscript{3}Plymouth University, Plymouth, United Kingdom

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Albert is currently a PhD student at the University of Western Australia. His research revolves the functioning of marine forest ecosystems. He has previously worked on climate change impacts on seaweed forests in the Mediterranean and the UK.

Climate change is driving a redistribution of species and reconfiguration of ecological communities at a global scale. Persistent warming in many regions has caused species to extend their geographical ranges into new habitats, with thermally-tolerant species often becoming competitively dominant over species with colder affinities. Although these climate-driven changes in species abundance and diversity are well documented, their ecosystem-level implications are poorly understood, and resolving whether reconfigured communities can maintain fundamental ecosystem functions represents a pressing challenge in an increasingly warmer world.

We investigated how climate-driven substitutions of foundation species influence processes associated with carbon and nutrient cycling (biomass production, detritus flow, herbivory, decomposition) by comparing two habitat-forming kelp species with contrasting thermal affinities. We examined the wider ecosystem consequences of such shifts for the observed (and predicted) emergence of novel marine forest communities in the NE Atlantic.

The warm-temperate kelps were more productive than the cold-water kelps and exhibited a distinct seasonal growth strategy. A greater proportion of their production entered higher trophic levels, as this species was a preferred food and was subjected to higher grazing rates. Like the other kelps, most of primary production was lost via erosion of the lamina, which decomposed faster than that of the cold-water species.

Our results show that, like species invasions, climate-driven range expansions and consequent shifts in the identity of dominant species can modify a wide range of important ecosystem processes. However, alterations in overall ecosystem functioning may be relatively limited where foundation species share similar ecological and functional traits.
Community dynamics and species co-occurrence over 3,000 years of coral reef development

Mr Timothy Staples1,2, Prof John Pandolfi1,2
1University Of Queensland, St Lucia, Australia, 2ARC Centre of Excellence for Coral Reef Studies, Townsville, Australia

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Timothy Staples is a community and quantitative ecologist interested in leveraging datasets with wide spatial or temporal replication to expand our understanding of how communities form and function.

The observed patterns in natural communities are products of historical processes and conditions. This is particularly true for long-lived organisms, such as trees and corals, where past conditions can continue to affect observed demographic and ecological patterns centuries later. This has two implications. Firstly, predicting future changes of a community using current conditions is challenging without knowing the historical trajectory. Secondly, the temporal scale that our theories of community change operate at (over multiple generations) is not matched by the temporal scale of many observational datasets. In this talk I use a millennial-scale time-series dataset of nine coral communities sampled from uplifted reef terraces along 35 km of the Papua New Guinean coast. These communities date from 9,000 to 6,000 years ago, an ideal time period for examining community dynamics, as reefs were continually accreting to match sea level rise, and human impacts were low. In addition, the region experienced a major volcanic eruption approximately 9,000 years ago, resulting in widespread coral mortality. With these data, I will talk about changes in community composition and species co-occurrence along and between time-series. In particular, I will focus on the detection of long-term trends that might inform our understanding of current community patterns, and our prediction of future changes.

Ocean deoxygenation through time: from decades to millennia

Dr Bryony Caswell1,2, Prof Christopher Frid3
1University Of Hull, Hull, United Kingdom, 2Environmental Futures Research Institute, Griffith University, Nathan, Australia, 3School of Environment and Science, Gold Coast, Australia

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Dr Caswell is an interdisciplinary marine ecologist who lectures geology at the University of Hull. Previously a researcher at Griffith University and lecturer at the University of Liverpool. Her research investigates long-term change in marine ecosystem dynamics and functioning.

In order to understand how the environment will change over the next 100–1000 years and how this will impact the biosphere we need information on long-term change from a range of scenarios. A long-term perspective can be achieved by looking at periods of comparable environmental change in Earth history. Two past periods of ocean deoxygenation, 150 and 183 million years ago, are considered: (1) a period of global climate change, analogous to that occurring today, and (2) a period of regional deoxygenation associated with changing circulation. Palaeoecological changes in populations, communities, and biological traits were investigated using data spanning millions of years at high resolution (100s–1000s years). Changes in the ancient systems were compared with those in present-day systems receiving anthropogenic organic enrichment for several decades.

Large shifts in biodiversity, body-size and the population-size of the dominant benthic taxa occurred in response to ocean deoxygenation. Ecological change spanned multiple trophic levels impacting organisms inhabiting the seafloor and their pelagic predators resulting in biogeographic range shifts.
Quantification of the relationships between ecological change and proxies for palaeoenvironmental change show that both hypoxia and primary productivity were important drivers. Furthermore, changes in biological traits and core ecosystem functions showed changes in nutrient regeneration, food web dynamics, and benthic-pelagic coupling. Jurassic ecosystems showed functional resilience and redundancy, but ultimately functioning collapsed. Critically, the recovery from global deoxygenation was very slow. This emphasises the risks of relying on patterns of short-term and small-scale resilience when managing modern marine systems.

Resolving the origins of Australia’s endemic blue mussel and hybrid interactions with a marine invader.

Ms Iva Popovic1, Dr Cynthia Riginos1
1University Of Queensland, St. Lucia, Australia

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Iva Popovic is a molecular ecologist interested in the application of genomic tools to answer ecological and evolutionary questions relating to invasive species, marine connectivity and biodiversity. She is currently finishing a PhD at the University of Queensland.

Human-mediated introductions of non-native species pose numerous threats to ecosystems worldwide, including displacement of native species. Despite the high ecological costs of invasive species, many introduced populations are only detected following successful establishment. In many cases, the identification of introduced taxa is obscured by the existence of closely-related but morphologically indistinguishable native species. Invasive species may also dissolve into hybrid swarms through ongoing hybridisation with native taxa, in turn, eroding the genetic integrity of endemic populations. Here, we leverage data-intensive genomic analyses to document the invasive spread of Mytilus galloprovincialis, one of the world’s most widely established marine invasive species, along the southeastern coast of Australia. We also quantify genetic interactions with a morphologically indistinguishable and taxonomically contentious native species, Mytilus planulatus, which obscures the extent of M. galloprovincialis establishment and its impact on native biodiversity. Our results indicate multiple introductions of M. galloprovincialis from different Mediterranean and Atlantic source populations. Invasive elements are not limited to major shipping ports and some native populations have already been displaced by hybrid swarms. Analyses of empirical and simulated genetic data suggest deep estimated divergence times between invasive M. galloprovincialis and the endemic taxon, supporting a separate species status for native Mytilus planulatus. Accurate species identification, however, requires using many genetic markers presenting an impediment for rapid and efficient identification of invasive and endemic population. Our findings raise ethical and practical questions regarding the value of protecting native genetic diversity when challenged with invasive hybridisation.
Real-time interaction of ecology and evolution in the sea: the curious case of scleractinian corals

Dr. Greg Torda1
1ARC Centre Of Excellence For Coral Reef Studies, Townsville, Australia

SYMPOSIUM: Marine ecology: new developments and human impacts, Meeting Rooms 4-5, November 27, 2018, 10:45 AM - 12:45 PM

Biography:
Greg is a molecular ecologist fascinated by the interplay of ecology and evolution in scleractinian corals. His research aims to understand how corals acclimatize and adapt to environmental changes, and whether their adaptation can keep pace with climate change.

The long-standing paradigm that ecology and evolution play out on different timescales is increasingly challenged by recent studies that show real-time interaction of the two. Similarly to terrestrial examples, it is expected that eco-evolutionary dynamics define both the population trajectories and adaptive capacity of marine organisms. But contrary to the relative simplicity of terrestrial ecosystems, the complexity of the natural history of many marine taxa pose significant challenges for our attempts to understand how ecology and evolution interacts on short timescales in the sea. I will demonstrate some of these challenges through the example of reef-building corals, that are the ecosystem engineers of one of the most biologically diverse, socially, ecologically and economically valuable, and environmentally sensitive ecosystems of the planet. Recent global-scale disturbances have decimated coral populations worldwide, and whether these populations will be able to recover in an era of ever more frequent and severe perturbations is at the focus of global interest. I will present the unprecedented ecological impact of the 2016/17 mass bleaching event on the Great Barrier Reef, during which over 50% of shallow reef corals were lost, and show how density dependent mechanisms, ecological feedback loops, connectivity that can drive both outbreeding enhancement or depression, complex reproductive strategies, and symbiotic relationships complicate ecological and evolutionary models that aim to predict the fate of this iconic reef system in the Anthropocene.

Can citizen science foster conservation citizenship?

Dr Angela Dean1
1The University Of Queensland, St Lucia, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Angela Dean is a social scientist whose research examines the social impacts of participating in citizen science. She collaborates with a range of marine and terrestrial citizen science organisations, including the Reef Citizen Science Alliance, ReefCheck Australia and NatureTrackers.

Environmental citizen science programs enable community involvement in research. In addition to generating data about ecological or environmental data, many citizen science programs aim to foster conservation citizenship. However, there are little data available to inform the degree to which participating in citizen science influences participants, and how citizen science experiences can be designed maximize engagement outcomes. We surveyed individuals after attending marine citizen science events in 2016 and 2017. Approximately half of participants reported intentions to adopt a new conservation behavior as a result of their participation. Key elements of the citizen science experience associated with new behavioural intentions were learning about actions (procedural learning), and experiencing negative emotions about environmental problems. Importantly, factual learning was associated with reduced behavioural intentions. Both direct experiences of nature and seeing others
take action were important ingredients for change. When designing citizen science programs, these findings suggest highlighting environmental impacts while providing meaningful experiences and building stewardship skills, to maximize citizenship outcomes.

**Detecting regional population declines using Australia’s common bird monitoring data**

**Dr David J Baker**, Dr Rohan H Clarke, Prof Melodie A McGeoch

Monash University, Melbourne, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

My research aims to quantify the impacts of environmental change on biodiversity, understand the mechanisms driving changes and, using these insights, project potential impacts under future scenarios. For much of this work I use long-term citizen science monitoring data.

Effective population monitoring must be able to reliably identify declining populations well in advance of catastrophic collapses. Australia’s common landbirds have been monitored continuously for two decades through BirdLife Australia’s volunteer-based monitoring scheme. To ensure long-term monitoring of the continent’s avifauna is effective, it is important to evaluate the likelihood that persistent population declines could be detected using these data. We use spatially explicit simulations of occupancy dynamics and virtual sampling that mimics the data collection process of BirdLife Australia’s monitoring scheme to predict the power in these data to detect regional population declines of different sizes (10-30% per decade). We show that in 7/10 regions centred on the major population centres of the continent (i.e. Adelaide, Brisbane, Canberra, Hobart, Melbourne, Perth, Sydney) there was sufficient power (≥0.8) to be confident in detecting declines of ≥30% per decade for at least one-quarter of the region’s common bird species. These species span a range of taxonomic orders, dietary guilds and body masses. Negligible power exists to detect even large declines where sampling effort or species detection probabilities were low. These results show the value of broad-scale monitoring for assessing trends in the most readily sampled species. They also highlight the importance of maintaining a range of long-term monitoring approaches tailored to particular species, regions and scenarios.

**A citizen science approach assessing health and conservation value of Flinders Reef, Moreton Bay**

**Dr Monique Grol**, Dr Chris Roelfsema, Dr Elisa Bayraktarov, Mr Cedric van den Berg, Ms Sarah Breeze, Ms Tania Kenyon, Dr Simone de Kleermaeker, Ms Jennifer Loder, Dr Morana Mihaljević, Dr Josh Passenger, Ms Phebe Rowland, Dr Julie Vercelloni, Dr Josh Wingerd

The University of Queensland Underwater Club, UniDive, St Lucia, Australia, CoralWatch, Queensland Brain Institute, The University of Queensland, St Lucia, Australia, The University of Queensland, St Lucia, Australia, Reef Check Australia, Brisbane, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM
Biography:
Monique Grol is a marine ecologist and passionate citizen scientist with a background in environmental monitoring. In her day job, Monique works at CoralWatch, Queensland Brain Institute, The University of Queensland.

There is limited monitoring data available on the state of subtropical reefs affected by multiple stressors. Citizen science carried out by trained volunteers can fill these data gaps to support conservation and effective environmental management. Here, we demonstrate a comprehensive ecological assessment and the first detailed habitat map of Flinders Reef - a subtropical reef in Moreton Bay, Southeast Queensland. An ecological assessment was carried out by >100 trained volunteers using standardised protocols (Reef Check, CoralWatch) resulting in 561 dives. Findings suggest an outstanding ecological health state of Flinders, likely preserved through its remote location and status as a green zone. We demonstrate that the coral cover at Flinders Reef (up to 79%) is higher than coral cover at other Southeast Queensland reef sites and is comparable to sites on the Great Barrier Reef. Cluster and substrate pattern analyses show a characteristic compartmentalisation of benthic substrate groups likely dominated by wave exposure between the western sheltered and eastern exposed side of the reef. Recorded impacts (physical coral damage, unknown scars and coral disease) at Flinders Reef were three times lower than those observed for more accessible monitored reef locations in Moreton Bay. This project contributed valuable data and insights to scientists and policy makers via a report, detailed underwater maps, and government briefing meetings; and also informed the community via a coffee table book, presentations and a project video.

Unleashing the potential of citizen science in environmental science for NSW

Dr Erin Roger¹, Patrick Tegart¹, Dr Michael Kinsela¹
¹Office Of Environment And Heritage, Sydney, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Erin is a Senior Scientist working in the Office of Environment and Heritage. Erin leads OEH’s citizen science team, who are responsible for developing citizen science for OEH. Erin is also the Chair of the Australian Citizen Science Association (ACSA).

In 2016 the NSW Office of Environment and Heritage (OEH) made a firm commitment to citizen science, and released a three-year Citizen Science Strategy. The vision is to “Drive a new era of public participation in science by developing collaborative projects that support decision-making and are engaging for the public”. The emphasis on a real contribution by citizen scientists to decision-making is a critical and distinguishing part of this vision. Here, we detail the ways in which OEH is using citizen science to support decision-making in NSW. The Warrumbungle post fire recovery work, including the Back to ‘bungles bird week has recorded over 5,300 birds and over 100 species over 4 years of biannual surveys. The project is monitoring how the park recovers from a severe bush fire in 2013. Over the 4 years, the bird community in the burnt areas has become more like the bird community in the unburnt area, although there are still differences in species mix and abundance. Results have been used to support Park management actions. OEH is also investing and partnering in the development of robust photopoint protocols so that images can provide both qualitative and quantitative data. This work has resulted in projects like CoastSnap which developed a simple, accurate methodology to monitor coastal change using smartphone images. This information is valuable for understanding the dynamic coastal environment. PointSnap is the terrestrial equivalent, it will allow users to capture and store images to allow quantitative information extraction.
What’s citizen science? Who’s advocating for it? What’s technology design have to do with it?

Jessie Oliver1,2, Prof Margot Brereton1, Prof David Watson3, Prof Paul Roe1
1Queensland University of Technology, Brisbane, Australia, 2Australian Citizen Science Association, Sydney, Australia, 3Institute for Land Water and Society, and School of Environmental Sciences, Charles Sturt University, Albury, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Jessie’s been involved in developing the Australian Citizen Science Association for 4.5 years. As a QUT PhD student, she’s now applying her background in ecology, science communication, and citizen science, to investigate how to design engaging citizen science technologies. @JessieLOliver

The term citizen science is becoming ubiquitous, but how does it differ from other activities such as science outreach, engagement, and education? Here, I demystify citizen science, explaining what it is, what it isn’t, and why I think it is an increasingly useful complement to more traditional modes of inquiry. Key examples will highlight how the general public and scientific communities cooperate to make scientific discoveries together, in terms of both ecology and applied conservation science. I will discuss how peak body groups and umbrella organisations such as the Australian Citizen Science Association (@CitSciOz) are developing and working at regional and global scales to advocate for citizen science and increase the impact of science on everyday lives. Lastly, I highlight specific technology design challenges for citizen science, considering global data, associated metadata, and key considerations for designing specific project applications. Although drawing on numerous examples, I will highlight my own work collaborating with citizen scientists to review extensive acoustic datasets for the elusive Eastern Bristlebird, Project #BristleWhistle. Understanding opportunities, limitations, advocacy channels, and technological needs of citizen science will increase the impact of conservation science and help to inform future decision making, while also making science more inclusive and relevant to the wider community.

Pollinator Observatories: citizen science to reconnect with nature in cities

Ms Blythe Vogel1,2, Dr Casey Visintin1, Prof Brendan Wintle1, Dr Luis Mata2
1Quantitative and Applied Ecology Group, School of BioSciences, University of Melbourne, Parkville, Australia, 2ICON Science, Centre for Urban Research, School of Global, Urban and Social Studies, RMIT University, Melbourne, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Blythe Vogel is a Master of Science student at the University of Melbourne. She is interested in studying plant-insect pollinator interactions in urban areas, and in particular, how we can engage citizen scientists to help conduct this research.

The successful conservation of urban insect biodiversity may be reliant on making insects, and their ecological interactions, tangible to people. However, most insects are small and fast, remaining largely unknown to onlookers, and are thus excluded from many conservation and citizen science programs. Plants can act as anchors through which to observe plant-pollinator interactions. We introduce the idea of pollinator observatories – a network of flowering plants monitored by both academic and citizen scientists – as a novel way to understand urban plant-pollinator interactions, and to reconnect people with nature in cities.
By monitoring these pollinator observatories across seasons, we gain a detailed understanding of the temporal match between an observatory’s flowering season and its associated pollinator assemblage. Using state-of-the-art hierarchical statistical modelling methods, we describe the link between flowering season, environmental conditions and pollinator interactions, producing predicted ‘observation windows’ for each pollinator observatory. Greenspace managers will be able to apply our findings to guide the timing of visitors to the pollinator observatories such that they are most likely to witness pollinators in action.

Pollinator observatories, and their corresponding predicted observation windows, allow us to understand the factors and seasonality driving plant-pollinator interactions within urban greenspaces. This knowledge is invaluable for planning public engagement with the intriguing but poorly understood ecological interactions between flowering plants and their insect pollinator partners, and to encourage urban dwellers to reconnect with the nature in their cities.

The Atlas of Living Australia - supporting citizen science in data capture and project discovery

Mr. Peter Brenton¹
¹CSIRO, Atlas of Living Australia, Canberra, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Peter Brenton has worked for the Atlas of Living Australia since 2009. He leads the ALA’s development and implementation of tools which support the many and varied needs of field-based data collection by the ecological and citizen science communities.

The Atlas of Living Australia (ALA) is a major supporter of citizen science in Australia, providing tools for creating, discovering and joining projects, as well as enabling project owners to collect, access and use their own data and to share it with others. Species occurrence data from citizen science projects is also aggregated with other data sources in the ALA and used by researchers, policy makers and natural resource managers to improve biodiversity knowledge and conservation outcomes.

The ALA BioCollect platform ensures that citizen science data is described with appropriate metadata, that records and images are appropriately attributed and that it conforms to applicable data standards in the same manner expected of professionally collected datasets.

Referencing recent and current examples, this talk will demonstrate application of the ALA digital platform for collecting, viewing, analysing and accessing citizen science data for research, management and policy applications, focusing on biodiversity research and conservation.
Lessons learned developing Citizen Science apps for Conservation

Alan Stenhouse1, Dr Philip Roetman2, Prof Lian Pin Koh1,3
1Centre for Applied Conservation Science, School of Biological Sciences, University Of Adelaide, Adelaide, Australia, 2School of Natural and Built Environments, University of South Australia, Adelaide, Australia, 3Conservation International, Arlington, USA

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
After a career in software development, Alan is now studying for a PhD and trying to improve conservation outcomes using Citizen Science.

Field data collection for conservation purposes by Citizen Scientists has been hugely assisted by the rapid development and spread of smart phones as well as apps that make use of the integrated technologies contained in these devices.

I will present lessons learned while developing apps and other software tools for two Citizen Science projects for the conservation of two of Australia’s iconic species – the koala and the echidna. Among our aims were improving both the recording of citizen science effort as well as the recording of “absence” data which would improve population modelling. Our solution was to increase the transparent use of the phone sensors as well as providing an easy-to-use user interface. The second app recording data on echidna is benefiting from being a longer-term project and thus being enhanced as feedback is received.

From a software perspective, I will provide some details on collaboration and integration with the Australian national biodiversity repository – the Atlas of Living Australia. I will also give some guidance on what we did well and on what we didn’t.

Surveillance of malleefowl mounds by the community leads to quantitative insights into malleefowl breeding ecology

Dr Heather Neilly1
1Australian Landscape Trust, Renmark, Australia

SYMPOSIUM: Maximizing the potential for citizen science to improve conservation outcomes, Hall B, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Heather is a postdoctoral researcher at Calperum station, SA, studying the role of fauna in ecological restoration. Current projects include: experimentally testing addition of woody debris as a multipurpose restoration tool and examining the role of malleefowl as ecosystem engineers.

The use of motion-sensor cameras for monitoring shy and elusive wildlife has created the opportunity for citizen scientists to be involved in the collection of large amounts of photographic data. Species such as malleefowl (Leipoa ocellata) are ideal for observing via motion-sensor cameras. Malleefowl are normally very difficult to directly observe in the wild, and their breeding activities centre around a nesting mound. Photographic data was collected by citizen scientists over five years, at malleefowl mounds on Calperum station, in a dry mallee woodland, north of Renmark, SA. This data was analysed to extract quantitative information about malleefowl breeding ecology, such as the nesting process timeline, mound use frequency, activity budgets of adult malleefowl and predation pressure at mound sites. Qualitative observations were also made from photographs and video, including observations of breeding pair interactions. Surveillance of malleefowl mounds by citizen scientists has provided detailed insights into malleefowl breeding ecology in a dry mallee woodland. This information is being used to
guide management decisions on Calperum station and provides supporting data for other malleefowl research taking place at this location.

Checking for Change (C4C) A new ecological condition assessment method enabling short-term adaptive management

Ms Jacqui Stol1, Dr Veronica Doerr1, Dr Erik Doerr2, Mr Micah Davies1
1CSIRO, Canberra, Australia, 2Not Applicable, Canberra, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Jacqui Stol has worked on ecological research projects across the temperate woodlands and rangelands of Australia over the past 27 years and is a senior researcher at CSIRO Land and Water, Canberra.

Over past decades the billions of dollars spent in Australia to improve ecological condition on private lands have lacked reliable measures of short-term change in ecological condition. Most monitoring requires long term expert assessment focusing on aspects of condition not expected to improve for decades. To accelerate adaptive management at multiple scales from landholders to the federal government and enable better reporting on ecological outcomes we began trialling 25 novel ecological indicators as well as more traditional measures of ecological condition by collecting baseline data over six years at control and treatment sites where a change had been recently implemented from sheep or cattle grazing to conservation management. Seven of the candidate indicators revealed statistically significant improvement in treatment sites compared to control sites. These results are particularly important as many of these measures are not currently in use by monitoring programs in Australia while many indicators that are currently in use failed to show improvements within two years. Through this research we developed a new suite of ecological indicators and methodologies to assess change in condition within just two to six years and that can easily be used by non-experts called ‘Checking for Change’ (C4C). This suggests we can better facilitate the implementation of outcomes-based incentive programs as well as more effective adaptive management by changing the way we monitor ecological condition by focusing more on functional processes and their resulting structure in the litter, soil and groundlayer.

The reference state in a contemporary landscape: Foundations for mapping vegetation condition in Queensland

Dr Teresa Eyre1, Dr Don Butler2, Mr Dan Tindall3
1Queensland Herbarium, Department Environment and Science, Toowong, Australia, 2Land Restoration Fund, Department Environment and Science, Brisbane, Australia, 3Remote Sensing Centre, Department Environment and Science, Dutton Park, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Teresa Eyre is a Principal Ecologist within the Queensland Herbarium, Department of Environment and Science. Research interests have focused on fauna and flora responses to management and modified landscapes, and ironing out issues with the assessment of vegetation condition.

Vegetation condition assessments for biodiversity are becoming increasingly integral to support decision-making, policy and conservation incentives, including offsets, restoration targets and monitoring responses to management. Regardless of the scale of application, vegetation condition assessments rely on benchmark data from ecosystems in a pre-defined ‘reference’ state, with the
assumption that this state supports the persistence of all species expected. While there has been scientific debate on the selection and assessment of appropriate attributes and how best to combine them to derive a condition metric for biodiversity, there has been less scrutiny on the selection and application of reference data and how to deal with variability in reference state attributes through space and time. There is also a need to validate the assumption that the reference state does sustain all expected species, particularly in the contemporary landscape. Queensland is embarking on a statewide condition mapping project. The project will build on strong foundations from the Regional Ecosystem mapping program and the Statewide Landcover and Trees Study and plans to use a suite of advances in remote-sensing data products and data mining approaches, but we still need to feel confident regarding the underpinning use of benchmarks. Here we explore data on the efficacy of condition attributes in predicting faunal composition, consider potential ways to deal with stochastic and deterministic variation in attributes within and between reference sites, and propose a list of priority attributes that could be used to map vegetation condition states across Queensland’s diverse ecosystems at the regional scale.

Systemic resilience and connectivity in coral reef systems

Dr Karlo Hock1, Dr Nichloas Wolff1,2, Dr Juan Ortiz1,3, Dr Scott Condie4, Dr Kenneth Anthony3, Prof Peter Mumby1

1University Of Queensland, St Lucia, Australia, 2The Nature Conservancy, Brunswick, USA, 3Australian Institute of Marine Science, Townsville, Australia, 4CSIRO, Hobart, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Karlo Hock is a postdoctoral research fellow in the Marine Spatial Ecology Lab at the University of Queensland, where he has been working on applications of network analysis and connectivity modelling to support management decisions in marine systems.

Populations on reefs are both connected through larval exchanges and exposed to different levels of disturbance impacts. This spatial heterogeneity will result in different functioning of reefs in a coral reef system. Notably, differences in exposure will result in, sometimes temporary, refugia that can support regional recovery of coral populations. Reefs with not only high replenishment potential but also preserved adult stocks due to low exposure will have the highest potential to support such regional recovery processes. The presence of such reefs will make the whole reef system more resilient, as the potential for recovery could persist and support against collapse even after large portions of the region have been disturbed. Here we use Australia’s Great Barrier Reef as an example to show how mapping disturbance impacts and combining it with a system-level connectivity network will highlight such regionally important reefs in patchy, spatially heterogeneous ecosystems. We also address the challenges inherent in such prioritisation, chiefly the need to account for spatiotemporal changes in connectivity and disturbance impacts that are becoming more intense and unpredictable with climate change. The principles we propose in our work can also be applied to not only conservation and planning of marine reserves under climate change, but also to guide restoration efforts, manage other spatially heterogeneous ecosystems, and detect potential regime shifts.
Empirical benchmarks are necessary for effective conservation, restoration and management in contemporary landscapes

Megan J. McNellie1,2, Ian Oliver3, Josh Dorrough4, Jian Yen5, Michael Somerville6, Christopher Watson7

1NSW Office of Environment and Heritage, Wagga Wagga, Australia, 2The Australian National University, Canberra, Australia, 3NSW Office of Environment and Heritage, Gosford, Australia, 4NSW Office of Environment and Heritage, Merimbula, Australia, 5The University of Melbourne School of BioSciences, Melbourne, Australia, 6NSW Office of Environment and Heritage, Armidale, Australia, 7NSW Office of Environment and Heritage, Sydney, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Megan McNellie is a Senior Scientist with the Science Division of NSW Office of Environment and Heritage. She is also part-time PhD student at the Fenner School for Environment and Society in The Australian National University.

Some conservation, restoration and management goals often aim for reference states that are perceived through a historical, near-natural or relatively undisturbed conceptual lens. However, the entire earth system is human-dominated, modified, often degraded and is fragmented. Therefore, we argue that historical reference frames are effectively unmeasurable and unsuitable and in some ecosystems, regaining these reference states may be unachievable.

To address this shortfall of defining historical reference states, we suggest an alternate framework--contemporary reference states. Contemporary reference states are more appropriate for the conservation, restoration and management of biodiversity in contemporary landscapes and can be described by empirical benchmarks. Here, we demonstrate the potential to use vegetation plot data to describe empirical benchmarks for ‘best-on-offer’ contemporary reference states for vegetation within contemporary landscapes in New South Wales.

We assembled the compositional and structural attributes for six growth form groups (trees, shrubs, grasses, forbs, ferns and others) from over 37000 vegetation plots, surveyed between 1984 and 2015. We modelled ‘best-on-offer’ as the upper percentile of the data distribution for each compositional and structural attribute to quantitatively define the contemporary empirical benchmarks. Our models accounted for differences in IBRA bioregion, vegetation class, climate, season and the total rainfall for the prior 12 months. This approach overcomes the intractable shortfalls of using historical or near-natural reference states.

Contemporary reference states and empirical benchmarks provide a framework for informing evidence-based decisions, are transparent, relatively easy to update and are necessary for effective conservation, restoration and management within our current and future human-dominated landscapes.
A new vegetation condition multi-metric to support rapid site-based biodiversity assessments

Dr Ian Oliver1, Dr Josh Dorrough2, Mr John Seidel3
1NSW Office Of Environment And Heritage, Gosford, Australia, 2NSW Office Of Environment And Heritage, Merimbula, Australia, 3NSW Office Of Environment And Heritage, Newcastle, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Ian Oliver is a Senior Team Leader in the NSW Office of Environment and Heritage’s Science Division. He manages a small team with a focus on undertaking rigorous science to support successful ecosystem restoration.

A range of vegetation condition multi-metrics have been developed in Australia to support regulated approaches to biodiversity offsetting and for market based schemes to guide investment in private land conservation. However, most existing metrics have a range of limitations including: semi-quantitative scoring of attribute condition; limited capacity to “unpack” the multi-metric score; static attribute weights; attribute “eclipsing”; and a reliance on static expert derived condition benchmarks. Overcoming these limitations will help deliver robust, reliable and repeatable decision making.

Our new multi-metric capitalises on 15 years of experience in the design, application and evaluation of site-based condition assessment metrics in Australia. It underpins the NSW Biodiversity Assessment Method which supports the NSW Biodiversity Conservation Act 2016 (see http://www.environment.nsw.gov.au/biodiversity/assessmentmethod.htm).

In this presentation we will briefly discuss the main components of the new metric, highlighting improvements over previous approaches including: (1) separate composition, structure and function scores within which the component attributes are scored using a continuous non-linear function, (2) the pivotal role of plant growth forms and data-driven dynamic best-on-offer benchmarks, and (3) the dynamic weighting of composition and structure attributes to accommodate the differing importance of growth forms among different vegetation types. We apply our new multi-metric to elucidate contemporary condition states across tenures and vegetation formations in NSW.

The Australian Ecosystem Models Framework

Dr Anna Richards1, Ms Fiona Dickson2, Dr Suzanne Prober3, Dr Kristen Williams4, Dr Garry Cook1, Mr Michael Doherty2, Dr Daniel Metcalfe3, Dr Helen Murphy7, Dr Steve Roxburgh4, Ms Amy Warnick6
1CSIRO Land And Water, Darwin, Australia, 2Department of the Environment and Energy, Canberra, Australia, 3CSIRO Land and Water, Floreat, Australia, 4CSIRO Land and Water, Canberra, Australia, 5Australian National University, Canberra, Australia, 6CSIRO Land and Water, Brisbane, Australia, 7CSIRO Land and Water, Atherton, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Richards is a plant and soil ecologist based at CSIRO Land and Water in Darwin. She investigates novel methods for monitoring and evaluating land management activities that aim to improve ecosystem condition, with a particular focus on fire.

Ecosystems are highly variable and dynamic across space and time as a result of landscape-scale disturbance and recovery processes overlaying climatic and edaphic gradients. The disturbance regimes that drive these dynamics may maintain or degrade ecological condition, depending on whether or not they mirror those regimes to which ecosystems are adapted at evolutionary timescales. The Australian...
Ecosystem Models framework (https://research.csiro.au/biodiversity-knowledge/projects/models-framework/) provides the conceptual underpinning for objectively interpreting ecological condition scores that takes account of the dynamic nature of ecosystems. To this end the framework aims to synthesise and summarise scientific knowledge of ecosystem dynamics, in relation to disturbance regimes, and systematically capture this in a set of conceptual models. These models have been organised into a disturbance-based typology of ecosystem reference states within which detailed state and transition model templates can be used to describe recent and transformative anthropogenic-driven impacts on ecological condition. We argue that without a framework to consistently describe differences between reference and observed condition states of ecosystems, it is challenging to develop effective national environmental policy, convincingly argue for intervention and investment, or make predictions of changes to ecological condition under rapid climate change. Using a case study from an expert-derived conceptual model of an east coast floodplain vegetation complex, we illustrate the utility of the framework for consistently interpreting condition scores and informing ecosystem management at both local and continental scales.

Measuring Biodiversity and Ecological Integrity in New South Wales: Method for the Biodiversity Indicator Program

Dr Kristen J Williams1, Dr Daniel P Faith2, Dr Michael Drielsma3,4, Dr Simon Ferrier1, Dr David Nipperess3,5, Mr Jamie Love3,4, Dr Randall Donohue1, Mr Paul Box6, Dr Sam Nicol7, Ms Jacqui Meyers3, Mr Tim Cooney3, Dr Mark Littleboy3,4, Dr Becky Schmidt7, Ms Maryam Ahmad3, Dr Karel Mokany1, Dr Eren Turak3, Dr Joanne Wilson3,8, Dr Laura Babian3, Dr Gregory Summerell3, Dr Jeremy Black3, Ms Jo White3, Dr Ian Cresswell3, Dr Kate Wilson3

1Commonwealth Scientific and Industrial Research Organisation (CSIRO) Land and Water, Canberra, Australia, 2Australian Museum, Sydney, Australia, 3NSW Office of Environment and Heritage, Australia, 4University of New England, Armidale, Australia, 5Macquarie University, Sydney, Australia, 6CSIRO Land and Water, Sydney, Australia, 7CSIRO Land and Water, Brisbane, Australia, 8(present address) NSW National Parks and Wildlife Service, Australia, 9CSIRO Land and Water, Hobart, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (1), Hall A, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Kristen (https://people.csiro.au/Kristen-Williams.aspx) has a broad background in theoretical and quantitative plant ecology with disciplinary expertise in field botanical survey, vegetation mapping, spatial ecological modelling and biodiversity conservation planning. She led the CSIRO partnership with OEH to develop the BIP method.

In 2014, an independent review of biodiversity legislation in New South Wales (http://www.environment.nsw.gov.au/biodiversitylegislation/review.htm) included a recommendation to develop and apply a comprehensive system for monitoring and reporting on the condition (extent and quality) of biodiversity for the purpose of assessing the effect of new legislation. A key premise is that by aiming to conserve habitats in good condition the rate of biodiversity loss can be reduced, while also improving social and economic outcomes. The NSW Biodiversity Indicator Program (BIP) within the Office of Environment and Heritage (OEH) has been established to assess the current status of biodiversity and ecological integrity for reporting at bioregional and state-wide levels, and to repeat the assessment at intervals to inform the five-year review of the new Biodiversity Conservation Act 2016 (the Act). The method for measuring biodiversity and ecological integrity in NSW is the outcome of a partnership between OEH and CSIRO, in collaboration with the Australian Museum and Macquarie University. It breaks new ground with the suite of indicators covering expected survival and state of biodiversity, habitat condition, management responses and effectiveness, and ecosystem integrity; which together provide a comprehensive basis for monitoring and reporting on biodiversity conservation outcomes. Several fundamental concepts and frameworks in biodiversity measurement and assessment provided a basis for the adopted suite of indicators and the structure for general communication and reporting; which we outline. The indicators couple direct monitoring of biodiversity
and management effectiveness with model-based and habitat-based methods to ultimately enable integrated assessment, prediction and forecasting.

**Quantifying rangeland condition in Mongolia’s Gobi desert: Putting stakeholders front and centre**

**Dr Steve Sinclair**, Dr Otgonsuren Avirmed, Mr Matt White, Ms Khorloo Batpurev, Dr Peter Griffioen, Dr Canran Liu, Dr Sergelenkhuu Jambal, Ms Hayley Sime, Dr Kirk Olson

1Arthur Rylah Institute For Environmental Research, Melbourne, Australia, 2Wildlife Conservation Society Mongolia, Ulaanbaator, Mongolia, 3LaTrobe University, Bundoora, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**

Steve Sinclair is a plant ecologist at Victoria’s Arthur Rylah Institute, with an interest in the conservation of grassy systems. His recent work has considered the incorporation of stakeholder viewpoints into ecological condition assessments.

There is a pressing need to quantify rangeland condition in Mongolia’s Gobi Desert. Land-use change has caused debate about sustainable grazing levels, and necessitated the introduction of offset schemes to mitigate the impacts of mining operations.

There is, however, no established means of quantifying condition in the Gobi. Further, there are multiple stakeholders who perceive condition in different ways, revealing that condition is at its core a subjective concept. This poses an apparent problem: Why is an evaluation credible if it is a subjective value judgement? We believe this difficulty can be addressed through appropriately wide consultation (conferring credibility from democratic principles) and the construction of repeatable metrics (conferring credibility from transparency and consistency).

Accordingly, we created algorithms for measuring rangeland condition using quantitative stakeholder evaluation data. The stakeholders represented four groups: nomadic pastoralists, specialists in botany, specialists in wildlife, and conservation practitioners and policymakers. The stakeholders evaluated numerous hypothetical sites, described by measurable site variables, providing each with a score between 100 (desired state) and 0 (no relevant values). We used these data to train models (ensembles of regression trees) capable of producing scores from the site variables. These models can be applied to any site as algorithms for predicting condition, representing the stakeholder consensus.

We devised ways of evaluating the performance of these metrics that are consistent with their subjective nature. We demonstrated that they are capable of producing scores for real field sites (not used in training) which are close to the consensus view of experts.
A model-based indicator of capacity for biodiversity persistence using vascular plant records and habitat condition

**Dr Michael Drielsma**, Mr Jamie Love, Dr Kristen Williams
1NSW Office of Environment and Heritage, University Of New England, Australia, 2University of New England, Armidale, Australia, 3CSIRO, Black Mountain, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

**Biography:**
Michael Drielsma is a principal scientist with the NSW Office of Environment and Heritage who develops and applies integrative spatial modelling approaches to biodiversity conservation assessment.

The NSW Biodiversity Indicator Program (BIP) within the Office of Environment and Heritage was established to assess the current status of biodiversity and ecological integrity, and contribute to reporting on the effectiveness of biodiversity management, including informing the five-year review of the Biodiversity Conservation Act 2016. Here, we present a model-based indicator for assessing the state of biodiversity, that estimates persistence of plant diversity (genetic, species and ecosystems) as a function of the proportion of functional habitat remaining in ecosystems.

We applied the method to a range of reporting regions: individual locations (250 m gridcells), bioregions, public reserves, Mitchell Landscapes, and all of NSW. The method incorporates reciprocal measures whereby each reporting region is evaluated in terms of both total and unique diversity, represented as percentages of total NSW pre-industrial levels. Two key sources of spatial data are employed: a Generalised Dissimilarity Modelling-based ecosystem classification derived using vascular plant records; and a modelled surface of Ecological Carrying Capacity. These are combined within the Biodiversity Forecaster (Drielsma et al., 2014, Ecological Modelling 274: 80), a biodiversity assessment methodology that evaluates scenarios and maps conservation benefits. Rather than simply summing across locations, the approach integrates fine-scale information into a model of regional biodiversity complementarity.

Results from the analysis are expressed as a series of charts and maps. These will be recalculated through time to assess impacts of changes in Ecological Carrying Capacity. Among other useful insights, results highlight the disparate, but mutual importance to biodiversity conservation of public reserves and other tenures.

National mapping of biodiversity habitat condition for comparative assessments across regions

**Dr Eric Lehmann**, Dr Thomas Harwood, Dr Randall Dononhue, Dr Kristen J Williams, Ms Fiona Dickson, Mr Peter Lyon, Dr Craig Macfarlane, Mr Mathew White
1CSIRO Data61, Canberra, Australia, 2CSIRO Land and Water, Canberra, Australia, 3Australian Government Department of Environment and Energy, Canberra, Australia, 4CSIRO Land and Water, Floreat, Perth, Australia, 5Victorian Department of Environment, Land, Water and Planning, Heidelberg, Melbourne, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM
Biography:

Eric (https://people.csiro.au/eric-lehmann) conducts research into signal and image processing, statistical methods for spatio-temporal modelling, and Bayesian estimation and tracking, for environmental mapping and monitoring applications. He has been a member of the multi-disciplinary HCAS team for the past four years.

The CSIRO and partner researchers, in collaboration with the Australian Government Department of Environment and Energy, have developed a method that links environmental patterns with remote sensing responses for broad-scale assessment of ecological condition—the Habitat Condition Assessment System (HCAS). HCAS addresses the need for consistent, repeatable and cost-efficient national biodiversity habitat condition assessment and reporting capabilities. The approach is designed to overcome three challenges in measuring habitat condition using remote sensing: 1) similarity in land-cover attributes between the intact state of one ecosystem type and the degraded state of another; 2) more than one possible ‘natural’ state for any given location or environment; and 3) ‘natural’ systems exhibit short to medium term temporal dynamics in land-cover attributes. Using a set of remotely-sensed, environmental, as well as reference data, HCAS produces a condition score based on the difference between how a site actually looks compared to the way it is predicted to appear in a natural state. HCAS performance is assessed by a series of quantitative validation transects and several qualitative case studies, both demonstrating the system’s strengths and known limitations. Broad patterns of habitat condition across the country are well represented by HCAS with more work to do in some specific areas to improve the basis of the source data used. With enhanced inputs, and routine monitoring protocols, HCAS will ultimately deliver a capacity to: 1) identify priority areas for management interventions; 2) contribute to national environmental reporting; and 3) help identify natural and non-natural influences on habitat condition.

Mismatches between expert-based condition assessments, management thresholds, and field data for alpine and subalpine peatlands

Dr Abbey Camaclang1,2, Ms Jessica Connolly1, Emily Clow1, Dr Joslin Moore1,2
1Monash University, Clayton, Australia, 2NESP Threatened Species Hub, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

Biography:

Dr Abbey Camaclang is a postdoctoral research fellow with the National Environmental Science Programme’s Threatened Species Recovery Hub at Monash University. Her research focuses on the use of decision tools to optimise the management of threatened species and ecological communities.

Site-based assessments of ecological condition are important for deciding when and how much management intervention is required to conserve and restore ecological communities. When formal guidelines and specific thresholds are not available, managers may rely on personal values and experience to determine whether a site requires management and when the desired condition has been achieved. However, these subjective judgements may result in inconsistent assessments across multiple sites, and lead to inefficient allocation of management resources. We explored this issue within the context of assessing the condition of alpine and subalpine peatlands in Victoria. We elicited information from peatland managers about key ecological attributes and thresholds that may trigger different types or levels of management interventions, and used data from an ongoing peatland monitoring program to classify peatlands into different management states according to these thresholds. We also elicited peatland condition assessments from peatland experts and the list of key attributes they considered in the assessment. We found an overlap in the set of attributes considered as important by managers and experts. However, for the set of peatland sites in our study, expert condition assessment did not
correspond with the condition class based on management thresholds. Analysis of field data also did not reveal significant differences between good and poor sites as assessed by experts. We discuss possible reasons for the lack of correspondence between expert condition assessment and field survey data or management thresholds, and the implications for the development of systematic condition assessment guidelines for alpine peatlands in Victoria.

Integrated model-data fusion approach to measuring habitat condition for ecological integrity reporting

Mr Jamie Love1,2, Dr Michael Drielsma1,2, Dr Kristen Williams3, Dr Rajesh Thapa2
1NSW Office of Environment and Heritage, Armidale, Australia, 2University of New England, Armidale, Australia, 3Commonwealth Scientific and Industrial Research Organisation, Canberra, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Spatial analyst for the NSW Office of Environment and Heritage with a degree in computer science and research interests in efficient solutions to spatial analysis and modelling problems that contribute to the delivery of effective biodiversity conservation

The NSW Biodiversity Indicator Program (BIP) within the Office of Environment and Heritage was established to assess the current status of biodiversity and ecological integrity in NSW, and contribute to reporting on the effectiveness of biodiversity management, including informing the five-year review of the Biodiversity Conservation Act 2016. The BIP method includes four fine-scale measures of habitat condition, three of which are presented here. Ecological condition estimates the intactness and naturalness of terrestrial habitat at each location without considering the indirect effects of surrounding habitat loss and fragmentation. A semi-inferential approach is used to select, weight and combine a set of proxy variables, including remotely-sensed vegetation cover, land-use and tenure, and landscape attributes; using expert knowledge of their relationship with ecological condition. Ecological connectivity estimates the contribution each location makes to habitat connectivity by way of its ecological condition and relative position in the landscape (e.g. as part of a habitat corridor, or a stepping stone). Ecological carrying capacity measures the ability of habitat to support native species and ecosystems by considering ecological condition and the effect surrounding habitat loss and fragmentation has on biological movements, such as foraging, dispersal and migration. Ecological connectivity and carrying capacity include generalised, scale-agnostic habitat connectivity measures that are independent of specific taxa, movement processes or timeframes (single and cumulative movements, by individuals and across generations). The approach provides a framework for incorporating new information and the expression tree underlying ecological condition may be heuristically optimised where suitable observed measures are available.
Standardised collection of ecological condition data, an information supply chain perspective

Mr. Peter Brenton
CSIRO, Atlas Of Living Australia, Canberra, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Poster 086 - Peter Brenton has worked for the Atlas of Living Australia since 2009. He leads the ALA’s development and implementation of tools which support the many and varied needs of field-based data collection by the ecological and citizen science communities.

Well informed policies and management outcomes in ecology are dependent on sound research and analysis which are underpinned by good quality data. Temporally and spatially dense data is very difficult and costly to generate, particularly at landscape and national scales and it is therefore inevitable that analyses will need to rely heavily on aggregated data from many sources, as well as professionally interpreted and calibrated remote sensed data.

The Atlas of Living Australia (ALA) is the most comprehensive platform in Australia for aggregated standardised biodiversity data and services, and is free for all people to access and use. The ALA provides a variety of tools and services which allow users to make informed choices in respect to fitness for use of specific datasets and for selecting specific required data for download. It also provides web and mobile tools for the collection of standards-compliant simple and complex field data and for such data to easily flow into the ALA and TERN (Terrestrial Ecosystem Research Network) data aggregation and access infrastructure. The BioCollect tool enables anyone to set up data collection projects for all manner of ecological and biodiversity related purposes, giving project owners control over data access and survey configuration.

This presentation outlines the role of ALA tools in the information supply chain, from data collection to access for analysis.

Predicting the ecological outcomes of economic trade

Dr Payal Bal, Dr Brendan Wintle, Dr Pia Lentini, Ms Natasha Cadenhead, Mr Simon Kapitza, Dr Tom Kompas, Dr Pham Van Ha
University Of Melbourne, Melbourne, Australia, Australian National University, Canberra, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
I am currently developing a framework to evaluate the impacts of global economic and social trends on biodiversity. In my previous work, I developed quantitative decision-analytic methods and structured decision-making approaches to evaluate biodiversity monitoring strategies for conservation decision-making.

Economic trade has a profound effect on nature and biodiversity through its pervasive influence on commodity demands and land use. Although the links between consumption, trade and biodiversity have been characterised, no spatially explicit analyses of the impacts of trade agreements on biodiversity via land use change have been developed to date. Moreover, specific methods are required to downscale global trade policies to local land use and its impacts on biodiversity. We propose a new integrated modelling framework to assess spatial and temporal impacts of economic trade on biodiversity. Using data from the Global Trade Analysis Project and the Global Biodiversity Information
Facility, we evaluate the impacts of regional trade-liberalisation agreements versus a business-as-usual trade scenario for Vietnam’s biodiversity. We show how predicted change in outputs of particular economic sectors (e.g. increased production of textiles and decreased production of rubber) results in changes in land-based production patterns and subsequently in biodiversity distribution. Our analytical framework comprises of: (1) economic models to assess changes in supply and demand for commodities under alternative trade policies; (2) land-use models to better represent non-linear feedbacks between commodity supply and demand and land-use decisions; and (3) species distribution models to predict changes in the availability of suitable habitat for species under trade scenarios. Our study demonstrates how this integrated approach can be used to evaluate the hidden economic, land-use and biodiversity costs and opportunities in alternative trade policies. We also show how the approach can be scaled up for global analyses of biodiversity trends.

Mapping landscapes of fear and stress as a tool for biodiversity conservation

Mrs Loren Fardell1, Dr Chris Pavey2, Dr Edward Narayan3, Prof Chris Dickman1
1The University Of Sydney, Camperdown, Australia, 2CSIRO Land and Water Division, Winnellie, Australia, 3Western Sydney University, Penrith, Australia

SYMPOSIUM: Measuring and mapping ecological condition through space and time (2), Hall A, November 26, 2018, 3:45 PM - 5:45 PM

Biography:
Loren Fardell is a PhD Candidate at The Dickman Lab, The University of Sydney. Her research focuses on understanding landscapes of fear and stress impacts imposed on prey species by introduced predators and human activity, to better direct conservation management.

Human populations continue to grow at an exponential rate. Inevitably, this has flow-on effects that degrade habitats. However, there is a growing body of evidence that suggest that wildlife persist, and sometimes prefer, fragmented urban and pastoral habitats. Human activity is increasingly being considered in conservation research, as being equivalent to or as exceeding the impacts of introduced predators. The impacts of human activity and introduced predators may both be seen as major threats to the longevity of local wildlife populations. Small mammal populations in Australia are subject to human disturbance and predation pressures from the introduced red fox (Vulpes vulpes) and domestic cat (Felis catus). Prey species subject to such threats may experience chronic stress from the accumulation of physiological stress from fear, induced either via human disturbance or introduced predators, as well as from standard ecosystem services. As wildlife persist nearby to human activity, however, it is worth questioning whether the presence of humans and the associated resource subsidies reduces the stress imposed by introduced predators. I am currently exploring methods to best investigate wildlife physiological and behavioural stress responses in conjunction with perceived landscapes of fear, the high- and low-risk foraging areas relative to predator-like pressures, across disturbance gradients ranging from human activity to remnant habitat. I am assessing the effects of habitat structure on small mammal responses, and am also trialing filmed giving-up density survey methods with treatments of introduced predator scent and sound and light disturbance, in conjunction with faecal corticosteroid assays to assess stress.
Waterbird recruitment and movements: New science for water and wetland managers

Dr Heather McGinness
CSIRO, Canberra, Australia

SYMPOSIUM: Murray-Darling Basin Environmental, Water, Knowledge and Research (MDB EWKR), Meeting Room 6, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Heather McGinness, Senior Research Scientist CSIRO, is an ecologist specialising in river, floodplain and wetland systems, with a particular interest in the integration of aquatic and terrestrial ecology to better inform natural resource management.

River floodplain wetlands provide critical waterbird habitats, however the quality and availability of these sites are influenced by our water and vegetation management decisions. The use of valuable ‘environmental water’ within Australia’s Murray-Darling Basin has often been focused on supporting completion of waterbird breeding events at nesting sites. However managers and policy-makers are becoming increasingly conscious of the need to also manage feeding sites at Basin scales. Appropriately managing environmental water placement is critical to facilitating the recruitment of juveniles into waterbird populations. Yet we lack basic knowledge of how water flows interact with other factors such as predation, weather extremes and food abundance to influence recruitment. We also lack knowledge of the movements of adults and juveniles during and between breeding events – where do they go, and why? Filling these knowledge gaps is key to improving the efficiency of environmental water management – applying water to the right places at the right times. The Waterbird Theme of the Murray-Darling Basin Environmental Water Knowledge and Research Project (MDB EWKR) has begun filling these knowledge gaps. By quantifying survival rates, movements, and their drivers using wildlife cameras and GPS satellite tracking, it is assisting managers to gain a better understanding of the scales at which habitats and environmental flows are required to support waterbirds. The Theme is a collaboration between the CSIRO, University of NSW and University of Canberra, funded by the Australian Government’s Commonwealth Environmental Water Office.

Freshwater ecosystem food webs: understanding critical basal resources supporting fish recruitment

Dr Paul McInerney, Prof Nick Bond, Prof Rebecca Lester, Prof Ross Thompson, Prof Darren Ryder
La Trobe University, Wodonga, Australia, Deakin University, Geelong, Australia, University of Canberra, Canberra, Australia, University of New England, Armidale, Australia

SYMPOSIUM: Murray-Darling Basin Environmental, Water, Knowledge and Research (MDB EWKR), Meeting Room 6, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Paul is an early career researcher at La Trobe University’s Centre for Freshwater Ecosystems. He is interested in food webs and how energy flow in ecosystems may be changed by both biotic and abiotic disturbance or by anthropogenic intervention.

The Murray Darling Basin Environmental Watering and Knowledge Research project aims to address Basin-wide research questions and knowledge gaps. The relationship between environmental flows and the provision of resources across life stages of plants and animals has been identified as a critical knowledge gap in the Murray–Darling Basin. Understanding trophic interactions in riverine food webs is essential for predicting ecosystem responses and improving management decisions. Flow is known to influence the amount and type of organic matter available to food webs, and is thought to be a primary driver of the recruitment of fish and waterbirds. Understanding which basal resources are supporting...
fish and waterbird recruitment will enable identification of specific habitats and flow characteristics that will deliver the resources required to support or enhance recruitment. We seek to identify critical basal resources supporting fish recruitment and aim to trace the flow of energy through riverine ecosystems. Stable isotope composition and fatty acid profiles of material from a range of compartments within food webs of wetlands, anabranche and river channels was determined. We present empirical data that expresses relative magnitudes of energy pathways to taxa of interest and provide information to inform and refine new and existing models.

**Riverscape recruitment: a conceptual synthesis of drivers of fish recruitment in rivers**

*Dr Amina Price*, Dr Paul Humphries, Dr Alison King, Dr Nicole McCasker, Dr Richard Kopf, Dr Rick Stoffels, Dr Brenton Zampatti

1La Trobe University, Wodonga, Australia, 2Charles Sturt University, Albury, Australia, 3Charles Darwin University, Darwin, Australia, 4CSIRO, Wodonga, Australia, 5South Australian Research and Development Institute, Adelaide, Australia

SYMPOSIUM: Murray-Darling Basin Environmental, Water, Knowledge and Research (MDB EWKR), Meeting Room 6, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

Dr Amina Price is an freshwater ecologist working on riverine and floodplain ecology in the Murray-Darling Basin. Amina’s work has largely focused on fish ecology, in particular, relationships between flow, habitat and biota and the early life-history of fishes.

For a fish to survive the early stages of life, it must find enough of the right type of food, avoid predation, and experience suitable water quality. Mostly, these elements are considered in isolation, and rarely considered in relation to species traits. Here we combine the essential components of fish recruitment hypotheses with the key features of rivers to develop a synthesis to predict relative recruitment strength for all fishes in all rivers, under all flows. The model proposes that: ‘interactions between flow and physical complexity will create locations in rivers, at meso-scales, where energy and nutrients are enriched, the resultant production of small prey concentrated, and prey and fish larvae located (through dispersal or retention) so that the larvae can feed, grow and recruit’. It builds on Bakun’s Fundamental Triad, and other river research. We predict relative recruitment strength for fishes from diverse river types. Our synthesis provides a rationale for how flow and physical complexity affect fish recruitment, and provides a conceptual basis to better conserve and manage riverine fishes globally.
From the four corners of the Basin: Assessing vegetation responses to flow regimes

Cherie Campbell1, Dr Sam Capon2, Dr Susan Gehrig1, Dr Cassandra James3, Dr Kaylene Morris4, Dr Jason Nicol5, Dr Daryl Nielsen6, Rachael Thomas7,8

1La Trobe University Research Centre for Freshwater Ecosystems, Mildura, Australia, 2Australian Rivers Institute, Griffith University, Nathan, Australia, 3TropWater, James Cook University, Douglas Campus, Australia, 4Arthur Rylah Institute for Environmental Research, Heidelberg, Australia, 5Aquatic Sciences, South Australian Research and Development Institute, Henley Beach, Australia, 6CSIRO Land and Water, Wodonga, Australia, 7NSW Office of Environment and Heritage, Sydney, Australia, 8Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, Australia

SYMPOSIUM: Murray-Darling Basin Environmental, Water, Knowledge and Research (MDB EWKR), Meeting Room 6, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Cherie Campbell is a vegetation ecologist based at La Trobe University’s Research Centre for Freshwater Ecosystems in Mildura, Victoria. Her research interests include vegetation responses to flow regimes, and multiscalar patterns in vegetation responses from long-term monitoring programs.

Understanding factors that structure plant assemblages is not only a key goal of ecology but is critical to informing sound conservation planning and management. Wetland and floodplain vegetation assemblages are strongly influenced by water regimes. In response to reduced water availability, environmental water is used to complement components of the natural water regime. A better understanding of how components of the water regime influence and interact with other factors to structure plant assemblages will help inform water management.

This study aimed to assess the influence of flood-return-frequency and vegetation structure on understory plant assemblages. We assessed extant and soil seed bank vegetation assemblages in 180 sites across four geographical regions (Mid-Murray, Lower-Murray, Macquarie Marshes and Narran Lakes) of the Murray-Darling Basin (MDB). We applied a factorial design with four geographical regions, four flood intervals (near annual, 1.5-3 years, 3-5 years and 5-10 years) and three vegetation structural types (non-woody, inland shrublands and inland woodlands).

Preliminary results highlight the uniqueness of individual sites through to geographic regions. Species richness at individual sites (alpha diversity) is often relatively low with greatly increased regional and Basin-scale richness (gamma diversity). Interestingly different geographic regions have relatively distinct species assemblages.

Outcomes from the study will help inform when and where to deliver flows to best support the diversity of floodplain and wetland vegetation assemblages and to prioritise locations for active management.

This research is part of the Murray-Darling Basin Environmental Water Knowledge and Research (MDB EWKR) project funded by the Commonwealth Environmental Water Office.
An introduction to the Environmental Water Knowledge and Research Project

Dr Nikki Thurgate
1La Trobe University, North Albury, Australia

SYMPOSIUM: Murray-Darling Basin Environmental, Water, Knowledge and Research (MDB EWKR), Meeting Room 6, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Nikki has undertaken research using reptiles, amphibians, butterflies and small mammals as model organisms to better understand processes contributing to extinction. All of her research has a strong emphasis on providing scientific outcomes that inform management and policy.

The Murray–Darling Environmental Water Knowledge and Research Project (MDB EWKR) improves the science available to support evolving needs of environmental water managers in the Murray–Darling Basin. This research supports the Basin Plan environmental and adaptive management objectives and reporting needs. Research also supports the collaborative role of the Commonwealth government in environmental watering within the Basin. Research focuses on improved identification, assessment and understanding of the links between ecological responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition medium- and long-term changes in ecological condition, including the effects of threats (hydrological, aquatic and terrestrial) which may reduce or prevent the ecological improvement expected. The project is providing information that includes experimental, field-based and theoretical applications to directly inform water use. This talk sets out the background and rationale for the project and serves to introduce the broader context for the four talks following.

An ecological assessment of Australia’s most common mosquito-borne disease, Ross River virus.

Ms Eloise Stephenson1, Ms Amanda Murphy2, Dr Cassie Jansen3, Dr Alison Peel1, Prof Hamish McCallum1
1Griffith University, Southport, Australia, 2Queensland University of Technology, Brisbane, Australia, 3Queensland Health, Brisbane, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I am an early career Scientist with a particular interest in the interactions between wildlife and people; either through the spread of diseases, human-wildlife conflict or the sustainable harvest of fish and game.

Ross River virus (RRV) is responsible for the most widespread and frequently reported mosquito-borne disease in Australia. The disease is associated with debilitating symptoms in humans and a significant public health burden, particularly in Queensland where the disease rates are high. At present, there is no treatment or vaccine available.

Ross River virus is maintained in the environment through enzootic cycles between mosquitoes and wildlife reservoirs, with subsequent ‘spill-over’ into human populations. More than 30 species of mosquitoes are capable of transmitting RRV, and antibodies to the virus have been found in several vertebrate species including kangaroos, possums, humans, dogs, cats and horses, suggesting a complex reservoir-vector interface. During the past 20 years, increasing numbers of human cases have been observed within metropolitan centres. This may be influenced by urban expansion in proximity to
wildlife and mosquito habitats, though the specific risks are unclear. Studies of RRV ecology are needed to manage public health risks and prevent future outbreaks.

Here we present ecological assessments comparing wildlife composition among Brisbane locations with high or low human RRV notification rates. Taking a novel multidisciplinary approach, we combine data on reservoir abundance with vector surveillance and wildlife serology. We identify differences in vector-host assemblages between locations of high and low human RRV notifications, and find animal diversity levels correlate with human disease rates. Our findings challenge the existing dogma that marsupials are the primary RRV hosts, and highlight the advantages of using ecological approaches to interpret human disease patterns.

**Biting the host that feeds you — context-dependent relationships between symbionts and their hosts**

**Dr Maggie Watson**1, Dr Tommy Leung2  
1Charles Sturt University, Albury, Australia, 2University of New England, Armidale, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**  
Maggie J Watson is a lecturer in ornithology at Charles Sturt University. Her research profile spans the effects of parasites in birds, reptiles and crayfish as well as applied conservation methods.

Symbioses are defined as generally pairwise close and long-term interactions between species that may or may not benefit one or both of the species involved. We systematically review macrosymbiotic relationships that are found between members of the Kingdom Animalia. We show how these symbiotic relationships, often defined as a ‘mutualism’, ‘commensalism’ or ‘parasitism’, limit our understanding of the inherently mercurial movement of species within and between relationship parameters. We therefore discuss the drawbacks of static frameworks that are traditionally used to describe specific symbiotic relationships and suggest that a variable state model be used. In this model, much like the atomic orbital in quantum mechanics, the host acts as the nucleus and the symbiotic organism orbits the host in a set pattern that can fluctuate between different states as dependent on external variables. As such, a particular symbiont may have different effects on a host at certain life-stages, times or places, and vary its diet between host-derived tissue and non-host-derived tissue in a clearly defined manner. In this paper we lay out a framework for understanding symbiotic relationships, whereby, despite the idea that all symbioses are moving (in an evolutionary sense) towards either the mutualistic or parasitoid endpoint, the symbiont makes a choice at any given point in time based on its own personal energetic needs and “prey-switches” as necessary. Classic predator-prey ecological theory is used and similar terms are adopted, adding yet more evidence that rather than discrete states, mutualisms are a moving feast.

**Conserving hosts at the peril of their parasites? Conservation and parasite extinction in the woylie.**

**Dr Stephanie Godfrey**1, Dr Amy Northover2, Assoc. Prof. Adrian Wayne3, Assoc. Prof. Alan Lymbery2, Prof. R. C. Andrew Thompson2  
1University Of Otago, Dunedin, New Zealand, 2Murdoch University, Perth, Australia, 3Department of Biodiversity, Conservation and Attractions, Perth, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM
Co-extinction is becoming more widely recognised as a significant threat that is faced by many ‘dependent’ organisms, including parasites. Parasites may be at even greater extinction risk than other mutualists or symbionts since conservation measures often directly or indirectly result in their removal. The woylie (syn. Brush-tailed bettong, Bettongia penicillata) has undergone significant population declines in south-western Western Australia, and the establishment of predator-free sanctuaries and fauna translocations have been at the forefront of the conservation of this species. We evaluate some of the impacts conservation activities have had on the parasite ecology of the woylie, which is host to at least 36 species of parasites. We discuss these impacts in context of the conservation of the species as a whole, and with respect to the potential role of disease in their decline.

Interactions between land use change, flying-fox ecology and Hendra virus dynamics

Dr Alison Peel1, Assistant Prof Raina Plowright2, Prof Hamish McCallum1, Dr Peggy Eby3
1Griffith University, Nathan, Australia, 2Montana State University, Bozeman, USA, 3University of New South Wales, Sydney, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Dr Peel is a veterinarian and wildlife disease ecologist interested in the dynamics and drivers of viral transmission in bats – particularly African fruit bats and Australian flying foxes. She is an Advance Queensland Postdoctoral Research Fellow at Griffith University.

Typically, flying foxes are nomadic nectar feeders and pollinators of native forests. Natural cyclical transitions from El Niño to La Niña periods impact Eucalypt phenology, causing intermittent acute food shortages for flying foxes and temporary fissioning of flying fox roosts. More recently, these ‘fission’ roosts are persisting outside of acute food shortages, manifesting as an exponential increase in flying fox roosts in urban areas. Immediately pre-dating these recent changes in flying fox ecology, the mid-1990’s saw a peak in destruction of their key habitats and the emergence of four novel zoonotic viruses from flying foxes. One of these, Hendra virus, stands out as an excellent model system for understanding bat virus transmission and spillover globally. Hendra virus spillover to horses tends to be associated with seasonal ‘pulses’ of viral excretion within bat populations, but the interactions between proposed broad-scale and roost-level drivers of Hendra virus transmission are complex and have not been fully elucidated. Our results indicate that landscape-scale processes driving flying fox roost fissioning are linked to processes driving Hendra virus excretion and spillover to horses. By gaining insights into the interactions between environmental change, bat ecology, viral dynamics and spillover, we hope to identify the root causes of viral spillover from wildlife hosts and develop of new ecological interventions to prevent bat virus spillover in Australia and globally.
Effects of habitat fragmentation on wildlife pathogens

**Prof Hamish McCallum**, Dr Christina Faust, Dr Raina Plowright, Dr Nicole Gottdenker, Dr Thomas Gillespie, Ms Laura Bloomfield, Dr Maria Duik-Wasser, Dr Colin Torney, Professor Andrew Dobson

1Griffith University, Nathan, Australia, 2University of Glasgow, Glasgow, Scotland, 3Montana State University, Bozeman, USA, 4University of Georgia, Athens, USA, 5Emory University, Atlanta, USA, 6Stanford University, Stanford, USA, 7Columbia University, New York, USA, 8Princeton University, Princeton, USA

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**
Hamish McCallum works on the ecology of wildlife disease, with current projects on Tasmanian Devil Facial Tumour, Hendra virus in fruit bats and the amphibian chytrid fungus.

Habitat destruction is one of the most pervasive anthropogenic influences on ecological communities. There has been relatively little attention given to the impact of habitat loss on the ecology of parasites and pathogens. Habitat destruction has two principal effects. First, it reduces the size of remaining patches of undisturbed habitat. Second, it increases fragmentation, isolating patches and also exposing the ecological communities in the patches to the influence of organisms that occupy the disturbed “matrix” surrounding the undisturbed patches. We used a range of modelling tools to explore theoretically the influence of each of these effects on parasites and pathogens. We used an allometrically scaled multihost model to show that declining habitat and thus declining biodiversity can lead to either increasing (amplification) or decreasing (dilution) infectious disease risk. Dilution effects were detected for most frequency-dependent pathogens, and amplification effects for most density-dependent pathogens but there were interesting exceptions to these generalisations. We also used a multihost model to investigate the effect of habitat loss on spillover of pathogens between undisturbed and the surrounding human-modified matrix. In most scenarios, the highest spillover risk to species such as humans or livestock occupying disturbed habitat occurred at intermediate levels of habitat loss. A stochastic model showed that, although epidemics are rare at high levels of habitat loss, when they do occur, they can be very severe. This framework provides insights into the mechanisms driving disease emergence and spillover during land conversion and has important implications for conservation and public health policy.

Hosts are landscapes: Linking host and population scale distributions of ticks

Henry Lydecker, Britany Etheridge, Dr Catherine Price, Prof Peter Banks, Dr Dieter Hochuli

1The University Of Sydney, Sydney, Australia; 2Marie Bashir Institute for Infectious Disease and Biosecurity, Sydney, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**
Henry Lydecker is an interdisciplinary researcher who studies the ecology of parasites and infectious disease in the anthropocene, and the ways in which infectious diseases shape and are shaped by the media and society.

Parasites are distributed across populations of hosts, but also on or inside of hosts: together the host population distribution and host landscape distribution comprise a part of the ecological niche of a parasite. For parasites that use multiple species of hosts, understanding parasite distributions on hosts at all scales is essential to understanding their ecological dynamics. In this paper we examine how a generalist parasite, the tick *Ixodes holocyclus*, is distributed at both the host population and host landscape scales in two species of host (Perameles nasuta and Rattus rattus) that co-occur. We
anaesthetized wildlife to systematically examine and locate ticks from five generalized body regions and analysis as niches. Due to significant differences in tick abundance between P. nasuta and R. rattus, we used coefficient of variation to describe aggregation, finding that I. holocyclus is more aggregated in the R. rattus population. At the host landscape scale, I. holocyclus’s utilized niche includes the entire surface of P. nasuta equally, while the niche on R. rattus is focused on the head. Differences in tick aggregation between host species may reflect tick habitat suitability at the host landscape scale, as well as differences in ecological and evolutionary histories.

Natural history of disease is central to investigating wildlife disease dynamics: examples from koala chlamydioidis

Dr. Laura Grogan¹, Dr. Alison Peel¹, Dr. Douglas Kerlin¹, Dr. William Ellis², Dr. J. Guy Castley¹, Prof. Hamish McCallum¹
¹Griffith University, Nathan, Australia, ²The University of Queensland, St Lucia, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
I’m a Griffith University Research Fellow with a background in veterinary science, ecology and epidemiology. I work at the interface of disease ecology/epidemiology and pathogenesis/immunology of infectious diseases of wildlife. My current research focuses on koala chlamydiosis and amphibian chytridiomycosis.

Infectious disease emergence is on the rise globally and poses dramatic sociocultural, political and economic challenges for human public health, domestic animal agriculture and biodiversity. Infectious diseases of wildlife may drive host population dynamics through alterations in fundamental demographic rates such as survival and recruitment, as well as population structure. Indeed, diseases may cause population declines and species extinctions, as empirically demonstrated in multiple instances. However, despite decades of research, the mechanisms underlying both (1) within-host disease dynamics, and (2) among-host infection transmission dynamics, remain poorly characterized for many systems. This contributes to sparse understanding of the relative importance of within-host dynamics for driving individual- and population-level outcomes, and limits our capacity to respond to and mitigate disease impacts. Here, we investigate the value of using the natural history of disease as a central framework for preliminary investigation of wildlife disease dynamics in the ecological setting. In particular, we focus on a case study concerning a poorly characterised aspect of koala chlamydioidis, investigating the impact that differing time courses of disease (chronic and latent/persistent versus acute and self-immunising) can have on our ability to model and mitigate disease in wild populations. Using simple epidemiological models in the koala chlamydioidis context, we demonstrate that such fundamental aspects of the natural history of disease need early elucidation in wildlife disease scenarios as they can have dramatic implications for population-level dynamics, and markedly affect decisions concerning appropriate management approaches.
Hunting for hidden hosts: DNA barcoding to identify paralysis tick hosts from bloodmeal analysis

Ms Tatiana Proboste1, Dr Nicholas Clark1, Dr Hawthorne Beyer2, Assoc. Prof. Jonathan Rhodes3, Prof. Jenny Seddon1
1School of Veterinary Science, The University of Queensland, Australia, Brisbane, Australia, 2School of Biological Science, The University of Queensland, Australia, Brisbane, Australia, 3School of Earth and Environmental Sciences, The University of Queensland, Australia, Brisbane, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Poster 092 - Graduate from The Austral University of Chile as Veterinarian with a master’s degree from the Autonomous University of Barcelona in terrestrial ecology and biodiversity management. Currently, she doing her PhD at the University of Queensland.

As urbanization is increasing, the conservation of many wildlife species requires finding creative ways for wildlife and people to co-exist in the same landscape. In Queensland, tick paralysis (caused by Ixodes holocyclus) is an economically important issue. However, some aspects of this species' ecology are unclear, such as host identities and the role of host communities in determining variation in paralysis tick distributions and abundances over the urban-rural interface. The aim of this study is to determine host species identification gathered from DNA barcodes of tick bloodmeal analysis. Using genetic barcodes we are able to determine the host that ticks collected from the environment were last feeding on. The advantage of this technique is that we avoid the bias associated with animal capture. Results will provide new insights into the role urban and rural wildlife play in the maintenance and dispersal of the ticks and will resolve whether bandicoots, previously described as a principal host of the paralysis tick, play a disproportionately important role in maintaining tick populations in the urban environment.

Introduced rabbits are hosts for immature ticks in urban areas of Sydney

Miss Casey Taylor1, Prof Peter Banks1, A/Proff Dieter Hochuli1
1University Of Sydney, Camperdown, Australia

SYMPOSIUM: Parasite ecology In the Anthropocene, Meeting Rooms 1-2, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Casey Taylor is a PhD candidate from the School of Life and Environmental Sciences at the University of Sydney. She is investigating the ecological drivers of human-tick interactions in urban environments and is interested in tick-host ecology in urban areas.

Understanding the interactions between animal hosts and ticks in human-modified landscapes is crucial for mitigating health impacts to humans. Ticks are vectors of zoonotic pathogens that cause health problems for humans worldwide. The aim of our work was to investigate the role of introduced rabbits, which are extremely abundant in urban areas of Sydney, as native tick hosts.

Wild rabbits culled in December 2017 in urban areas of Sydney were sampled for ticks. Individual rabbits were searched systematically in a 2-hour time frame to gain an accurate estimate of tick load. Ticks were removed, taking note of the site of attachment, life stage (larva, nymph or adult) and identified to species or genus.
251 ticks were removed from the culled rabbits, 95% were Australian Paralysis Ticks (Ixodes holocyclus) and the remaining 5% were from the Haemophysalis genus. The vast majority of ticks collected were larvae. Interestingly, the rabbits were culled in the peak season for adult paralysis ticks, yet very few adults or nymphs were found. Our findings suggest that rabbits might be important hosts for the immature tick life stages in urban areas and may support urban tick populations.

The Australian Paralysis Tick causes thousands of paralysis cases a year in pets, and serious allergic reactions and a ‘lyme-like’ illness in humans in Australia. Understanding the role of introduced animals in tick-ecology in areas where people are frequently encountering ticks and suffering health impacts is central to managing conflicts between wildlife and humans.

A digger’s gotta dig: assessing the impacts of reintroducing Australian digging mammals

Ms Bryony Palmer1, Dr Leonie Valentine1, Prof Richard Hobbs1
1University Of Western Australia, Perth, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Bryony Palmer is an ecologist and PhD student at the University of Western Australia, studying the effects of reintroducing digging mammals. Her previous work included the conservation, management and translocation of threatened mammals.

Reintroductions are likely to impact recipient ecosystems and their elements, but this is not always explicitly addressed in reintroduction planning and monitoring. Ecosystem impacts may be positive (e.g. the restoration of ecosystem services), but negative outcomes are also possible (e.g. competition with other species of concern). Ecosystem engineers, species that change resource availability for other organisms through physical alterations to their environment, are likely to have greater impacts. Many Australian digging mammals, often considered ecosystem engineers, have experienced dramatic declines and are threatened. As a result, these species have been the focus of many reintroduction programs. It has been suggested that reintroducing these species may restore ecosystem processes. However, despite some understanding of their roles, information about the impacts of reintroducing digging mammals on recipient ecosystems is lacking. We reviewed Australian digging mammal reintroductions to determine how often effects on recipient ecosystems were addressed in program planning and goals, whether these were then monitored and what the results were. Over 180 translocations of digging mammals were identified but few (<20%) included explicit consideration of the impact of reintroducing ecosystem engineers into the environment. Less than 2% were carried out for the purposes of restoring ecosystem functions. Regular, long-term monitoring of the impacts of the reintroductions was uncommon, with most monitoring undertaken as short-term research projects. Understanding how reintroductions affect ecosystems will help management agencies set priorities, make decisions on which species to include in reintroduction programs, and may help to explain observed changes to ecosystems and ecosystem elements.
Revisiting the role of Australian mammals in arid-zone vegetation dynamics

Charlotte Mills1, Dr Katherine Tuft2, Dr Mark Ooi1, Associate Prof Mike Letnic1
1UNSW, Kensington, Australia, 2Arid Recovery, Roxby Downs, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Charlotte is in the final throes of her PhD looking at mammal extinction and its role in vegetation change in arid Australia. When not in the field Charlotte enjoys obscure sports and tending to her balcony garden.

Australia’s record rate of extinction has led to many mammals becoming extinct before we even began to understand the role they play in the ecosystem. The arid zone has been particularly hard hit by mammal extinctions and range contractions. Rewilding programs in central Australia are providing opportunities to develop our understanding and test ideas around the functional roles of rare mammals in arid Australia. In this presentation we will discuss several experiments which have allowed us to tease out the nuanced role of native mammals such as bettongs (Bettongia spp.) and hopping mice (Notomys spp.) in arid zone vegetation dynamics.

To determine the influence of rare native mammals on the soil seedbank and above-ground vegetation composition, we established exclosure experiments in arid areas where native mammals have been reintroduced. Using these experiments, we tested hypotheses around native mammals and their role as drivers of vegetation change through seed predation and herbivory.

We have found differences in the soil seedbank inside and outside our exclusion fences, with more exotic species present and fewer seeds from nitrogen-fixing species in areas accessed by mammals. We found corresponding differences in vegetation composition, with fewer nitrogen-fixing species and fewer shrubs in areas where native mammals were abundant.

Overall our data suggest that the loss of voracious mammals from the Australian arid zone has facilitated vegetation change. Continued reintroductions of native mammals will likely restore lost ecological functions including seed predation and herbivory to arid Australia.

Bettongs as Ecosystem Engineers - the Mulligan's Flat Woodland Experiment

Ms Catherine Ross1, Dr Sue McIntyre2, Dr Philip Barton1, Prof Saul Cunningham1, Prof Adrian Manning1
1Australian National University, Acton, Australia, 2CSIRO, Canberra, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Catherine is a PhD student, studying woodland ecology at the ANU Fenner School. Her research focuses on the reintroduction of the eastern bettong at Mulligan’s Flat Woodland Sanctuary, and the role of digging marsupials as ecosystem engineers in grassy woodlands.

The Mulligan’s Flat-Goorooyarroo Woodland Experiment is located near Canberra in south-eastern Australia. This ‘outdoor laboratory’ provides an opportunity to trial a range of restoration techniques to inform the conservation of critically endangered box-gum grassy woodlands, including the reintroduction of several locally extinct species within a predator-proof sanctuary.

Soil-foraging mammals such as bettongs, bandicoots and bilbies are known as ecosystem engineers because they modify habitats and resource availability for other species. The loss of many of these
species is believed to have contributed to the decline of Australian ecosystems, and their reintroduction is seen as a possible tool for restoration. Since the successful reintroduction of eastern bettongs (Bettongia gaimardi) to Mulligans Flat Sanctuary in 2012, their digging behaviour has had a marked effect on ecosystem processes in the reserve. However, after an absence of over a century, the reintroduction of this ecosystem engineer may have unexpected consequences.

I found that bettong digs provided a favourable niche for seed germination, particularly in dense grasslands where diggings create gaps which are vital for many species. Surprisingly, native species benefited more from the presence of diggings than exotic species. However, high rates of herbivory have also been observed for some species of native forbs, particularly the early nancy (Wurmbea dioica). My results indicate that bettongs play an important role as ecosystem engineers in grassy woodlands. Understanding these complex ecological relationships will have implications for management of bettongs within the reserve, as well as future reintroductions.

Effects of digging mammal reintroduction on biodiversity and ecosystem function

Dr Heloise Gibb

1La Trobe University, Melbourne, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Associate Professor Heloise Gibb is a Future Fellow at La Trobe University, Melbourne. Her research interests include community ecology and conservation and she works predominantly on terrestrial invertebrates.

Devastating changes in mammal assemblages resulted from European invasion of Australia, with many medium-sized fossorial species declining significantly or becoming extinct in the wild. Many of these species structured habitats and are thus regarded as ecosystem engineers, but they may also have played important trophic roles. Despite this dramatic change in the structure of Australian ecosystems, little is known about the effects on biodiversity or ecosystem function. Reintroductions provide an ideal venue in which to determine the ecological role of threatened species. We surveyed areas inside and outside five reintroduction sites along a precipitation gradient and conducted a replicated exclusion experiment (n = 10) within a reintroduction sanctuary to test the effect of mammal loss on ecosystems. Mammal reintroduction was associated with changes in soils, vegetation and invertebrate biodiversity. It was also associated with complex climate-dependent changes in decomposition and decreased invertebrate decomposition while increasing microbial decomposition. Further, results from mensurative and experimental approaches did not always agree. Our results suggest that the ecological extinction of many mammal species from Australia is likely to have substantially altered biodiversity and function in Australian ecosystems. Reintroductions of digging mammals may reinstate these measures, but we lack baselines that would allow us to determine whether we are restoring or creating novel ecosystems.
Modelling and decision making in complex ecosystems

Dr. Christopher Baker¹
¹The University Of Queensland, Brisbane, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Christopher Baker is a research fellow at the School of Biological Sciences at The University of Queensland. He uses models of species dynamics to inform conservation decision making.

Improving the management of complex ecosystems is a great challenge for conservation managers. This is one where ecological modellers have an important role to play, particularly when it comes to species introductions or eradications. The large number of interactions in these systems makes them hard to model, but the real challenge is due to the uncertainty. This raises a real issue for modellers: how can a model be constructed that accounts for large uncertainty, whilst still providing answers that are actually useful? In this presentation I will discuss some of the modelling issues around complex ecosystems and some important nuances to dealing with uncertainty. I will present recent work, combining data sources to get better-fitting models and model validation, and discuss how we can use these models to inform decision making, despite large uncertainty.

Digging down memory lane: Can digging mammals restore pre-European soil bacteria communities and functions?

Orsi Decker¹, Assoc.Prof. Heloise Gibb¹
¹La Trobe University, Melbourne, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Orsi Decker is interested in species functions and how these functions might change across environmental gradients. She started her PhD course in 2015 and she is studying the impacts of digging mammals extinctions on soil ecology.

Biodiversity loss can affect ecosystems in various ways given the complex interactions between species and their habitats. The extinction of specific species might not have the same consequences along environmental gradients, therefore it is challenging to identify the uniform consequences of biodiversity loss. Australia has lost six digging mammals, with many more now range-restricted. These digging mammals contribute to important soil functions via their foraging activity, such as nutrient cycling and microflora distribution. Several studies showed the beneficial microsite effects of foraging pits on soil processes, but to date we do not know to what extent digging mammal impact varies along an environmental gradient on a landscape-scale. To fill this gap, we measured plant litter material decomposition and soil bacterial community composition and function with and without digging mammals along an annual rainfall gradient between 150 and 900 mm. The response of the measured variables was largely context dependent with the highest magnitudes of the digging mammal effect in dry areas. Digging mammals increased soil microbial functions significantly, but only had an impact on the early stages of plant litter decomposition (first 4 months) driven by short-term rainfall.

Our results show that the effect of ecosystem engineers on soil processes differs across a large environmental gradient. Therefore, a predictive understanding of species functions is necessary to identify achievable restoration goals.
The Nailtail Nursery: A novel conservation strategy for endangered wallabies

Ms Alexandra Ross1, Dr Jasmin Lawes1, Ass. Prof. Mike Letnic1
1Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, Kensington, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 095 - I work with Australian natives that are at risk of extinction due to predation. I am particularly interested in finding unique strategies to allow our naive species to coexist with feral predators.

The bridled nailtail wallaby (Onychogalea fraenata) is currently found as only one remnant and one introduced population, with a combined total of less than 500 individuals in the wild. A major source of population decline is predation from invasive cats. Juvenile bridled nailtail wallabies are highly susceptible to predation, with a survival rate of only 47%, mostly as a result of feral cat predation. To protect vulnerable juveniles from predators a ‘Nailtail Nursery’ was built at Avocet Nature Refuge. Wild juveniles were captured and placed in the nursery and released back into the wild at 3kg. Nursery raised wallabies were found to have reduced flight initiation distances than wild raised wallabies, but differences disappeared within 1 month after release into the wild, with no differences in survival following release between wild and nursery raised wallabies. This represents the first trial of the nursery as a conservation strategy.

The foraging ecology of an introduced ecosystem engineer on two islands

Ms Ella Loeffler1, Dr Duncan Sutherland2, Dr Nicholas Porch1, Dr Amy Coetsee3, A/ Prof Euan Ritchie1
1School of Life and Environmental Sciences, Deakin University, Melbourne Burwood Campus, Burwood, Australia,
2Phillip Island Nature Parks, PO Box 97, Cowes, Australia,
3Zoos Victoria, Wildlife Conservation and Science, PO Box 74, Parkville, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Poster 094 - Ella Loeffler completed her honours at Deakin University in 2018 and holds a Bachelor of Science (Zoology) and Arts (Literature) from Monash University. She is passionate about wildlife conservation, with a particular interest in threatened species management.

Australia is home to a highly endemic mammal fauna that has suffered the highest rate of recent mammal extinctions in the world. Many of these have been digging mammals, or ecosystem engineers, that play an important role in bioturbation, soil fertility and vegetation growth. Their loss from ecosystems can have negative consequences but translocations of such species can be used as a conservation tool to restore ecosystem function.

We investigated the foraging ecology of two introduced populations of mainland eastern barred bandicoots (Perameles gunnii) on Churchill and Phillip Islands, Victoria. This subspecies has suffered dramatic decreases in distribution and abundance due to introduced predators and habitat loss. It is currently classified as “extinct in the wild”. We collected 400 scats from known individuals from the two populations (between August 2015 and May 2018), including multiple samples through time for some individuals. This provided a unique opportunity to examine both intra- and inter-individual variation in diet across site, season, sex and habitat type. We examined identifiable invertebrate structures in order to determine variation in diet at a population and individual level. Preliminary results show scats contain high frequencies of beetles (65.8%), spiders (55.6%), earthworms (50.9%) and lepidoptera larvae.
(50.7%), as well as fungi and onion weed bulbs. Notably, crabs were found in several scats (8.4%). Further results of this study will be presented and the implications for the management of this critically endangered species discussed.

**The perils of paradise: An endangered species conserved on an island loses antipredator behaviours within 13 generations**

**Mr Chris Jolly**\(^1\), Associate Professor Jonathan Webb\(^2\), Associate Professor Ben Phillips\(^1\)

\(^1\)University Of Melbourne, Parkville, Australia, \(^2\)Flora and Fauna Division, Department of Land Resource Management, NT Government, Berrimah, 0828, \(^3\)University of Technology Sydney, Ultimo, 2007

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Chris is a University of Melbourne PhD Candidate based in Darwin, NT. He spends most of his free time looking for little brown skinks, but occasionally finds time to pursue his passion and interest of behavioural ecology and evolutionary biology.

The most obvious means of conserving a threatened species is to isolate the species from the threatening process. When imperilled by a threatening process, the choice is often made to conserve threatened species on isolated, offshore islands that typically lack the full suite of predators present on the mainland. Such action, whilst keeping the species extant, releases the conserved population from predator-driven natural selection. As a consequence, antipredator traits are no longer actively maintained by natural selection and may be lost. It is implicitly assumed that such trait loss will happen slowly, but there are few empirical tests. In Australia, northern quolls (Dasyurus hallucatus) were moved onto a predator-free offshore island in 2003 to protect the species from the arrival of invasive cane toads on the mainland. We compared the antipredator behaviours of wild-caught quolls from the predator-rich mainland to those on this predator-free island. We compared the responses of both wild-caught animals and their captive-born offspring, to olfactory cues of two of their major predators (dingoes and feral cats). Wild-caught quolls from the mainland recognised and avoided predator scents, as did their captive-born offspring. By contrast, island quolls, isolated from these predators for only 13 generations, showed no recognition or aversion to these predators. This study suggests that antipredator behaviours can be lost very rapidly, and that this rapid loss may make a population unsuitable for reintroduction to a predator-rich mainland.

**The Superb Lyrebird: Farmer, Firefighter or Ecosystem Engineer?**

**Mr Alex Maisey**\(^1,2\), Prof Andrew Bennett\(^1,2,3\), Dr Steve Leonard\(^1,2\)

\(^1\)Landscape and Conservation Ecology Group, Department of Ecology, Environment and Evolution, La Trobe University, Bundoora, Australia, \(^2\)Research Centre for Future Landscapes, La Trobe University, Bundoora, Australia, \(^3\)Arthur Rylah Institute for Environmental Research, Heidelberg, Australia

SYMPOSIUM: Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Alex Maisey’s PhD project aims to determine the ecosystem engineering role of the Superb Lyrebird. By studying this charismatic species, he aspires to uncover understanding applicable to forest management where avian engineers play important roles in ecosystem function.

Ecosystem engineers are species that physically modify, create or destroy habitats. Such disturbance often results in change to species diversity and composition through regulation of resources such as water, nutrient flows or shelter. The superb lyrebird (Menura novaehollandiae) is considered to be an ecosystem engineer due to the high volume of soil displaced when foraging. This activity changes habitat structure in the litter and soil horizon, potentially exerting large and important forces on the distribution and quality of resources available for microbial, macroinvertebrate and floristic...
communities. As such, the presence and level of activity of the superb lyrebird in a forest is likely important to forest health and function. Despite this, little is known of the influence of lyrebirds, and indeed birds in general, on edaphic processes, and the biotic response to engineering has to date been entirely over-looked. We investigated the role of lyrebirds as ecosystem engineers in the southern fall of Victoria’s central highlands. An experimental approach, using fenced exclusion plots with paired controls, was utilized to assess the impact of lyrebirds on nutrient cycling, soil structure and seedling growth and survival. A sound understanding of the impacts of ground-foraging, avian ecosystem engineers is essential for effective conservation management of forest ecosystems.

**One-way gates: the influence of feeding on burrowing bettong persistence outside a fenced reserve**

*Jessie Moyses*¹, Prof Brendan Wintle¹, Dr Bronwyn Hradsky¹, Dr Katherine Moseby²,³, Dr Katherine Tuft²  
¹University Of Melbourne, Parkville, Australia, ²Arid Recovery, Roxby Downs, Australia, ³University of New South Wales, Sydney, Australia

**SYMPOSIUM:** Reintroduction for restoration, Hall B, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Jessie Moyses is a final-year Masters student in the Quantitative and Applied Ecology group at The University of Melbourne. She is interested in conservation management for threatened species and strategies to improve reintroduction success.

Thirty-two Australian mammal species susceptible to introduced predators have been reintroduced to predator-free spaces across Australia. Fenced reserves are currently crucial to the conservation of these “Critical-Weight Range” (CRW) mammals, but they also come with problems including high building and maintenance costs, impacts on dispersal, and size limitations. The question of whether sustainable CRW mammal populations can be established outside fenced reserves relies on knowing how individual species can tolerate predator pressure in an open landscape. Our project seeks to answer part of this question. Bettong-specific one-way gates - are currently used to minimise grazing pressure of burrowing bettongs (Bettongia lesueur) at Arid Recovery reserve in South Australia and to develop techniques for establishing animals allowed to disperse out of fenced reserves. We explored the conditions affecting persistence of bettongs that have left the reserve via one-way gates. We monitored activity of bettongs and predators outside the fence over two field seasons using track surveys, and experimentally tested the effect of supplemental feeding as a soft-release strategy. We used linear mixed models to characterise the relationship between residence time and a range of factors including supplementary feeding and vegetation cover. Bettong activity declined over time, but persistence was positively associated with supplemental feeding and shelter. Predators were more frequently detected at supplemental feeding sites when bettong track counts were high, indicating a potential issue with supplemental feeding attracting predator activity. Further research on conditions to support the persistence of CRW mammals beyond fenced reserves is required for their long-term conservation.
Dormancy as a potential determinant of threat

Mr Justin Collette, Dr Mark Ooi
Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, UNSW Australia, Kensington, Australia

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Justin is a PhD candidate from the Centre for Ecosystem Science at UNSW. He is mid way through his PhD which is focused on seed dormancy in fire-prone, temperate systems of Australia.

Numerous explanations have been put-forth attempting to understand causes of rarity in plants, however seed dormancy is often not one of them. In cases where dormancy is included, it is usually only as a binary variable; dormant or non-dormant. We suggest that dormancy type should be included as a potential determinant of threat, as different dormancy types are functionally very dissimilar. For example, in fire-prone systems, species with physical dormancy (PY) have their dormancy broken by heat shock, and germination can occur immediately post-fire provided there is adequate rainfall. However, for species with physiological dormancy (PD), dormancy is broken by seasonal temperature regimes, and germination won’t occur until these temperatures are met, regardless of moisture availability. We collected dormancy data for 4686 shrub species from 476 genera from four different regions across temperate fire-prone Australia. Two of the regions experience winter rainfall and two have aseasonal rainfall. We compared the distribution of dormancy types between regions for both threatened and common species. We found a strong interaction between threat status and rainfall climate-type, indicating that PD species were more likely to be threatened in aseasonal rainfall climate regions. This may be due to delayed post-fire emergence of PD species, meaning they would emerge to face more competition relative to species with other dormancy types. We propose that dormancy type should be considered when assigning species to different functional groups.

The germination niche versus the geographical niche of alpine shrubs

Dr Susanna Venn, Dr Rachael Gallagher, Prof Adrienne Nicotra
Deakin University, Macquarie University, Australian National University

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Susanna Venn is a plant ecologist with a strong interest in the abiotic drivers and challenges that face alpine plants and communities.

Worldwide, shrub cover is increasing across alpine tundra. In Australia, alpine shrub increases match a trend spanning four decades of rising temperatures and declining snowpack. Alpine shrubs are notoriously clonal, however sexual recruitment will be necessary for dispersal and for ongoing population maintenance into the future. With a changing climate, species recruitment may need to operate outside of the optimum range. The germination niche of a species is defined as the entire range at which germination can occur, including optimums, but also the extreme edges of germination; from very poor germination rates at very low and very high temperatures, to higher germination rates at favourable temperatures. Hence, the germination niche of some species will be important for understanding future regeneration and recruitment under a warming climate. But do germination niche limits coincide with species range limits? And how will the germination opportunities for some shrubs change in the future as the germination niche ‘envelope’ becomes smaller or larger? We compared data on the germination niche requirements of several alpine shrubs to climatic niche limits derived from herbarium records. Specifically, we compared the breadth of temperatures (both averages and
extremes) experienced across 11 alpine species ranges derived from cleaned occurrence records in the Australian Virtual Herbarium. We then compared the range of extent of the target species with the temperatures that allowed for germination in the lab. This study will enable us to make better predictions about the potential for encroachment and the possible range of alpine shrubs into the future.

The influence of awn morphology on native grass diaspore dispersal and burial

**Annette Cavanagh**, Dr Robert Godfree, Dr John Morgan

1La Trobe University, Bundoora, Australia, 2CSIRO, Black Mountain, Australia

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
I am a plant ecologist who conducted this research while doing my Honours at La Trobe University

Awns are characteristic of many Australian native grasses and occur in a range of morphologies. Awns have been found to enhance dispersal and burial of grass diaspores but little is known about the influence of different awn morphologies on this movement. This study aimed to construct an awn typology on the diversity of awn morphologies in the native grass species of Australia and investigate the influence of awn morphology on diaspore surface dispersal and burial. Twenty awn types were identified across all Australian native grasses. The presence of an awn significantly facilitated surface movement and burial of diaspores; however, species and awn types varied in their levels of efficiency between dispersal and burial. Geniculated awns were the most efficient at surface movement. Burial efficiency, however, was dependent on the microsite, with three-awned species being most efficient at burying beneath an obstruction and falcate-awned species being most efficient at burial when an obstruction was not present. This study indicates that awn morphologies play different functional roles in the success of Australian grass progeny. An increased understanding of the ecological role of awns in seed dispersal will enable awn morphology to be used as a plant functional trait to predict grass species fitness in different environments and improve species distribution models.

The influence of fire on seedling emergence in long-undisturbed peat bog wetlands

**Mr James Trezise**, Associate Professor David Paton, Dr Jose Facelli, Dr Richard Davies

1The University Of Adelaide, Adelaide, Australia, 2Department for Environment and Water, Adelaide, Australia

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
I'm James Trezise, a PhD student at the University of Adelaide studying fire ecology. I research the interplay between fire, seed banks and succession. My current focus is on threatened flora's dormancy mechanisms and restoring long-undisturbed wetlands with ecological burns.

In Fleurieu Peninsula wetlands, threatened plant species are becoming senescent and cannot recruit due to a lack of fire. Without disturbance, species inhabiting late-succession niches have become monodominant. Furthermore, seed of many fire-adapted species requires dormancy cues to germinate in sustainable quantities. Local extinctions have occurred and will be permanent if the time between fires is greater than the expiration date of a species’ seed bank. We conducted a seedling emergence experiment to determine effectiveness of ecological burns to restore biodiversity. Ninety-four soil samples were taken across several wetlands and a smoke plus heat treatment was used on half of each
sample. Seedling counts were assessed for all species in relation to the fire treatment. A total of 88 species germinated, consisting of 8381 native and 2862 exotic seedlings. The treatment resulted in a 2.8-fold increase in germination of the Critically Endangered Fleurieu Peninsula endemic, Hibbertia tenuis. Several native species responded positively to the fire treatment, and no exotic species showed a significant response to the treatment. Some species germinated in samples from wetlands where those species did not occur, indicating that dormant seed banks allow species to persist without standing vegetation. In response to these findings, two of the wetland sites were subjected to ecological burns. Pre- and post-fire surveys indicate positive ecological outcomes; the population size of Hibbertia tenuis had a tenfold increase and overall plant diversity doubled. Ecological burns can thus be used as a management tool to promote germination of Hibbertia tenuis and other wetland species.

Seedling recruitment success linked to season of fire in a Mediterranean-climate woodland

Mr Russell Miller1,2, Prof Neal Enright1, Dr Joe Fontaine1, Dr Ben Miller2, Dr David Merritt2
1Murdoch University, Perth, Australia, 2Department of Biodiversity, Conservation and Attractions, Perth, Australia

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Russell is a PhD candidate studying the impacts of varying fire regimes on plant population demographics in Banksia woodland, a biodiverse Mediterranean-climate vegetation type on southwestern Australia’s Swan Coastal Plain.

Postfire seedling recruitment is vital for the persistence of many plant species in fire-prone ecosystems. The season of fire is known to have an impact on recruitment success in Mediterranean-climate ecosystems with research showing that recruitment is best after dry-season fires. Altered fire seasonality due to changing climate conditions and human activities is, therefore, a cause for concern for species persistence. In the research presented here, I quantified the impact of planting seeds at monthly intervals during autumn-spring on seedling emergence and survival as well as seed survival over summer for those failing to germinate in the first winter-spring. For the Banksia woodland species studied, recruitment was best from autumn-mid winter plantings (May-July). Seeds that were planted in late winter-spring (August-October) failed to emerge in the same year and many died over the ensuing summer, leaving few propagules to emerge the next year. I also discovered that seedlings emerging later in winter showed lower survival over the first summer, presumably because they had a shorter establishment period. This research suggests a negative impact of fire in late winter-spring with seeds either germinating but quickly dying or having to survive over summer to the following winter. Therefore, burning in winter-spring in strongly seasonal environments may present tradeoffs in the persistence of obligate seeders and resprouters. Information on fire patchiness and intensity according to season could help identify pathways of persistence for obligate seeders under certain burning regimes. Integrating ecological knowledge into fire management can assist in avoiding unwanted impacts on biodiversity.
Seed traits shape seed survival of fire of varying intensity and season

Mr Ryan Tangney¹
¹Kings Park Science, Perth, Australia, ²Curtin University, Bentley, Australia

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Ryan Tangney, a PhD student at Curtin University and Kings Park Science, in the final months of his PhD examining how seed traits drive seed survival in fire. Interested in seed trait plasticity, trait evolution, fire ecology and invasion ecology.

Fires are increasing in severity and frequency around the globe. Prescribed burning, or hazard reduction burning, is a common practice to reduce the risk of high-severity fires that put people and infrastructure at risk. Appropriate fire management also considers biodiversity conservation while ensuring public safety. Within fire-prone systems, seed banks are critical for many plant species’ regeneration, and seeds are typically adapted to survive and regenerate in response to cues associated with natural fire regimes. But how do seeds respond to altered fire regimes? Here we present a multifaceted approach to understanding seed survival during fire in different seasons. We consider seed survival of high temperatures in the context of seed moisture content, soil temperature, and seed depth in the soil profile. Through the identification of key seed traits associated with seed survival and seedling emergence depth, and examination of the interactions between seed traits, fuel dynamics and soil temperatures, we model how seeds will survive and seedlings emerge with a set of varying fuel bed loadings. Seed moisture content is the primary driver of lethal temperatures thresholds in seeds, and seed embryo type is a second influential trait. Larger seeds are able to emerge from deeper within the soil profile, but lower lethal temperature thresholds in larger seeds from some species will likely hinder emergence under heavier fuel loads.

Residual seed banks, and soil seed bank longevity in a fire-prone shrubland in SW WA

Dr Ben Miller¹, Dr David Merritt¹, Prof Kingsley Dixon², Prof Peter Poschlod³
¹Kings Park Science, Department Of Biodiversity Conservation And Attractions, Kings Park, Australia, ²Curtin University, Bentley, ³University of Regensburg, Regensburg, Germany

SYMPOSIUM: Seed ecology in a changing world (1), Meeting Rooms 4-5, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Ben has recently moved from Kings Park, where he was Director of Science, to establish a Fire Science Program within the WA Department of Biodiversity Conservation and Attractions’ Biodiversity and Conservation Science service.

Soil seedbanks are a key component of the life cycle of many Australian plant species. They enable a range of important ecological strategies supporting persistence and resilience of populations, and buffering against short term selective pressures, and disturbance-cued recruitment strategies. They are also hard to study. If all seeds in a species’ seedbank committed to germination after a single disturbance, then the entire population is exposed to significant risk if an event such as drought, herbivory or a second disturbance were to occur before seedlings establish and plants become mature. A residual seedbank strategy requires a proportion of the seedbank to respond to germination cues, with the remainder remaining dormant but alive, and able to be cued by a subsequent event. In this study, we prevented seed inputs into an array of intact soils for several years and used cold smoke application to stimulate germination in replicated plots one to six years after inputs ceased, to assess seedbank persistence. We also annually smoked a subset of plots to assess the residual seedbank. The
study occurred in species rich Mediterranean kwongan shrubland north of Perth in Western Australia. Community-level seedbank survival was high for three years but dropped rapidly thereafter. About 25% of germinable seeds did not respond to smoke stimulation in the first treatment, but did in subsequent events, although most did not respond immediately, only germinating after several years of treatment.

**Legume granivores and their responses to climate disruption**

**Mr Desi Quintans**, Dr Paul Rymer, Prof James Cook, Dr Tony Auld

*Hawkesbury Institute For The Environment, Richmond, Australia, Office of Environment and Heritage, Hurstville, Australia*

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

Desi Quintans is a PhD candidate with the Hawkesbury Institute for the Environment, WSU. He studies how insects interact with legumes to predict how granivory and herbivory will shift in response to climate disruption.

Legumes (family Fabaceae) are key nitrogen-fixing plants and post-fire pioneers. Their seeds are eaten by the larvae of some beetles, and those larvae are in turn eaten by the larvae of parasitoid wasps. Within Australia, the beetles that are involved in this tri-trophic food web are more host-specific than legume-feeding beetles that have been observed in other parts of the world.

I am creating a big picture of the food web that exists between native Australian legumes, seed-eating beetles, seed-eating wasps, and carnivorous parasitoid wasps. To do this, I established an altitudinal gradient study in the Blue Mountains, NSW. An altitudinal gradient features rapid changes in temperature and rainfall within a compact area, without the confounding effects of population structure and landscape changes over a larger area. I am able to use the temperature difference between the foot of the mountain and its summit to look backwards in time at what the assemblage, fecundity, predation, and genetic diversity of plants and insects must have been like, and relate it to the state of the system today.

I am particularly interested in how climate disruption is pushing species out of their climatic niches or changing the timing of plant fruiting and insect maturation. These 'mismatches' may force insects to diversify their diet and reproductive cycle to new and unexpected host plants. An understanding of what could push host-specific granivores to jump to new plants is invaluable in the context of food security in a changing world.

**The role of ants in novel community assembly**

**Maia Raymundo**, Dr. John Dwyer, Prof. Margie Mayfield

*University Of Queensland, St. Lucia, Australia*

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

**Biography:**

Maia Raymundo is a PhD student at the University of Queensland studying dispersal ecology in novel systems.

Much of ecology has been concerned with understanding the patterns of diversity, species interactions, and the mechanisms underlying species coexistence. In novel ecosystems, for example, understanding the seemingly stable coexistence of native and exotic species has gained importance in light of rapid environmental change. There is increasing evidence to suggest that facilitation, specifically ant-plant
dispersal mutualisms, affects plant community structure by influencing seed recruitment, competition, local diversity, and possibly coexistence. However, it could be argued that these mutualisms may also be facilitating the invasion of exotic plants into native communities by disturbing soils and/or dispersing exotic seeds. To address this, a two-year study was conducted in the herbaceous understory of York gum-jam woodlands in the WA wheatbelt. Field surveys were conducted during the 2016 and 2017 spring growing seasons in three remnant reserves. Above ground ant nests and adjacent, undisturbed plots were then opportunistically surveyed and mapped within these areas. Species composition, proportional abundance of vegetation, and soil were recorded. Preliminary data analyses showed species richness and abundance of vegetation growing on ant nests were higher compared to undisturbed plots. Additionally, plant communities on ant nests had a higher proportion of exotic species suggesting that ants may be playing a role in facilitating the introduction of exotic plant species into the reserve. Understanding the processes by which species diversity is maintained and identifying the subsequent changes in ecological interactions involved in the formation of novel communities is crucial, as these communities may be an inevitable consequence of global environmental change.

Germinating in a warmer world: Tropical plant species are at greater risk from climate change

Mr Alexander Sentinella1, Prof David Warton1,2, Prof William Sherwin1, Dr Cathy Offord3, Prof Angela Moles1
1Ecology & Evolution Research Centre, UNSW Sydney, Sydney, Australia, 2School of Mathematics and Statistics, UNSW Sydney, Sydney, Australia, 3Australian Botanic Garden, Mount Annan, Australia

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Alex is a PhD student interested in the links between genetics and ecology, especially in how we can use both to understand the effect of climate change. Alex is also passionate about science communication, co-hosting the radio program "Boiling Point".

Since Janzen’s 1967 paper “Why mountain passes are higher in the tropics”, tropical species have been hypothesised to withstand a narrower breadth of temperatures than species at higher latitudes. While this is true for animals, this assumption has yet to be tested for plants. We used 7721 records for 866 species from the Kew Gardens’ global germination database to quantify global patterns in germination temperature. Surprisingly, we found no evidence for a latitudinal trend in the range of temperatures across which plant species can germinate. However, tropical plants are predicted to face the greatest risk from climate change, because they are closer to their upper thermal limits. By 2070, over half (84/149) of tropical plant species are predicted to exceed their optimum germination temperatures with some even exceeding their maximum (35/190). Conversely, 97% of species at higher latitudes (above 45°) are predicted to benefit from warming, with temperatures shifting closer to the species’ optimal germination temperatures. Thus, the prediction that tropical species would be most at risk under future climate change was supported by our data, but through a different mechanism to that generally assumed.
Evidence for direct effects of fire-cues on germination of some forbs common in grassy ecosystems

Mr Joshua Hodges1,2, Dr Jodi Price1, Dr Dale Nimmo1, Dr Lydia Guja2,3
1Institute For Land, Water And Society, Thargoona, Australia, 2National Seed Bank, Canberra, Australia, 3Centre for Australian National Biodiversity Research, Canberra, Australia

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Joshua is a PhD student at Charles Sturt University, Albury. Joshua’s research interests are in fire and disturbance ecology of grassy ecosystems.

In grassy ecosystems fire maintains diversity of forbs. It is commonly thought that fire promotes regeneration by removing biomass, reducing competition for light and providing gaps for recruitment rather than directly stimulating germination. However, physiological dormancy is common, and few studies have explored direct responses to fire-cues among dormant or hard-to-germinate grassy ecosystem forbs. Studies from other fire-prone systems suggest that fire-cues may not alleviate physiological directly, but instead promotes germination in combination with dormancy alleviating treatments. We aimed to experimentally test the prevailing hypothesis that forbs common in grassy ecosystems do not germinate in direct response to fire. Responses to fire-cues both inherently and in combination with treatments which alleviate dormancy were investigated. Two fire-cues (smoke and heat) plus a treatment of both smoke + heat was applied to fresh seed and seed that had undergone three treatments commonly used to alleviate dormancy (warm stratification, cold stratification and dry-after-ripening). Two species—Arthropodium strictum and Dianella revoluta—responded to fire-cues inherently. High germination was only seen in Dianella revoluta when fire-cues were combined with warm stratification. Fire-cues had no effect on germination of Brunonia australis, Burchardia umbellata and Eryngium ovinum. Our finding that fire-cues did not promote germination for three of the five study species was consistent with the current hypothesis that germination of perennial forbs is not promoted by fire-cues. This study also provides evidence that fire-cues play an important role in directly promoting germination of some forbs inherently and/or in combination with treatments used to alleviate physiological dormancy.

Seed ecology in a changing world

Dr Mark Ooi1
1University of New South Wales, Sydney, Australia

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Mark is a Senior Research Fellow at UNSW, Sydney. His research encompasses plant (particularly seed) ecology, fire and global change biology. This work is often applied to understanding key ecological issues, including maintaining biodiversity and the impacts of climate change.

Developing a sound knowledge base of the ecological functions of key life-history traits within the regeneration niche is a major challenge. Life-history surrounding seeds, in particular, are critical for the persistence of plant populations, and the key processes of dormancy and germination are arguably some of the most complex, yet least understood, attributes in Australian plants. Additionally, despite the key role seeds play across all stages of the plant life-cycle, few seed traits are included in functional trait analyses. Predicting the impacts on our natural vegetation from the rapid changes forecast across the globe, and understanding the best way to manage for the conservation of native systems is dependent on moving the discipline of seed ecology forward as we enter the Anthropocene.
The restoration capacity of soil seed banks in abandon cropping fields of semi-arid landscapes.

Ms Peta Zivec¹, Dr Stephen Balcombe¹, Dr Samantha Capon¹
¹Griffith University, Brisbane, Australia

SYMPOSIUM: Seed ecology in a changing world (2), Meeting Rooms 4-5, November 28, 2018, 4:00 PM - 6:00 PM

Biography:
Peta Zivec is a PhD Candidate at the Australian Rivers Institute, Griffith University. She started her PhD in October 2017 researching the regrowth and restoration of floodplain, riparian and wetland vegetation in cotton growing regions of QLD and NSW.

As the climate changes and water availability becomes more constrained, the abandonment of croplands in semi-arid regions of Australia is likely to become more prevalent. The capacity of soil seed banks to restore abandon cropping lands is important for understanding what the appropriate management strategies are to regenerate these areas. This research takes soil seed bank samples from abandon cropping fields of different time since abandonment (i.e. 1 year, 5 years and 8 years) from semi-arid agricultural areas of Queensland and New South Wales, Australia. Field surveys found that despite 8 years after abandon there was still no majors signs of recruitment or regeneration. The seed bank samples were then grown in a glass house, to understand the regeneration capacity and what may be causing the lack of recruitment. The experiment provided insight if the abandoned cropping areas requires seed input, abiotic structural habitat or appropriate watering requirement to start the regeneration process. The results of this experiment provides explanations regarding the lack of regeneration observed in these areas and what the appropriate management steps are.

Landsat observations of large-scale land degradation with Google Earth Engine

Dr Zunyi Xie¹, Prof Stuart Phinn¹, Dr Peter Scarth¹, Dr Edward Game², Prof David Pannell³, Prof Richard Hobbs³, M.Sc. Peter Briggs⁴, Prof Eve McDonald-Madden¹
¹The University of Queensland, Brisbane, Australia, ²The Nature Conservancy, Brisbane, Australia, ³The University of Western Australia, Perth, Australia, ⁴CSIRO Oceans and Atmosphere, Canberra, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
I am a remote sensing researcher of terrestrial ecohydrological systems. My work focuses on hydrological dynamics, ecological functions and their interactions under climate change impacts, with application of remote sensing, GIS, and spatial statistics across various spatial and temporal scales.

Land degradation on the top of already limited land resources has exerted dramatic impacts on agriculture and natural assets. Despite these significant consequences, government strategies and scientific research to solve this issue have been largely hindered by missing and often unreliable information on the location, extent and condition of these degraded lands. In this study, we mapped land degradation at pixel level (30m) across the entire Queensland state of Australia with Google Earth Engine (GEE), using three decades of Landsat satellite observations along with datasets for validation and following case studies. We developed the mapping model with an ensemble methods such as extracting dynamic reference cover to remove the rainfall effect and calculating drought index to determine the successive dry periods when the 'true' land conditions are best uncovered. Here we focused on investigating the potential of the GEE platform for solving 'big data' issue required with large-scale applications of land change. Accuracy assessment yielded an overall classification accuracy of...
84.6% (Kappa = 0.69) with 78.8% and 80.0% producer’s and user’s accuracy for degraded land, respectively. Results showed around 20% of Queensland areas were observed in unhealthy land conditions, covering a considerable area of \( \sim 3.7 \times 10^5 \) km². These degraded lands exhibited much reduced resilience to droughts with clumping landscape characteristics. Moreover, we found land degradation increases dramatically when the land use has more human impact. The methods developed herein can be further developed for Australian continental and global applications to aid nations reach the global sustainable development goals.

Monitoring rehabilitation and recovery of damaged Sphagnum peatlands with a UAS (aka drone)

Dr Turner Perpetua¹², Dr Darren Turner², David Bowman
¹Forest Practices Authority, Hobart, Australia, ²University of Tasmania, Hobart, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Perpetua Turner is an ecologist and bryologist with expertise in forested to subantarctic and alpine ecosystems. She also is Chair of EMR. Darren Turner is a remote sensing scientist, who specialises in UAS technology. @PerpetuaTurner @dazz_turner @EMRjournal

The sub-alpine and alpine Sphagnum peatlands in Australia are geographically constrained to poorly drained areas. Sphagnum is an important contributor to the resilience of peatlands, but a sensitivity to disturbance contributes to slow recovery after disturbance. This recovery is largely dependent on anaerobic conditions with the level of the water table being sufficiently high. Damage to peatlands, e.g. by fire or trampling by feral animals, modifies drainage, lowers the water table and reduces the rate of peat accumulation. The ability to create high resolution Digital Surface Models (DSMs) of the Sphagnum peatlands allows the surface hydrology of the peatlands to be modelled to determine where flow channels exist and where water is likely to accumulate. Australia’s peatlands are fragmented and small in area (individually) making them ideal for mapping by capturing ultra-high spatial resolution (1cm/pixel) imagery from an Unmanned Aerial Systems (UAS). Highly overlapping UAS based imagery can be used to create high resolution DSMs, from which hydrological models can be derived. These models can be used to monitor hydrological changes and assist with restoration. The ultra-high spatial resolution imagery can also be used to identify areas of healthy and/or damaged Sphagnum, allowing rates of recovery to be monitored over time. In this talk we present the results of a pilot study that demonstrate that hydrological modelling of wild fire damaged Sphagnum peatlands in Tasmania is possible and practical. The potential to apply this methodology elsewhere, e.g. mainland alpine peatlands that are being damaged by feral horses, is also proposed.
Drivers of introduced grass species distributions in Australia

Mr. Kyle Hemming1
1University Of Canberra, Bruce, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
I am a PhD student at the Institute for Applied Ecology, Canberra. My research interests are plant ecology, particularly invasive species dynamics.

Determining the drivers of species distributions is central for predicting the spread potential of introduced species. At a continental scale, patterns in native species richness are often correlated with climatic gradients but this may not be the case for introduced species, where distributions may reflect human drivers associated with the location and purpose of introduction, and incomplete dispersal through otherwise suitable climatic space.

Here, we employ a novel approach to deal with this challenge. We assume that native Australian grasses provide a template for the long-term distribution of grasses across the continent. By comparing the pattern of introduced grass species richness to native grass species richness, we may be able to identify locations with the potential for further establishment and spread of introduced species.

We used herbarium data and rarefaction to compare native and introduced grass species richness across Australia. Introduced species have high richness in cooler, temperate regions characterised by high levels of human impact, while native species have high richness in warmer, northern and coastal regions. These differences, however, can be largely explained by photosynthetic pathway. Introduced grasses are predominantly C3 species, and both introduced and native C3 grasses have higher species richness in southern temperate regions. Native grasses, in contrast, are dominated by C4 species, with higher richness in northern regions. Our results highlight that physiological factors play a major role in determining both native and introduced grass species distributions, and there is considerable potential for introduced C4 grass species to spread further in Australia.

Fine scale variability in an arid landscape complicates detection of anthropogenic changes

Mr Al Healy1, Professor Stuart Phinn1, Dr Ayesha Tulloch1,2, Dr Rod Fensham1
1University Of Queensland, St Lucia, Australia, 2University of Sydney, Camperdown, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Al Healy is a PhD student assessing change in water availability across time and space in Australia’s arid and semi-arid zone, and the associated impacts on threatened species.

Australia’s drylands have highly variable rainfall, with long periods of dry “bust” conditions interspersed with rain events. These unpredictable underlying environmental conditions make it difficult to detect whether changes in vegetation occur in response to anthropogenic influences (e.g. increased grazing pressure) or simply due to natural variability. Distinguishing between anthropogenic and natural changes requires datasets with fine spatial and temporal resolution, as well as a sufficient temporal archive to record infrequent large rainfall events. Fine-scale remote sensing data with sub-30m pixel size and sub-weekly revisit schedule has become increasingly available, providing opportunities to
investigate subtle differences. This project combines earth observation datasets with digital repeat photography (phenocams) and ground-based measurements of floristic composition and phenological phase to measure different rates of vegetation greening response across multiple arid vegetation communities. This provides better understanding of the scope of natural variability, enabling categorisation of vegetation communities according to temporal dynamics. Through comparison of the results from different satellite platforms, we assess the opportunities and limitations for ecological applications, such as detecting ground cover and structural differences between grazed and ungrazed areas in the spatially complex land systems of Queensland’s Channel Country.

Seeing the woods and the trees: physiological and demographic responses of woodlands to global change.

Dr Garry Cook¹, Dr Mick Meyer¹, Dr Anna Richards¹, Dr Adam Liedloff¹, Mr Jon Schatz¹
²CSIRO, Winnellie, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Cook is a savanna ecologist with 30 years’ experience in understanding the dynamics of vegetation and greenhouse gases in northern Australia.

The relative roles of demographic and physiological responses of trees and tree stands is a critical uncertainty in predicting changes in terrestrial carbon stocks under changing management and environmental drivers. This uncertainty limits our ability to predict the outcomes of changes in fire regimes, rainfall, atmospheric CO2 and temperatures. We have applied scaling rules and mathematical approaches to define a relationship between the biomass of tree stands and physiological and demographic properties of individual trees. The physiological properties are integrated into growth rates, while recruitment and mortality are the demographic properties. We apply these approaches to the savannas of northern Australia to calculate total numbers of trees in this biome, their total carbon stock and its annual turnover. We argue that this approach has broad applicability across the multi-age woodlands of much of semi-arid Australia. The dynamics of the savanna woodlands are discussed in relation to two key drivers: fire regimes and rainfall variation.

A statistical approach in satellite remote sensing to model ecosystem areas and trends

Mr Calvin Lee¹, Dr Clare Duncan, Dr Emily Nicholson³, Dr Nicholas Murray²
¹Deakin University, Burwood, Australia, ²University of New South Wales, Kensington, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Calvin is a PhD student at Deakin University. His research focuses on using satellite remote sensing methods within the ecosystem assessments, such as the IUCN Red List of Ecosystems.

Satellite remote sensing is increasingly used as a method of large-scale monitoring in conservation. Much attention has been given to land-use or land-cover change studies using only a subset of available images at coarse temporal resolutions (annual). These methods limit our ability to represent uncertainty in the detection and classification process. Conventional statistical approaches in ecology, such as occupancy-detectability models, explicitly model errors in the detection process, but have not yet been applied to remote sensing problems.
Using mangroves as our study ecosystem, we applied a statistical method to explicitly quantify uncertainty within classification maps produced using all images available from Landsat 4-8 (1982-2018) within our region of interest. This method allows the incorporation and testing of covariates that can affect ecosystem detectability, including sensor type, number of sensors, cloud cover, time of year, modelling algorithm, and predictor selection, all of which are likely to affect area estimates. By taking advantage of the full temporal suite of SRS data available, we produce areal trends of ecosystems with explicit uncertainty.

Quantifying uncertainties is an essential part of ecology, and these methods take advantage of the statistical methods developed to apply them to satellite remote sensing. The results can be used in time-series analyses and models that investigate the drivers of these areal trends. They can also be applicable for ecosystem risk assessments, such as the Red List of Ecosystems, allowing not only more accurate Red List classifications, but also a means of investigating pathways to collapse.

A continental scale analysis of threats to orchids in Australia

Miss Jenna Wraith1,2. Prof Catherine Pickering1,2
1School of Environment and Science, Griffith University, Gold Coast, Australia, 2Environmental Futures Research Institute, Gold Coast, Australia

SYMPOSIUM: Separating natural variability and human impacts in ecosystem dynamics, Hall B, November 26, 2018, 11:00 AM - 1:00 PM

Biography:
Jenna Wraith is a doctoral candidate in the Environmental Futures Research Institute and in the School of Environment at Griffith University. Her research interests include conservation ecology, global biodiversity, human impacts and climate change.

Many plants are at risk of extinction globally due to human activities, including hundreds of species of orchids. This study assesses types of threats and threat distributions for the 184 orchids listed as threatened by the Australian Government. Based on information in listings and management plans, threats to the orchids were allocated to 28 categories. Additional data on species characteristics and distributions was obtained, including mapping orchid distributions using 14,651 location records from the Atlas of Living Australia. The most common threats were fire regimes (74% of all threatened Australian orchids), invasive species (65% of species), habitat modification (64%), grazing (63%), tourism and recreation (47%) and illegal collection (46%), which often co-occurred as threat syndromes. Most threatened orchids are terrestrial, and many occur in temperate forests (96 species) and temperate Shrubland (36 species). Generalized linear models were used to assess patterns in threats to orchids by bioregions in Australia. Bioregions with less native vegetation cover were more likely to have orchids threatened by habitat modification, grazing or weeds (p<0.05). Bioregions with greater protected area coverage were more likely to contain orchids threatened by tourism and recreation, but less likely to have orchids threatened by habitat modification (p<0.05). Understanding these driving factors is crucial for successful management as they highlight key areas and habitats for conservation. The methods used here could be applied to other threatened species and locations. Results also highlight that threats to orchids from climate change is not yet fully reflected in current listing documents and plans.
Can artificial intelligence help abate the biodiversity crisis?

Dr Iadine Chades
CSIRO, Brisbane, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Iadine is an artificial intelligence scientist and team leader of the conservation decisions team at CSIRO.

Across vast regions globally, biodiversity is facing numerous threats that are causing species extinctions and the loss of ecosystem services. In Australia alone, the number of federally listed species rose by about 10% (44 species) between 2011-2018, yet the resources required to implement the existing recovery plans are inadequate. In addition, competition for resources worldwide means that conservation research and management organisations face a new challenge – doing more with less. There are increasing demands for organisations to account for the efficiency and effectiveness of investments in natural capital. This demand for better outcomes from decreasing investment, combined with the accelerated rate at which species are becoming threatened, means that ecologists face an uncertain but inevitable era that requires achieving more with less, faster. The fields of ecology and conservation have not progressed fast enough to meet the enormity of the environmental challenge we are facing. Other disciplines, facing similar challenges have embraced technological advancements in data analysis and artificial intelligence to do more with less by harnessing smart algorithms that can find patterns and make real-time recommendations from complex data. Ecological research has historically been challenged by the complexity of the natural world and by a lack of resources to collect and analyse sufficient data to make timely recommendations. These are challenges that artificial intelligence can help resolve. The immediate AI opportunity lies in exploiting and developing research that can handle small data sets to provide big environmental rewards.

Using strategies from business start-ups to identify viable innovations for conservation

Mr Anurag Ramachandra, Dr Iadine Chades, Dr Gwen Iacona, Jennifer Jennifer McGowan, Dr Alasdair Davies, Dr Lucas Joppa, Dr Lian Pin Koh, Eric Fergraus, Dr Edward Game, Dr Gurutzeta Guillera-Arroita, Prof Rob Harcourt, Dr Karlina Indraswari, Dr José J Lahoz-Monfort, Jessica Oliver, Prof Hugh Possingham, Dr Adrian Ward, Dr David Watson, Dr James Watson, Prof Brendan Wintle

Conservation International, Arlington, USA, Centre of Excellence for Environmental Decisions, School of Biological Sciences, The University of Queensland, Brisbane, Australia, Department of Biological Sciences, Macquarie University, North Ryde, Australia, Zoological Society of London, London, UK, Microsoft, USA, School of Biological Sciences, University of Adelaide, The Nature Conservancy, South Brisbane, Australia, School of BioSciences, The University of Melbourne, Parkville, Australia, School of Electrical Engineering and Computer Science, Queensland University of Technology, Brisbane, Australia, School of Earth and Environmental Sciences, The University of Queensland, Brisbane, Australia, Institute for Land, Water and Society, Charles Stuart University, Albury, Australia, Wildlife Conservation Society, Bronx, USA, CSIRO, Dutton Park, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Anu is a technical advisor with Conservation International working in sectors ranging from mine and infrastructure design to urban and transportation planning. He uses conservation technology solutions to support environment impact studies, conservation planning, field-based biodiversity and carbon assessments.
Conservation science and practice struggles to identify viable solutions to counteract escalating threats to species persistence. Technological innovations have the potential to enable conservation science and practice to respond to these threats, but this potential will only be realized if innovations are aimed at solving actual conservation needs. We propose that strategies from the business world can be applied to assess the viability of innovations for solving biodiversity conservation challenges. Business models commonly used to plan start-ups, projects, and strategic management can help to plan development, evaluate effectiveness, and improve existing and long-term use of technological innovations in conservation. Here, we outline a four-step structured approach for considering conservation innovations from a business planning perspective. We use three case studies of high profile conservation technology initiatives -- Marxan (software), Conservation Drones (technology support), and Mataki (tracking device) -- to show how to use business planning tools to assess the viability of an innovation for achieving desired conservation outcomes.

Listening to nature in the Anthropocene: ecoacoustics and an NGO perspective on applied research

Eddie Game¹
¹The Nature Conservancy, South Brisbane, Australia

Biography:
Eddie Game is Lead Scientist for TNC’s Asia Pacific region. Much of his work is on research to support decision making, and the role technology can play in helping measure and report on the impact.

A major challenge for applied research is matching the speed and scale of conservation decisions. Ecoacoustics is a good example of a technology rapidly becoming integral to NGO conservation. Why this is so provides insights for applied research more generally. Drawing on experiences from The Nature Conservancy, I will cover some of the challenges of supporting decisions with science as we become increasingly aware of the complexity of the social-environmental systems we work in.

Harnessing exponential technologies for applied ecology and conservation

Dr José Lahoz-Monfort¹
¹University Of Melbourne, Parkville, Australia

Biography:
José Lahoz-Monfort is Senior Lecturer in Ecological Modelling at the University of Melbourne. With a background in engineering, statistics and ecology, he conducts research on statistical methods for wildlife monitoring, and on evaluating emerging technologies for ecology and conservation.

The exponential growth experienced by modern technology has deeply transformed the way we live, work and interact at an unprecedented scale. Accelerating engineering progress and cheaper development and production costs have coincided with accessible computing power and near-global connectivity. Applied ecology is already benefiting from some technologies (e.g. telemetry, remote-sensing...) and is exploring the application of others (e.g. autonomous vehicles, sensor networks), but there is still a huge opportunity gap: new technologies could truly revolutionize the way we collect data on species, habitats and processes, and provide new tools to support the management of natural systems.
To date, applied ecology research has mostly been a consumer of technology driven by big industries for other purposes (military, biomedical etc). A growing international movement believes the time is ripe for us to move to the driver’s seat, becoming innovation leaders, actively seeking to design novel technologies and devices to suit our needs. New collaborative forms of creation (e.g. open source) and the dawn of a new industrial revolution, with more agile design and production cycles, open the window to the development of cheaper, more targeted technology. But this situation is unprecedented and faces many technical, human and organisational challenges. Although collaborations are slowly emerging, the situation is still scattered. We need a coordinated approach to establish bridges between disciplines, and explore new mechanisms for collaboration, funding, and production.

What are the big opportunity gaps, and how best to navigate these uncharted waters to fully reap the benefits of exponential technologies?

Guiding the management of Crown of Thorns through real time recommendations

Dr Cameron Stuart Fletcher1, Dr David A. Westcott1
1CSIRO Land & Water, Atherton, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Cameron Fletcher is an interdisciplinary scientist, combining a range of techniques from computer modelling, mathematics, and economics with a variety of ecological approaches. He leads the modelling component of the Crown-of-thorns starfish research programme within the NESP TWQ Hub.

Crown-of-Thorns Starfish (CoTS) population outbreaks are one of the major threats to the Great Barrier Reef (GBR). They are also the threat that is most directly and immediately manageable in the short term through active control. The scale of the CoTS problem, however, threatens to dwarf the resources available to combat it. It is therefore vitally important that CoTS control activities are conducted as efficiently and effectively as possible.

The effectiveness of current CoTS control activities can be maximised by ensuring that CoTS are removed efficiently from areas of ecological or economic importance, or areas which foster the growth and spread of the population. Identifying and prioritising the areas where the greatest impact can be achieved requires knowledge of the current distribution of CoTS from control and surveillance activities, and a detailed understanding of the ecology that drives the spread of their population.

The CoTS Control Centre is a tablet-based, ecologically-informed, on-water decision support system. It uses the cull and surveillance data collected by the control program, coupled with detailed ecological and management models, to recommend which sites control program staff should survey and which they should dive at, how often, and at what point they should move to the next priority site in order to achieve the greatest improvement in coral health and resilience on the GBR. It coordinates decisions across the fleet of control program vessels to optimise control strategies given current knowledge, while also generating the data required to improve our knowledge and decisions in the future.
The future of applied ecology in an exponential growth era: An economist’s perspective

Dr Andrew Reeson1
1Data61, CSIRO, Canberra, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Andrew Reeson is an applied economist in CSIRO’s Data61. Current research interests include the design of environmental markets and modelling the impact of digital technology on industry and employment.

As economic growth continues to increase living standards both the threats to biodiversity, and the desire for its conservation, are mounting. Technology and innovation are increasing productivity, but these gains are uneven. Ecological research may fall victim to the ‘cost disease’, with activities such as fieldwork becoming more expensive relative to other industries. Enhanced agricultural and supply chain productivity can in theory reduce the pressure on conservation land, but in practice drives up the opportunity cost of conservation. It is clear that business-as-usual conservation will not achieve its goals. In a rapidly changing world, how can conservation disrupt itself to provide the step change needed to truly address the biodiversity crisis? How can ecological research achieve scale and avoid the cost disease? Technology offers many opportunities, for example real-time data collection (from sensors to satellites), drones and citizen-science platforms. However, technology also requires innovation, in both mindsets and management. Comparisons with other sectors show how the science and practice of conservation might adapt to meet these challenges.

Ecological aspects of wildlife tourism: a review

Dr Ronda Green1
1EFRI, Griffith University, Running Creek, via Rathdowney, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Ronda Green is a zoologist conducting research on frugivores and seed dispersal but also involved in research on wildlife tourism and is currently chair of Wildlife Tourism Australia.

The demand for getting closer to nature and seeing wildlife while traveling is growing worldwide, and likely to continue doing so, prompting concern in some regions, and in others promoted as an aid to biodiversity conservation, while various authors have bemoaned the dearth of relevant ecological research for supporting either claim. Although wildlife-watching sounds like a benign activity, some wildlife tourists and tour operators are more likely than those involved in general tourism to disturb birds and other animals. There are plenty of examples, both anecdotal and research-based, of wildlife being disturbed by tourists, but far less on whether this translates into changes in population numbers or disruption of ecological communities. There are also many examples of ecotourism ventures that attempt positive impacts on wildlife, especially involving protection or restoration of habitat and public education, but often with little research or monitoring of the effectiveness. This paper offers a concise review of the literature covering research and monitoring of both positive and negative impacts of various aspects of wildlife tourism on population and community ecology of wildlife with brief consideration of the potential for citizen science within tourism.
What is the potential to predict the effectiveness of conservation actions using machine learning?

Dr Sam Nicol
CSIRO, Dutton Park, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Sam Nicol is a Research Scientist with CSIRO Land and Water. His research interests include decision science, optimisation, risk analysis, and ecological modelling. He specialises in decision techniques to help managers allocate limited resources over time to achieve environmental goals.

Measuring the effectiveness of conservation actions has been confounded by the tremendous complexity of ecological systems, including the importance of context and local conditions. This variability in context often leads to extreme variability in ecological responses to conservation action, making it extremely difficult to generalise ecological outcomes. With sufficient data, machine learning techniques may allow conservation biologists to predict accurately despite this variability, but we cannot do this by continuing to implement individual short-term studies, all conducted using different experimental techniques. For machine learning techniques to become viable for predicting conservation effectiveness, we need to collect large volumes of standardised data across many different contexts. This requires a radical change in the way we think about conservation biology studies—we need to move beyond individual studies to a collaborative model where every study contributes contextual data to answer bigger questions. We also need to evaluate success or failure far better than we currently do. In this talk I will give a very brief overview of machine learning and its potential for use in predicting conservation effectiveness. I will present my thoughts on the challenges that such a paradigm shift presents, highlight some of the key research questions that must be answered to set us on the path, and speculate on some promising areas to start building our collective capacity to evaluate effectiveness.

Conservation connect: a platform to connect managers and funders

Dr Josie Carwardine, Dr Samuel Nicol, Dr Iadine Chadès
CSIRO, Dutton Park, Australia

SYMPOSIUM: The future of applied ecology in an exponential growth area, Hall A, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Josie is an applied conservation decision scientist in CSIRO Land & Water. Her core interest is in prioritisation and decision making approaches that combine ecological, economic and social objectives to discover better outcomes for nature and people.

Communication between on-ground managers and strategic decision makers at the regional, state and national scales is one of the big challenges to achieving conservation outcomes. How can strategic planners make decisions about investing in biodiversity across broad spatial scales whilst considering local level land managers preferences, values and management outcomes? And how can land managers gain resources, support and recognition for their efforts to sustain biodiversity and create broader benefits to society? We used an innovation approach to seek potential solutions to this challenge, by engaging broadly with potential end-users to refine our understanding of their needs and guide the solution design. In response to our learnings, we are developing the science for a digital platform to increase and streamline biodiversity investments, creating greater and more effective on-ground outcomes. The Conservation Connect platform brings together the best available information on current and highest priority management actions for expansion that can achieve specific conservation goals. Importantly, it connects people who want to invest in improving biodiversity with people who are
seeking resources for on-ground work, using smart matching technology, and enables sharing of critical information for conservation success. We believe the Conservation Connect platform can help solve key challenges identified in our preliminary stakeholder survey – lack of resources (for managers) and inadequate decision making and planning – thereby improving the outcomes of conservation efforts at all levels.

Developing biodiversity indicators using the IUCN Red List of Ecosystems

Ms Jessica Rowland, Doctor Lucie Bland, Professor David Keith, Doctor Emily Nicholson

1Deakin University, Mooroolbark, Australia, 2Centre for Ecosystem Science, School of Biological, Earth and Environmental Science, University of New South Wales, Kensington, Australia, 3New South Wales Office of Environment and Heritage, Hurstville, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
I am a PhD Candidate at Deakin University. My PhD research focuses on developing biodiversity indicators for ecosystems based on the IUCN Red List of Ecosystems risk assessments data.

World leaders have committed to significantly reducing the rate of biodiversity loss via the UN Sustainable Development Goals and Aichi Biodiversity Targets. Various biodiversity indicators are used to measure progress towards these targets, yet indicators synthesising change across ecosystem types and regions are lacking. The IUCN Red List of Ecosystems (RLE) is the global standard for ecosystem risk assessment and provides the idea foundation for indicators applicable across thematic and spatial scales. Here, we fill the gap by presenting three complementary indices that quantify past and future change among ecosystems. The Red List Index for ecosystems (RLie) summarizes trends the overall risk and risk based on symptoms of ecosystem collapse. The Ecosystem Area Index (EAI) and Healthy Ecosystems Index (HEI) complement the RLiE by providing finer detail on the magnitude of declines in area and functionality towards ecosystem collapse, respectively. We applied the indices using RLE assessments of Colombian ecosystems and forests across the Americas to demonstrate their complementarity and flexibility across thematic and spatial scales. Synthesising the state of the world’s ecosystems in a simple way is critical to allow clear communication with decision-makers, managers and the general public. Our indices synthesize complex information to highlight the regions and ecosystems most at risk of collapse and the type of change driving risk, providing valuable tools for guiding future policy and prioritising management actions.
Metrics of conservation progress: measuring our understanding of threats and progress towards alleviating their impacts

Ms Hayley Geyle1,2, Prof Stephen Garnett1,2
1Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia, 2National Environmental Science Program Threatened Species Recovery Hub, Darwin, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Hayley Geyle is a research assistant at the Research Institute for the Environment and Livelihoods at Charles Darwin University. She works with the Australian Government’s Threatened Species Recovery Hub, where her research interests include introduced predators (understanding their impacts and effective management), threatened species conservation and optimal monitoring.

Measuring the success of conservation management for threatened taxa is crucial to ensuring ongoing support, efficient allocation of resources and the development of sound policy. Despite this, there are currently no standard metrics for assessing progress in research or management. To address the need for a consistent approach, we have developed five metrics that are capable of quantifying the need for further action whilst measuring the effectiveness of attempts to alleviate the impact of threats. Our metrics allow for comparison of large numbers of threatened taxa, and may be aggregated to understand trends for an individual taxon or for threats across multiple taxa and locations. We present the progress framework, and demonstrate its’ use by applying the metrics to a subset of Australia’s threatened fauna. We show the potential for our metrics to encapsulate the major trends in research and management of both threats and threatened taxa, providing a basis for international comparisons of conservation success.

Using and evaluating biodiversity indices for fire management

Dr Katherine Giljohann1, Dr Luke Kelly1
1University Of Melbourne, Melbourne, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
As research fellow on ARC Linkage project ‘Spatial Solutions for Fire Ecology’, Kate is working on a suite of spatially explicit models to enhance capacity to design and evaluate alternative fire management strategies for biodiversity conservation in real-world landscapes.

In this talk we discuss the development and use of biodiversity indices in fire management, and how to overcome key issues for implementation. The geometric mean of species’ abundance, G, can be used to synthesize information on multiple species and their responses to fire regimes. This can assist management decide when, where and how to take action to promote species persistence.

First, we describe how G is currently used to track changes in species and ecosystem composition in several Victorian ecosystems. Second, we explore the sensitivity of G to the underlying biodiversity data and index assumptions, and consider direct vs indirect embedding of conservation values. Understanding the types of decisions which cause indices to perform well, or perform poorly, is essential for effective management. Such evaluations are rarely undertaken but are critical.

Due to its inherent complexity, uncertainty in future bushfire occurrence is often left out of environmental decisions. This is a concern as it could lead to sub-optimal decisions and actions. Finally, we briefly discuss how G can be combined with simulation or optimization approaches to explicitly...
account for uncertainty in future bushfires, thereby increasing the scope for making robust environmental decisions.

Developing a program to assess status and trends for a national network of wildlife sanctuaries

Dr Liana Joseph1, Dr John Kanowski1
1Australian Wildlife Conservancy, Milton, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Liana Joseph is a Senior Ecologist at the Australian Wildlife Conservancy. She is interested in threatened species management planning and monitoring. She is currently working on developing a program for measuring and reporting on conservation assets of the AWC sanctuaries.

Australian Wildlife Conservancy (AWC) has developed a program to report on the status and trends in biodiversity and threats on our large private protected area estate. AWC is a not-for-profit nature conservation organisation that manages 4.6 million hectares on 27 properties across Australia. We rely on an integrated program of monitoring and research to improve conservation outcomes and meet our mission of effective conservation of Australian species and their habitats. Our monitoring program has been developed to assess and report on the status and trends in biodiversity, ecological processes and threats on each sanctuary. At the core of the monitoring program is a suite of omnibus survey sites typically stratified by major vegetation type across each of our sanctuaries. In addition, targeted surveys are conducted to monitor key conservation assets that require an individualised survey methodology. These surveys deliver a sanctuary-wide status and trend assessment for a broad range of flora and fauna. For each of the AWC sanctuaries, the status and trends of the biodiversity and threat indicators are reported annually on a scorecard that is supplemented with a more detailed report outlining results and interpretation. This program of status assessment and reporting is key to AWC’s ongoing success in managing threatened wildlife across our conservation estate.

Invertebrates as indicators of ecosystem change on sub-Antarctic islands

Ms Melissa Houghton1, Dr David Merritt2, Dr Aleks Terauds3, Dr Justine Shaw1
1Centre for Biodiversity and Conservation Science, University of Queensland, St Lucia, Australia, 2School of Biological Sciences, University of Queensland, St Lucia, Australia, 3Australian Antarctic Division, Kingston, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Melissa has worked on several pest-eradication programs on islands around Tasmania, most notably in the sub-Antarctic for the Macquarie Island Pest Eradication project as a dog handler. She has since developed a keen interest in the fascinating world of invertebrates.

Eradication ‘success’ typically refers to the removal of the target invasive species. Ecosystem recovery is often assumed to follow. Commonly, post-eradication monitoring focuses on the recovery of threatened or charismatic species rather than quantifying overall conservation benefit. Although the conservation of iconic species often drives eradication programs, these species are generally vertebrates with relatively long lifespans, such as seabirds, whose responses to environmental change are slow. Monitoring these species does not typically capture immediate and large-scale ecosystem changes. Invertebrates, on the other hand, are rarely the focus of conservation research in themselves, but are
critical components of ecosystems. Their short life-cycles and rapid response to environmental change make them ideal biological indicators.

Here we report on the results of invertebrate monitoring specifically designed to measure ecosystem change following a large-scale mammal eradication program. Rabbits and rodents had wide-ranging impacts on the sub-Antarctic Macquarie Island ecosystem for over 140 years and were successfully eradicated in 2013. We quantify their impacts on invertebrate community assemblages using historical data and contemporary invertebrate surveys. We established 24 island-wide sites in five different vegetation communities and used six different trapping methods over three consecutive field seasons. Preliminary results indicate an increase in spiders and moths in recovering vegetation communities, and range expansions in some non-native invertebrates.

By tracking invertebrate community change across space and time, we quantify the ecosystem-level conservation benefits and the return-on-investment of this $25 million eradication program. We propose methods for efficient and effective long-term monitoring of the post-eradication ecosystem using invertebrates.

A Threatened Species Index for Australian Birds

Dr Elisa Bayraktarov1, Mr Glenn Ehmke1,2, Dr Ayesha Tulloch3, Ms Stephanie Avery-Gomm1, Dr Alienor Chauvenet4, Dr Megan Barnes5, Ms Louise McRae6, Prof Brendan Wintle7, Mr James O’Connor2, Ms Joris Driessen7, Prof Stephen Garnett8, Prof John Woinarski8, Prof Hugh Possingham9,1

1The University of Queensland, St Lucia, Australia, 2BirdLife Australia, Carlton, Australia, 3University of Sydney, Sydney, Australia, 4Griffith University, Gold Coast, Australia, 5The University of Hawaii at Mānoa, Honolulu, USA, 6Zoological Society of London, London, UK, 7University of Melbourne, Melbourne, Australia, 8Charles Darwin University, Darwin, Australia, 9The Nature Conservancy, Arlington, USA

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Biography:
Dr Elisa Bayraktarov is an ecologist at the NESP Threatened Species Recovery Hub with background in environmental monitoring. Elisa works with eNGOs, academia and governments to establish a credible index reporting on annual population changes in Australia’s threatened species.

Understanding whether, and where, species are declining is crucial for monitoring progress towards national and global biodiversity conservation targets, justifying management resourcing, and stimulating targeted responses to environmental problems. Most indicators of trends in species populations focus on common species and exclude rare or threatened species. We developed an approach for building the first Threatened Species Index and tested its robustness as an indicator for Australia’s birds. The main purpose of this index is to engage the public and decision-makers by allowing them to track changes in threatened species populations in the same way as stock market indices report on economic health. The Threatened Species Index is built using standardised monitoring data on population trends and covers >30% of all threatened and Near Threatened Australian birds. Preliminary index results show an overall decrease of at least 25% between 1980 and 2015. This index also enables reporting on trends for different functional groups of species, regions and jurisdictions, thus indicates which locations and groups of species may be suffering greater relative declines (e.g. migratory shorebirds show a decrease of 57%). This knowledge will help halt species extinctions by empowering targeted recovery actions under Aichi Target 12. A web-visualisation tool enabling people to interrogate and visualise the index, as well as to download data, will be launched by the National Environmental Science Program’s Threatened Species Recovery Hub in the evening following this symposium. Research integrating further taxonomic groups (plants, mammals, and freshwater species) into the Threatened Species Index is well underway.
PANEL DISCUSSION: What indicators do we need to adequately track and manage biodiversity

**Dr Ayesha Tulloch**

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (1), Hall B, November 27, 2018, 1:30 PM - 3:30 PM

Panellists:

Hugh Possingham
James O’Connor
Elisa Bayraktarov
Ayesha Tulloch

Quantifying land clearing impacts on threatened species habitat across Queensland

**Dr Melinda Laidlaw, Dr Gordon Guymer, David Halford**

Queensland Herbarium, Mount Coot-tha, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**

Melinda Laidlaw is a Senior Ecologist at the Queensland Herbarium within the Queensland Department of Environment and Science. She coordinates the Queensland Herbarium’s threatened species modelling project and the Weed Spotters Network citizen science project.

The Queensland Herbarium has modelled the potential pre-clearing habitat distribution of more than 300 of Queensland’s threatened flora and fauna species. By intersecting modelled distributions with changes in remnant vegetation mapped biannually for the past two decades, trends in habitat loss have been quantified revealing that threatened flora and fauna habitat loss is not only ongoing but has accelerated over the most recent remnant vegetation mapping period (2013-2015). By 2015, 26% of remnant threatened fauna habitat and 35% of remnant threatened flora habitat had been cleared. Most notably, almost half of threatened reptile habitat and 62% of threatened invertebrate habitat had been cleared by 2015. While more than half of the pre-clearing habitat for most flora groups remained uncleared by 2015, two-thirds of habitat for threatened grassland and forbland flora species had been cleared.

The modelling of threatened species habitat in Queensland also allows the adequacy of our current reserve system for protecting threatened species habitat to be assessed. While much (80.3%) of Queensland’s Protected Area Estate is predicted to provide remnant habitat for threatened species, the area of total threatened species habitat that was remnant vegetation in 2015 coincident with a Protected Area is modest at 21.3% for threatened flora, 16.5% for threatened fauna and 15.6% overall. By modelling and mapping the spatial distribution of remnant threatened species habitat across Queensland we can better prioritise new areas for protection or restoration and better direct our survey and monitoring efforts.
Can taxonomic completeness indices be used to compare biodiversity change in rivers and semi-arid woodlands?

Dr Eren Turak1,2, Prof Klaus Henle3, Mr Sandy Booth1, Mr Mick Kelly4
1NSW Office Of Environment And Heritage, Parramatta, Australia, 2Australian Museum, Sydney, Australia, 3Helmholtz Centre for Environmental Research -UFZ, Leipzig, Germany, 4NSW Office of Environment and Heritage, Buronga, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
PhD, UTS, Biological Classification of Rivers of NSW. Lead NSW component of National River Health Program. Principal Scientists Biodiversity Research and Assessment. Developing biodiversity monitoring programs in rainforests, semi-arid woodlands and alpine streams. Co-chair Freshwater Biodiversity Observation Network (FWBON).

Taxonomic completeness of river macroinvertebrate assemblages is widely used as a measure of a river health to guide river and catchment management. Comparable indices at not known to be applied to terrestrial animal assemblages. Lizard assemblages in semi-arid (mallee) woodlands in Western NSW have some of the characteristics that make river macroinvertebrates good indicators of ecological integrity. Hence they can potentially help detecting biodiversity change in these ecosystems and may be useful in evaluating the effectiveness landscape-scale management interventions including Aboriginal cultural burning.

We used outputs of habitat suitability models of 38 lizard species based on sighting records from the South Olary Plain IBRA subregion to estimate hypothetical expected species numbers at 1s resolution in a reserve in South-Western NSW where aboriginal cultural burning is currently being trialled as a tool for maintaining and improving ecological integrity. We then estimated the observed number of species using occupancy modelling based on lizard sightings in the same reserve based on sightings made between over a period of 7 months. We also estimated expected and observed numbers of macroinvertebrate taxa in a mildly disturbed river on the South Coast of NSW. We then constructed conceptual models that linked management interventions to changes in taxonomic completeness index values based on published information. Comparison between these two models suggest that taxonomic completeness of animal assemblages in both rivers and semi-arid woodlands are similarly sensitive to landscape-scale management interventions.

The human footprint is causing global reductions in terrestrial mammalian movements.

Dr. Marlee Tucker1,2, Professor Thomas Mueller1,2
1Senckenberg Biodiversity and Climate Research Centre, Frankfurt Am Main, Germany, 2Department of Biological Sciences, Goethe University Frankfurt, Frankfurt am Main, Germany

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Marlee is interested in large-scale patterns in ecology and biogeography, and species vulnerability to changing environments. Marlee’s research encompasses macroecological questions related to allometric scaling, predator-prey interactions and animal movement.

Understanding the causes and consequences of animal movements is important because any changes in movement can have both direct and indirect effects on species’ survival and ecosystem processes.
Animal behaviour is being altered by the increasing human population, land use changes and habitat fragmentation, however, the effects of the anthropogenic footprint on animal movements has not been quantified across species. Using a unique GPS-tracking database of 803 individuals across 57 species, we estimated the global effect of anthropogenic landscape changes on mammalian movements. We calculated straight-line displacements between GPS locations across various temporal resolutions (1 hour to 10 days) and annotated these data with the Human Footprint Index, NDVI, body mass and diet guild. We then compared movements among individuals to examine how the environment influenced movement patterns accounting for taxonomy and spatial autocorrelation. We found that mammalian movements in areas with a comparatively high human footprint were on average two-to-three times smaller than those in areas with a low human footprint. We attribute this reduction to both behavioural changes of individual animals and the exclusion of species with long-range movements from areas with higher human impact. The global reduction of movement alters a key ecological trait of animals that not only affects population persistence, but also ecosystem processes, such as predator-prey interactions, nutrient cycling, and disease transmission.

Lasting implications of intact forest loss for Earth’s climate

Mr Sean Maxwell1, Mr Adam Duncan2, Dr Tom Evans2, Dr Hedley Grantham2, Dr Nancy Harris3, Prof. Yadvinder Malhi4, Dr Alexandra Morel4, Dr Peter Potapov5, Dr Rebecca Runting1, Prof James Watson1,2

1University Of Queensland, St Lucia, Australia, 2Wildlife Conservation Society, Bronx, USA, 3World Resources Institute, Washington DC, USA, 4University of Oxford, Oxford, England, 5University of Maryland, College Park, USA

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
PhD student at the University of Queensland

Conserving forests that are free of significant anthropogenic degradation (which we term ‘intact forests’) is a potential way for nations to meet commitments under the Paris Climate Agreement. But support for intact forest conservation in the Paris Agreement is limited because the perceived level of threat to and emissions from intact forests is low. Intact forests are actively threatened, however, and subsequent carbon emissions from recent intact forest loss have not been quantified, leaving nations uncertain about how intact forest conservation can deliver real and verified emission reductions. A clear pathway for monitoring and enforcing intact forest conservation also remains unclear. We used a satellite-based approach to estimate carbon emissions from deforestation and forest degradation activities that occurred inside intact forests between 2000 and 2013. We estimated ‘pulse’ emissions from deforestation, road construction, fire and selective logging activities between 2000 and 2013. These activities increased forest fragmentation and likely reduced faunal diversity and carbon sequestration rates in intact forests beyond 2013. We therefore estimated ‘committed’ emissions from these indirect sources between 2013 and 2050. We propose a pathway for how intact forest conservation could deliver real and verified emission reductions under the Paris Agreement, focusing in particular on how nations can overcome monitoring and enforcement challenges that continue to plague reforestation and REDD+ projects.
**Quantifying the impacts of metric choice on threatened species during simulated biodiversity offsetting scenarios**

*Ms Erica Marshall¹, Dr Heini Kujala¹, Prof Brendan Wintle¹, Mr Roozbeh Vilavi¹, Miss Natasha Cadenhead¹, Miss Louise O’Connor¹*

¹University Of Melbourne, Moonee Ponds, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
Poster 057 - I am a conservation ecologist passionate about protecting threatened species. I am currently undertaking a PhD aimed at researching better biodiversity offsetting schemes to promote the persistence of rare and vulnerable species in Australia.

Biodiversity offsetting has been increasingly used around the world to compensate for the rising environmental impacts caused by development. There is significant scepticism about whether traditional offset metrics can effectively account for the biodiversity lost during development. Habitat focused metrics often fail to capture biodiversity values, resulting in offsets which rarely compensate effectively for what is lost. Here we aimed to quantify how the use of these common offsetting metrics may impact the long-term population viability for several vulnerable species in the Hunter Region, NSW, and assess options for improvement. We simulated hypothetical scenarios of land-clearing and offsetting through restoration, following commonly used offsetting protocols and using different offsetting metrics to quantify development impacts. Population Viability Analyses (PVAs) were then conducted to assess the long-term impact of developments and offsets on regional populations. Our results show that standard habitat and area focused offset metrics frequently underestimate the impacts of development and often fail to account for them. However, offsetting schemes in which information on species habitat is included within the offset metric, show greater likelihood of achieving a no net loss in population viability over time. This result is consistent across species, even when development impacts vary between species, with some species being more severely impacted by development scenarios than others. Our findings call for more systematic testing of offsetting metrics, as accurately measuring losses and gains is essential to mitigating further environmental degradation and maximising biodiversity conservation.

**Using remote sensing and global datasets to identify plant species impacted by forest loss**

*Miss Fiona Robinson¹, Dr William Cornwell², Dr Nicholas Murray²,³*

¹Not applicable, St Ives, Australia, ²School of Biological, Earth and Environmental Sciences, University of New South Wales, Randwick, Australia, ³School of Biological Sciences, The University of Queensland, St Lucia, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

**Biography:**
My name is Fiona Robinson and I recently completed Honours in Environmental Science where I received the University Medal. I am interested in using satellite data and citizen science to understand species distributions.

Forests are rapidly declining around the world, threatening a wide range of forest-dependent organisms. Plants are highly diverse and the basis of terrestrial primary production, yet compared to other taxa we have little information about the impact of threats on the risks of extinction in these organisms. To evaluate the impact of forest loss on plant species globally, we integrated deforestation satellite data dating between 2000 and 2015 with a global dataset of historical herbarium records, and conducted an
uncertainty analysis to address data quality concerns. Plant species were considered potentially impacted when at least 5 records, 2 unique locations and 95% of their records matched sites of recently observed forest loss. Our analysis of 95,684,832 herbarium records indicated sixty-six plant species were potentially impacted by forest loss between 2000-2015. The most heavily impacted plant species from forest loss spanned eleven countries, were typically endemic to small geographical areas, and encompassed a range of lifeforms. Hotspots of biodiversity with warmer climates characterised these heavily impacted species. Alarming, only one species has been re-assessed since 1998 to update its status on the IUCN Red List. These poorly documented species could likely ‘slip through the cracks’ if no action is taken. Biodiversity data is unevenly spread across the world; some of the most important conservation challenges are located in areas with the sparsest data. Our approach of combining herbarium collection data with satellite deforestation data improves our ability to target species and geographic areas for further conservation action.

Applying lessons from economics to biodiversity indicators

Ms. Simone Stevenson¹, Dr. Emily Nicholson¹, Dr. Kate Watermeyer¹
¹Deakin University, Burwood, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Simone is a PhD candidate at Deakin University's Centre for Integrative Ecology. Her PhD research aims to develop and apply new theory for designing, testing and selecting global biodiversity indicators for use in conservation decisions.

Biodiversity indicators are essential tools for conservation. Different indicators flag change at different stages in the process of biodiversity change, but to date, little attention has been given to the relationships between various indicators and the sequence in which they signal change: some flag change before permanent loss of biodiversity occurs; others only confirm change after it occurs. We drew upon economic theory to classify biodiversity indicators according to these temporal properties. In economics, indicators are classified as leading or lagging, dependent on whether they predict or confirm transition from recessions and expansions (the process they are most interested in).

We developed a theoretical approach for classifying biodiversity indicators as leading or lagging that can be applied to different processes and scales of biodiversity change, and apply it to two different processes of biodiversity change and their respective indicators: Global species extinctions (using indicators of Sustainable Development Goals and Convention on Biological Diversity targets), and degradation of a fished marine ecosystem (using INDISEAS ecosystem indicators). We found measures of species abundance and fishery catches to be leading, whereas indicators of extinction and fish life spans were classified as lagging indicators.

Because biodiversity loss is often impossible to reverse, indicator timing is directly relevant to their effective use. Indicators which signal change early are essential for instigating preventative actions, whereas indicators that confirm change after the event are important for evaluation of past policy. Our approach can help structure indicator sets to ensure predictive as well as confirmatory information is available.
A structured approach is needed for designing, selecting and evaluating biodiversity indicators

Dr Kate Watermeyer1, Dr Guru Guillera-Arroita Guillera-Arroita2, Dr Payal Bal2, Mike Burgass3, Dr Lucie Bland1, Dr Ben Collen4, Dini Fardila2, Chris Hallam2, Dr Luke Kelly2, Prof Michael McCarthy2, Dr Tracey Regan5,2, Prof Brandon Wintle2, Dr Emily Nicholson1

1Deakin University, Melbourne, Australia, 2University of Melbourne, Melbourne, Australia, 3Imperial College London, London, United Kingdom, 4University College London, London, United Kingdom, 5Arthur Rylah Institute for Environmental Research, Melbourne, Australia

SYMPOSIUM: Tracking species and ecosystem change to inform effective environmental management (2), Hall B, November 27, 2018, 4:00 PM - 6:00 PM

Biography:
Research Fellow at Deakin University, Centre for Integrative Ecology, working on testing biodiversity indicators for conservation and monitoring. I’m an ecologist with a background in marine systems and research interests in ecosystem modelling, function, monitoring, and drivers of change.

Biodiversity indicators, e.g. the Living Planet Index and Red List Index, are used to measure system change and progress towards conservation goals. Yet how well they detect trends of interest, such as declines in threatened species or ecosystem function, remains poorly understood. Change in indicators can therefore be difficult to interpret, meaningless, or even misleading. High profile calls for biodiversity indicators to be combined with predictive models to evaluate policy scenarios can only be met if the indicators themselves are first evaluated. Decision theory provides an ideal framework for a structured approach to assessing indicators. We evaluate a selection of indicators commonly used in terrestrial, marine and freshwater realms against five criteria: i) objectives; ii) design; iii) behaviour; iv) uncertainty and v) constraints. Our criteria are equally applicable for both the design and selection of indicators. Results varied widely across indicators, highlighting the need for further testing, development of uncertainty measures, and transparency regarding limitations. Without a clear statement of what an indicator is designed to measure, its performance and utility cannot be assessed, and therefore the outcomes are of little value to tracking change in biodiversity. Indicator development should be embedded in a structured decision making process to make them as useful and suitable as possible.

Valuing residential yards to reduce urban landscape fragmentation

Dr Alessandro Ossola1, Dr Dexter Locke2, Dr Brenda Lin3, Prof Emily Minor4

1Macquarie University, Sydney, Australia, 2The National Socio-Environmental Synthesis Center (SESYNC), Annapolis, USA, 3CSIRO, Land & Water Flagship, Aspendale, Australia, 4University of Illinois at Chicago, Chicago, USA

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Alessandro is a Research Coordinator at The Centre for Smart Green Cities at Macquarie University in Sydney, Australia. His interests encompasses basic and applied research related to ecology, forestry and environmental management in human-dominated ecosystems.

Urban landscapes are highly fragmented, thus limiting species dispersal and viability of populations. Landscape fragmentation can be mitigated by vegetation as it constitutes both primary habitat and functional ecological corridors for numerous urban species. However, as residential land makes up most of the urban matrix, the most promising opportunities to reduce landscape fragmentation through vegetation management are likely to fall within private yards.

By applying a novel GIS workflow, we located all back-, front- and corner yards within Boston’s greater metropolitan area. A 3D vegetation model was calculated from LiDAR and multispectral imagery.
Canopy fragmentation was quantified through morphological spatial pattern analysis to identify canopy cores, edges, isolated green islets and vegetated connector paths across the entire urban landscape.

Yards covered 24.19% of Boston’s urban landscape (12.81, 6.89 and 5.21% for back-, front- and corner yards, respectively) enclosing 37.46% of the whole urban canopy. Yards contained a third of all urban canopy cores, but also high percentages of inner and outer edges (44.78% and 40.51%), and isolated green islets (38.16%). Greener neighbourhoods had reduced fragmentation due to larger canopy cores spreading across multiple back-yards and properties.

This study suggests that private vegetation can be individually managed by homeowners to collectively reduce urban landscape fragmentation. By integrating back-yard vegetation management throughout properties, neighbours could create larger habitat patches while increasing cores, reducing edges and integrating isolated islets. Front-yards and streetscapes could be used to strategically reconnect back-yard habitat patches by creating canopy bridges and saturate urban canopy connectivity networks.

Climate change is predicted to decrease suitable habitat for Australia’s urban plants

*Dr Hugh Burley*, Linda Beaumont, Alessandro Ossola, John Baumgartner, Manuel Esperon-Rodriguez, Gallagher Rachael, Shawn Laffan, Anthony Manea, Michelle Leishman

1Macquarie University, Sydney, Australia, 2UNSW, Sydney, Australia, 3Western Sydney University, Sydney, Australia

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

Biography:

Hugh Burley is a geographer with a background in analysing biodiversity data, focusing on continental scale plant distributions. He is currently investigating the impact of climate change on plants in Australian cities at Macquarie University in Sydney.

Globally, local government authorities are increasing their investment in urban greening interventions, yet there is little consideration of whether the current palette of species for these plantings will be resilient to climate change. We assessed the distribution of climatically suitable habitat, now and in the future, for the 200 tree species most commonly grown by nurseries and planted across Australia’s urban landscapes.

Species’ occurrence records were obtained from myriad tree inventories and natural history collections, along with baseline climate data (WorldClim) and six scenarios for three time periods: 2030, 2050, 2070. We calibrated climatic suitability models (CSMs) for each species and projected these onto current and future climate scenarios. For each species, we calculated i) changes to the size of climatically suitable habitat across Australia, ii) future loss of currently suitable urban habitat and iii) future gain of habitat across urban areas currently unsuitable.

Although our target species are commonly sold within Australia, too few occurrence records existed for ~ one-third of species for adequate models to be calibrated. For the most of the remainder, suitable habitat is projected to decline by 2070 to less than half of its current extent, with suitable habitat in urban regions projected to decline for ~90% of species. Our results highlight changing patterns of climatic space for different species, indicating that a pro-active approach is needed to identify new planting opportunities. We also identify key issues associated with the use of CSMs for species in urban environments.
The vulnerability of urban trees to climate change in southeast Australia

Dr Craig Nitschke¹, Mr Scott Nichols¹, Dr Kathy Allen¹, Dr Cynnamon Dobbs², A. Prof Steve Livesley¹, Prof Patrick Baker¹, Ms Yvonne Lynch³

¹University Of Melbourne, Richmond, Australia, ²Universidad de Chile, Santiago, Chile, ³City of Melbourne, Melbourne, Australia

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Dr Craig Nitschke is a forest and landscape ecologist. He is interested in the interactions between climate variability and change, forests and the provision of ecosystem services for sustainable livelihoods in both natural and urban areas.

The recent decline in the health of the City of Melbourne’s deciduous tree species during the millennium drought has led to concerns about the vulnerability of the city’s trees to future climate change. Understanding the response of tree growth to past climate is critical for determining the likely impacts of climate change on future growth and can provide insights into the suitability of current species to future climates. We used dendrochronological approaches to determine the relationships between climate and tree radial growth for common deciduous tree species in Melbourne’s urban forest. All studied species showed radial growth in a given year was negatively impacted by arid conditions in the previous autumn and arid conditions in the spring or early summer of that year. Interspecific differences in climate – growth relationships, consistent with xylem anatomy trait differences (ring vs. diffuse porous), were observed. Successive years of drought had a significant negative influence on radial tree growth. Future climate change scenario testing suggested that a shift towards a warmer, drier climate would exacerbate declines in radial growth, and thereby health, highlighting that the studied species are vulnerable to climate change. From a planning perspective, a balance between a) conserving these vulnerable tree species through proactive management; and, b) planting more drought and heat tolerant species is likely the best approach towards adapting Melbourne’s urban forest to climate change.

Effects of climate variability on urban garden plant richness and gardener water use behavior

Ms Monika Egerer¹, Dr Brenda Lin², Dr Caragh Threlfall³, Dr Dave Kendal⁴

¹University Of California, Santa Cruz, Santa Cruz, United States, ²CSIRO Land and Water Flagship, , Australia, ³University of Melbourne, , Australia, ⁴University of Tasmania, , Australia

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Monika Egerer is a doctoral candidate in Environmental Studies at the University of California, Santa Cruz. She studies the local and landscape drivers of biodiversity, ecosystem services and human well-being in urban agricultural landscapes.

Urban environments are subject to combined effects of changing climate and higher temperatures due to increased impervious surface. Changing environmental conditions coupled with people’s management decisions can influence how urban vegetation grows and survives. Urban gardens are an increasingly popular green space that supports unique climate-human behavior interactions. However, despite ongoing climatic changes in cities, it is less known how this influences gardeners’ management decisions and plant diversity. In this study we worked in 11 community gardens in Melbourne, Australia to monitor air temperature variation and to measure plant species richness at the garden and garden
plot scale. We concurrently surveyed >180 gardeners in these gardens to better understand the relationships between climate variation, plant species diversity, and gardener management. We found that garden scale temperature variability is driven by regional context, with more stable temperatures in more impervious landscapes. Gardeners agreed that regional climate changes influence their watering behavior, but not their plant selection, which is determined by food provisioning ability. Yet temperature variability negatively affected plant species richness within garden plots, providing evidence that plant survival is related to climate at this scale. Thus although gardeners may water more in response to regional climate changes, gardeners may not be able to completely control the effects of climatic drivers on plant survival in variable conditions. This has implications for where community gardens should be placed in the landscape. Gardens in the inner city may have more stable climates and therefore may be able to produce more stable food supplies.

Historic ecosystems inspiring the development of novel ecosystems, the example of extensive green roofs

**Prof. Dr. Martin Hermy**¹, Ms Jan Vanstockem

¹KU Leuven, Heverlee, Belgium

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

I mostly worked on the relationship between history and current biodiversity of forests (historical ecology). From about 2000 onwards I gradually changed to urban ecology and in particular to green roofs & vertical green

Novel ecosystems will become the main ecosystems in the Anthropocene where people live and work. Historic ecosystems will increasingly come under pressure. Apart from their huge conservation importance, they may at the same time inspire use for developing novel ecosystems. This so-called habitat template hypothesis may be used to develop novel ecosystems, e.g. extensive green roofs. More and more, a consensus is growing that ecosystem services are linked to ecosystem properties (e.g. resilience, resistance) that in turn can be predicted by functional diversity of plant communities. So we used functional diversity as a framework for species selection on extensive green roofs. Using the habitat template concept, specifically taking into account drought adaptation and self-regulation, we developed a screening procedure using both functional plant traits and utilitarian aspects. The results were incorporated into a hierarchical multi-criteria screening tool. Ultimately a selection of the species was tested. In a second phase some characteristics (seed banks, plant species diversity) of these extensive green roofs were analyzed and compared with findings from (semi-)natural plant communities, suggesting both correspondence but also difference.
Urban gardens under heat and drought: Local management to maintain soil moisture during climate fluctuations

**Dr. Brenda B Lin¹**, Ms. Monika H Egerer²

¹CSIRO Land & Water, Aspendale, Australia, ²University of California Santa Cruz, Santa Cruz, USA

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

Dr. Lin is a Senior Research Scientist in CSIRO Land & Water. Her research examines how natural systems can be maintained or integrated into an increasingly developed landscape to provide ecosystem services that optimise both environmental and human well-being.

Urban gardens are vital green spaces, providing food for residents and space for engaged citizenry and community development. In California, climate change conditions (heat and drought) are becoming more extreme, threatening the resilience of urban gardens. Water use restrictions limit the timing and amount of water that gardeners can access, exacerbating these climate challenges for urban food production. Together with volunteer gardeners, we examined how ambient temperature, water use, vegetation, ground cover, and soil management affect rates of soil moisture gain and loss in urban gardens for a six-week period in the summer of 2017. We found that plot level management decisions can combat climate challenges by creating systems that limit water loss. Greater watering by gardeners (liters/m²) drives faster soil moisture gain and loss rates. However, plots with better soil quality (soil organic matter and water holding capacity) and more straw cover maintained soil moisture in plots longer, while greater crop cover increased loss rates. High ambient temperatures before watering events slowed gain rates, but did not affect loss rates. Overall, such fine-scale dynamics highlight the complex challenges and opportunities faced by gardeners under climate fluctuations and the management options available to maintain soil moisture under extreme climate conditions.

Effects of urbanisation on arthropod trophic interactions on Pittosporum undulatum

**Mr Daniel Jin¹**, Prof Dieter Hochuli³

¹The University Of Sydney, Sydney, Australia

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

**Biography:**

I am a graduate and current PhD student of the University of Sydney. My area of research interest is the effects of urbanisation on the species composition and ecological functions of arthropods.

Urbanisation affects both the composition of biota in cities as well as the interactions among them. Of particular importance are trophic interactions, such as herbivory and predation. Urbanisation may cause a reduction in predator abundance, reducing predation on herbivores and hence increasing herbivory. We investigated the effects of urbanisation on the arthropod trophic interactions on Pittosporum undulatum (Vent.), a native shrub/tree that is becoming increasingly dominant in urban areas. We sampled arthropods, herbivory and (as a measure of reproductive fitness) fruit from P. undulatum across an urbanisation gradient. We also measured predation on insect herbivores using three different methods: enclosing predators with herbivores in field cages; setting out model prey for predators to attack; and laboratory feeding trials.

We found that urbanisation is associated with an increase in the abundance of arthropods on P. undulatum, including herbivores. This also increased herbivory on urban pittosporums compared to...
those in natural areas, but this did not then lead to decreased reproductive fitness. However, we did not find evidence that this increase in herbivory was driven by a loss of top-down control. Predators in enclosures had no effect on herbivores, and predation on models increased with urbanisation in a similar manner to herbivory. Laboratory feeding trials provided further support for top-down control being relatively unimportant in this system. These results are consistent with the general view of urbanisation altering trophic interactions, but they also show that it can affect predation positively as well as negatively.

Remote sensing and metabarcoding help resolve the role of Phytophthora species in urban tree declines

Professor Giles Hardy¹, Mr. Mohammed Baidhani¹, Dr. Paul Barber², Associate Professor Treena Burgess¹
¹Murdoch University, 90 South Street, Australia, ²Arborcarbon, Perth, Australia

SYMPOSIUM: Urban greening in the Anthropocene: new challenges and approaches, Meeting Rooms 1-2, November 29, 2018, 11:00 AM - 1:00 PM

Biography:
Giles is a forest pathologist with an interest in how biotic and abiotic diseases impact on ecosystem health and function. He is also interested on the role Phytophthora species play in urban forest health and their management.

Urban forests contribute to human well-being and environmental health and function. Due to anthropogenic activities, urban forests are considered a jumping point for invasive pathogens into the wider landscape. Worldwide, Phytophthora species are implicated with the decline of trees and shrubs, and to changes in ecosystem function and health. Phytophthora cinnamomi and P. multivora in Australia are good examples. The need to rapidly access the health of vegetation over large areas, diagnose causes and implement management is of increasing interest to urban greenspace managers, both for existing parks but also for on-going biodiversity plantings. Between 2012 and 2015, 91 parks over 99 km² were assessed for canopy health changes using digital multi-spectral imagery at a spatial resolution of 5 m pixels. Across 236 sites in these parks where vegetation health was observed to decline, rhizosphere soil samples were collected and assessed for the presence of Phytophthora species using traditional and eDNA extraction and metabarcoding.

Out of the 236 soils collected from declining vegetation, 24 had one or more Phytophthora species by traditional approaches, with four Phytophthora species recovered. In contrast, 168 contained at least one Phytophthora species by metabarcoding. Overall, forty-five Phytophthora species were detected, many of which are known exotic plant pathogens to Australia. A number of Phytophthora species were new to science, or first records for Australia. The implications to the health of ecosystems and biodiversity they support of this diverse Phytophthora community with regards to managers of urban and natural ecosystems is discussed.
Biodiversity reporting, decisions and now accounting...will we ever get it right?

Mr Pete Lyon1
1Australian Government Dept of the Environment and Energy, Canberra, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Pete Lyon has worked on biodiversity data, information and decision making within the Australian Government’s Dept of the Environment and Energy for twenty years. His current role is in the Department’s Knowledge and Technology Division.

The Australian Government has long standing responsibilities in reporting on the state and trends of the nation’s biodiversity. Inside the Department we make tools and run activities to get this done. We go beyond reporting to meaningfully informing decisions on where to invest and regulate. Beyond that comes the questions about whether such interventions have any impact. This presentation will review some of the ways the department has engaged with these needs over the last thirty years and where it might head to next. This will be a broad ranging story-based presentation covering areas such as governance, policy, institutional arrangements, priority setting, data management, observations and surveys, standards, engaging with ecological science, modelling, environmental economic accounting and innovative web tools. If you’ve wondered how things work inside an ever-more-efficient government environment agency, and particularly if you’ve managed to read this far, you’ll enjoy this presentation.

Shedding new light on the cryptic world of subterranean fauna: an end-user driven research program

Dr Lesley Gibson1,2,3
1Western Australian Biodiversity Science Institute, Perth, Australia, 2Department of Biodiversity, Conservation and Attractions, Kensington, Australia, 3The University of Western Australia, Crawley, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Lesley is a Program Director with the Western Australian Biodiversity Science Institute. Lesley was seconded in 2016 from the Department of Biodiversity, Conservation and Attractions where, as a Principal Research Scientist, she led the Science and Conservation Division’s Biogeography Program.

Subterranean environments contain a unique and diverse fauna: either aquatic, living in the groundwater (stygofauna), or air-breathing, living in rock voids above the water table (troglofauna). The decision by the Western Australian Environmental Protection Agency in the mid-1990s to recognise subterranean fauna as a factor to be considered in environmental impact assessments highlighted the dearth of information available to make informed decisions. Since then, research in Australia on this group of mainly invertebrates has grown exponentially. However, much of this research has focused on taxonomy, diversity and evolutionary history, and recent reviews have indicated that large knowledge gaps still exist. We know that due to their narrow ranges, high local endemism and poor dispersal capacity, subterranean fauna are vulnerable to local impacts, but the deficiencies in knowledge continue to present challenges. In early 2017, the Western Australian Biodiversity Science Institute was tasked with leading the development of a research program to improve on the current state of knowledge of subterranean fauna. The development pathway applied to this program was one that focused on iterative co-development with a diverse range of stakeholders. The shared vision of this program is to
dramatically improve confidence in assessing likely impacts of resource developments and threat mitigation strategies on subterranean fauna, by transforming our knowledge of patterns and processes in subterranean ecosystems. Here, I present the key challenges as articulated by end users, describe the research program development, and provide a synthesis of the critical knowledge gaps and research initiatives to address these.

An introduction to achieving policy impact for early career researchers

**Dr Megan Evans**1,2, Dr Christopher Cvitanovic3

1University of Queensland, Brisbane, Australia, 2Department of Environment and Science, Brisbane, Australia, 3University of Tasmania, Hobart, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
Dr Megan Evans is Principal Scientist in the Project Management Office of the Land Restoration Fund, Department of Environment and Science, Queensland Government; and Honorary Research Fellow at the Centre for Policy Futures, University of Queensland

Scientists are increasingly required to demonstrate the real world tangible impacts arising from their research. Despite significant advances in scholarship dedicated to understanding and improving the relationships between science, policy and practice, much of the existing literature remains high level, theoretical, and not immediately accessible to early career researchers (ECRs) who work outside of the policy sciences. In this paper, we draw on the literature and our own experiences working in the environmental sciences to provide an accessible resource for ECRs seeking to achieve policy impact in their chosen field. First, we describe key concepts in public policy to provide sufficient background for the non-expert. Next, we articulate a number of practical steps and tools that can help ECRs to identify and enhance the policy relevance of their research, better understand the policy world in practice and identify a range of pathways to achieving impact. Finally, we draw on our personal experiences to highlight some of the key individual characteristics and values that are needed to operate more effectively at the interface of science, policy and practice. Our hope is that the information and tools provided here can help to empower ECRs to create their own pathways to impact that best suit their individual goals, circumstances, interests and strengths.

So you want your research to have impact?

**Dr Jennie Fluin**1, Dr Daniel Rogers1

1SA Department For Environment And Water, Adelaide, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

**Biography:**
Jennie Fluin manages research partnerships between state government and the research sector. Her role is to foster and strengthen relationships between researchers and NRM decision makers, improve communication and knowledge sharing, encourage collaboration, and seek new opportunities for research partnerships.

We hear a lot from scientists about how to improve the impact of their research. In recent years there has been a plethora of journal articles, blogs, conference papers and seminars, by researchers, proffering advice on the best way to increase the value and uptake of your research to decision-makers, and how to navigate the often mysterious pathway between science and evidence-informed decisions. Most of this advice is useful, but it often fails to communicate the complexities of government decision making, and what happens to scientific information once it enters the decision making processes of
governments. How does government make decisions? How are conservation priorities developed? How is evidence synthesised? What type of research outputs are most useful? This talk will focus on what we have learnt from working as research brokers / facilitators between the research sector and a state environment department over the past ten years. While there are lots of elements to this challenge, fundamental to the success of getting science into decision making is the need for long-term, respectful relationships, and a recognition that science-to-policy is not a one-way path. We will discuss what gives science-policy relationships longevity (and what doesn’t work), what informs government priorities, and what researchers can practically do to better engage with government decision makers.

Creating science-policy engagement as a robust conversation

Dr Rachel Morgain
Australian National University, Acton, Australia

Biography:
Rachel Morgain is an interdisciplinary researcher with research interests in environment and society, science communication and the social role of science. She has a background working at the interface of science and policy and in policy research management.

Researchers in science communication have long questioned the ‘deficit’ model by which science is presented wholesale to fill a blank page, proposing in its place an ‘engagement’ model, which understands engagement as a dialogue or conversation between parties (research scientists and those not in a research role) who each have knowledge, insights and perspectives to offer. Behind this engagement approach is a recognition that this is more effective for generating meaningful shared understandings and insights that can bridge different perspectives, and lay a stronger foundation for changing practices and decisions. This applies as much to science-policy engagements as to other modes of science communication. But what does this mean in practice? This presentation will discuss the benefits and challenges involved in taking an engaged approach science-policy interactions, address a few different options in science-policy engagement such as collaboration and coproduction, and consider the circumstances where these different approaches to engagement might be usefully applied.

Psychological dimensions of effective communication - lessons for promoting evidence-based policy

Dr Angela Dean
The University Of Queensland, St Lucia, Australia

Biography:
Dr Angela Dean is a quantitative social scientist. Her research, drawing on a range of disciplines including environmental psychology, and communications, examines how to foster meaningful environmental citizenship within communities.

Successful communication between scientists and decision makers is an essential component of fostering evidence-based policy. While scientific findings need to be packaged in ways that are accessible to decision makers, effective communication is more than just transmission of scientific information. Communication success is also determined by diverse psychological factors that influence how information and our messages are processed. When evaluating complex information, it is common for people to reduce mental effort by adopting ‘mental short cuts’. Cognitive biases, motivated reasoning, and issues such as emotions and identity may restrict consideration of new information. How
a message is framed, and whether the messages are familiar or novel will also influence information transmission. This presentation will examine how psychological factors associated with our messages—message source, message content, the recipient, and the context—can all influence communication success, and discuss ways to address these issues when planning communication initiatives.

Private land conservation: a necessary strategy to improve land-use outcomes

Mr Philip Martin1
1Australian National University, Acton, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
I am an environmental field officer and developing environmental/public policy researcher with an ambition to contribute to practical initiatives and research within the natural resource management sector.

Private land conservation is a necessary strategy for addressing global challenges to biodiversity conservation, food production, sustainable development and climate change. This review analyses how the social and political dimensions of landholders influence their willingness to participate in private land conservation. Overall themes within the literature suggest principal barriers influencing landholder willingness to participate in conservation are landholder perceptions as to whether conservation practices will help landholders achieve their goals, and landholder characteristics (i.e. social and situational circumstances). We argue that over the last two decades, the conversion from community-based natural resource management to payment for ecosystem services as a principal landholder engagement strategy within Australia, has reduced landholder willingness to participate in conservation. To improve the effectiveness of extension efforts and socio-political acceptability of conservation upon private land within Australia and internationally, we recommend 1) revitalising community-based natural resource management as a cost-effective learning and responsive strategy to addressing landholder and conservation needs, 2) utilising the socio-ecological systems framework as a ‘best-use’ mixed diagnostic tool for incorporating socio-ecological information into private land conservation decision-making, and 3) utilising the socio-ecological information framework for incorporating environmental justice considerations into future private land conservation planning.
Urban Forest, meet your new sibling, Urban Ecology

Ms Lee Harrison1,2, Mr David Callow1, Dr Rodney van der Ree1,2,3
1City of Melbourne, Melbourne, Australia, 2University of Melbourne, Parkville, Australia, 3Ecology and Infrastructure International, Wantirna, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
Lee Harrison is an Ecologist at the City of Melbourne, delivering the Nature in the City Strategy. She co-ordinates a number of capital works projects, as well as integrating ecological principles into the strategic and operational functions of council.

Many cities around the world are hotspots for biodiversity and have the potential to play an important role in the conservation of biodiversity. The City of Melbourne acknowledges that healthy ecosystems form the basis of liveable cities, yet more research and collaboration is needed to translate scientific ecological principles into achievable conservation actions.

An important collaboration has developed within the City of Melbourne’s Urban Forest and Ecology team, where we translate scientific ecological and forestry principles into conservation and management actions as part the city’s strategic and operational work.

In this presentation I will outline some of the conflicts between managing our Urban Forest and Urban Ecology that are ripe for scientific investigation. I will also discuss the important ways we have learned to turn seemingly conflicting objectives into improved management of urban ecosystems and the liveability of our city.

One of the tensions we have identified between our disciplines is the need for diverse tree species to manage the multiple risks of climate change, pests and diseases, with the need to also select indigenous trees species to support whole-of-ecosystem biodiversity.

Through a commitment to evidence–based decision making, we have (i) created a framework for integrating a ‘coordinated distributed experiment’ on carved hollows into our operational work; (ii) collaborated with researchers to review and test the potential of mistletoe to provide novel ecosystem services in urban environments, and (iii) are exploring the highest and best use of trees removed from urban landscapes for ecological and social outcomes.

Designing and evaluating alternative fire management strategies using participatory scenario planning

Dr Luke Kelly1, Dr Kate Giljohann1
1University Of Melbourne, Parkville, Australia

SYMPOSIUM: Why won’t people just listen to me? Integrating ecology into environmental decisions, Hall A, November 28, 2018, 11:00 AM - 1:00 PM

Biography:
I’m an ecologist who enjoys contributing solutions to global conservation problems. My research interests are in spatial ecology, biodiversity conservation and environmental decision making. Much of my work focuses on understanding animal and plant responses to fire and climate change.

Fire has shaped Australia’s unique and globally significant biodiversity for millennia. However, the size, frequency and severity of fires are being modified by human land-use and climatic changes. There is an urgent need to make forecasts of fire and biodiversity in a complex and uncertain future. Here, we
outline an approach for assessing the robustness of alternative fire management strategies under a range of possible futures. First, by developing alternative fire management strategies using participatory scenario planning. Second, by linking biodiversity and fire simulation models to translate scenarios into predicted consequences for environmental values. Our study ecosystems are the ‘mallee’ woodlands and shrublands and ‘foothill’ forests of south-eastern Australia. We facilitated a series of scenario planning workshops with stakeholders to identify conservation and fire management objectives, alternative fire management strategies and critical uncertainties likely to influence decisions. In foothill forests, for example, participatory scenario planning helped to: identify conservation of arboreal mammals and forest owls as a regional priority; develop alternative management strategies including fixed hectare vs. flexible risk-based targets for planned burning; and highlight variation in extreme fire weather as a critical uncertainty. Spatially explicit biodiversity models and fire regime simulations were then used to translate alternative management and scenarios into projected consequences for ecosystems. Linked models indicated that fire management strategies that maintain mid- to late-successional vegetation are particularly important for conservation of priority species. Co-designing scenarios with stakeholders is a useful way to clarify objectives, generate creative solutions and build support for conservation decision-making.