Abstracts – Oral Presentations

Competitive ability of clonal versus non-clonal plants in natural communities

Mr Joshua Griffiths1, Assoc Prof Stephen Bonser1
1University of New South Wales, Sydney, Australia

Biography:
Joshua Griffiths is currently a PhD candidate at UNSW, researching the evolution of sexual and clonal reproduction in plants, as well as how reproductive strategies change in response to stress.

The competitive ability of species plays an important role in growth and fitness in habitats where coexisting species have limited resources. In plants, clonality is often associated with increased competitive ability due to benefits such as resource transfer between clonal ramets due to clonal integration. However, previous studies found no difference in competitive ability in clonal and non-clonal species, and comparisons across studies are difficult where the competitive effect of neighbours is not assessed. Here we test if clonal plants have a greater competitive ability than non-clonal plants in field experiments. We collected data from published experimental studies conducted in natural populations measuring plant performance in neighbour removal (competition) experiments. We also tested whether the type of clonal growth form (guerrilla or phalanx habit) altered the competitive ability of species. We used habitat productivity in these studies as a measure of the competitive effect of neighbours. We found that clonal plants are affected less by the presence of neighbours compared to non-clonal plants across a broad productivity gradient. We show that a clonal lifestyle does offer a competitive advantage over an obligate sexual lifestyle. The benefits also appear to be universal within clonal species, as both guerrilla and phalanx growth forms performed equally well in the presence of neighbours. Our research demonstrates the benefits of adopting a clonal lifestyle may improve individual performance and survival which offers a competitive advantage in natural communities.

Refugia and connectivity sustain amphibian metapopulations afflicted by disease

Dr Geoffrey Heard1, Professor Chris Thomas2, Dr Jenny Hodgson3, Dr Michael Scruggie4, Dr David Ramsey4, Mr Nick Clemann4
1School of BioSciences, University of Melbourne, Parkville, Australia, 2Department of Biology, University of York, York, United Kingdom, 3Department of Evolution, Ecology and Behaviour, University of Liverpool, Liverpool, United Kingdom, 4Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Australia

Biography:
Dr Geoff Heard is a Research Fellow in the Quantitative and Applied Ecology Group at the University of Melbourne. His research focuses on applied spatial ecology, particularly that of Australian frogs and reptiles.

Metapopulation persistence in fragmented landscapes depends on habitat patches that can support resilient local populations and sufficient connectivity among patches. Yet epidemiological theory for metapopulations has largely overlooked the capacity of particular patches to act as environmental refuges from disease, and has suggested that connectivity can undermine persistence. Here, we show that relatively warm and saline wetlands are environmental refuges from chytridiomycosis for an endangered Australian frog, and act jointly with connectivity to sustain frog metapopulations. We coupled models of microclimate and infection probability to map chytrid prevalence, and demonstrate a strong negative relationship between chytrid prevalence and the persistence of frog populations. Simulations confirm that frog metapopulations are likely to go extinct when they lack environmental refuges from disease and lose connectivity between patches. This study demonstrates that environmental heterogeneity can mediate host-pathogen interactions in fragmented landscapes, and provides evidence that connectivity principally supports host metapopulations afflicted by facultative pathogens.

Using ecological disturbance to conserve Fleurieu wetland assemblages: trials, pilots, processes and future experiments

Ms Rebecca Duffield1, Mr David Taylor2, Mr Andrew West2, Assoc.Prof David Paton3
1Conservation Council SA, Adelaide, Australia, 2Taylor Ecology, Bathurst, Australia, 3Natural Resources, Adelaide and Mount Lofty Ranges, Adelaide, Australia, 4The University of Adelaide, Adelaide, Australia

Biography:
Bec Duffield is the Research Ecologist with the Conservation Council of SA (involved in environmental sciences for over 17 years). She is focused on conservation of freshwater wetland systems and ecological-disturbance based management. She is currently upskilling in eco-hydrological and bio-physical assessments to better understand critical drivers of wetland health.

The Fleurieu Peninsula Swamps (FPS) are critically endangered wetlands that only persist as small disconnected patches within the landscape. The application of standard conservation practices (the removal of all forms of disturbance) 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 and long-lived species. Fire, grazing and slashing are options for creating desirable successional changes within FPS.

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The FPS Recovery Team has committed to understanding and implementing ecological disturbance in these systems. Initial work commenced over 17 years ago and has been complemented by a PhD study, a pilot study and more recently, monitoring of accidental and control burns (2012 and 2014). Currently, there is a dedicated project (called the “Fleurieu Swamp Fire Trial”) that aims to expand on the previous ecological disturbance work in FPS. The project has been judiciously developed with strategic phases over the last 18-months. The success of the project is underpinned by effective collaboration (and governance) between researchers, government, NGO, regional officer and most importantly landholders. This project has the potential to concurrently deliver measurable conservation outcomes and scientific learning’s.

This conference presentation will provide a history from 1997 to present that includes a synopsis of a) ecological disturbance work implemented b) results from monitoring c) technical challenges c) legislative and policy requirements d) operational considerations e) determination of conservation priorities f) landholder engagement and inclusion and g) how we intend to move forward.

Spotted-tailed quolls: Australia’s forgotten mesopredators.

Mr Trent Forge1, Dr Guy Ballard2, Dr Peter Fleming2
1University of New England, Armidale, Australia, 2Vertebrate Pest Research Unit, NSW Department of Primary Industries, Armidale & Orange, Australia

Biography:
Third year PhD student studying the conservation ecology of the spotted-tailed quoll (Dasyurus maculatus) in northeast NSW.

The mesopredator release predicts changes in the behaviour and/or abundance of mesopredators following the decline or removal of higher order predators. In Australia, debate continues over the role the dingo (Canis familiaris) plays, particularly regarding potential suppressive effects on two introduced mesopredators – the red fox (Vulpes vulpes) and feral cat (Felis catus). In some parts of Australia, dingoes, foxes and cats live sympatrically with an endangered native mesopredator – the spotted-tailed quoll (Dasyurus maculatus). Despite notable similarities between spotted-tailed quolls, foxes and cats, their relationship with dingoes has been largely overlooked. We study the interactions between these four predators in the biodiverse ecosystems of northeast NSW. Here we consider observed spatial and temporal relationships between dingoes and spotted-tailed quolls using data obtained from GPS telemetry and camera monitoring to discuss the implications of mesopredator release for our largest quoll.

New dimensions in understanding the ecology of leaf form: Three dimensional quantification of leaf shapes.

Mr Amit Singh1, Dr Adrienne Nicotra1
1Australian National University, Canberra, Australia

Biography:
Amit Singh is a PhD student at the ANU. His interests are in understanding mechanisms of formation and ecology and evolution of diverse leaf shapes.

The unique characteristic shape of leaves and their immense diversity has been an intriguing problem for research for the longest time. In order to quantitatively describe shapes and to understand the process of formation of diverse leaf forms, we develop a technique to translate leaf shapes based on their curvatures. Based on fundamental concepts of differential geometry and soft tissue mechanics we treat Pelargonium leaves as elastic sheet in-plane and out-of-plane deformations, which allows us to describe the global curvature of leaves as well as the waviness of the margins. This method has a wide range of applications from ecophysiology and to comparative anatomy. We aim to further develop this method towards conceptual understating of developmental and evolutionary processes in shaping leaves.

Riverine Recovery – Improving ecological functioning of the River Murray by restoring variable water levels

Mr Daniel Hanisch1, Dr Karl Hillyard1, Dr Tumi Bjornsson1, Mr Nathan Clisby1, Mr Kieran Squire1
1DEWNR, ADELAIDE, Australia

Biography:
Daniel Hanisch is an environmental water management professional who has been working as a Project Officer on the Riverine Recovery Project since early 2014. He has particular expertise in monitoring the ecological benefits and risks of environmental watering trials and projects.

River regulation and water extraction have dramatically altered the ecology of the Murray-Darling Basin, transforming the South Australian River Murray from a dynamic ionic river into a series of stable, near lentic pools. As a result, many wetlands that fringe the river are now either too wet or too dry for optimal ecological functionality. These changes to river flow, together with a reduction in overbank flooding have reduced the river’s resilience and increased its vulnerability to a range of stressors, evident in the death and dieback of riparian and floodplain forests during the Millennium drought (2006-10).

The Riverine Recovery Project (RRP), a $98 million state and federal project, aims to address this degradation by improving water dependent ecosystem health, recovering water for the environment and optimising conditions for ecological community recovery. The project will also increase community and scientific knowledge and understanding to support environmental management of floodplains, wetlands and the river channel. To achieve this, RRP is building new, or improving existing, infrastructure to better manage water across a range of spatial scales. Operation of the infrastructure allows wetland scale drying and re-inundation, floodplain inundation through better management of the existing weirs and improved water delivery and fish passage to major floodplains. Underpinning the management and operation of these sites and infrastructure is a range of investigations and surveys, clear management objectives and targets and a robust MERI framework. The project is delivered with collaborations between government, the scientific community and the general public, including landholders and traditional owners.
The ecology of male and female vocal tutoring in an Australian songbird

Ms Christine Evans1, Professor Sonia Kleindorfer1

Flanders University, Adelaide, Australia

Biography:
I am a PhD student from Adelaide, Australia studying the ontogeny of male and female song in the Superb Fairy-wren. My research interests include bioacoustics and behavioural ecology.

Female song is widespread and ancestral in songbirds, yet extant females generally sing less than males. We propose that predation poses an ecological constraint for singing females at the nest, and females are therefore less successful vocal tutors than males. Our study system is the Superb Fairy-wren, Malurus cyaneus, in which both males and females sing solo song to defend the year-round territory. We test if there is a fitness cost (nest predation) to vocal tutoring effort (song rate) in males and females, and if there are sex differences in vocal tutoring success as measured by vocal repertoire in parents and offspring. Male song was longer and more complex than female song. Female, but not male, song rate predicted nest predation, as females were more likely to sing from inside the nest during incubation and brooding. Pairs had comparable element diversity whereby the songs per pair had shared elements (same element found in male and female) and unique elements (different element in male versus female). The fledgling song contained shared elements and unique elements from both male and female vocal tutor. Surprisingly, the fledgling song had a significantly higher proportion of unique female vocal elements. Increased predation risk should select for less singing behaviour in females, which we found; but the fact that females got a larger percentage of their unique elements into the next generation means they are more effective vocal tutors.

Parthenium hysterophorous invasion changed soil pH and altered soil nematode assemblages and food web structures

Dr Olusegun Osunkoya1,2, Ms Layla Lim2, Dr Olufemi Akisanmi2, Ms Jennifer Cobon2, Ms Juliane Henderson6, Ms Perrett Christine7, Dr K Dhileepan2

1James Cook University, College of Marine & Environmental Sciences, Cairns Campus, Australia; 2Biosecurity Sciences, Department of Agriculture & Fisheries, Dutton Park, Brisbane, Australia; 3The University of Queensland, Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation, Brisbane, Australia; 4The University of Queensland, Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation, Brisbane, QLD 4102; 5Horticulture and Forestry Science, Department of Agriculture and Fisheries, Brisbane, Australia; 6The University of Queensland, Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation., Brisbane, Australia; 7Invasive Plant and Animal Science Unit, Biosecurity Sciences, Department of Agriculture and Fisheries, Brisbane, Australia; 8Invasive Plant and Animal Science Unit, Biosecurity Sciences, Department of Agriculture and Fisheries, Brisbane, Australia

Biography:
I am a plant population biologist with interest in forest ecology and biological invasion, currently teaching at JCU Cairns Campus. Prior to that, I worked as a research scientist within Queensland Biosecurity Unit and also taught Ecology at the University of Newcastle, NSW, and the Universiti Brunei Darussalam, SE Asia.

Parthenium hysterophorous L. (Asteraceae) is an annual weed of national significance in arable/non-arable grasslands and in riparian corridors of central-western Queensland Australia. We collected soil sample in Parthenium infested and non-infested vegetation patches across eight sites of varying land-use types in Queensland, and analyzed them for physico-chemical and biotic contents, including enzyme activity, and nematode assemblage. The weed established in various soil types from rich clay to fine sand aggregates. We found no difference in major nutrients of N, P, and K, and in total, organic and labile carbon in response to infestation. Nonetheless, close to 50% of the 20 soil chemical traits showed significant infestation effects. A lowered pH, elevated Nitrogen in form of nitrate and ammonium ions, higher trace ions of chloride, Ca, Mg, and heavy metals of Cu, Zn and Fe were detected in the infested soil patches. Parthenium infestation increased the activity of β-glucosidase but not that of Fluorescein Diacetate hydrolysis enzymes. The phenomenon has no effect on soil total nematode abundance, but it increased the abundance of certain trophic groups, especially the fungal-nematodes and to a limited extent – the bacteria and predator/omnivore groups. These results indicated that Parthenium might not improve soil fertility directly, but through it roots allelochemicals, influenced soil pH and nutrient cycling, which in turn impact on fungivorous-nematodes with consequent changes in bacteria to fungi biota. This way, it creates a positive-feedback, making the soil substratum favourable for its own growth at the expense of co-occurring native plant species.

125 living kakapo: can we learn from the dead? Using museum specimens to aid conservation.

Dr Lindsey Gray1

1University of Sydney, University of Sydney, Australia

Biography:
Currently I am working on Kakapo.My PhD was in evolutionary biology and nutritional ecology. I used Drosophila as a model. Prior to this I was an Operation Nest Egg kiwi keeper for the National Kiwi Trust in New Zealand. My honours was on plague locust behaviour and neurophysiology.

19th Century natural historian’s enthusiastic collecting of bizarre antipodean organisms, combined with present day threatening processes, has led to individuals of many endangered species being numerous preserved in museums than live in the wild. The evolutionarily incomparable parrot, the kakapo, is no exception. While 125 living kakapo persist in New Zealand, entirely dependent on intensive conservation management, many 100s of historic kakapo ‘study specimens’ are held across museums worldwide, presenting as un-tapped research resources.
Museum specimens can act as portals to the past yielding information valuable to the future. My study uses historic kakapo specimens, collected in the 1870’s, to gather information relevant to current Kakapo conservation management practices and to gain insight to the culture of 19th Century biology.

My research program has four domains from which I will present findings:
1) With Dr Bruce Robertson (Otago University) using ancient-DNA techniques to identify changes in genetic diversity between the tiny modern population and historic populations of kakapo to inform mating pedigrees;
2) Comparing bill and claw morphology between modern and historic specimens to identify changes due to inbreeding and/or captive management practices (e.g. artificial diets);
3) With Dr Matt Renner (National Herbarium of NSW), identifying the bryophytes used as in situ specimen-stuffing by 19th Century field collectors to determine past kakapo habitat type and potential location;
4) Together with the ancient-DNA work, using museum archives to determine the provenance of the Macleay Museum Kakapo collection, adding breadth to our knowledge of 19th Century natural history networks.

That big tree’s not from around here – provenance decision-making during uncertain times.

Mr Nicholas Gellie1, Dr Martin Breed1, Professor Andrew Lowe1
1School of Biological Sciences and the Environment Institute, University of Adelaide, North Terrace, SA 5005, Australia, Adelaide, Australia

Biography:
Nick Gellie is a PhD candidate in Professor Andrew Lowe’s lab group. Our research group includes infrastructure for large scale ecosystem monitoring, forensic timber tracking technologies, biogeography and restoration genetics. By using genetic tools and phenotypic data from field experiments he aims to contribute to more successful restoration practices.

An estimated 2 billion ha of degraded land drives the global call to restore 370 million ha by 2030, a target with no historical precedent. This mobilisation will require the optimal use of limited seed resources, and seed provenance can have a significant impact on restoration success. Local provenancing is the conventional seed collection strategy, as it’s based on the assumption that local is best. This conservative view places less emphasis on the effect of climate change and does not incorporate the impacts of habitat fragmentation. To test whether local seed is best, we established a common garden experiment of ca. 500 seedlings from a local and two non-local provenances of Eucalyptus leucoxylon ssp. leucoxylon across an aridity gradient in the Mount Lofty Ranges of South Australia. We collected fitness proxy data after 2 years of the trial, including survivorship, height, invertebrate herbivory and physiological stress. We found that the local provenance was outperformed by both non-local provenances for all fitness proxies. Our results show that strict use of local provenances would generate suboptimal restoration outcomes. Particularly if conditions continue to shift towards a more arid environment with climate change. Synthesising our results in light of current restoration practices suggests that field experiments embedded within restoration projects that address topical issues can provide adaptive management options that currently do not exist.

Climate change predictions and future control prospects of invasions

Dr Ben Hoffmann1
1CSIRO, PMB 44 Winnellie, Australia

Biography:
Dr Ben Hoffmann’s research focuses on improving management outcomes against invasive ants. He has conducted extensive research into the biology of invasive ants, and provides support for many eradication programs. He is an invited member of the IUCN Invasive Species Specialist Group, and represents CSIRO on the National Biosecurity Management Consultative Committee.

Thousands of species have and are being accidentally dispersed by people outside of their native ranges. Opinion is that invasive species are predicted to increase their influence with climate change. However, I will present recent work that has shown that this is not necessarily the case for most of the current suite of invasive ants, and instead changing conditions may lead to a rise of a new suite of invasive species. I will also show how numerous invasive species are expected to have their habitat suitability changed from now with climate change both globally and within the world’s biodiversity hotspots. Additionally, species dispersing into new environments and experiencing climate change may also experience adaptive change. I will present recent work showing dramatic morphological change at a global scale, which will “set the scene” for what to expect for other species. Finally, despite a very poor history of dealing with ant invasions, recently more than 100 eradication programs have been achieved, making ants one of the most eradicated taxa in the world. These successes are expected to increase exponentially in the near future. I will provide a broad overview of ant eradications, detail what information, technologies and techniques are needed to improve ant eradications, and provide insight into what is predicted to provide the greatest change for all invasive species management within 10 years.

Key trends in the ecological impacts of climate change

Professor Barry Brook1, Dr Damien Fordham
1University of Tasmania, Hobart, Australia

Biography:
Fundamental species traits across a latitudinal gradient: does the competition-colonization trade-off hold true?

Ms Sally Bracewell, Professor Emma Johnston¹, Dr Graeme Clark¹
¹University of New South Wales, Sydney, Australia
Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Sally Bracewell is a marine ecologist with a background in intertidal and subtidal ecology. She is interested in understanding how community composition and species traits vary across large biogeographic scales in response to environmental and evolutionary gradients. Currently, her work is focused on marine sessile invertebrates across 3000km of Australia’s east coast.

One of the most common explanations for species coexistence is that trade-offs in species traits prevent any one species from excluding all others. The competition-colonization trade-off is a classic example, whereby species can spatially coexist if there is an inverse relationship between colonizing and competitive abilities. The strength of the trade-off is predicted to vary with latitude due to environmental and evolutionary gradients. In sessile invertebrates, patch size can be used as a tool to measure the strength of trade-off. This is because smaller patches are more difficult targets for larvae so are usually dominated by good colonizing species with high fecundity, whereas good competitors with lower fecundity can more easily find larger patches where they can grow and dominate. We measured the strength of trade-offs across 20 degrees of latitude by deploying patches of various sizes in the field. There was clear evidence for the trade-off, and the strength varied with latitude. Latitudinal variation was likely due to variation in the rate of ecological processes, particularly resource acquisition and competitive exclusion. Trade-offs were most evident at locations where resource limitation had been reached, indicating that the strength of the trade-off is mediated by resource availability.

Don’t panic everywhere: applying a framework for guiding landscape management response under a changing climate

Sally Maxwell, Dr Daniel Rogers¹
¹SA DEWNR, Adelaide.
Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
The challenges of a changing climate for native biodiversity can be overwhelming, particularly in the context of other threats. The impacts of climate change on biodiversity depend not only on the magnitude of climate change and the sensitivity of biota to this change, but also on the adaptive capacity of biota to respond. These will vary between landscapes and ecosystems, and therefore our management response to climate change should also vary depending on this context. We have applied this framework to the agricultural landscapes of South Australia, by populating two ‘axes of concern’ – climate sensitivity and resilience – demonstrating the utility of such a framework in guiding generic management response at landscape scale. This demonstrated that our options for strategic response to climate change vary among these landscapes depending on inherent climate sensitivity, and, importantly, on the intensity and timing of landscape modification. We discuss the issues we faced in populating the axes and provide caveats in using such an approach.

Why does germination strategy of Oreomyrrhis eriopoda (Apiaceae) plants vary within and among populations?

Ms Annissa Satyanti¹,², Dr. Lydia Guja²,³, Assoc Prof. Adrienne Nicotra¹
¹Research School of Biology, the Australian National University, Acton, Australia, ²The Australian National Botanic Gardens, Canberra, Australia, ³Center for Plant Conservation - Bogor Botanic Gardens, Indonesian Institute of Sciences, Bogor, Indonesia, ⁴Centre for Australian National Biodiversity Research, Australia
Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Annissa Satyanti, currently a PhD student in the Nicotra Lab, is a seed researcher at the Center for Plant Conservation, Bogor Botanic Gardens. Previous projects include: West Java limestone flora (PI, grant: Rufford Foundation UK), and germination of native biofuel plants (PI, grant: Humboldt Foundation/ Regensburg Universität Germany).
The timing of germination, regulated by seed dormancy mechanisms, is a key life-history trait that may strongly influence plant fitness and survival. We examined intraspecific differences of germination pattern among 21 populations of Oreomyrrhis eriopoda to understand whether contrasting selection pressures associated with environmental conditions explain variation in seed dormancy patterns. Seeds were collected across the distribution of the species, spanning high country regions from the Australian Capital Territory in the north to Tasmania in the south, along an elevation gradient of 1500 m. Germination assays ran for 34 weeks including an eight week cold stratification and early seedling growth was recorded. Three patterns of germination were observed. Seed from some populations germinate immediately, without cold stratification, and so will produce autumn seedlings. Other populations germinate following cold stratification and thus would produce spring seedlings. Finally, some ‘stagged’ populations germinate both prior to and after cold stratification and thus produce both autumn and spring seedlings. There were no significant differences between early seedling leaf morphology, i.e. SLA, longest leaf, and average leaf length, among germination strategies. However, across strategies the established spring seedlings had fewer leaves than autumn seedlings. Germination strategy could not be explained simply by temperature, precipitation or radiation conditions at site of origin, but were somewhat associated with elevation. The results suggest that the more seasonal, higher elevation environment selects for a postponed seed germination strategy, while populations at lower elevation, and perhaps more unpredictable environments, tend to show more variation in germination strategy.

Light-driven tipping points in polar ecosystems

Dr Graeme Clark1, Dr Ben Raymond2, Dr Martin Riddle2, Dr Jonathan Stark2, Dr Ezequiel Marzinelli1, Professor Emma Johnston1

1University of New South Wales, Sydney, Australia, 2Australian Antarctic Division, Kingston, Australia

Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Graeme Clark is a benthic ecologist at UNSW, Sydney. His main research interests are Antarctic ecology, invasive species, and human impacts to coastal marine environments.

Some ecosystems can undergo abrupt transformation in response to relatively small environmental change. Identifying imminent “tipping points” is critical for biodiversity conservation, particularly in the face of climate change. Here we identify a nonlinear relationship between the timing of ice melt and the amount of light that some ecosystems receive annually, and describe how this may induce widespread regime shifts in polar ecosystems. We demonstrate the principle on Antarctic shallow seabed ecosystems, which data suggest are sensitive to small changes in the timing of sea-ice melt. Algae respond to light thresholds that are easily exceeded by a slight reduction in sea-ice duration. Earlier sea-ice loss is likely to cause extensive regime-shifts in which endemic shallow-water invertebrate communities are replaced by algae, reducing coastal biodiversity and fundamentally changing ecosystem functioning. Modeling finds that recent changes in ice and snow cover have already transformed annual light budgets in large areas of the Arctic and Antarctic, and indicates that both aquatic and terrestrial ecosystems will experience further significant change in light. We present spatially-explicit predictions of where vulnerable shallow Antarctic habitats are likely to occur, and a recently documented example of the reverse transition.

Detecting patterns in global assemblages of insect pests: Incorporating zeta diversity into pest risk analyses

Ms Mariona Roige1, Associate Professor Melodie A McGech2, Dr Guillaume Latombe2, Professor Cang Hu2, Associate Professor Susan P Worner1

1Bio-Protection Research Centre, Lincoln University, Lincoln 7640, New Zealand, 2School of Biological Sciences, Monash University, Melbourne 3800, Australia, 3Centre for Invasion Biology, Department of Mathematical Sciences, Stellenbosch University, Matieland 7602, South Africa

Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Mariona Roige holds a Bachelor in Economics and a Masters in Environmental Sciences from the University of Girona (Spain). In her PhD she is exploring the complex relationships in insect pest communities and finding ways to understand their composition. She is strongly interested in ecological modelling and invasion ecology.

The study of the global distribution of insect pest assemblages sits somewhere between biogeography and community ecology, and has potential to provide powerful insights into ecological processes at a global scale. Previously, research on the composition of global pest assemblages has been very useful in pest risk assessment (PRA). Such research involves clustering insect pest communities using modelling approaches such as self-organizing maps (SOM). The SOM approach has been used to create ranked lists of invasion risk for many taxa of potentially invasive species, including insects, fungi and bacterial plant pathogens. However, the results of the SOM approach have not yet been fully studied from a community ecology perspective. The aim of this research was to apply the newly conceptualized zeta diversity metric to 1) validate the classification results of the SOM approach, and 2) provide a quantitative measure of uncertainty for the pest risk analysis process, serving as a threshold value for the interpretation of the ranked lists. In contrast to classic pair-wise beta diversity measures, the zeta diversity metric is able to handle multiple assemblages, a feature that makes it suitable for investigating the global composition of the insect pest communities after the SOM clustering. The results of this study are expected to improve quantitative methods for PRA, as also provide mutual validation for the value of SOM and the zeta diversity metric for analyzing community patterns.

Coordination of leaf and wood traits and hydraulic properties across woody species of eastern Australia.

Dr Melanie Zeppel1, Dr Amy Zanne2, Dr Anna Richards3, Dr Tanja Lenz4, Dr Ian Wright1

1University of Tasmania, 2Department of Botany, University of Adelaide, South Australia, 3School of Biological Sciences, Monash University, Melbourne 3800, Australia, 4School of Biological Sciences, Monash University, Melbourne 3800, Australia

Climate Change (1), Ballroom C, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Melanie Zeppel is a plant ecologist at the University of Tasmania. Her main research interests include climate change impacts on forest ecosystems and carbon sequestration in forests.
Background
Water transport in plants is driven by supply (e.g. branch conductivity) and demand (e.g. size of evaporative surface), regulated by stomatal conductance and environmental factors. Water storage in sapwood provides a buffer against external variability in water availability, allowing species to photosynthesise longer into the day, or longer into a dry spell. While numerous studies have quantified relationships among key supply-demand traits, the manner in which water storage is coordinated with supply-demand is still poorly understood, as is coordination with leaf properties describing the ability of leaves to maintain function at low water potentials (e.g. turgor loss point, TLP). Here, for a wide range of woody species from eastern Australia, we quantified relationships between clusters of traits indexing: sapwood water storage potential, sapwood anatomy, hydraulic conductivity, leaf resistance to wilting, and leaf:stem deployment. Together, these trait-clusters describe the overall hydraulic “strategy” of species.

Results:
Higher potential for sapwood water storage was associated with lower density wood, higher proportion of cross-section that was vessel lumen, larger total leaf deployment per sapwood cross-section, and negative TLPs. There was strong patterning with site rainfall, high-rain species falling at the high water-storage end of each of these relationships. Not only did dry-site species show less-developed ability to store water in sapwood, they also tended to show lower variation among species in all measured traits (strong evolutionary convergence). These results provide compelling evidence for coordinated variation in multiple facets of plant hydraulic strategy, and potential for better predicting species range-shifts under future climates.

Climate Change: Transforming our Forests

Dr Niels Brouwers1, Dr Katinka Ruthrof1, Dr Melanie Zeppelin1, Professor Giles Hardy1, Dr George Matusick3,1
1Macquarie University, Centre of Excellence for Climate Change, Woodland and Forest Health, , 2CSIRO, 3The Nature Conservancy.

Biography:
Since 2010, I have been affiliated with the Centre of Excellence for Climate Change, Woodland and Forest Health at Murdoch University. My research interests are in the fields of forest and landscape ecology, with a particular focus on informing conservation and sustainable land management.

Global changes in climate are increasingly affecting forested ecosystems in Australia and around the world. The most striking examples of these effects have been reported in relation to extreme climatic events, such as droughts and heatwaves. In response, dominant tree species have shown distinct periods of severe dieback and mortality, resulting in major changes in forest structure and composition. Less visible, but equally important, are changes in forests driven by gradual long-term changes in temperature and rainfall. These gradual climatic changes increase tree mortality rates, and decrease growth and health. The primary negative flow-on effects of these processes are the reduction in biodiversity as well as a decrease in the potential for long-term carbon uptake and storage in forest ecosystems.

In Australia, the majority of work in relation to climate change processes and their effects on forested ecosystems has been focusing on extreme climatic events, primarily on droughts. There is, however, a real lack of studies looking at the effects of long-term climate trends and their effects on forest health. Several regions in Australia have progressively become drier and warmer over the last five decades and are projected to continue this trend. In these regions, such as the southwest of Western Australia, the aforementioned forest change processes have become more prominent in recent times. To effectively counter the changes, we have to better our understanding of where, when, and what kind of changes are likely to occur through long-term monitoring and research.

‘Good Years’, not ‘Crippling Droughts’ are danger periods for many arid species

Dr John Read1
1Ecological Horizons, University of Adelaide, Kimba, Australia

Biography:
Dr John Read's research interests have evolved from the ecology of arid zone wildlife to proactive means of addressing their key threats, especially feral animals, invasive weeds, and unsustainable industry. John is the author of over 80 scientific papers and two books.

Inevitable dry periods in the Australian arid zone can be crippling for farmers and unappealing for tourists and policy makers who typically embrace our deserts mainly when waterbirds and wildflowers respond spectacularly to unpredictable rainfall events. Ecologists too sometimes assume that droughts are the key threatening periods for many plants and animal species, despite these species possessing adaptations to low rainfall. In this presentation I outline how the key threatening processes for many desert plants, animals and indeed ecosystems are the real beneficiaries of...
high rainfall periods. Population booms of feral animals, invasion and expansion of transformer weeds like buffel grass and favourable conditions for devastating fires are all enhanced in wet years. These threats are magnified in fertile areas typically considered to be refuges for many species. Recognition of the climatic and landscape drivers of these threatening processes will inform threat abatement planning and also selection of optimal refuge or sanctuary sites in the Australian arid zone.

Lightweight unmanned aerial vehicles or drones do revolutionise population monitoring

Dr Rohan Clarke¹, Mr Shane Baylis¹, Mr Ashley Herrod¹, Mr Rowan Mott¹, Mr Jarrod Hodgson¹

¹Monash University

Biography:
Dr Rohan Clarke is an ecologist at Monash University. His research interests focus on the ecology of Australian fauna, especially birds and the management and mitigation of threatening processes. Recent research includes leading the monitoring program for birds as part of the post Montana Oil Spill assessment.

Much has been published about unmanned aerial vehicles (UAVs) and their potential to reshape ecological monitoring. Practitioners continue to refine UAV sampling protocols, demonstrate functionality of consumer packages and improve understanding about the complex issues surrounding wildlife disturbance. Despite the predictions of ‘great things to come’, the benefits of UAVs for population monitoring compared to traditional methods at a biologically relevant scale have not yet been demonstrated. This is achieved here through UAV monitoring of breeding seabird colonies. We show UAV counting provides count sizes similar or consistently higher with a level of precision that is an order of magnitude greater for complex seabird colonies in both tropical and subantarctic environments when compared with concurrent monitoring undertaken using traditional methods. While the uptake of UAVs for wildlife monitoring is likely to be rapid, careful consideration will be required to transition traditional monitoring programs without loss of data continuity.

Assessing risk of ecosystem collapse in habitat-mosaics using the IUCN Red List criteria.

Mr Peter Mahoney¹

¹Macquarie University, Sydney, Australia

Biography:
Peter Mahoney is a second year PhD student investigating the impacts of thematic scale in assessing the risk of collapse in estuarine ecosystems.

Assessment of risk to biodiversity is increasingly focused at the scale of the ecosystem. However, schemes for assessing risk of ecosystem collapse have primarily been applied to terrestrial vegetation communities, often defined by a single characteristic species. We consider, using estuaries as an example, how such schemes might be applied to ecosystems incorporating habitat mosaics. Functional mosaic-ecosystems, including estuaries, are characterised by habitat heterogeneity, connectivity between patches, the capacity of constituent habitats to be self-sustaining, and complex trophic structures containing apex predators. Additionally, in aquatic ecosystems such as estuaries, the biomass tends to be dominated by benthic as opposed to pelagic species. Hence, homogenisation of habitat types, decreased connectivity, recruitment failure, loss of apex predators and, in aquatic ecosystems, a decreased ratio of benthic to pelagic biomass may each be symptoms of a trajectory towards collapse in mosaic ecosystems. The boundaries of many mosaic ecosystems are defined by geomorphology, topography and/or water bodies, rather than by the distribution of a single habitat. Hence, risk assessment criteria based on a decline in distribution may not be useful tools for assessing risk of collapse in mosaic ecosystems. Furthermore, because some mosaic ecosystems are topographically constrained to small sizes, assessments based on area of occupancy may over-inflate risk. Instead, criteria based on abiotic and biotic changes may be more useful for risk assessments of mosaic ecosystems. Hence, long-term monitoring programs tracking the status of characteristic biota and/or abiotic variables that are causally linked to decline are essential for risk assessment of mosaic ecosystems.

AusPlots surveillance monitoring: Evaluating foundations in the rangelands.

Mr Emrys Leitch¹, Mr Ian Fox¹, Mr Ben Sparrow¹, Mr Rick Flitton¹, Mr Finn Hutchings¹, Ms Christina Pahl¹, Dr Andrew Tekmakoff¹, Ms Sally O’Neill¹, Professor Andrew Lowe¹,²

¹TERN Ausplots, Adelaide, Australia, ²University of Adelaide, Adelaide, Australia

Biography:
Emrys Leitch studied at the University of Adelaide and has a passion for arid flora. He has worked extensively in the arid and semi-arid zone across Australia. Emrys is interested in understanding how landscape processes including fire, grazing and invasive species affect vegetation communities.

Beginning in 2010 AusPlots Rangelands has employed a four stage stratification process for site selection. Stage 1 involved a hierarchical cluster analysis of all Australian bioregions to produce ‘groups’ of similar bioregions across Australia. These were then prioritised at a workshop of national...
agency and expert ecologists and 21 ‘groups’ were selected for potential sampling locations. Stage 2 involved a process of consultation with jurisdictions, analysis of previous surveys and identification of data gaps before selecting representative bioregions to sample. Stage 3 involved stratifying areas of interest within bioregions based on sub-regions; land system and land unit stratification maps; and information on disturbance and historical monitoring regimes to select broad areas of interest within the bioregions. The 4th stage is the selection of the sites on the ground and is based on ensuring homogeneity of the plot with a consistent mix of vegetation, slope, relief and soil.

In this presentation we will discuss how this process has been implemented across the rangeland bioregions where more than 400 plots have been established using the Ausplots Rangelands method. We will compare structural summary descriptions from on the ground data with data from NVIS major vegetation groups (MVG) and Subgroups, Hutchinson climatic data, Landform Patterns from the regolith of Australia and the Latest Interim Bio-regionalisation of Australia We will show how this process has defined current gaps in our sampling and how it is driving decisions on future work to provide national scale baseline ecological data across arid and semi-arid Australia.

Assessing risks to ecosystems: the IUCN Red List of Ecosystems

**Dr Emily Nicholson**, Professor David Keith

Deakin University, Burwood, Australia, +UNSW, Sydney, Australia

Environmental Management and Monitoring (1), Balcony Rooms 3-4, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**

Dr Emily Nicholson’s research aims to find solutions to conservation problems, including new methods for measuring change in biodiversity, quantifying risks to biodiversity, and making conservation decisions. She completed her PhD at the University of Queensland, with Hugh Possingham and Bob Pressey, and postdocs at Princeton, Imperial College London and University of Melbourne.

Ecosystem-level management is increasingly the focus of governments, NGOs and scientists, across fisheries, natural resource management and biodiversity conservation. Effective management relies on understanding the risks to biodiversity at the ecosystem-level. The Red List of Ecosystems was developed over the last decade to provide a set of transparent, repeatable and quantitative rules for assessing the risk of ecosystem collapse, and culminated in their formal adoption by the IUCN (International Union for the Conservation of Nature) in May 2014. The criteria place ecosystems within a threat category based on quantitative assessments of (A) change in distribution, (B) restricted distribution, (C) change in abiotic processes, (D) change in biotic function, and (E) quantitative risk analysis through process-based modelling.

In this presentation, I will give an overview of the IUCN Red List of Ecosystems, and how the criteria can be applied across diverse ecosystems illustrated with case studies including: the Coorong Lagoon, woodland and kelp forest ecosystems. I will discuss future directions and applications of the Red List of Ecosystems, including its integration with ecosystems services, plans for global assessments, and future research needs. The aim of the presentation is to gain feedback on the criteria from the Australian ecological community, and to seek further collaboration to expand robust assessments of diverse Australian ecosystems, particularly with the view of establishing an Australian Red List of Ecosystems, to improve methods for tracking biodiversity change and focussing management efforts.

Monitoring waterfowl populations using high-resolution images from UAV surveys

**Dr John McEvoy**, Dr Paul McDonald, Prof Graham Hall

Zoology, ERS, University of New England, Armidale, Australia

Environmental Management and Monitoring (1), Balcony Rooms 3-4, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**

Dr John McEvoy is a postdoctoral researcher in Zoology at UNE. His research focusses on the movement behaviour of nomadic species and specifically how they utilise information from environmental cues on different temporal and spatial scales. Current work includes using UAV and satellite tracking technology to inform evidence-based wildlife management decisions.

Current monitoring of waterfowl populations in Australia relies heavily on manned aerial surveys which can be costly and rely on the skill of a small number of observers. Given the highly mobile nature of Australian waterfowl, the fact that many important wetlands are ephemeral or semi-permanent and the costly nature of manned aerial surveys we propose utilising cutting edge photographic equipment in conjunction with unmanned aerial vehicles (UAVs) which can be deployed to target wetlands (selected from up to date satellite imagery) with minimal disturbance to birds. This approach yields a large dataset of high quality images which can be analysed by a team of trained observers or potentially by an automated image recognition process. We will present initial results of UAV surveys of wetlands in NSW revealing a high quality dataset allowing for easy identification of small to medium sized water bird species.

Too much of a good thing: How can eucalypts with abundant nectar promote pollinator movement?

**Ms Hayley Merigot**, Associate Professor David Paton, Associate Professor Jose Facelli

The University of Adelaide, Adelaide, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM
Nectar rewards are used by eucalypts to attract bird and insect foragers and facilitate cross pollination. Heinrich and Raven (1972) suggest that nectar rewards must be sufficient enough to attract and sustain foragers, but not too great to promote forager movements to other flowering plants. However, many eucalypts produce large floral displays and may provide enough nectar to sustain the daily energy requirements of many foragers. If eucalypts do provide abundant nectar how can they encourage pollinator movements between trees?

The flowering phenology of eucalypts is poorly documented. Particular flowering patterns may influence pollinator movement. First, a ten year dataset on flowering of Eucalyptus leucoxylon in the Mt Lofty Ranges, South Australia, shows asynchronous plant flowering within and between populations. Second, individual eucalypts only make some of their flowers available at one time and this varies over a flowering season such that not all flowers are available at once. Asynchronous flowering may lead to different levels of pollination success; early, mid and late flowering individuals and populations may experience different pollinator abundance. Regional asynchrony may encourage long distance movement of birds potentially dispersing pollen over wide areas. Asynchrony may also force insects to move between trees over a flowering season.

Flowering phenology provides a base for assessing if climate related temperature and rainfall changes will disrupt eucalypt flowering. A change in the timing and duration of plant flowering regionally and within populations could have detrimental effects on pollinators.

The contribution of non-bee insects to global crop pollination

Dr Romina Rader

1University of New England, Armidale, Environment and Rural Science, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM

Wild and managed bees are well documented as effective pollinators of global food crops of economic importance. Yet, the contributions by insects other than bees have been little explored despite their potential to contribute to crop production and stability in the face of environmental change. "Non-bee" pollinators include flies, beetles, moths, butterflies, wasps, ants, birds and bats among others. In this study, we investigate 37 studies distributed worldwide that directly measured non-bee and bee pollination and compared their respective contributions to crop pollination. We found that non-bees performed 25-50% of the total number of flower visits. Despite being less efficient than bees on a per visit basis, they effectively transferred pollen in the 11 studies where this was measured. In the 15 studies that measured fruit set, fruit set increased with non-bee visits independently of bee visitation rates. Finally, we show that non-bees are not as reliant on the presence of remnant natural or semi-natural habitat in the surrounding landscape as bees, likely due to differences in life history characteristics, i.e. body size, diet and/or mobility (20 studies). These results suggest that non-bee pollinators play a significant role in global crop production and respond differently to bees with respect to landscape structure. Non bees provide a valuable service and potential insurance when bees are absent, not active or under threat from bee-specific pests and diseases.

Review of the reliability of nectar storage before sugar analysis and implications for results.

Ms Bianca Amato1, Dr Sophie Petit1

1University of South Australia, Mawson Lakes, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM

Nectar sugar characteristics (mass, concentration, and ratios) are common measurements in ecological studies of plant-pollinator interactions. Nectar sugar concentration can change quickly after sampling, and inappropriate nectar storage between collection and analysis can give inaccurate results. In spite of their great significance to ecological research, optimal nectar storage methods have been the focus of few investigations. The aims of this review were to examine nectar sugar stability in storage, assess storage methods, and make recommendations for nectar storage. Hydrolysis of sucrose converts the disaccharide molecule into glucose and fructose. The presence of invertase and microbial activity can accelerate hydrolysis and alter nectar chemistry. While invertase and microorganisms appear in some plants and nectar, their influence once nectar is stored has not been studied. To prevent the alteration of nectar sugars before chromatography analysis, nectar is stored as a liquid or spotted and dried on filter paper. Either form can be frozen or refrigerated, an antimicrobial agent can be added to liquid nectar, a desiccant can be stored with the filter paper, or a combination of these treatments can be used. Nectar stored on filter paper is removed by washing it with a solvent. Elution methods are often complex, unverified, and mostly unreported in published work. Ideally samples should be analysed as soon as possible. Biologists need to
report their storage treatments (storage and elution methods, and the duration nectar is stored) to legitimise comparisons among independent studies. It is imperative that storage methods be quantified to ensure results are reliable.

Platykurtic pollen dispersal by honeyeaters and cryptic spatial genetic structure in Eucalyptus caesia (Myrtaceae)

Ms Nicole Bezemer1, Professor Stephen Hopper1, Dr Siegfried Krauss2,3, Dr Cameron A. McConchie3, Dr David Roberts1,2
1Centre of Excellence in NRM, University of Western Australia, Albany, Australia; 2Botanic Gardens and Parks Authority, Kings Park and Botanic Garden, West Perth, Australia; 3School of Plant Biology, University of Western Australia, Crawley, Australia; 4Research School of Biology, ANU College of Medicine, Biology and Environment, Canberra, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

Nicole Bezemer commenced her PhD candidature with UWA’s Centre of Excellence in NRM in June 2015. Prior to that, she attended the University of Tasmania and completed a Bachelor of Science majoring in Botany in 2013. In 2014, she completed first-class Honours in Botany at the University of Western Australia.

Pollination by animals typically results in a leptokurtic pollen dispersal distribution due to optimal foraging behaviour. However, complex social interactions amongst highly mobile honeyeaters in temperate Australia may result in different mating patterns to those typically observed in insect-pollinated plants. To test whether pollination by honeyeaters enhances genetic diversity in insular plant populations, mating patterns, realised pollen dispersal and spatial genetic structure were examined in a stand of Eucalyptus caesia. Nine microsatellite markers were used to genotype the entire adult stand (n = 412) and 181 seeds from 28 capsules collected from six trees. The estimated population size, based on the number of unique multilocus genotypes, was 203. MLTR analysis revealed low correlated paternity (rp = 0.136 ± 0.048) and paternity analysis revealed high outcrossing rates (population = 0.72) and high multiple paternity, with 4.6 sires for every 6.5 seeds in a capsule. There was a weak negative relationship between outcross mating events and geographic distance (P = 0.004, R = -0.349), and the overall distribution was platykurtic (K = -0.881). Despite extensive pollen dispersal within the stand, there was evidence of genetic differentiation (FST = 0.054 – 0.059), with weak spatial clustering of plants within each of three genetic groups identified by STRUCTURE analysis. These results suggest that large-scale recruitment events are extremely rare in the study population. Platykurtic pollen dispersal within stands by honeyeaters may enhance genetic diversity over long periods and counter the potential loss of genetic diversity in naturally or recently fragmented populations.

Pollinators and mating system of Calotropis procera (Ait.) W.T. Alton (Asclepiadaceae) in an invaded range

Mr Enock Mengen1, Dr Graham Brown2, Dr Cameron A. McConchie3, Prof Michael J. Lawes1
1Charles Darwin University, Darwin/Casuarina/Darwin, Australia; 2NT Museum, Darwin, Darwin, Australia; 3Department of Resources, Plant Industries Group, NT Government, Australia, Darwin/Benimah/Darwin, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

Enock O. Menge is a PhD researcher in Charles Darwin University. His research interest centres on the assessment of the invasiveness of rubber bush (Calotropis procera). The project covers the biology and ecology culminating in development of distribution models of rubber bush throughout Australia. He holds BSc and MSc (Agriculture).

Pollination is a critical determinant of an invasive plant’s fecundity and range expansion. Rubber bush (Calotropis procera (Ait.) W.T. Alton (Asclepiadaceae)) is invasive but has a complex flower with saccate pollen that relies on larger Hymenopteran insects to vector pollinia. In the native range, the plant species depends on carpenter and honeybees for pollination but the pollinator assemblage in the invaded range is not clear. The aims of this study were to identify the pollinators in an invaded range together with any consequential variations in flower morphology and the mating systems employed by the species. Five populations were studied between December 2011- December 2014. The study involved field observations, video recording, still photography, hand pollinations and a planting trial to determine seedling vigour. At one site, only carpenter and honeybees visited flowers. In the remainder of the locations, larger wasps were the main flower visitors that carried pollinia and no bees were observed. Of 19 insect species in 8 Families from Order Hymenoptera, 11 carried pollinia thus confirming their pollinator status. Rubber bush had a mixed mating system, with crossing more common (~ 57.1%) than selfing (~ 42.9%). Flower morphology varied minimally across sites but pollinator species varied in size. Crossed and selfed seeds had similar germinability however, seedling growth performance was dependent on site. We conclude that the invasiveness of rubber bush is partly due to a generalist flower, a dynamic pollinator assemblage and mixed mating system.

Keywords: Rubber bush, flower morphology, breeding system, wasps, invaded range, pollination syndromes

Challenges for plants and their pollinators in fire-prone landscapes

Mr Julian Brown1, Prof Alan York1, Dr Fiona Christie
1University of Melbourne, Melbourne, Australia

Pollination Ecology (1), Suite 3, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

A PhD candidate in the Forest and Ecosystem Science School at the University of Melbourne.
Prescribed fire is a widely used conservation and land management tool, though research into its effectiveness in managing pollination has only recently begun. Fire effects have not been explored in sexually-deceptive pollination systems that are highly specialised and therefore potentially vulnerable to disruption of pollination services. Here we investigate relationships between the post-fire successional status of vegetation, pollinator visitation, and pollinator habitat (larval hosts). We collected data from Australian heathy woodland sites varying in successional status. At each site we observed pollinator visitation to flowers of Caladenia tentaculara and captured pollinator hosts, and then related these responses to the successional status of the vegetation at a range of spatial scales. There were positive associations between pollinator visitation and the amount of vegetation burnt greater than 50 years ago within 100-200 m, and between pollinator hosts and the amount of vegetation burnt 36-50 years ago within 200-800 m. We suggest pollinators enter succession following establishment of insect hosts and subsequently impose top-down control. Our results suggest that fire management of pollination for thynninae-pollinated sexually-deceptive orchids – which flower predominantly in the early post-fire environment – should include measures to maintain long-unburnt vegetation in the surrounding landscape.

Reintroduced ecosystem engineers and aridity influence habitat availability and termite density.

Ms Nicole V Coggan1, Dr. Matthew W Hayward2,3, Dr. Heloise Gibb1
1La Trobe University, Bundoora, Australia, 2Australian Wildlife Conservancy, Subiaco East, Australia, 3Bangor University, Bangor, United Kingdom

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Nicole Coggan is a PhD Candidate at La Trobe University. Her project examines interactions between burrowing mammals and invertebrate communities following reintroductions.

Burrowing ecosystem engineers modify soil habitats and thus affect plant and animal communities. Aridity may limit direct influences of engineers on habitat properties, whereas trophic interactions can directly impact prey communities. We used mammal reintroductions across a climatic gradient to test three hypotheses: 1. burrowing engineers would target microhabitats with high termite abundance, 2. their interference affects termite density, biomass and community composition, and 3. the magnitude of ecosystem engineer effects on termites depend on aridity. We surveyed six paired sites inside and outside three reintroduction sanctuaries along an aridity gradient. We measured termite density, biomass and community composition using trench sampling, habitat selection by reintroduced engineers using spool tracking, and habitat availability using quadrats. Termite density and biomass were lower where engineers were reintroduced, and the magnitude of effects was stronger in less-arid habitats. Responses were strongest for the most specialised termite species. Reintroduced engineers increased the cover of bare ground and used habitats in line with their availability, whereas termite preferred logs, which were the least-available habitat. Our work suggests that declines of burrowing engineers in Australia are likely to have altered termite community structure. However, impacts were lowest in the most arid sites, where habitat modification by engineers was least. Counter-intuitively, our research suggests that ecosystem impacts of reintroductions (and conversely of species loss) may be lower in resource-poor sites, which is important in the context of reserve carrying capacities and understanding the pre-European state of Australian ecosystems.

Honeydew production, availability and harvesting by ants on a climate gradient: an experimental approach

Mr Katayo Sagata1, Associate Professor Heloise Gibb1, Associate Professor Nigel Andrew2, Dr Daniel Diaz3, Professor Ute Roessner4, Dr Nirupama S. Jayasinghe3
1La Trobe University, Zoology Department, Melbourne, Australia, 2University of New England, Armidale, Australia, 3University of Melbourne, Department of Botany, Melbourne, Australia

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Katayo Sagata has submitted for his PhD where he investigated climate change effects on tri-trophic interactions using native Australian species (Eucalyptus camaldulensis, Ericococcus coriaceus and ants). He is currently in Papua New Guinea managing a small national NGO he co-founded in 2008.

Species distribution predictions under climate change suggest that species will track suitable climate and resource availability. Net Primary Productivity (NPP) is often used as a crude measure of energy availability in the environment. However, only a subset of NPP is available to a specific taxon. For the majority of ants, only seeds, liquid carbohydrates or detritus and prey are used as food. Use of these resources depends on production, availability and quality. We used honeydew as a focal resource to test how honeydew production, availability and quality (sugars) and ant use of this resource will change under climate change. We used four sites along a latitudinal gradient and seasonal temperature change as a surrogate for the current climate. Host plants (Eucalyptus camaldulensis) were reciprocally transplanted and infested with a native honeydew producing scale insect (Ericococcus coriaceus) to assess honeydew production and ant removal. Honeydew production and availability were high during summer at low and high latitudes. Plants from lower latitudes at higher latitudes and plants from higher latitude at lower latitude had high honeydew production and availability. Honeydew production was high in the presence of ants than when ants were absent. However, we found no significant effect of latitude, season or plant provenance on ant honeydew mass while ants and latitude had a significant effect on glucose. Honeydew quantity may not be sensitive to climate; however, quality may become more sensitive. Ants attracted to honeydew will be expected to increase harvesting, and play a key role in structuring ecosystems.

Determining columnar cactus age and the implications of losing old individuals in the Caribbean
Dr Topa Petit1,2,3, Mr Leon Pors2, Ms. Anna Rojer3
1UnISA, Mawson Lakes, Australia, 2Curaçao Footprint Foundation, , Curaçao, Dutch Caribbean, 3Institute for Caribbean Research and Management of Biodiversity (CARMABI), , Curaçao, Dutch Caribbean

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr S. "Topa" Petit is a wildlife ecologist at UnISA. She studied the mutualism between bats and columnar cacti on Curaçao, Dutch Caribbean, during her Ph.D. studies at the University of Miami. She goes back occasionally to continue the research. She also works in other ecosystems in Australia and Fiji.

Three columnar cactus species occur on the semi-arid Caribbean island of Curaçao, and other localities in the region: Subpilocereus (syn. Cereus) repandus (kadushi), Stenocereus (syn. Ritterocereus) griseus (datu), and Pilosocereus lanuginosus (kadushi di pushi). They are pollinated by two nectar-feeding bat species in a mutualism considered keystone. Cacti provide essential resources to wildlife, and large and old cacti flower and fruit year round. In view of the extensive cactus scrub clearance taking place on Curaçao, understanding the growth rate and size class distribution of these plants is important. Based on measurements in the field over 11 years and checks against "historical" cacti matching old photographic records, we determined that counting branches was the best method to age cacti (in comparison with index of volume and trunk circumference), and found a yearly growth of 0.745 branch per cactus (kadushi). However, cacti could "shrink" as a result of natural damage or predation by livestock and people; small cacti were particularly at risk of death. Belt transects at 10 sites (total 2.65 ha) revealed very few seedlings of each species, and very few very large cacti. Considering the time needed to reach a large size (100-200 years), low recruitment, and a disease affecting kadushi, continuing cactus clearance could have disastrous consequences for several Caribbean ecosystems, including the loss of a keystone pollination mutualism. Even the immediate restoration of cactus scrub may be too late to prevent a series of extinctions.

Do plants on islands escape herbivores and cast away defences?

Mrs Floret Meredith1, Ian Wallis', Prof Angela Moles1
1University of New South Wales, Sydney, Australia

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Floret Meredith is a PhD candidate under the supervision of Dr Angela Moles at UNSW. Floret is interested in spatial differences in plant traits and ecology. In particular, she enjoys exploring the diversity of plant defence strategies.

Plants on islands are thought to suffer less herbivory and to express lower levels of defence than do mainland plants. The reasoning behind this idea is that fewer herbivorous species can colonise islands, so plants experience lower herbivore pressure and consequently lose defences. This idea is well-accepted, but studies that investigate herbivory and plant defence in paired island and mainland sites are limited, find mixed results, and are narrow in geographic and taxonomic breadth. Our study is the first to include multiple plant and herbivore taxa at a broad geographic scale. To test whether there is a difference between island and mainland plants in leaf area lost and plant defence traits, we conducted a field study comprising five, paired island-mainland sites and spanning 20° of latitude. We measured leaf damage over time and plant defence traits (including toughness, spinescence, pubescence, the effect of tannins, the presence of alkaloids, and nitrogen content) in the five most abundant plant species per site. Our study is unique in its consideration of multiple vegetation types and plant species abundance. We demonstrate that island and mainland plants do not display significantly different levels of defence. Interestingly, island plants suffered significantly higher levels of herbivory (p < 0.05). These results are not in agreement with the predictions of traditional theory, and may stem from the inclusion of all herbivorous taxa, including invertebrates. Overall, our results show the importance of testing venerable ideas, particularly those without substantial grounding in data appropriate to the scale of their predictions.

Novel hosts get the tick of approval: Ecology of native ticks on introduced black rats

Mr Henry Lydecker1, Dr. Dieter Hochuli, Dr. Nathan Lo1, Dr. Peter Banks1
1The University of Sydney, Camperdown, Australia

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Henry Lydecker is a PhD student at The University of Sydney studying the urban ecology of ticks. His research focuses on the impacts of urbanization upon tick abundance and distribution, tick-host relationships, and tick-human interactions.

Increasing concerns over the role of ticks as significant vectors of zoonotic diseases afflicting humans are a major driver of human-wildlife conflicts in urban environments. Understanding the relationships between ticks and their vertebrate hosts, and how anthropogenic changes are impacting these relationships is central to understanding the ecology of ticks and potential health threats. Urbanization has led to the modification and creation of new habitats and the proliferation of several species across the globe, one of the most successful being the black rat, Rattus rattus. To explore the ecology of ticks biting introduced rats in urban areas, we assessed the tick loads on R. rattus culled as part of native rodent reintroduction to identify what ticks are parasitizing R. rattus and to measure the state of hosts. We found three species of native ticks parasitizing R. rattus: Ixodes
Does topsoil age affect plant growth and symbiotic soil biota?

Dr Christina Birnbaum1, Dr Joseph B Fontaine1
1Murdoch University, MURDOCH, Australia

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Christina Birnbaum is a post-doc at Murdoch University, Western Australia. She is broadly interested in plant-soil interactions and plant ecology.

Understanding the trophic role of marsupial predators in Australia’s deserts

Dr Chris Pavey1, Dr Gerhard Körtner2, Professor Fritz Geiser3
1CSIRO Land and Water, Alice Springs, 2Queensland Museum, Brisbane, 3Centre for Behavioural and Physiological Ecology, Zoology, University of New England, Armidale

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Chris Pavey is a wildlife ecologist with CSIRO Land and Water in Alice Springs and was formerly Director of Threatened Species, Northern Territory government. His areas of research interest include resource pulses, trophic ecology, threatened species management, ecology of species with invptive population dynamics and the discipline of autecology.

Australia has lost several large marsupial predators during the Holocene and gained three species of eutherian carnivore. These species now co-occur in arid Australia with a range of small (body mass <200 g) marsupial mesopredators. Given the significant upheaval in the composition of mammalian predator assemblages in arid Australia, understanding the trophic ecology of native mesopredators and the degree of overlap in diet with introduced carnivores is important. Here we quantify the diet of the three largest extant marsupial mesopredators from arid Australia, kowari (Dasyuroidea byrnei), brush-tailed mulgara (Dasycreuterus byrnei), and crest-tailed mulgara (Dasycreuterus cristicauda). Between them these species occupy the major environments of arid Australia including stony desert, cracking clay plains, sand plains and sand ridges. We quantified diet by carrying out microscopic examination of scats collected during a dry (‘bust’) phase of mammal population cycles. We examine dietary diversity, the level of predation on vertebrates, and the degree of dietary overlap with syntopic introduced carnivores. The diet of each marsupial mesopredator was dominated by invertebrates particularly insects with spiders, scorpions and centipedes also consumed. Each species consumed vertebrates but the importance of vertebrates in the diet varied across species. Rodents were the main vertebrate prey for kowari and brush-tailed mulgara with rodents and dasyurids being taken by crest-tailed mulgara. Our results indicate that the red fox and house cat are both potential competitors and predators of the three marsupial mesopredators. These results are of relevance for understanding the functioning of and managing Australia’s arid ecosystems.

Spatial predator avoidance strategies may allow survival of Christmas Island’s last remaining wild reptile.

Ms Melissa Wynn1
1The Australian National University, Canberra, Australia

Species Interactions (1), November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Melissa Wynn is a PhD candidate and conservation ecologist, based at The Australian National University (ANU). She is primarily interested in predator-prey interactions and the role of invasive species in the decline of island reptiles.

The introduction of invasive predators to islands results in either extinction of native prey or adaptation towards coexistence. Christmas Island has undergone catastrophic declines in five of six species of native reptiles. While invasive predators are thought to be the primary culprits, predator-prey interactions are largely unknown. The persistence of the endemic Christmas Island giant gecko (Cyrtochelys sadleri), suggests it can evade invasive predators and may avoid extinction from this threat. Before reintroducing captive-bred reptiles, we need to understand how this last wild reptile interacts with invasive species, and how this moderates its risk of decline.

Nocturnal field surveys were conducted in replicated sites across different forest types over five months between seasons. We aimed to understand demographics of the gecko and discover its ecological overlap with two invasive predators; the wolf snake (Lycodon capucinus) and the giant centipede (Scolopendra subspinipes).

We used a Capture-Mark-Recapture analysis to test hypotheses that forest type and season mediated predation effects on juvenile gecko survival. We found support for reduced survival in the wet season compared to the dry season, and variation in juvenile survival among sites correlating with increased observations of some predators.

We then tested for spatio-temporal niche overlaps, finding that geckos use site-dependent spatial avoidance strategies to evade predation by some species but not others. Further knowledge of specific microhabitat use, predator recognition and response, and trophic interactions with other invaders, is required before we can fully understand why the last remaining reptile on Christmas Island continues to avoid extinction.

Translating Science into Practice: Building Networks and Landholder Capacity

Dr Samantha Lloyd1, Mr Craig Welden1
1South East Queensland Fire & Biodiversity Consortium, George Street, Brisbane, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Samantha Lloyd has sixteen years experience in ecology, entomology and natural resource management. She graduated from Wollongong University with a PhD in pollination ecology in 2006, worked as environmental manager for SEQ Catchments and on the Queensland Fire Ant Programme. Samantha currently manages the SEQ Fire and Biodiversity Consortium.

The South East Queensland Fire and Biodiversity Consortium (SEQFBC) aims to translate science into practice for improved fire management and biodiversity conservation in SEQ through education, research and representation with private land holders and public land managers. The SEQFBC is hosted by SEQ Catchments and supported by 16 organisations. Key objectives of the SEQFBC include assisting land managers and private landholders with practical information on biodiversity and fire management (i.e. recommended fire regimes); and translating fire science into useable formats (e.g. fact sheets, workshops). The most popular services are the biannual forums, “Recommended Fire Regimes” fact sheet and Fire Management Planning Workshops for private landholders. Workshops are delivered in partnership with local government and the RFS. Participants are guided through the development of a fire management plan, complete with property maps.

The Hotspots Fire Project (Hotspots) is co-delivered by the NSW Rural Fire Service and the NSW Nature Conservation Council. Hotspots believes that well-informed and prepared communities complement the roles of land managers and fire agencies and that a shared fire management approach is critical to effective planning. Hotspots workshops are based on best available science and operational knowledge and delivered over multiple days. Program topics include fire ecology, fire behaviour and map-based planning and aim to improve knowledge and understanding through knowledge transfer, practical planning and observation of a small planned burn.

This presentation provides an overview of how SEQFBC and Hotspots engage with private landholders and fire agencies to build capacity for improved biodiversity and fire management practices.

Addressing uncertainty and tradeoffs in savanna fire management: a structured decision making approach

Mr Finley Roberts1, Dr Brett Murphy2, Dr Libby Rumpff2
1School of BioSciences, The University of Melbourne, Parkville, Australia, 2Charles Darwin University, Casuarina, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Finley Roberts is a Master of Science student in the QAECo Lab at the University of Melbourne. His research focuses on fire ecology and management in northern Australian savannas, applying tools from decision science and spatial modelling to look the effects of alternative fire management strategies.

Fire management decisions are often made under high uncertainty about how biodiversity will respond. Designing an optimal fire management regime is made more difficult when there are multiple competing objectives. Structured decision-making is a framework that facilitates robust,
defensible and transparent decisions under uncertainty, by evaluating the impacts and tradeoffs of multiple objectives under a set of alternative management strategies. We investigated the utility of applying structured decision-making to fire management, using the fire-prone Arnhem Plateau of the Northern Territory as an example. This area is managed for multiple objectives including conserving its high biodiversity value and reducing greenhouse gases emissions caused by wildfires. To evaluate the impacts of different fire regimes we developed a set of management alternatives, varying the overall amount and spatial arrangement of prescribed burning. Twenty-two experts were presented with descriptions of the resulting fire regimes and asked to predict how three vegetation communities and five small mammal species would respond. Results indicated that there is high uncertainty among experts about the efficacy of fire management to achieve conservation objectives, but that this did not alter which alternative experts judged as the best for conservation. Increasing time between fires was viewed as the most favourable strategy for both vegetation communities and small mammal species. Further analysis focused on developing a model to investigate the impacts of alternative strategies on greenhouse gas emissions. We will discuss the role of values-based trade-offs between conservation and greenhouse gas emissions when identifying the preferred management alternative.

Linking research and policy: measuring ecosystem resilience in strategic bushfire management planning

Mr Gordon Friend1, Mr Andrew Blackett1, Ms Imogen Fraser4
1Department of Environment, Land, Water and Planning, East Melbourne, Australia

SYNOPSIS: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Gordon Friend, Andrew Blackett and Imogen Fraser (presenting) work in DELWP’s Strategic Bushfire Risk Assessment Unit, which focuses on developing tools, models and processes to measure and manage bushfire risk, including risks to ecosystems.

One of the primary objectives of bushfire management on Victoria’s public land is to maintain or improve ecosystem resilience. The integration of science into bushfire management policy and decision making, and the adoption of a strategic, risk-based approach to planning are critical to achieving this objective. To this end, the Victorian Department of Environment, Land, Water and Planning (DELWP) commissioned a major review of measures of ecosystem resilience that could be used to monitor and predict ecological responses to fire, and inform planning of strategies to manage bushfire risk to ecosystems. This review provided a foundation for developing the Department’s policy position for defining, measuring and reporting on ecosystem resilience in the context of bushfire management. Here, we outline the three adopted measures of ecosystem resilience – tolerable fire interval, geometric mean abundance of species in a community and vegetation growth stage structure. We also describe the nature of the research-policy collaboration and partnerships that inform policy development. DELWP is continuing to test and progressively refine the metrics through ongoing research and monitoring as part of an adaptive management framework.

Can we optimise growth-stage optimisation for fauna?

Dr Matthew Swan1, Dr Julian Di Stefano1, Dr Holly Sitters1, Associate Professor Alan York1
1University of Melbourne, Creswick, Australia

SYNOPSIS: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Matt Swan is a postdoc in the Fire Ecology and Biodiversity Group in the School of Ecosystem and Forest Sciences at the University of Melbourne. He is interested in the effects of disturbance regimes on ecological processes such as animal movement, resource acquisition and species interactions.

A primary objective of fire management is to maintain or improve the resilience of natural ecosystems. As such, land managers are increasingly adopting metrics that explicitly relate ecosystem resilience to the effects of fire management. For example growth-stage optimisation is used in Victoria to model the effects of different fire management scenarios on the geometric mean abundance of species, a metric which is related to extinction risk. While this technique has a strong theoretical underpinning, its use in the real world is still in its infancy. The data used in this process are species abundance in different post-fire growth stages across a landscape. However these data may not be appropriate in circumstances where organisms don’t respond to growth stage per se but to vegetation structure. In this presentation we will discuss some methodological issues with growth-stage optimisation and explore complementary methods for measuring resilience and determining fire management objectives using species responses to vegetation structure. We will discuss with reference to an extensive data set on mammals and birds from the Otway Ranges in southern Victoria.

On the use of biodiversity indices for managing fire regimes

Ms Katherine Giljohann1, Dr Luke Kelly2, Prof Michael McCarthy3, Dr Tracey Regan4
1The University of Melbourne, Parkville, Australia, 2The University of Melbourne, Parkville, Australia, 3The University of Melbourne, Parkville, Australia, 4The University of Melbourne, Parkville, Australia

SYNOPSIS: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
The use of indices to measure biodiversity and ecosystem resilience is a relatively new approach in fire management planning. Biodiversity indices can help identify the optimal mix of vegetation growth stages for conservation based on the fire responses of multiple species in the community. This can assist managers to determine whether the vegetation growth stage structure is adequate to maintain habitat or whether interventions such as planned burning are needed to create or protect key growth stages. Yet, there is a need to better understand how to use biodiversity indices to set fire management objectives in parks and nature reserves.

Challenges remain in applying such methods including obtaining measurement data of sufficient precision and the need to understand how to use biodiversity indices to set fire management objectives in parks and nature reserves.

This study investigates the sensitivity of one suggested index, the geometric mean of species’ relative abundance to: (i) the type of species data, (ii) differences between local vegetation types, (iii) the number of vegetation growth stages and (iv) species weightings. Using a case study of the Victorian Northern Mallee Parks, the analysis included models of how 63 fauna species from three different datasets respond to time-since-fire in two spatially interspersed vegetation types.

We found the optimal vegetation growth structure was sensitive to the type of data and species included in the analysis. The optimal vegetation growth structure was largely consistent across growth stage classifications, albeit not consistent across vegetation types. The weighting schemes reflected different environmental values held by people and land managers. Biodiversity indices provide a useful measure of biodiversity status, yet the optimal solution is context dependent and society’s values should be recognised and incorporated appropriately.

Fuel as vegetation: using species indices and environmental predictors to map landscape fuels for fire management

Dr Thomas Duff1, Mr Brett Cirulis1, Dr Graeme Newell2, Dr Matt White3, Mr Peter Griffioen2, Ms Belinda Cant2, Associate Professor Kevin Tolhurst1

1University of Melbourne, Burnley, Australia, 2Arthur Rylah Institute, Department of Environment, Land Water and Planning, Heidelberg, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Thomas Duff is a scientist working at the University of Melbourne on problems relating to the management of fire. He works across a broad array of fields, including fire simulation, operational research, landscape flammability and plant ecology. Prior to research, he worked as a forester operating in forests in Southern Australia.

An understanding of the nature of fuel in the landscape is of key importance to managing fires. Fuel maps are used for identifying areas of risk and are critical inputs for fire simulation models. The collection of field fuel data is highly labour intensive. As a consequence, maps of vegetation class are typically used as proxies to estimate average fuel parameter values. However, as variation in vegetation properties (such as species composition, biomass and productivity) is not necessarily constrained to these classes, uncertainty can be high. Maps of environmental properties are commonly used to develop models that can predict patterns of vegetation composition in the landscape. As fuels consist of living and dead vegetation, these methods should also be valid for developing continuous maps of fuel parameters.

We investigated the potential for using environmental predictors to create models to map fuel parameters across South Eastern Australia. Data representing over 30,000 field forest fuel assessments were collated from Victoria and South Australia. These included measurements of fuel hazard, litter depth, tree height and elevated fuel. Not all parameters were measured at each survey site; missing values were imputed using modelled floristic information. Fuel attributes were modelled spatially using a regression tree approach with environmental predictors that included climate, terrain and satellite imagery. Fuel was found to be inherently predictable and could be mapped continuously across the landscape. Challenges remain in applying such methods including obtaining measurement data of sufficient precision and the need to understand dynamic processes (for example fire impacts).

Continental patterns of biomass consumption by landscape fire

Dr Brett Murphy1, Prof. David Bowman2, Prof. Mark Cochrane1, Dr Grant Williamson2, Dr Lynda Prior2

1Charles Darwin University, Charles Darwin University, Australia, 2University of Tasmania, Hobart, Australia, 3South Dakota State University, Brookings, United States

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Brett Murphy is a fire ecologist with a particular interest in the tropics. His research focuses on how fire has shaped the biota of tropical savanna landscapes, and how contemporary fire regimes can best be managed for biodiversity conservation, especially in relation to declining small mammals and fire-sensitive vegetation communities.

Landscape fire is a critical component of the global carbon cycle, releasing carbon from biomass back to the atmosphere, thereby accelerating rates of carbon turnover through ecosystems. However, rates of biomass consumption by fire have not been directly quantified at large spatial scales. We undertook an extensive, continent-wide survey of surface fuels, fire severity and rates of fuel consumption by fire (135 sites across Australia). Our results show that in the forests and woodlands of southern Australia, where fuel loads tend to be high and fires intense, biomass consumption by individual fires is greatest. In the savannas of northern Australia, where fires are of low intensity, biomass consumption by individual fires is low. By coupling our ground-based observations of fuel consumption with remotely-sensed estimates of fire frequency, we have produced estimates of total fuel consumption by fires across the Australian continent. We demonstrate that the extremely high fire frequencies experienced in the northern...
savannas lead to total biomass consumption which far exceeds that in southern Australia. We estimate that most of the carbon captured by the northern savannas (i.e. net primary productivity) is released back to the atmosphere during fires. Our results emphasise the primary role of frequent fire – driven by extremely high rainfall seasonality and grass abundance – in turbo-charging carbon turnover in the tropics.

Intense fire impacts on plant diversity in Warrumbungle National Park, an infrequently burnt inland woodland.

**Dr Elizabeth Tasker**, **Dr Penny Watson**

1Office of Environment & Heritage NSW, Hurstville, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

*Dr Liz Tasker has been a fire ecologist since 1997, first with the universities of Sydney and Wollongong, and since 2006 with the NSW Office of Environment & Heritage. Her particular interest is the nexus between conservation, science, management and fire.*

In January 2013 almost 90% of Warrumbungle National Park in north-western NSW burnt in a single bushfire. The fire was severe, with more than ¾ of the final area of 56,000 ha burnt in a single day under extreme conditions: an unprecedented event in the history of the park. The fire raised concerns about impacts on the biota of this largely volcanic park, but has also provided a rare opportunity to study the response. In all NSW national parks, fire managers use the state-wide Fire Biodiversity Thresholds of Kenny et al. (2004), based on Noble & Stiatery functional response groups, to determine appropriate upper and lower fire frequencies. However these thresholds are based on data largely collected from elsewhere in the state, which differ in climate (more mesic), geology (sedimentary) and frequency of fire (more frequent). Since the fire we have collected data on fire response and time to first flowering/reproduction for approximately 300 species (almost half the known flora) in and around the park. Vegetation response has been rapid and vigorous: diversity is high and many early post-fire 'boomers' have already flowered en masse and declined. All grasses, graminoids and forbs appear to have seeded by the second year post-fire. Many resprouter shrubs have also flowered, as have some obligate seeders. A range of species are more abundant after the fire than before, including seven species not previously known from the park. We discuss the results in context of the utility of a functional response approach for management.

Shrubs up in flames: how often vs how hot?

**Dr Michele Kohout**, **Dr Matt Bruce**, **Dr Josephine MacHunter**, **Dr Lauren Bennett**, **Dr Cristina Aponte**

1Arthur Rylah Institute, Australia, 2School of Ecosystem and Forest Sciences, The University of Melbourne, Creswick, Australia, 3School of Ecosystem and Forest Sciences, The University of Melbourne, Richmond, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

*Dr Michele Kohout is a plant ecologist with research interests in the fire ecology field with an emphasis on improving the understanding of the response of flora to fire in order to improve management.*

Plants have different mechanisms for regeneration after a fire, and their persistence is also influenced by fire regime. Understanding the influence of fire severity and frequency is important when plants take a long time to reach maturity or have seeds susceptible to fire. We examined the occurrence of plant functional groups (based on regeneration strategies) in the understory of mixed species eucalypt forests of south-eastern Australia. We examined 80 sites, stratified by time since last fire (long unburnt or recently burnt) and 2009 bushfire severity (high, low or unburnt).

Plant functional groups responded differently to time since fire and fire severity. Overall, shrubs regenerating by resprouting were more common than shrubs regenerating soley from seeds. Resprouting shrubs with a long time to reach reproductive maturity were most common at high severity or unburnt sites. In contrast, resprouting shrubs with a short time to maturity were favoured by recent fires, regardless of severity.

We suggest that there are potential biodiversity trade-offs: too many fires before a plant reaches maturity against greater fire intensity potentially decreasing seed survival. Our work demonstrates the importance of optimising fire regimes to allow for different mechanisms of regeneration.

Using spatially explicit models of post-fire formation or tree cavities to inform fire management

**Dr Natasha Schedvin**, **Dr Simon Watson**

1Department of Environment, Land, Water and Planning, Mildura, Australia, 2La Trobe University, Bundoora, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

*Dr Natasha Schedvin works as a Senior Biodiversity Officer with the Department of Environment, Land, Water and Planning. This research was undertaken in partnership with La Trobe and Deakin Universities as part of a statewide project that addressed Recommendation 58 of the Victorian Bushfire Royal Commission.*

Mallee woodlands support at least 45 species of cavity dependent fauna. Stand replacing fires, strongly reduce the availability of tree cavities which can take centuries to reform. As such, it is critical to manage fire in a way which protects and enhances the capacity of these woodlands to support tree cavities. To do so requires, reliable spatial information on the extent and availability of hollows in the landscape.
This study used an extensive field dataset (measurement of 2,492 hollows at 181 sites) to define the time post-fire required for the formation of tree cavities of sizes suitable for key groups of cavity-dwelling fauna. Small (minimum entrance: <40mm) and medium (minimum entrance: 40-99mm) cavities took approximately 50 and 110 years respectively to develop, whereas large cavities (minimum entrance sizes: >99 mm) were too rare to build robust models. Hollow tree densities were greater in saltbush mallee than hummock grass mallee vegetation and distribution models highlighted a limited number of key areas with high densities of tree cavities that are likely to be disproportionately important for cavity dwelling species. The limited availability of large cavities in these vegetation types elevates the importance of appropriate management for nearby remnants of semi-arid woodland which have a greater capacity to contain these large cavities. Our spatially explicit models greatly enhance the ability of fire management strategies to incorporate the needs of biodiversity both in the planning and suppression phases.

Fire behaviour in Victoria's Wetter Eucalyptus Forests: a case study under prescribed conditions

Dr Jane Cawson1, Dr Thomas Duff1, Simon Murphy1, Sean Walsh1, Brett Cirulis1, Dr Trent Pennman1, A/Prof Kevin Tolhurst1

1University of Melbourne, Melbourne, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Dr Jane Cawson is a postdoctoral fellow at the University of Melbourne investigating the flammability of wet and damp Eucalyptus forests. Previously she worked in fire management in the Department of Environment, Land, Water and Planning and completed a PhD about the effects of prescribed burning on soil hydrology and erosion.

Wet and Damp Eucalyptus forests can be burnt by intense, crown fires or surface fires which ignite only the ground and small tree strata, leaving the overstorey largely undisturbed. The latter fire type may occur as part of a prescribed burn, where ignitions occur in the adjacent dry forest and the fire burns into the wetter forest before self-extinguishing. In this sense, areas of wetter forest act as passive barriers to stop prescribed burns and wildfires spreading. The purpose of this pilot study is to identify the key factors driving ignition, fire behaviour and self-extinguishment at a landscape-scale under these lower fire intensity conditions, and the relative importance of these factors. We measured vegetation structure in 44 pre- and post-burn plots, fire behaviour, weather conditions and fuel moisture in a prescribed burn in the Upper Yarra region. Additionally, the burnt-unburnt boundary was mapped and 35 plots were assessed along this boundary to identify the determinants of self-extinguishment. We found that ignition success, fire behaviour and self-extinguishment were driven by fuel moisture, changes in fuel properties (particularly in relation to species transitions), and local fuel discontinuities. The relative importance of these factors varied depending on the weather conditions, preceding fire intensity (or source of ignition) and topographic position. An increased understanding of fire behaviour in a landscape context under mild conditions is needed to more effectively implement prescribed burns on wet forest margins, predict burn outcomes and understand bushfire risk.

Closing the loop: Monitoring the effectiveness of bushfire management for achieving multiple objectives

Ms Shannon Treloar1

1Department of Environment, Land, Water and Planning, East Melbourne, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 1), Ballroom A, November 30, 2015, 11:00 AM - 1:00 PM

Biography:
Shannon Treloar has a background in zoology, environmental and fire science and has worked in emergency management and bushfire MER for DELWP and CFA. She managed the former Landscape Mosaic Burn Monitoring Program before her current role to develop and implement an MER Framework for Bushfire Management on Public Land.

Monitoring, evaluation and reporting (MER) is a critical part of the Department of Environment, Land, Water and Planning’s risk-based approach to bushfire management. The MER Framework for Bushfire Management on Public Land (DELWP, 2015) supports DELWP to measure the effectiveness of our bushfire management, as well as validate and improve the fuel and ecological models used to inform decision-making. The MER Framework connects science with policy by providing a system for identifying knowledge gaps, targeting those knowledge gaps with monitoring, improving knowledge through evaluation of the data and communicating that knowledge through reporting. The MER Framework identifies priorities for monitoring by describing our key knowledge gaps as Key Evaluation Questions (KEQs). The KEQs help effectively target monitoring, and provide a basis for changes to be evaluated against. This paper describes how the MER Framework was developed and how it is being implemented through the development of Regional MER Plans and the Victorian Bushfire Monitoring Program to support an evidence-based approach to bushfire management.

Rebuilding woodlands and resetting community expectations at Mulligans Flat Woodlands Sanctuary

Assoc. Prof. Adrian Manning1, Dr Jason Cummings2

1Australian National University, Canberra, Australia, 2Woodlands and Wetlands Trust, Canberra, Australia

SYMPOSIUM: Joining the dots - the role of sanctuaries in biodiversity conservation, Ballroom B, November 30, 2015, 11:00 AM - 1:00 PM

Biography:

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Box Gum Grassy Woodlands are symbolically ingrained in the history of inland Australia. From a biodiversity perspective, woodland biodiversity condition and extent has declined as European development and settlement has progressed through their distribution. The woodlands we experience now are in a vastly depauperate condition compared to those enjoyed by Indigenous Australians for millennia. In order to understand how to reverse loss and modification of this ecosystem, a restoration experiment was established at Mulligans Flat and neighbouring Goorooyarroo. Emerging from this multi-organization research partnership, the feral predator-proof Mulligans Flat Woodland Sanctuary was created. Concomitant to the experiment, urban development has proceeded to abut the Sanctuary. Key research from over a decade of research will be summarized, including that made possible by the building of the Sanctuary and the reintroduction of a locally-extinct ‘ecosystem engineer’. The emerging role of the Sanctuary in broader landscape conservation will also be discussed. Key challenges and opportunities include resetting community expectations of woodlands and battling the ‘extinction of experience’, and the potential for protecting, providing and sharing source populations of species for national landscape repair programs. Going ‘beyond the fence’ with reintroductions and sustaining new populations of long-lost flora and fauna remains the ultimate end-game, which requires new considerations of the role of the Sanctuary in landscape-scale biodiversity conservation.

Wildlife restoration: applying lessons learned from revegetation to safeguard native animal populations

**Prof David Watson**
Dr Maggie Watson

Charles Sturt University, Albury, Australia

SYMPOSIUM: Joining the dots - the role of sanctuaries in biodiversity conservation, Ballroom B, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**
Professor Dave Watson has a long-standing interest in fragmented landscapes and conservation on private land. His conservation ecology research in south-eastern Australia is one component of a broader-reach program focusing on parasitic plants, plant-animal interactions and determinants of diversity.

Although many woodland species are sufficiently mobile to colonise new or improved patches, many species are not—effectively marooned in habitat remnants. Unable to move long distances or subject to predation outside woodland habitats, many reptiles, amphibians and small mammals can become stranded. This has two consequences. Firstly, those woodland remnants where species persist so often contain more individuals than can be supported, leading to increased levels of density-dependent mortality and greater likelihood of local extinction. Secondly, once the subpopulation of a particular species has gone extinct within a particular patch, the woodland is unlikely to be recolonised in the future, even though it may contain all the resources needed by that species. So, for many dispersal-limited species in many landscapes, there may be too many individuals in some patches of decreasing quality and no individuals in patches of increasing quality. A short-term solution to this worsening situation is targeted translocations—moving individual animals to unoccupied patches. Rather than willy-nilly, conducting them in an informed and carefully-monitored manner will yield valuable insights into habitat preferences, microclimatic tolerances and other distributional constraints. The Landcare movement has demonstrated the willingness of landholders to repopulate their properties with native plants—why not give them the opportunity to put some of the animals back as well? Having explored the benefits of large-scale translocation of animals within urban and agricultural landscapes, we demonstrate that lessons learned from these interventions will resolve many of the current knowledge gaps constraining assisted migration and other conservation-based interventions presently deemed prohibitively risky.

Fenced Reserves and Prey Naivety: can in situ predation improve prey responses?

**Dr Katherine Moseby**
Dr Rebecca West, Dr Dan Blumstein, Dr Mike Letnic

Arid Recovery/University of Adelaide, Roxby Downs, Australia, University of New South Wales, Sydney, Australia, University of California, Los Angeles, USA

SYMPOSIUM: Joining the dots - the role of sanctuaries in biodiversity conservation, Ballroom B, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**
Dr Katherine Moseby is an arid zone ecologist specialising in reintroduction biology, feral animal impacts and threatened species. She is passionate about reducing the impacts of feral cats and foxes and reversing the decline in our threatened fauna and flora.

Australia’s mammals evolved in isolation from eutherian mammalian predators such as introduced cats and foxes. Prey naivety is thought to have contributed to the decline of our native mammals through the failure of species to recognize and react appropriately to introduced predators. The recent proliferation of islands and fenced reserves used as sanctuaries for our threatened wildlife has successfully established populations of several threatened species. However, the exclusion of all mammalian predators from these areas may be exacerbating the problem of prey naivety through causing “island syndrome” and eroding the resilience of our native species to novel predators. We outline an experiment at the Arid Recovery Reserve in northern South Australia where in situ predation is being trialed as a method of promoting long term co-existence. Low levels of mammalian predators are being introduced into fenced paddocks containing populations of threatened species. The survival and behavior of native prey species is being compared over successive generations. Initial results are presented for a feral cat introduction into a population of burrowing bettongs and greater bilbies, and western quolls reintroduced into a paddock supporting a population of stick-nest rats. We call for managers of fenced reserves and islands to consider introducing low levels of mammalian predators (novel or native) in order to retain and improve anti-predator behaviour in threatened prey.
Islands as refugia for threatened species: Multi-species translocation and evidence of species interactions 40 years on.

**Symposium:** Joining the dots - the role of sanctuaries in biodiversity conservation, Ballroom B, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**

Lauren White is a PhD candidate studying at the Australian Centre for Ancient DNA. Her thesis is concerned with the conservation genetics of a variety of Australian mammal species.

Genetic diversity is a vital aspect of reintroduction programs as low genetic variation can lead to reduced adaptive capacity, decreased population fitness, and increased risk of extinction. These problems are often exacerbated in reintroduced populations due to founder events, bottlenecks, small population size and the isolated nature of sanctuaries. The Arid Recovery reserve is an exclosure site in northern South Australia to which four native mammal species were reintroduced 12 years ago. Tissue or blood samples were taken from every founder individual so the reintroduced species provide a unique opportunity to study changes in genetic diversity, through time, in managed populations. We use next-generation sequencing techniques to generate a large dataset of single nucleotide polymorphisms (SNPs) for two of the reintroduced species, the burrowing bettong (Bettongia penicillata) and the western barred bandicoot (Perameles bougainville). We analyze this dataset to determine the relative contribution of each founder, estimate the amount of genetic diversity lost and investigate selection in the reintroduced vs. source populations. We use this information to determine whether additional reintroductions are necessary at Arid Recovery and make recommendations for future reintroduction programs.

**Effects of native omnivore restoration on invertebrate diversity and function**

**Symposium:** Joining the dots - the role of sanctuaries in biodiversity conservation, Ballroom B, November 30, 2015, 11:00 AM - 1:00 PM

**Biography:**

Assoc. Prof. Heloise Gibb is a Future Fellow at La Trobe University, Melbourne. She specializes in the community ecology and conservation of terrestrial invertebrates. Current projects investigate effects of mammal extinctions on invertebrate diversity and function, global and local drivers of ant traits and fire-detritivore interactions.
Devastating changes in mammal assemblages resulted from European invasion of Australia, with many medium-sized species with omnivorous diets declining significantly or becoming extinct in the wild. Despite this dramatic change in the trophic structure of Australian ecosystems, little is known about the effects on invertebrate prey species, either in terms of diversity or the ecological functions these invertebrates perform. We compared diversity and function using landscape-scale surveys inside and outside mammal reintroduction sites at Scotia Sanctuary (NSW), Yookamurra Sanctuary (SA) and Arid Recovery (SA) and a replicated exclusion experiment (n = 10) within Scotia Sanctuary. Our landscape-scale surveys showed that mammals consumed scorpions and reintroductions reduced scorpion abundance, with effects cascading through to spider assemblages. These results were supported by our exclusion experiment. Cross-survey surveys showed that termites remained at resources longer and consumed more in the absence of reintroduced mammals, with effect sizes greatest in the wettest environments. Trends from the exclusion experiment were similar, but non-significant. Our results suggest that the ecological extinction of many mammal species from Australia is likely to have substantially altered invertebrate diversity and function in Australian ecosystems.

Re-curlowing the landscape. Reintroducing the bush stone-curlew to Mulligans Flat Woodland Sanctuary

Dr Kate Grarock¹
¹Woodlands and Wetlands Trust, Canberra, Australia

Biography:
Dr Kate Grarock works the Ecologist for Mulligans Flat Woodland Sanctuary. In this role she has worked on reintroducing the Eastern Bettong, New Holland Mouse and Bush Stone-curlew. Kate has a PhD from the Australian National University that focused on the effective management of introduced species. Kate enjoys bushwalking and packrafting.

Mulligans Flat Woodlands Sanctuary is a 485 ha feral-predator-free reserve, protecting critically endangered box gum woodlands. It is the site of successful reintroductions of the eastern bettong and New Holland mouse. The bush stone-curlew became extinct in the ACT 50 years ago. Nationally the species is declining, due to habitat clearing and predation. However, the curlew persists in regions where fallen branches have been retained and fox density is low.

We are in the second stage of reintroducing the bush stone-curlew to the Sanctuary. In 2014, 11 captive bred birds were released and radio-tracked. We are hopeful that these birds will attempt to breed this year. An additional 10 birds have been released in 2015 to increase numbers. The reintroduction of the bush stone-curlew is an ongoing learning process that aims to continually evolve and develop over the years. It is anticipated that the project will roll-out over several years, with multiple phases of reintroductions

The project objectives are to:
1) reintroduce a population of bush stone-curlews to establish a wild, self-sustaining population within the Sanctuary and landscape
2) increase our ecological knowledge of this species
3) improve future reintroductions and monitoring methods
4) contribute to woodland restoration and management
5) highlight the plight of this iconic species to the wider community

The project is a collaboration between the several groups and volunteers have provided significant support feeding and tracking curlews. The presentation will provide an overview of the project to date and outline the key learnings from each year.

Best Practice Guidelines for Maximising the Conservation Benefits of Fenced Reserves

Dr Katherine Moseby¹, Dr John Read¹, Dr Jason Cummings², Dr Adrian Manning³
¹Arid Recovery, University of Adelaide, . . . ; ²Wetlands Conservation Trust, . . ; ³Australian National University, .

Biography:
Katherine Moseby is an ecologist specialising in threatened species, reintroduction biology and arid zone ecology. She is co-founder of Arid Recovery, a fenced conservation reserve near Roxby Downs in South Australia.

Fenced reserves are becoming increasingly popular as a tool for protecting wildlife from threats such as feral cats and foxes. A number of successful mammal reintroductions into fenced reserves has encouraged both government and private organisations to invest heavily in this intensive conservation method. However, the conservation perspective of fenced reserve proponents can vary considerably and this is reflected in different management activities and objectives. For example, practitioners can measure the success of their fenced reserve based on reserve size, removal of pests, population size of animals protected, number of species reintroduced, ecosystem processes, vegetation regeneration, research outputs and/or educational benefits. Here we present a prospective set of principles for fenced reserves that we feel could help maximize their present and future conservation benefit. Suggestions for best practice design and management of fenced reserves are discussed and include factors such as size, fence design, order of reintroductions, overpopulation strategies, functional groups, genetics, monitoring, predators and provision of supplementary water.

Nutrients falling from a mature Eucalyptus canopy: insect frass deposition under elevated CO2
Mr Andrew Gherlenda, Dr Ben Moore, Dr Anthony Haigh, Dr Scott Johnson, A/Prof Markus Riegler

1Hawkesbury Institute for the Environment, University of Western Sydney, Penrith, Australia, 2School of Science and Health, University of Western Sydney, Penrith, Australia

Climate Change (2), Ballroom C, November 30, 2015, 4:00 PM - 5:45 PM

Biography:

Andrew Gherlenda is a Ph.D candidate who studies tri-trophic interactions of eucalypt feeding insects and their natural enemies such as parasitoids under a changing climate, specifically elevated CO2, temperature and their interactions

Herbivorous insects are important nutrient cyclers because they produce nutrient-rich frass that can be utilised by soil biota or reassimilated by plants. The impact of elevated atmospheric CO2 on insect mediated nutrient cycling is poorly understood and rarely quantified, in particular for nutrient-limited forest ecosystems. Here, we tested the effect of elevated CO2 on the quantity and composition of frass deposited at the Eucalyptus free-air CO2 enrichment (EucFACE) facility, a mature and nutrient-limited Eucalyptus woodland. Frass deposition was quantified and analysed for chemical composition monthly over a two-year period. Elevated CO2 did not significantly alter the quantity or quality of frass deposited to the woodland floor. In contrast, and independent of CO2 treatment, timing and amount of rainfall combined with average maximum temperatures affected the quantity of frass deposited which was lower in the second year. Furthermore, nitrogen and phosphorus deposition via frass declined by 45% and 44%, respectively, due to reduced frass nutrient concentration in the second year. Elevated CO2 may not strongly alter nutrient transfer by insect herbivores, however, this may be a function of forest nutrient status, length of CO2 fumigation or climatic conditions. In the studied ecosystem summer rainfall coupled with average maximum temperatures exerts strong effects on nutrient cycling, potentially through shifts in leaf phenology with consequences for insect population dynamics. This shift in the timing and quantity of nutrient-rich frass may have implications on soil processes which may rely on this labile source of nutrients.

Enduring the hot and dry: carbon-use-efficiency of Eucalyptus tereticornis trees exposed to warming and drought

Dr John Drake1, Professor Mark Tjoelker1, Professor Peter Reich1,2, Dr Craig Barton1, Dr Remko Duursma1, Dr Mike Aspinwall1

1Hawkesbury Institute for the Environment- University of Western Sydney, Richmond, Australia, 2Department of Forest Resources, University of Minnesota, St. Paul, USA

Climate Change (2), Ballroom C, November 30, 2015, 4:00 PM - 5:45 PM

Biography:

Dr John Drake is a postdoc at the Hawkesbury Institute for the Environment, where he studies the interactions between climate, tree physiology, and ecosystem ecology.

Tree photosynthesis and respiration exert strong control over the cycling of C in ecosystems. The efficiency by which trees create new biomass out of photosynthesize is termed carbon-use-efficiency (CUE) and is calculated as the ratio of net to gross primary production (CUE = NPP/GPP) or from autotrophic respiration and GPP (CUE = 1-Ra/GPP). Despite the importance of CUE to tree growth and feedbacks between the C cycle and climate change, CUE data are scarce as it is challenging to measure at an ecologically meaningful scale with the temporal resolution to detect environmental drivers of CUE. We measured the aboveground CUE of field-grown Eucalyptus tereticornis trees (up to 9-m tall) exposed to factorial combinations of warming (ambient +3 °C) and drought with nine months of continuous measurements of whole-canopy CO2 exchange (GPP and Ra) and fortnightly growth (NPP) in twelve whole-tree chambers in western Sydney. At the daily timescale, CUE varied in response to environmental drivers of GPP; CUE was positively correlated with photosynthetically active radiation but negatively correlated with vapour pressure deficit. At longer timescales ( fortnightly to quarterly), CUE was ~0.45 and did not decline with experimental warming or drought. We suggest that this insensitivity of CUE is partially explained by homeostatic temperature acclimation of respiration and the inherent coupling of photosynthesis, respiration, and growth. These results suggest that climate warming and drought may not depress tree CUE, and that modelling frameworks which couple Ra and GPP are more likely to provide robust predictions of tree response to climate change.

Decreasing Net Primary Production trends in forest and shrub vegetation across southwest Western Australia

Dr Niels Brouwers1, Professor Nicholas Coops2

1Murdoch University; Centre of Excellence for Climate Change, Woodland and Forest Health, Murdoch, Australia, 2University of British Columbia; Department of Forest Resource Management, Vancouver, Canada

Climate Change (2), Ballroom C, November 30, 2015, 4:00 PM - 5:45 PM

Biography:

Since 2010, I have been affiliated with the Centre of Excellence for Climate Change, Woodland and Forest Health at Murdoch University. My research interests are in the fields of forest and landscape ecology, with a particular focus on informing conservation and sustainable management.

Climate conditions in Mediterranean ecosystems have undergone and are projected to undergo significant change in the future. In the southwest of Western Australia, a number of endemic tree species have experienced significant declines in health and mortality since the early 1990s primarily...
due to these climatic changes. These health declines are likely to have flow-on effects to regional biodiversity as well as the carbon sequestration potential of the woody vegetation in this region. We report on analysis examining trends in Net Primary Production (NPP) of the woody vegetation in the southwest Australia (SWAU) ecoregion from 2000-2011. To do so, we examine NPP estimates derived from satellite imagery and climate data to answer the questions: (1) what is the extent and rate of change in NPP for the SWAU region over the study period, and (2) how important is fire as a contributing factor in the observed trends. Our results suggest that between 2000-2011, overall NPP declined across the region, with the majority of declines occurring in the transition zone between tree-dominated vegetation and shrublands. Fire attributed for just over 25% to the observed declines. The overall rate of NPP decline for the region was estimated to be -0.38 megaton C per year since 2000. Under the current climate change projections, the declining trends are likely to continue and our results suggest that a shift from tree-dominated to lower shrub-dominated vegetation is occurring, gradually decreasing the carbon storage potential in this region.

Managing persistent vegetation dieback within an endangered wetland community

Ms Rebecca Duffield1, Ms Barbara St John2, Mr Tim Vale1, Mr Dane Wilden3
1Conservation Council SA, Adelaide, Australia, 2Natural Resources, Adelaide and Mount Lofty Ranges, Adelaide, Australia, 3The University of Adelaide, Adelaide, Australia

Biography:
Bec Duffield is the Research Ecologist with the Conservation Council of SA (involved in environmental sciences for over 17 years). She is focused on conservation of freshwater wetland systems and ecological disturbance based management. She is currently upskilling in eco-hydrological and bio-physical assessments to better understand critical drivers of wetland health.

The critically endangered Fleurieu Peninsula (FP) Swamps are a nationally listed (EPBC Act 1999) ecosystem. Recent dieback of vegetation within the FP Swamps has had a devastating effect on one swamp in particular with observed dieback in other areas within the Fleurieu. Dieback events can be related to hydrological changes, imbalance of chemical/physical properties, exogenous stressors and land management. This recent dieback study assesses cause and effect of the FP Swamp dieback.

Dieback was first observed in a Myponga swamp system in 2008. Since this time, the condition of vegetation has continued to deteriorate with key FP swamp plants demonstrating considerable dieback. Species that appear to be highly susceptible to this dieback comprise more than one plant group. The dieback has resulted in dead clumps of biomass that are interspersed with distinctive gaps. These gaps have provided prolific germination opportunities for weeds.

This study will present a synopsis of how the research team approached the dieback dilemma, this included a) constructing a strategic approach with limited financial/human resources b) identifying possible causes of the dieback c) assessing changes in response to the dieback and d) predicting the succession of swamp vegetation and proposing restoration strategies. A suite of methods have been used including spatial analysis, field data collection (vegetation and soils), pathogen testing and conceptual climate stress modelling.

Results from this study will allow planners and landholders to identify other FP Swamp systems that are susceptible to dieback and manage accordingly.

Influence of surface temperature on South Australian invertebrate assemblages inhabiting hard versus soft intertidal boulders

Mr Nathan Janetzki1, Professor Peter Fairweather1, Associate Professor Kirsten Benkendorff2
1School of Biological Sciences, Flinders University, GPO Box 2100, Adelaide, Australia, 2School of Environment, Science and Engineering, Southern Cross University, PO Box 157, Lismore, Australia

Biography:
Nathan Janetzki is a PhD candidate with the School of Biological Sciences at Flinders University, Adelaide. His research currently focuses on the effects of rock type, and some of the physical attributes of different rock types, on the structure of algal and invertebrate assemblages on Australian temperate rocky seashores.

Many invertebrate species on rocky seashores are thought to be living at or near their upper tolerable thermal limits. Given that global climate change is predicted to gradually increase atmospheric temperatures, the response of intertidal invertebrates to the surface temperature of the rocky substrates they occupy must be understood to evaluate their persistence in these environments. Consequently, an experimental translocation was conducted across four seashores on South Australia’s Fleurieu Peninsula during an austral summer to examine whether the surface temperature of hard-rock (i.e. siltstone) versus soft-rock (i.e. fossiliferous limestone) boulders influenced the structuring of intertidal invertebrate assemblages. Forty hard-rock and forty soft-rock bare boulders were sourced from a single seashore of each rock type. Ten boulders of each rock type were then translocated among two seashores of each rock type. A thermal imaging camera was used to measure boulder surface temperature, with the darker-coloured siltstone having significantly warmer upper and lower surface temperatures than the lighter-coloured limestone. The diversity of invertebrates colonising these initially-bare boulders was recorded after one and two months. Several species of intertidal invertebrates showed differences between siltstone versus fossiliferous limestone boulders. It is possible that these species-specific differences across rock type may be driven by boulder surface temperature, with the abundances of some species negatively correlated with boulder surface temperature. Consequently, boulder surface temperature may represent an important environmental variable structuring SA intertidal boulder invertebrate assemblages.
Interactive effects of habitat loss and rainfall decline on bee and wasp diversity

Mr Mark Murphy1, Prof. Raphael D’Odorico1,2, Dr. Rachel Stanalish1,3
1The University of Western Australia, Crawley, Perth, Australia, 2CSIRO Land and Water Flagship, Floreat, Perth, Australia, 3Murdoch University, Murdoch, Perth, Australia

Biography:
Mark Murphy is a PhD student at The University of Western Australia in Perth, researching the effects of global change on insect diversity and interaction networks. He has a background in community ecology and biodiversity research, with field experience in both terrestrial systems and wetlands.

Recent evidence has shown that multiple drivers of global change often interact in unexpected ways to influence species and their interactions, and these effects can translate into whole-community responses to anthropogenic change. Habitat loss and climate change are likely important interactive drivers of community response in fragmented ecosystems, but few data exist currently to test this hypothesis. Here, in a large-scale mesoscale experiment in southwest Western Australia, we examined the response of insect communities to habitat loss and climate change, with a focus on bees and wasps (Hymenoptera: Aculeata). We sampled over 100,000 invertebrates in woodland edges and interiors across 48 landscapes representing gradients of native vegetation loss, historic rainfall, and recent rainfall decline. We found reduced species richness of bees at habitat edges and reduced evenness with increasing habitat loss, while the proportion of common species declined with high rainfall decline. Wasp species evenness was reduced at habitat edges but only in higher-rainfall landscapes, and richness of wasp families increased with high rainfall decline. Individual bee and wasp species responses showed interesting variation, with multiple species increasing in abundance with high rainfall decline. Using nature reserves as habitat references, we also found that community dissimilarity of invertebrate orders increased with high habitat loss, and declined with high rainfall decline. Dissimilarity of bees was also lower with higher rainfall decline, but only in higher-rainfall landscapes. Our results indicate the presence of interesting interactions between drivers of community response, and also highlight the important influence of rainfall changes in these systems.

Distinct zooplankton size spectra in Lake St. Clair as observed by Laser Optical Plankton Counter

Dr Yajun Sun1, Dr Mathew Wells, Dr Sarah Bailey
1University of Toronto, Toronto, Canada, 2Fudan University, Shanghai, China

Biography:
Dr Yajun Sun is a post-doc researcher (Fudan University) focused on the implications of eco-evolutionary understandings for the practical possibility of environmental ethics. His doctoral research (University of Toronto) was about the influences of physical mixing on aquatic invasions in Lake Huron-Lake Erie corridor, an invasional hotspot in the Great Lakes.

Spatial heterogeneities of water properties have long been observed across Lake St. Clair (the lake connecting the upper and lower Great Lakes in North America), due to its heterogeneous mixing patterns and different shoreline land uses. Correspondingly, zooplankton abundance and composition are expected to be heterogeneous distributed spatially. However, it has been difficult to measure zooplankton using traditional methods of sampling and counting by microscopy. Here we utilized a new Laser Optical Plankton Counter to measure zooplankton abundance and size composition in Lake St. Clair in June 2011, along a total distance of 105 km with fine resolution in space (~ 1 m) and body scale (15 µm). Measured data demonstrate a spectrum with slope b = −1 as body mass changes over six orders of magnitude. The spatial patterns indicate three ecological zones characterized by distinct spectra, with nearshore b significantly less negative. The shifts in spectral slope and taxonomic composition correspond with nutrient level or environmental stability, consistent with previous studies on other waters. Principle component analysis reveals that the spectral shift is related to distinct niches between small and large zooplankton, with a threshold of body mass ~ 100 g. These findings may have implications for ecological management related to eutrophication and invasion biology. For example, our results imply that highest invasibility could occur in areas with both steep size spectra and high habitat suitability, such as shallow water depth and high water temperature.

Monitoring population trends in a population of the threatened brush-tailed rock-wallaby in North-eastern NSW

Ms Alison Martin1, Dr David Robertson2, Mr Greg Wilkinson3
1Greentaoing Biostudies Pty Ltd, East Lismore, Australia, 2Cumberland Ecology Pty Ltd, Carlingford, Australia, 3Clarence Valley council, Grafton, Australia

Biography:
Alison Martin has over 35 years experience in ecological surveys and impact assessments. She is currently the director of Greentaoing Biostudies Pty Ltd, a small company specializing in threatened species studies, impact assessments and environmental management. Alison has a Bachelor of Science and Masters in Environmental Law.

The Brush-tailed Rock-wallaby (Petrogale penicillata) (BTRW) is well known as an iconic Australian species, although the typically relatively rugged and often remote shelter habitat of the species means individuals are not often observed by the general public. A population of the species was
known from sandstone escarpment habitats, near Grafton, prior to construction of a water storage facility. As the project had the potential for significant impact on the species, project conditions of approval included baseline surveys and long term monitoring of the population (NSW conditions) and pre-construction and post-construction census surveys (Commonwealth conditions).

Baseline surveys were conducted on three escarpments within the Shannon Creek catchment from 2003 to 2006 and monitoring surveys were undertaken from 2003 to 2013. Two reference sites in separate catchments were also surveyed from 2006/2007. Survey procedures entailed feral pellet counts along standardised transects, plus records of observations of any individuals and use of a number of identified shelter sites.

Census surveys were conducted in 2006, 2013 and 2014, utilising an adaptation of the ‘Walked Line Method.’ Camera monitoring of some locations within BTRW habitat also was implemented during the course of the monitoring programme, initially to investigating fox occurrence, and recently to investigate shelter site use.

The results from the different types of surveys yielded differing results, with studies overall indicating the difficulty in monitoring BTRWs, the value of long term monitoring and the usefulness of employing a range of survey methods to provide more comprehensive insight into BTRW occurrence, populations and habitat usage.

Improving temporal datasets of frog calling activity by quantifying error associated with audio recognition software

Ms Amelia Walcott1, Dr Andrew Hall1, Dr Skye Wassens1

1Institute for Land, Water & Society, Charles Sturt University, Albury, Australia

Environmental Management and Monitoring (2), Balcony Rooms 3-4, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Amelia Walcott is currently completing a PhD with Charles Sturt University on ‘Frog community responses to environmental change: a case study in the mid Lachlan’. Amelia has an avid interest in freshwater ecology, particularly in identifying ecological implications for predicting the impacts of climate change.

Call recorders have the potential to provide important insight into frog call phenology. Nine call recorders were deployed for 12 months in aquatic habitats spanning the middle and upper Lachlan catchment, south east NSW. Audio recognition software (SongScope) was used to develop species specific recognisers to identify calls across a large audio dataset. Bioacoustic variability across sites, coupled with difficulty training the software arising from the relative simplicity of the frogs’ calls, led to high levels of false positives. False positives increased during periods of very low and very high calling activity. Classification of the levels of false positives and negatives is typically calculated using single percentages deduced from a subset of outputs and across a range of sites. This study identified significant variability in recogniser performance spatially, temporally and across species, due to the different bioacoustics across a range of habitats.

A novel approach to identifying machine recognition performance was developed to account for the variability of recogniser performance over time and space. Firstly, data extracted using recognition software were assessed for accuracy on a site by site basis; the extent of site-specific variability was therefore quantified. Secondly, the standard error of the true positives was continuously determined from randomly selected time intervals until the cumulative mean of the error stabilised, rather than testing an arbitrary sample size. A complimentary similar approach determined the rate of false negatives resulting from the automated software analysis. The calling activity time series thus produced includes valuable qualifying data describing statistical confidence.

Designing monitoring programs for tracking native vegetation condition at large spatial scales in South Australia.

Dr Jane McKenzie1, Dr Brad Page1, Dr Annelise Wiebkin, Dr Lachlan McLeay2

1DEWNR, Adelaide, Australia, 2SAID Aquatic Sciences, West Beach, Australia

Environmental Management and Monitoring (2), Balcony Rooms 3-4, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Dr Jane McKenzie has worked as a research ecologist for over 20 years in Australia and the United States. Her work has encompassed a variety of disciplines including the demographics and foraging ecology of marine mammals, management of overabundant species and the development of conceptual models of terrestrial ecosystems.

An understanding of the condition of native vegetation is a priority for all Natural Resources Boards in South Australia. Three regional monitoring programs were developed to measure and track the condition of native vegetation using procedures that were qualitative, repeatable and feasible given logistical and budget constraints. The impetus for these programs was a lack of comprehensive information to adequately report to the community and inform managers of the outcomes and effectiveness of regional-scale investment in native vegetation. We discuss how three programs were designed to be fit-for-purpose, fit-for-budget, able to incorporate existing monitoring data and value-add or complement existing monitoring and reporting within each region. The process of designing each project involved stakeholder engagement, prioritisation of vegetation communities and management outcomes, consideration of statistical power of sample sizes and appropriate benchmarks. These programs provide a consistent regional and state-wide approach for measuring and reporting on the condition of native vegetation that can also feed into national reporting frameworks.

Optimizing ecological monitoring when incurring travel costs
Biography:
Professor Michael McCarthy does ecological modelling that improves environmental management. He helps direct the ARC Centre of Excellence for Environmental Decisions. He likes mathematics. And scones with jam and cream, please. His co-author, Alana Moore, also likes mathematics and scones. With black cherry jam and clotted cream, preferably. Many thanks.

Optimal monitoring to maximise the number of detections of a species (Hauser and McCarthy 2009, Ecology Letters) has considered how best to allocate a search budget across sites that vary in: 1) the probability of presence; 2) the rate of detection given presence; and 3) the cost of failed detection. Recent research (Moore et al. 2014, PLoS One) has considered how to optimize the number of times to visit an individual site when detection rate varies over time, and each visit incurs a travel cost. Here we describe a method that integrates both these approaches, optimising searches over both space and time. The solution defines the total budget that should be allocated to each site, and the number of visits over which that search budget should be expended. We show that the solution has close affinities with that of Hauser and McCarthy (2009) that ignored temporal variation and travel costs. In doing this, we also solve an alternative model to Moore et al. (2014) that considers the trade-off between the number of visits and length of each visit. We compare the predictions of the original model of Moore et al. (2014) and the new model to experimental data on detections of two species.

Artesian spring wetland function and dynamics revealed by Landsat inundation time series

Dr Ken Clarke1, Professor Megan Lewis1
1University of Adelaide, Urrbrae, Australia

Biography:
Dr Ken Clarke is interested in understanding, monitoring and managing natural and built systems at broad scales. His interest stems from a belief that human aspirations and intrinsic environmental values are equally important, and that with the right information and perspective we can pursue our aspirations and improve our environmental stewardship.

As artesian spring wetlands are globally threatened by anthropogenic demands on groundwater the need for effective monitoring increases. However, the natural range of variation in these aquatic habitats is not well documented or understood, and there are few tools available for monitoring. In arid South Australia Great Artesian Basin spring flows support extensive wetland complexes of vegetation and surface water that vary considerably over time. Detecting anthropogenic impacts on these dynamic systems requires a thorough understanding of their natural drivers and range of variation. We analysed the Water Observations from Space (WOfS) product, a time series of apparent surface water derived from Landsat imagery by Geoscience Australia for Dalhousie Springs Complex in northern South Australia. We examined the pattern and drivers of annual inundation extent for each year from 1988 to 2013, and of monthly mean inundation over that period. We showed that there is significant variation in open water extent within and between years (orders of magnitude difference), even though artesian spring flows are thought to be relatively constant. We determined that inter-annual variation in open water extent was moderately positively influenced by annual rainfall ($r^2 = 0.55$), and that intra-annual open water extent was strongly negatively related to temperature ($r^2 = 0.74$). Furthermore, we determined that open water area was anomalously high for the two most recent years, suggesting that removal of invasive species may have reduced evapotranspiration. The study demonstrates the power and benefit of WOfS as a spatially-explicit wetland monitoring tool.

The River Monitoring and Assessment Program (RiverMAP): assessing, predicting, and monitoring Victoria’s rivers health condition

Dr. Paula Sardina1, Lauren Hodgson1, Zuzanna Graszkiewicz1, Andrew Kramer1, Ros StClair1, Matthew Johnson1, Chris Garland1
1Environment Protection Authority (EPA) Victoria, Macleod, Australia

Biography:
Dr Paula Sardina is an aquatic ecologist with a focus on the impacts of human-driven stressors on aquatic ecosystems, including pollution, invasive species, and climate change. She is currently working as a freshwater scientist of the RiverMAP program for EPA Victoria.

For over 20 years the Department of Environment, Land, Water, and Planning (DELWP) and Environment Protection Authority (EPA) Victoria have been sampling macroinvertebrates to evaluate the health of Victoria’s rivers. The body of knowledge on the current condition of rivers is now at a level of maturity that a logical next step is to shift the focus to prioritisation and evaluation of management or regulatory intervention. The River Monitoring and Assessment Program (RiverMAP) is a program funded by DELWP and managed by EPA with three streams of work: (1) The River Health Model project aims to develop a state-wide predictive model of river health. This model will increase our understanding of the ways land use, vegetation cover, and environmental variables affect river ecological condition across Victoria. By predicting the condition of unsampled rivers, the
model will help identify current locations where active management is needed to counteract stressors and improve river condition. This model will also help guide management planning through scenario modelling. (2) The Hotspots Project aims to identify sources of pollution in rivers in rural Victoria, including mercury and dairy effluents, and (3) The Long Term Sites Monitoring project monitors the condition of macaroonibetral species at 66 long-term sites across Victoria to evaluate changes to stream condition over time. These three projects interact to assess, predict, and monitor threats to river health posed by land use-derived pollutants. Through these projects RiverMAP will help guide management practices and evaluate investment by DELWP and other agencies toward improving Victoria’s aquatic environments.

Functional trait responses to small-scale environmental variability in temperate grasslands on five continents

Dr Jodi Price1, Dr Riin Tamme2, Dr Antonio Gazol3, Dr John Morgan4, Dr Steve Leonard4, Dr Claire Wainwright4, Ms Gisella Stotz5, Prof James Cahill6, Prof Juan Jose Cantero7, César Núñez8, Dr Ricardo Ibañez9, Dr Inga Hilesalu10, Dr Uille Reier10, Professor Meelis Pärtel10

1University of Western Australia, Perth, Australia, 2University of New South Wales, Sydney, Australia, 3Instituto Pirenaico de Ecología (CSIC), Zaragoza, Spain, 4La Trobe University, Melbourne, Australia, 5University of Queensland, Brisbane, Australia, 6University of Alberta, Edmonton, Canada, 7Universidad Nacional de Río Cuarto, Córdoba, Argentina, 8University of Navarra, Navarra, Spain, 9Czech Academy of Sciences, Třeboní, Czech Republic, 10University of Tartu, Tartu, Estonia

Environmental Management and Monitoring (2), Balcony Rooms 3-4, November 30, 2015, 4:00 PM - 5:45 PM

Biography:

Dr Jodi Price is a community ecologist based at the University of Western Australia. Jodi is broadly interested in understanding community dynamics, particularly mechanisms governing species coexistence. Jodi likes testing ecological theories in herbaceous ecosystems, and recently she has been conducting field work in temperate grasslands around the world.

Temperate grasslands are diverse communities at small-scales where plant species interact, generating questions about how species coexist when they require the same limiting resources. Coexistence may be promoted by functional differences among species reducing competition (niche partitioning), or functional similarity due to competitive equivalence among co-occurring species. We sampled 42 temperate grassland sites in 6 countries (Canada, Estonia, Spain, Mongolia, Australia, and Argentina), and ask if there are general patterns in the relationship between functional similarity, species richness and environmental variability. In each site, we established a transect (10 x 0.1 m), consisting of 100 quadrats (10 x 10 cm). In each quadrat, we recorded species composition, and measured soil moisture, and light availability. We measured plant traits (height, leaf area, and specific leaf area) for most of the species occurring in each transect. We calculated functional diversity (FD) for all traits at the quadrat scale, and compared the observed FD to that expected at random using null models generated from species that occurred in the transect. Quadrat mean trait values and FD were then related to small-scale mean environmental conditions and heterogeneity respectively. We found co-occurring species were more functionally similar than expected for many traits, and this was partly related to soil moisture, in support of environmental filtering. We found few significant relationships between environmental heterogeneity and FD as might be expected by niche partitioning. In conclusion, there was little evidence for general relationships between functional traits and environmental variability among the study regions.

The birds and the bees… and the mammals: Reproductive ecology of Astelia australiana

Mrs Linda Parker1, Dr Joanne Birch2, Dr Sabine Kasel1, Dr Cristina Aponte1, Dr Vivienne Turner1, Dr Craig Nitschke1

1University of Melbourne, Edithvale, Australia, 2The Royal Botanic Gardens, Melbourne, Australia, 3Arthur Rylah Institute, Heidelberg, Australia

General Ecology, Balcony Rooms 1-2, November 30, 2015, 4:00 PM - 5:45 PM

Biography:

Linda Parker is a PhD student examining the ecology of Astelia australiana, a threatened perennial endemic to Cool Temperate Rainforest in Victoria. Her research is looking at the decline and viability of A. australiana populations and the reproductive ecology and eco-physiology of the species.

Astelia australiana is a vulnerable perennial herb, endemic to Cool Temperate Rainforest in Victoria. Monitoring of A. australiana over the last 20 years revealed the species is in decline. Very few flowering or juvenile individuals have been observed over the last 20 years suggesting the species reproductive output may be low and a contributing factor in this decline. Previous research on A. australiana has variously described the species as dioecious and gynodioecious and found that pollination is by bees and flies. This study aimed to gain a greater understanding of the reproductive ecology of A. australiana. We examined the flowering phenology and morphology of A. australiana, its seed ecology using laboratory and field based methods, and its pollination and dispersal ecology using motion sensing cameras. As a proxy for dispersal success limitation in A. australiana we conducted a translocation experiment and an in situ seed and seedling trial. We also examined the relationship between flower production and availability of light using a field light manipulation experiment. Astelia australiana was found to be polygamomous and fruit set and seed production was higher in females compared to hermaphrodites. Germination rates in the laboratory (94%) were higher than those in situ (7%). Survival of translocated individuals was over 98%. Bird and mammal species were pollinators of flowers and also consumers of fruit. Flowering occurred under canopy gaps but was absent under full canopy controls. Our results suggest that the reproductive output of A. australiana is limited by light availability.

Selecting optimal taxa for ecological monitoring: A meta-analytic approach

Dr Martin Westgate1, Dr Ayesha Tulloch1, Dr Philip Barton1, Dr Jennifer Pierson1, Prof. David Lindenmayer1

1Fenner School of Environment and Society, The Australian National University, Canberra, Australia

General Ecology, Balcony Rooms 1-2, November 30, 2015, 4:00 PM - 5:45 PM
A fundamental decision when deciding how to measure or monitor biodiversity is the choice of study taxon, but this choice is often made using qualitative criteria such as historical precedent or available expertise. A more robust approach would be to state some a priori expectation as to which taxa will provide the best possible information on the distribution of 'total' biodiversity; but few data are available to inform such hypotheses. Using results from a global meta-analysis, we identify groups that explain the highest proportion of variability in the richness or composition of unmeasured taxa, under a range of scenarios and assumptions. We show that simple methods for aggregating data between studies provide counter-intuitive recommendations regarding the choice of optimal surrogates. In contrast, methods that account for well-known drivers of cross-taxon congruence (spatial scale, grain size, and latitude) are more consistent between metrics (richness versus composition), and with known ecological relationships between taxa. Birds, vascular plants, and some insect taxa (Coleoptera and Exopterygota) are the most consistently useful surrogates for other taxonomic groups. However, the extent to which any one taxon is the 'optimal' choice of surrogate is highly context dependent. In the absence of other information, ecologists can use our results to assess which taxa are most likely to provide information on 'total' biodiversity.

Reconciling recreational use and conservation values in a coastal protected area

Ms Madeleine Stigner1, Dr Hawthorne Beyer1, Dr Richard Fuller1
1University of Queensland, St Lucia, Australia

Biography:
Madeleine is a recent Bachelor of Science Honours graduate from the University of Queensland School of Biological Sciences. Her research interests broadly include conservation biology and applied ecology.

Recreational use of protected areas is growing rapidly in many parts of the world, and there is urgent need to understand how to balance this important function of protected areas with that of biodiversity conservation. Here we show how this can be done by using zoning to minimise the impact of recreational disturbance to threatened migratory shorebirds in a coastal protected area. We develop models of shorebird occupancy and abundance based on empirical data (shorebird and recreational use surveys), and use these to inform a zoning plan that balances human and domestic dog recreation with shorebird protection in Moreton Bay Marine Park. We discovered that the presence of dogs along the foreshore significantly reduced the abundance of faring shorebirds, twice that of the effect of people alone. Despite this, a high level of shorebird representation (91%) can be met when people and dogs have access to all areas of foreshore. However, by restricting the number of sites which permit access to dogs, shorebird representation can be increased to 97%, indicating that if dog recreation is restricted, people recreation does not need to be, minimising social cost to recreationalists. Compliance to zone types is often voluntary, so integrating the current pattern of recreational use is more likely to generate workable zoning plans. The principal importance of our work is that we have used empirical data in a transparent manner to inform the prioritisation, and we show the conflict between alternative stakeholders in this case can readily be reconciled through careful planning.

Resistance and resilience of terrestrial birds in drying climates: do floodplains provide drought refugia?

Katherine Selwood1, Jim Thomson2, Rohan Clarke1, Melodie McGeoch1, Ralph Mac Nally2
1Monash University, Clayton, Australia, 2University of Canberra, , Australia

Biography:
Katherine Selwood is completing her PhD at Monash University on the significance and future prospects of terrestrial floodplain avifauna under a drying climate.

Climate refugia will become increasingly important for biota as climate change causes an increased frequency and intensity of extreme events, such as drought. Floodplains are potential drought refugia because they have cooler and more mesic microclimates than adjacent areas, and greater water availability through shallower groundwater and flooding.

We explored the role of floodplains as drought refugia by estimating the resistance and resilience of terrestrial birds in the Murray-Darling Basin over a 13-year drought (the ‘Big Dry’, 1998-2009) and following the break in the drought (2010-13) in floodplain and non-floodplain zones using Atlas of Australian Birds survey data.

We found greater resistance to drought in floodplain zones compared to non-floodplain zones: species trends in floodplain zones tended to be more positive, declines in many species were less severe, and fewer species declined (19% vs. 29%). More species showed a recovery in reporting rates in non-floodplain zones (40%) than in floodplain zones (15%) during the post-drought period, which was expected because drought-declines were more common in non-floodplain zones. There was some evidence for limitations in the resilience of floodplain avifauna: only 18% of species that declined in floodplain zones during the drought subsequently recovered.

Floodplains appear to enhance resistance to drought for many bird species, and are likely to be particularly important as refugia in areas with an arid climate. However, their role in resilience is less clear. Floodplain ecosystems require long-term management to relieve ressures and restore ecological condition so that their role as drought refugia is maintained or enhanced.
Biotic and abiotic factors predisposing marri (Corymbia calophylla) to canker disease caused by Quambalaria coyrecup

Ms Sarah Sapsford1, Dr. Trudy Paap2, Dr. Anna Hopkins3, Dr. Giles Hardy4, Dr. Treena Burgess5
1Murdoch University, Murdoch, Australia, 2Murdoch University, Murdoch, Australia, 3Murdoch University, Murdoch, Australia, 4Murdoch University, Murdoch, Australia, 5Murdoch University, Murdoch, Australia

General Ecology, Balcony Rooms 1-2, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Sarah Sapsford is a PhD student at Murdoch University studying biotic and abiotic factors predisposing marri trees to canker disease. Her main research interest is in disease ecology with past research focusing on the amphibian chytrid fungus. Sarah hopes to continue her research in disease ecology with emphasis on fungal pathogens.

Marri (Corymbia calophylla) is an iconic and keystone forest tree in Western Australia. A canker disease caused by the fungus Quambalaria coyrecup has devastated many marri stands. Disease incidence is higher in remnant stands that border cleared land such as road edges and farmland where there is greater anthropogenic disturbance, such as fertiliser, pesticide and herbicide use, and the introduction of plant pathogens. The progression of the decline strongly suggests a breakdown in the ability of the trees to maintain nutrient balance and we hypothesize that mycorrhizal fungi play a role in this process. The aim of this project was to examine the mycorrhizal species associated with marri and how these communities differ between intact and anthropogenically disturbed forest sites and whether pesticide use, changes in soil nutrition and/or soilborne pathogens are responsible for changes in communities of mycorrhizal fungi and hence canker disease incidence and severity. Seventeen sites were surveyed. Each site consisted of a disturbance gradient. Soil was collected from each transect and tested for nutrient composition, mycorrhizal composition and pathogens. Preliminary results demonstrate differences in soil nutrition between the disturbed transect and all intact forest transects. In addition, there are differences among the communities of fungi between the disturbed and intact forest transects. Disturbed transects show a higher proportion of pathogenic fungi particularly Phytophthora species, than in intact forest transects. Currently, the presence of pesticides and herbicides across the transects are being examined to determine their role in marri decline.

Testing a sniffer dog to detect invasive Hawkweeds

Dr Cindy Hauser1, Ms Inka Veltheim1, Dr Beth Crase1, Dr Gurutzeta Guillera-Arrolt1
1School of BioSciences, University of Melbourne, Parkville, Australia

Open forum, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Dr Cindy Hauser develops models and decision tools that support environmental management and account for uncertainty. She’s particularly interested in cost-effective designs for monitoring and surveillance, adaptive management and robust optimisation. Hauser’s research has encompassed systems as diverse as recreational waterfowl hunting, woodland regeneration, threatened species recovery and invasive species management.

Since the 1999 discovery of Hawkweeds (Hieracium spp) on the Bogong High Plains of Victoria, managers have relied upon human search teams to detect and treat infestations. Research has shown that these searchers are unable to detect hawkweeds with 100% confidence, with detection rates severely hampered in the presence of other yellow-flowering species or dense vegetation, and when Hawkweed is not flowering.

Trained detection dogs rely upon scent rather than sight for detection and may thus offer a complementary approach to human searches. In this study, we have developed a set of Hawkweed search trials to assess the detection capabilities of a newly trained detection dog on the Bogong High Plains. We placed potted Hawkweeds and control plants in replicated plots, recording the path of the detection dog and her handler, and measuring the time taken for the dog to detect the Hawkweeds. These data have been used to build a time-to-detection model that considers the influence of Hawkweed species, Hawkweed abundance, background vegetation and weather variables. We compare this model to previous time-to-detection models built for human searches, and discuss the circumstances in which a detection dog may be a cost-effective alternative to current survey methods.

Culling canids increases mesic macropods while reducing livestock losses

Dr Peter Fleming1,2, Dr Jim Thompson2, Dr Guy Ballard1,3
1Vertebrate Pest Research Unit, NSW DPI, Orange, Australia, 2Department of Agriculture & Fisheries, Queensland, Brisbane, Australia, 3School of Environmental & Rural Sciences, UNE, Armidale, Australia

Natural experiments in xeric Australia have indicated that dingoes likely regulate macropod abundance, and control of introduced predators is a suggested mechanism for releasing macropod population suppression. However, these concepts are untested in eastern mesic environments: could lethal wild dog and fox control conducted for livestock protection also benefit endangered and other macropods there?

Contrasting a treatment site, where 3 annual reductions of wild canids for sheep protection were applied, with an untreated site, we determined the responses of prey population indices; four macropods, including brush-tailed rock-wallahies (Petrogale penicillata), lagomorphs and possums. Indices of abundance of dingoes and foxes were annually substantially reduced in the treatment site and macropods were always fewer in the untreated site. Brush-tailed rock-wallahies were not detectable in the untreated site but were abundant in the treated site. Lagomorph and possum indices were similar at both sites and did not change between years or with treatment. This suggests that wild canids might regulate macropod populations in mesic Australia and that effective canid control for livestock protection can provide benefits brush-tailed rock-wallaby populations. Lagomorph and possum populations were likely unregulated by wild canids. Experimental design limitations and production effects will also be discussed.

Ant community responses to disturbance: an overview

Prof Alan Andersen3
3CSIRO Land & Water Flagship, PMB 44 Winnellie, Australia

Ants are Australia’s ecologically dominant faunal group, and are widely used as bio-indicators in land management. I provide a framework for understanding and predicting the responses of ant communities to habitat disturbance. Following Grime, disturbance is defined as any factor that removes biomass, and is distinguished from stress, which describes factors limiting growth in biomass (productivity). The ground-nesting habits of most ant species mean that habitat disturbance often causes little loss of ant biomass, such that the main effect is indirect through changes in habitat suitability and therefore environmental stress. From an ant’s perspective, a key feature of disturbance is that it increases habitat openness, and understanding ant responses to habitat openness is fundamental to understanding ant responses to disturbance. The same disturbance will have a greater effect in closed and complex habitats (by creating openness and reducing complexity) than it will in habitats that are already open and simple. Similarly, ant species adapted to shady and complex habitats will be more sensitive to disturbance than are species adapted to open and simple habitats. Indeed, in complex habitats the latter are often promoted by habitat disturbance. Ant community responses to disturbance therefore vary predictably in relation to habitat structure and the functional composition of the fauna. Such variation in ant responses occurs not only along gradients of habitat complexity, but also between different regions with functionally different ant faunas, including the same biome occurring in different continents.
Does grazing pressure and vegetation type influence seed harvesting by ants?

Ms Kimberley Solly¹, Dr Kieren Beaumont², Associate Professor Duncan Mackay², Associate Professor Molly Whalen², Dr Richard Davies²
¹Arid Recovery, Roxby Downs, Australia, ²Flinders University, Adelaide, Australia

Species Interactions (2), Suite 3, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Kieren Beaumont is a postdoctoral researcher at Flinders University. His research interests include the ecology of animal-plant interactions, particularly in the context of natural and anthropogenic disturbances.

Seed harvesting is an important animal-plant interaction that at broad scales may be shaped by plant community composition and disturbance. Grazing by livestock in particular is a widespread source of disturbance in arid environments of Australia where ants are often the predominant taxa responsible for seed harvesting. We investigated the effects of vegetation type (Maireana aphylla or Atriplex nummularia dominated vegetation) and past grazing pressure (proximity to dams) on seed harvesting by ants and on the plant species composition of ant refuse and middens. Fieldwork was carried out on a former pastoral property and now NFSA property, Witchelina Reserve, located in the mid-north of South Australia.

Seed depot experiments showed that seed-harvesting rates tended to be lower at sites near to dams (high grazing pressure) compared with sites far from dams (low grazing pressure), and that harvesting rates were not influenced by vegetation type. Also, harvester ant activity was significantly less at sites near to dams, but was not affected by vegetation type. Two ant species, one in each of the genera, Melophorus and Monomorium, dominated seed harvesting and examination of their refuse piles revealed over 70 plant taxa. Plant taxa composition, based on relative weights in refuse and middens, differed between harvester ant species and vegetation type but was not influenced by proximity to dams. This study shows that seed harvesting was reduced as a result of past grazing pressure. Even so, the broad diets of the two predominant harvester species may help to buffer them against grazing impacts.

Using near infra red reflectance spectroscopy to describe foraging behavior in a generalist herbivore.

Ms Keryn F. Bain¹, A/Prof Alistair Poore¹
¹University of New South Wales, Australia

Species Interactions (2), Suite 3, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Keryn F. Bain is a PhD student at the University of New South Wales, focusing on marine ecosystems. Her work explores feeding behaviour in marine herbivores, investigating the relative importance of extrinsic and intrinsic mechanism in driving diet mixing at various spatial scales.

Consumers are important to all environments, with predators, herbivores, and detritivores all fundamental in determining community structure and maintaining ecosystem functions. Predicting the role of a given consumer is dependent on knowledge of the breadth and composition of dietary items, which are highly variable both among and within species. In the field, individual diets are governed by behavioural preferences as well as factors intrinsic and extrinsic to the organism that may constrain their choices. Given that the diets of free living animals are often difficult to obtain, we examine whether near infrared reflectance spectroscopy (NIRS) can be used to quantify dietary composition in an abundant marine herbivore.

NIRS successfully classified and quantified the proportions of five dominant algal species from a Sydney rocky shore in mixed algal material. We then assessed whether NIRS could predict dietary composition for the marine gastropod Turbo torquatus using faecal material from single diets, artificial mixtures and mixed diets. Partial least squares methods were used to develop prediction models that effectively discriminated among species, and, for some species, effectively predicted the proportion of a given species in all possible two species mixtures. Given the strong link between spectra collected from faecal material and individual diets, we then surveyed faecal material obtained from free living animals to describe spatial and temporal patterns in the diet of T. torquatus. This survey indicated that on larger spatial scales, the diets of this herbivore are constrained by extrinsic factors, in particular the local availability of their algal foods.

Dispersal plays a key role in explaining increased species diversity in a field experiment

Prof Barbara J. Downes¹, Dr Jill Lancaster¹
¹The University of Melbourne, 221 Bouverie Street, Australia

Species Interactions (2), Suite 3, November 30, 2015, 4:00 PM - 5:45 PM

There are important hypotheses regarding the role dispersal plays in driving community structure across landscapes. Few, however, have been field-tested due to the difficulties of quantifying the contributions of successful dispersal events. We conducted a landscape-scale, fully controlled experiment in Hughes Creek, Victoria, in which we boosted the resources of living space and food, which resulted in increased species diversities at experimental sites. During the experiment, we collected data on dispersing individuals: those moving downstream along the stream corridor using the drift and, for some insects, dispersal by terrestrial adults. We distinguished between responses caused by density increases at experimental sites due to local population growth (no dispersal), drift dispersal from upstream or dispersal by adults followed by egg-laying and larval recruitment. Of the 26 taxa with marked density increases at experimental sites, most increased densities in patterns that were consistent with dispersal into
Underground competition and the heterogeneous distribution of nutrients in the soil are known to affect root responses underground. However, it is still unclear how roots respond to nutrients deposited by nitrogen fixing facilitator plants. One study suggests that plants forage closer to the roots of nitrogen fixers as the addition of nutrients lessens the costs of competition. To test this idea, we conducted a greenhouse experiment to assess root responses in Taraxacum officinale and Hypochaeris radicata to competition with Bidens pilosa and to nitrogen fixation with Medicago sativa. I used rhizotrons to observe root growth underground and quantified responses through root asymmetry and root to shoot ratios. Both species proportioned root growth away from the roots of B. pilosa when grown in competition and proportioned root growth towards the roots of M. sativa. Target plants also allocated significantly more biomass underground when placed in competition with B. pilosa compared to plants growing with M. sativa. The addition of increasing levels of nitrogen supplementation was not met with an increase in the magnitude of root foraging response. Both species maintained growth towards M. sativa but there were no significant differences in the magnitude of this response across different nitrogen treatments. The results of this study suggest that the identity of neighbouring plants and presence of nutrients trigger a general response in root foraging. Plants will avoid root competition with superior neighbours, and will grow towards nitrogen fixing facilitator plants, but the amount of nitrogen in the soil does not alter this response.

Alien black rats are effective substitutes for extinct native mammalian pollinators

Ms Amelia Saul1, Dr Charlotte Taylor2, Dr Peter Banks3
1The University of Sydney, The University of Sydney, Australia, 2The University of Sydney, The University of Sydney, Australia, 3The University of Sydney, The University of Sydney, Australia

Alien species pose major economic and ecological threats worldwide. Yet, over time, alien species should also develop positive effects in ecosystems, especially in those where they replace extinct native species. Here, we test this idea and examine whether alien black rats (Rattus rattus) act as effective pollinators of native plants (Banksea ericifolia), replacing locally extinct native mammalian pollinators in an Australian peri-urban landscape. We compared the pollen load carried by black rats (n=17) and native mammals (n=30), and used game cameras to measure the foraging/pollinating behaviours and interplant movement of mammals within artificial pollination networks. Then, we measured the effects of mammal exclusions upon B. ericifolia seed set. We found that black rats carry equivalent pollen loads and exhibit similar pollination behaviour to native mammals, although some black rats were found to forage destructively. Seed set in B. ericifolia was larger with mammal access to inflorescences and was also larger when black rats were pollinators. Together, these results indicate that black rats are active as substitutes for native mammalian pollinators, which are often lost from urban bushland remnants. Our results thus challenge traditional singular negative views of “alienness”: given that black rats are performing essential ecosystem services, should they be considered native?

Who are the natural enemies of fruit spotting bugs, Amblypelta sp. in Macadamia orchards?

Ms Bryony Wilcox1, Dr Romina Rader1, Dr Ruth Huwer2
1University of New England, Armidale, Australia, 2NSW Department of Primary Industry, Wollongbar, Australia

Bryony Wilcox is currently completing a Masters degree in Environmental Management at the University of New England. Her research interests include better understanding biodiversity in production landscapes. Bryony will be completing a PhD looking at linking pollinator efficiency and tree characteristics at different landscape scales.
Altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes

Prof Neal Enright1, Dr Joseph Fontaine1
1Murdoch University, Perth, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Professor Neal Enright is Professor of Plant Ecology and Dean of Graduate Studies at Murdoch University. His research focus is the fire ecology of plants, and particularly the population dynamics of woody plant species in relation to changing climate and fire regimes. He has published more than 150 refereed articles and chapters.

Projected effects of climate change across many ecosystems globally include more frequent disturbance by fire and reduced plant growth due to warmer (and especially drier) conditions. Such changes affect species – particularly fire-intolerant woody plants – by simultaneously reducing recruitment, growth, and survival. Collectively, these mechanisms may narrow the fire interval window compatible with population persistence, driving species to extirpation or extinction. We present a conceptual model of these combined effects, based on synthesis of the known impacts of climate change and altered fire regimes on plant demography, and describe a syndrome we term “interval squeeze”. This model predicts that interval squeeze will increase woody plant extinction risk and change ecosystem structure, composition, and carbon storage, especially in regions projected to become both warmer and drier. These predicted changes demand new approaches to fire management that will maximize the in situ adaptive capacity of species to respond to climate change and fire regime change.

Is Eucalyptus pauciflora vulnerable to interval squeeze? Impacts of repeat fire on a resprouting eucalypt

Mr Thomas Fairman1, Ms Shauna Tupper1, Dr. Lauren Bennett2, Dr. Craig Nitschke1
1The University of Melbourne, Burnley, Australia, 2The University of Melbourne, Creswick, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Thomas Fairman is a PhD Student at the Department of Ecosystem & Forest Science at The University of Melbourne. His research focuses on the effects of short-interval recurrent fire on eucalypt demography and structure in south-eastern Australia.

In the south-eastern Australian State of Victoria, over four million hectares of native forest has burned in wildfires of varying severity in the last decade (2003-2014; 4.3 million hectares), roughly equivalent to the cumulative area burned in the preceding fifty years (1952-2002; 4.4 million hectares). This peak in fire activity over the last decade has been characterised by a series of large fires, some >1 million hectares in total area. Some of these fires have overlapped the boundaries of prior fires, leading to 350,000 hectares of eucalypt forest having been burned two (and sometimes three) times within a decade. The effect of fires of this frequency on eucalypt demography, structure, and regeneration has not been studied in great depth. We explore the effects of frequent, high severity wildfire on the sub-alpine resprouting Eucalyptus pauciflora (Snow Gum). Using data from a range of sites across the Victorian high country, we show the effect of cumulative disturbances on snow gum structure and regeneration in stands burned once, twice and three times in recent wildfires (2003, 2007, and 2013). Our results show an increase in mature tree mortality and decrease in resprouting with increased fire frequency. We discuss these changes in the context of “interval squeeze” – interactions that increase woody plant extirpation or extinction risk – and what these changes may mean to the broader sub-alpine ecosystem. We close by reflecting on what management options may be available to minimise the negative impacts of frequent fires on snow gum populations.

Where has all the fire gone? The extent of fire exclusion in Byron Shire, NSW.

Mr Andy Baker1, Dr Claudia Catterall2
1Wildsite Ecological Services, MULLUMBIMBY, Australia, 2Southern Cross University, Lismore, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM
Structural vegetation change following fire exclusion is well documented throughout Australia. Such changes include the displacement of treeless ecosystems by forest, and the transition of open forest to rainforest. These changes displace essential habitat for myriad plant and animal species and are likely drivers of localised species extinctions. Research identifying the spatial extent of fire-excluded ecosystems is largely absent from the ecological literature. This study identifies the spatial and temporal extent of fire exclusion in Byron Shire in north-east New South Wales. GIS analysis compared modern fire history with recommended fire intervals for the maintenance of fire-dependent vegetation types. Fire exclusion (low-frequency fire) vastly exceeded high-frequency fire, comprising 99.1% of areas affected by inappropriate fire frequency. Most fire-dependent vegetation was fire-excluded, with less than 10% within recommended fire-interval thresholds. Most affected areas were fire-excluded for multiple recommended fire-return cycles, increasing the likelihood of vegetation change and localised extinctions. These findings demonstrate the operation of a major threatening process affecting Byron Shire’s biodiversity that has previously been little recognised.

A growing body of ecological literature suggests that irreversible change to fire-excluded vegetation is likely wherever plant growth resources are sufficient to enable transition. Irreversible vegetation change and rapid species declines have already been reported for several communities in Byron Shire. With increasing time since fire, efforts to restore these sites may be complicated by encroaching trees resistant to removal by fire, and the difficulties of reintroducing low-intensity understory fires where the flammable understory has been lost through shading.

Drought-fire interactions: compound disturbance effects on woodland trees of coastal Western Australia

Dr Joe Fontaine1, Mr Aaron Brace2, Ms Wilia Veber1, Dr Ben Miller3
1Murdoch University, Murdoch, Australia, 2Plymouth University, Plymouth, United Kingdom, 3Kings Park and Botanic Gardens, West Perth, Australia

Biography:
Dr Joe Fontaine is a fire ecologist based in Perth, WA. He studies a range of fire and fire management related issues in heathland and woodland portions of WA as well as western North America. He is particularly interested in disturbance interactions.

Frequency and intensity of disturbance is projected to increase for many ecosystems globally, with uncertain consequences, particularly when disturbances occur in rapid succession. Implications of these changes are most urgent in fire-prone regions undergoing warming and drying (e.g. Mediterranean type ecosystems) where increased fire (both managed and unmanaged) may interact with increasing drought leading to punctuated tree mortality and recruitment failure. We quantified tree mortality and recruitment following historic drought in Banksia-dominated woodlands surrounding Perth, Western Australia. Stands experienced drought alone (N=18), drought and wildfire (N=11) or drought and prescribed fire (N=15). We evaluated species and individual tree susceptibility to mortality and evidence for compound disturbance —whether wildfire or prescribed fire during drought increased tree mortality risk. We further quantified regeneration to understand if the drought or drought-fire event resulted in longer term shifts in stand structure and tree species composition. We observed a shift in dominance towards Eucalyptus and away from Banksia with elevated mortality of large Banksia. Evidence of compound disturbance effects was modest. Improved understanding of disturbance interactions are critical to forecasting effects of climate change and informing fire management.

Managing recovery after fire in long-unburnt environments

Mr Andrew Denham1,2, Ben Vincent2, Peter Clarke2, Tony Auld1,3,4
1Office of Environment and Heritage NSW, Hurstville, Australia, 2Botany, School of Environmental and Rural Science, University of New England, Armidale, Australia, 3Institute for Conservation Biology and Environmental Management, School of Biological Sciences, University of Wollongong, Wollongong, Australia, 4Centre for Ecosystem Science, University of New South Wales, Sydney, Australia

Biography:
Andrew Denham is a fire ecologist working for the NSW Office of Environment and Heritage. He is interested in understanding the mechanisms that allow plant species to persist in fire-prone habitats, particularly in relation to seed banks and post-fire recruitment.

Long unburnt habitat is increasingly recognised as critical to effective biodiversity conservation. When burnt, management of the subsequent fire regime is critical to minimise the risk of substantial habitat alteration and potential loss of biodiversity. After a mega-fire in Warrumbungle National Park NSW that burnt more than 50000 ha in 2013, we examined the response of nine eucalypt and two Callitris species and quantified the structural changes to the vegetation. While eucalypts predominantly survived and resprouted, Callitris were killed when exposed to crown scorch leading to losses of up to 83% of trees for all species combined in plots where fire severity was high. Over 50% of eucalypt individuals were topkilled and even when they resprouted epicormically, many had most of their trunks killed. Hence there has been a substantial change in vegetation structure with a shorter and possibly more open landscape likely to persist for several decades. We observed relatively few Callitris seedlings in the first two years after the fire, but post-fire recruitment of acacias in high density thickets is creating a new mid-storey layer in some areas that experienced high fire
Modelling age class diversity under different wildfire management scenarios in a Heathland community.

Mr Matthew Chick1, Dr Craig Nitschke1, A/Prof Alan York1, Dr Janet Cohn1
1University of Melbourne, Melbourne, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Matthew Chick is currently completing a PhD in Forest and Fire Ecology with the University of Melbourne. He is researching the ecological responses of Australian heathy woodland to different seasonal timings of fuel reduction burning in interaction with climate change.

Prescribed fire is a necessary tool for mitigating wildfire risk through managing forest fuels. As well as fuel management, attempts to use prescribed fire as a tool to protect and promote biodiversity are occurring. This is occurring through burning a patchwork or mosaic of age classes throughout the landscape. The concept behind mosaic burning is to promote landscape resilience through achieving a diversity of age classes across the landscape, and therefore a diversity of species compositions in differing successional stages. Furthermore, after the 2009 wildfires in Victoria a bushfire royal commission recommended increasing prescribed burning to around 5% of public land per year. Currently land managers are uncertain what the ideal proportion of age classes across landscapes is, and what increased prescribed burning will mean for current plant species compositions.

To address this gap, we have parameterised the landscape succession and disturbance model LANDIS-II to attempt prediction of future landscape change under alternate wildfire management scenarios. This has occurred using data from a heavily managed Heathland community. Scenarios included burning 5% of public land as recommended, burning the current amount of around 1.7%, or no prescribed fire and periodic wildfires. Model results include resulting age class distributions and species richness after 50 and 100 years of each scenario.

As age class management is current practice, modelling such as this is important in order to build predictions under alternate scenarios and help inform land managers.

Location, location, location: habitat preferences of a semi-arid marsupial and implications for fire management

Ms Amanda McLean1, Dr Jasmin Packer1, Dr Steven Delean1, Dr Melanie Lancaster2, Prof Steven Cooper1,3, Prof Sue Carthew4
1The University of Adelaide, Adelaide, Australia, 2Zoos Victoria, Healesville, Australia, 3South Australian Museum, Adelaide, Australia, 4Charles Darwin University, Darwin, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Amanda McLean has recently submitted her PhD thesis at The University of Adelaide on the conservation biology of an endangered semi-arid marsupial, the sandhill dunnart (Sminthopsis psammophila). Her research interests include the ecology of the Australian arid zone, the conservation biology of small mammals and conservation genetics.

Australia has one of the highest rates of mammal extinction in the world. However, before management plans can be developed and implemented, key aspects of a species’ ecology, including habitat preferences, need to be understood. The sandhill dunnart (Sminthopsis psammophila) is an endangered dasyurid marsupial and its ecology is poorly understood. This study aimed to define the habitat preferences of S. psammophilavegetation structure and risking local extinction of Callitris. Our capacity to return the system to its pre-fire state depends on minimising fire while recovery occurs.

Interaction of fire and fragmentation: Influences on reptiles in a mallee agricultural landscape

Ms Juliana Lazzari1, Professor Don Anthony Driscoll2,1
1Fenner School of Environment and Society, Australian National University, Canberra, Australia, 2School of Life and Environmental Sciences, Deakin University, Burwood, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM
Biography:
Juliana Lazzari is a PhD student with research interests in fire ecology. In particular, understanding how species respond to fire in fragmented landscapes. This knowledge will enable us to inform fire regime management.

Fire, including fire suppression, is a tool used to manage reserve and non-reserve environments. In highly fragmented agricultural landscapes we are uncertain how native animal species respond to fire. Fires in isolated patches could lead to local species extinctions if small remnants are not being re-populated by nearby source populations. These localised extinctions could lead to regional declines. Limited knowledge of species responses to fire affects our ability to make decisions about fire regime management because we do not know the conservation implications of fire in small, isolated remnants. We surveyed reptiles in a mallee Eucalypt woodland landscape, Eyre Peninsula, South Australia. Three hundred pitfall traps were located over 30 transects. We placed 12 transects within a large reserve hypothesised to act as a source population. We also surveyed 18 small remnant patches isolated from the reserve by an agricultural matrix of dryland cropping, including remnants near the reserve, and far from the reserve. We experimentally burnt eight of these isolated remnant patches. Our findings indicate we need to consider the interaction of fire and fragmentation on reptiles when determining the effects of fire regimes on their persistence in fragmented landscapes.

The mammals that fire research forgot

Dr Matt Bruce¹, Ms Phoebe Macaik¹, Dr Geoff Brown¹, Dr Belinda Cant¹, Dr Josephine MacHunter¹, Ms Annette Muir¹
¹Arthur Rylah Institute, Department of Environment, Land, Water and Planning, Heidelberg, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Dr Matt Bruce is an animal ecologist at the Arthur Rylah Institute in the Victorian Department of Environment, Land, Water and Planning. His research interests include the influence of fire on animals, plants and carbon stores. He also likes spiders.

Understanding the effect of fire on plants and animals is of both ecological and management interest. Research in this area however, is typically biased towards plants, birds and non-volant mammals. Bats represent about 25% of Australian terrestrial mammal species, yet fire effects on this group remain little known, particularly in the forests of south-eastern Australia. Here we present the results of two studies into the effect of fire on microbats. In the first study we used space-for-time substitution to investigate bat activity at sites with a range of fire histories (time since fire and number of recent fires) in Gippsland, Victoria. In the second study we investigated the effect of multiple fuel-reduction burns at different frequencies (3 or 7 year intervals) and burns in different seasons (spring or autumn) within a replicated experimental design that was established in 1984. In both studies bats were surveyed using automated sound recorders (“bat detectors”) which allow for the nightly activity of individual species to be determined without interfering with their behaviour. Our results from the space-for-time substitution showed that bat species differ in their response to fire history showing both positive and negative responses to the number of recent fires. The experimental study revealed lower overall bat activity at sites frequently burnt in spring, compared to those burnt infrequently. Taken together our results suggest that bats have differing responses to fire and that this may depend on their foraging requirements. Furthermore, frequent planned burning in spring may be detrimental to microbats.

Doing science that policy makers and land managers might care about

Prof Mike Clarke¹
¹Dept of Ecology, Environment and Evolution, La Trobe University, Bundoora, Australia

SYMPOSIUM: Fire Regime Management - connecting science & practice (part 2), Ballroom A, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Professor Mike Clarke studies the impact of fire upon fauna. He has published internationally on the ecology and conservation biology of birds, reptiles, mammals, fish and plants. In 2007 he was awarded the DL Serventy Medal for his outstanding contribution to the scientific literature in ornithology.

The field of fire ecology presents outstanding opportunities to do science that is intellectually challenging and innovative, while at the same time has the potential to influence current and future management of fire. I will present an overview of several of our group’s large scale and long term studies in fire ecology and use them as case studies to explore factors that enhance or inhibit conducting genuinely collaborative research programs with land managers. This will include consideration of aspects of study design and project management that have enhanced the longevity of these studies. Most fire ecologists are keen for their findings to influence policy and the on-ground practices of land management agencies or private landholders. However, it is not uncommon for our findings to be overlooked or ignored. I will reflect on my experience of where we have had greater or less success in influencing land management policy and practice. I will explore the relative contribution of scientific rigor, advocacy and the art of gaining influence in my experience of attempting to do science that matters.

Fire ecology in semi-arid shrublands: a synthesis from Charles Darwin Reserve, WA

Dr Robert Davis¹, Mr Tim Doherty¹, Dr Eddie Van Etten¹
¹School of Natural Science, Edith Cowan University, Joondalup, Australia

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM
Fire management is a complex and important issue for conservation reserve managers that must reconcile the contrasting requirements of plant and animal communities. Although relatively well researched in many landscapes, fire ecology has been poorly studied in the semi-arid shrublands that dominate much of the arid-mesic interface of south-western Australia. We present a synthesis of multiple studies on fire impacts on vegetation, small mammals, reptiles and birds in extensive semi-arid shrublands at Bush Heritage Australia’s Charles Darwin Reserve in Western Australia. We consider how vegetation structure, predation, behavior and morphology may drive observed changes in community composition with increasing time since fire and consequently we suggest a framework for fire management in this landscape. Structural attributes such as canopy cover, litter cover and patch size increased with time since fire. The cover of re-sprouting plants increased with time since fire, but decreased with increased fire frequency. Plant species richness and diversity decreased with time since fire, whereas bird species richness and diversity increased. Most small mammal and reptile species favoured either recently burnt (8–13 years old) or long unburnt shrublands (25–49 years). Rodent foraging behaviour differed between fire ages and large insectivorous birds were most abundant in areas remaining unburnt for > 34 years. Our work points to the importance of maintaining long unburnt vegetation in the landscape and minimizing broad-scale fires that homogenise habitat structure.

Australian Wildlife Conservancy—integrating conservation practice with Science

Dr David Roshier1, Dr John Kanowski2
1Australian Wildlife Conservancy, Adelaide;
2Australian Wildlife Conservancy, Sydney.

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Dr Davis Roshier, as Regional Ecologist, manages research and conservation on seven reserves owned and managed by the Australian Wildlife Conservancy. These sanctuaries cover 1,016,000 ha in southern and central Australia. He focuses on key threatening processes such as feral predators, feral herbivores and wildfire, and the re-introduction of regionally extinct fauna.

Australian Wildlife Conservancy (AWC) manages for conservation more than 3 million hectares in 23 sanctuaries across the continent. A feature of AWC’s model of private nature conservation is the considerable investment in science expertise in the organisation, with researchers and conservation practitioners co-located on wildlife sanctuaries in each region. The primary advantage of this model is that it ensures a tight focus of research on issues relevant to the interests of AWC. While AWC does collaborate with external researchers to leverage investments in conservation projects, these programs are typically focused on issues relevant to academic researchers; further, there can be considerable uncertainty in research delivery where students are involved. Nonetheless, collaborations bring additional expertise, money and effort to bear on conservation problems being managed by AWC.

AWC’s research and conservation programs have made a substantial contribution to ecological understanding in Australia. AWC’s reintroduction program has demonstrated the dominant impact of introduced predators on critical-weight-range mammals. In the Kimberley, research programs coupled with extensive fire and feral herbivore management, has generated new insights into the ecology of threatened birds and mammals; in turn, this knowledge has helped refine land management programs. AWC ecologists demonstrated the interplay between fire management, grazing and the ecology of feral cats in northern Australia. This approach will be extended to feral predators in southern Australia with the objective of managing impacts on native wildlife at a landscape scale. These insights have been facilitated by the tight integration of conservation practitioners and ecologists in the AWC model.

Managing species across vast spatial areas: does one size fit all?

Dr Aaron Greenville1, Prof. Glenda Wardle1, Mr Vuong Nguyen1,2, Prof. Chris Dickman1,2
1Desert Ecology Research Group, University of Sydney; 2Long Term Ecological Research Network, Terrestrial Ecosystem Research Network.

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Aaron Greenville completed his PhD this year and has been working as a Research Assistant for the past 10 years for the Desert Ecology Research Group at the University of Sydney. His research interests are desert ecology, population biology and trophic ecology.

Understanding how the spatial and temporal dynamics of populations vary across the landscape is fundamentally important to managing and conserving species. For example, populations may fluctuate in synchrony, or exhibit other forms of spatial sub-structuring, due to intrinsic population parameters or to influences from environmental factors. Importantly, synchronous populations may be at greater risk of extinction if all populations are decreasing to zero at the same time, thereby reducing rescue through colonisation. Different species may not have similar dynamics, even if they share the same environment and thus unravelling the spatial dynamics of multiple species provides vital information about what scale to apply management actions. Using long-term data (17-22 years) across a large-scale study region (8000 km²) in arid central Australia, we test for regional
synchrony in a population driver, annual rainfall, across nine sites (>20 km apart). We then draw from examples from small mammal and reptile populations and investigate if each species exhibits synchrony. For species that did not exhibit synchrony, we used multivariate autoregressive state-space (MARSS) models to explore four other sub-population structures. We also use the MARSS models to identify important drivers that may regulate populations of these species. We show that species exhibited different spatial population structuring and respond to extrinsic factors in different ways. We conclude that investigating how the spatial connections among populations interact with their temporal dynamics and eventual persistence or decline, is important for determining the appropriate scale to implement management actions and that “one size does not fit all”.

Of horses and honeyeaters: what shapes the bird assemblages of Carnarvon Station Reserve?

Dr Martine Maron1, Dr Alison Howes1, Ms Emma Burgess1, Mr Murray Haseler2
1The University of Queensland, Brisbane, Australia, 2Bush Heritage Australia, Point Lookout, Australia

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Dr Martine Maron is Associate Professor of Environmental Management at The University of Queensland and an ARC Future Fellow. Her research group, part of the Centre for Biodiversity and Conservation Science, works on conservation policy, particularly biodiversity offsets, woodland bird ecology, and landscape ecology.

The Brigalow Belt, a large and distinctive bioregion in eastern Australia, has been mostly cleared and converted to intensive agriculture. Some large and spectacular reserves remain, such as Carnarvon National Park and the adjacent Carnarvon Station, owned by Bush Heritage Australia. The extensive uncleared woodlands of Carnarvon Station have been destocked and fire, weeds and feral animals are managed. Yet, like many remnants in the bioregion, the property’s avifauna remains dominated by a homogeneous assemblage of large bird species, with very few of the woodland birds whose decline in woodlands in more-fragmented parts of eastern Australia is increasingly well-documented. The reason appears to be extremely high densities of noisy miners – the despotic native honeyeater whose presence markedly reduces small bird diversity within its territories.

In this talk, I will outline BHA’s collaboration with university researchers over the past ten years which aimed to understand this phenomenon. Despite the apparently intact vegetation, there were several key factors acting to facilitate noisy miner densities as high as anywhere in Australia, including fire regimes that favoured creation of more-open woodlands, and grazing by feral horses. An initial program of research quantified the site-level effects of fire and grazing, and a second examined the consequences of the fire mosaic for bird diversity at multiple scales, and identified drivers of bird richness across landscapes. The work will help refine the fire plan for Carnarvon station, and also inform those for other remnants in bioregion and across the subtropical woodland zone.

Ecosystem risk assessment of Georgina gidgee woodlands in central Australia

Prof Glenda Wardle1,2, Dr Aaron Greenville1,2, Dr Anke Frank1, Dr Max Tischler1, Dr Nathan Emery1,2, Prof Chris Dickman1,2
1University of Sydney, Sydney, Australia, 2Long Term Ecological Research Network

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Professor Glenda Wardle is a Professor of Ecology and Evolution at the University of Sydney and lead the Desert Ecology Research Group. She studies the dynamics of populations, species and ecological interactions with a focus on plants. She applies this knowledge to the conservation and management of ecosystems, particularly deserts.

Ecosystem risk assessments are a new instrument in the ecological manager’s toolbox. The key component is a set of quantitative decision rules that address the distribution and function of the target ecosystem. Here we focus attention on a relatively poorly known ecosystem. Georgina gidgee woodlands are widespread across central Australia but occur in relatively small patches of a few hectares.

To address the extensive knowledge gaps for this understudied ecosystem, we gathered data to provide the first description of the characteristic biota, distribution of dominant species and the processes that support the ecosystem. Criteria evaluated included historical, current and future declines in spatial distribution, the extent and area of occupancy, and disruptions to abiotic and biotic processes, including uncertainty in the bioclimatic models.

The risk status of Georgina gidgee woodlands was vulnerable based on the degradation of abiotic and biotic processes. Bioclimatically suitable habitat was predicted to decline by at least 30% in eight scenarios over the period 2000 to 2050. Pressures from grazing, weed encroachment and altered fire regimes further threaten the ecosystem; therefore, vulnerable status was also recorded for future declines based on altered biotic processes. Accurate mapping and monitoring of the study ecosystem should receive priority to inform conservation decisions, and sustainable grazing practices encouraged.

Our findings highlight the importance of other patchily distributed ecosystems that may also have escaped attention despite their contribution to supporting unique biodiversity and ecosystem services. It is timely that environmental monitoring and policy account for these natural assets.

When neighbours become good controls: using control site monitoring to evaluate post-grazing shrub recovery.
Mr Daniel Bateman, Dr. David Duncan, Dr. Libby Rumpf, Dr. Jim Radford, Associate Professor Brendan Wintle, Dr. Chris Jones
1Quantitative and Applied Ecology Group, University of Melbourne, Brunswick, Australia, 2Bush Heritage Australia, Melbourne, Australia

SYMPOSIUM: The contribution of private conservation organisations to advances in ecological understanding, November 30, 2015, 4:00 PM - 5:45 PM

Biography:
Kate Cranney is a Master of Science (Botany) student at the University of Melbourne. Kate is interested in private conservation, Indigenous caring for country projects, botany, insect ecology and art. She grew up on a sheep/cattle station outside Goondiwindi, in western Queensland, and moved to Melbourne from the Torres Strait.

Bush Heritage Australia (BHA) has a clear incentive to demonstrate ‘return on conservation investment’: how have donor-funded management actions improved the ecological health of BHA’s 37 reserves?

Through its Ecological Outcomes Monitoring (EOM) program, BHA collects data on ecological indicators—data that help investigate on-reserve ecological variation over time. But what state would the reserves be in without BHA’s management? This question requires data from control sites; however BHA’s current EOM program does not include control site monitoring, fundamentally constraining the scope of their evaluation—a common issue for both public and private monitoring programs.

For BHA’s Boolcoomatta Reserve—a former sheep station in South Australia—we asked: what variables drive change in saltbush shrubcover (the dominant vegetation type)? Our conceptual model, developed using expert elicitation, suggested that the key variables driving change are rainfall, distance to watering points and the abundance of various herbivores. We tested this conceptual model with data, including BHA’s monitoring data from 2006-2014. The generalised linear model we created indicates the relative strength of management and climate drivers of vegetation change—

Next, in 2014, we surveyed sites on neighbouring properties to act as control sites for BHA’s management. Our working assumption was that Boolcoomatta’s vegetation condition was similar to the surrounding properties upon acquisition, in 2006. As such, we used 2014 survey data to estimate the change in shrubcover between Boolcoomatta and adjoining properties between 2006 and 2014.

This research is an important pilot study, helping BHA to use on-reserve and control data to illustrate return on conservation investment.

The conservation of soft sediment fishes: the vast unknown

Mr Lachlan Fetterplace, Professor Andy Davis, Dr Matt Taylor, Dr Nathan Knott
1School of Biological Sciences, University of Wollongong, Wollongong, Australia, 2NSW Department of Primary Industries, Sydney, Australia

2014 TNC Applied Conservation Award, December 1, 2015, 8:35 AM - 8:50 AM

Biography:
Lachlan Fetterplace is a PhD Student at the University of Wollongong and NSW Department of Primary Industries. He has a long held interest in both marine and freshwater fish ecology. His current research focuses on the ecology of fish found on marine soft sediments and the impacts of fishing on these fish communities. He co-founded Fish Thinkers Research, a science communication initiative that encourages conversations on marine science and sustainable fishing practices with the general public.

More than 70% of Australia’s marine protected areas (MPAs) cover soft sediments- sand. Recently there have been MPA zoning changes in NSW based on the notion that fish on sand do not show site attachment and therefore spatial closures over sand, provide little conservation value. However, as there is no movement information available for the majority of fish species found on sand it is impossible to say whether these zones really are an effective management tool. The bluespotted flatehead- BF (Platypus platypus platypus) is a commercially and recreationally exploited species found on sand in South East Australia. There is no published data on adult movement patterns. Here we aim to quantify movement and habitat-use of BF to: (1) determine whether they show site fidelity, (2) identify whether they undertake migration or long range movements, (3) compare their movement to current no-take reserve design. We use surgically implanted acoustic tags and 48 acoustic receivers within Jervis Bay Marine Park to assess movement. Twenty of these receivers make up a vemco positioning system (VPS) providing fine-scale (<4m) positioning across >81 hectares. The remaining receivers line the Bay perimeter or gate the entrance to the Bay, allowing the detection of broader scale movements. BF were caught and tagged within the VPS in spring 2014 (n=25) and autumn 2015 (n = 15) and the study is ongoing. To date tagged fish have remained in the array for up to 7 months and this outcome indicates that bluespotted flathead show considerable site fidelity.

Predator vs. facilitator: indirect effects of the European shore crab, Carcinus maenas, on mussel-bed invertebrates

Mr Daniel Bateman
1Macquarie University, North Ryde, Australia

2014 Jill Landsberg Trust Fund Scholarship presentation, December 1, 2015, 8:55 AM - 9:10 AM

Biography:
Where predators modify the population structure of foundation species, they may potentially cause major changes to associated communities. In mangrove forests of south-eastern Australia, the complex habitat provided by the native bed-forming mussel, Xenostrobus securis, supports dense and diverse invertebrate communities. The non-native crab, Carcinus maenas, a global pest species and voracious generalist predator, overlaps with the mussels' distribution. Carcinus may modify mussel density and population structure through predation, thereby causing indirect effects on resident invertebrate communities that exceed direct consumptive effects on invertebrates. Using a combination of aquarium and field experiments we compared the direct and indirect effects of the non-native crab, C. maenas, and the native crab, Paragrapsus laevis, on invertebrate communities associated with mussel beds. In aquaria, there were negative effects of each predator on mussel and invertebrate density that increased linearly with the amount of time mussels were exposed to crabs. On average, C. maenas consumed 5 times more mussels and invertebrates than P. laevis. When mussel beds were assembled at densities representing a variety of predation intensities, defaunated and transplanted to the field, differences among treatments in colonisation by invertebrates were observed, indicating indirect effect of crab predation on invertebrate communities. The magnitude of this indirect effect of crab predation on invertebrate assemblages outweighed direct effects. These findings highlight the cascading effects of predation and emphasise the importance of considering indirect effects when evaluating impacts of invasive predators.

Behavioural patterns in animal movement modify range dynamics and extinction risk

Dr Damien Fordham¹, Dr Kevin Shoemaker², Dr Nathan Schumaker³
¹University of Adelaide, Adelaide, Australia, ²Stony Brook University, Stony Brook, USA, ³US Environmental Protection Agency, Corvallis, USA

Biography:
Damien Fordham is an ARC Future Fellow and Senior Research Fellow at the University of Adelaide’s Environment Institute and School of Biological Science. His research focuses on the causes and consequences of extinction, and developing simulation models to anticipate ecological responses to synergies of human impacts on the biosphere.

Forecasts of range dynamics now incorporate many of the mechanisms and interactions that drive species distributions. However, connectivity continues to be simulated using overly simple distance-based dispersal models with little consideration of how the individual behaviour of dispersing organisms interacts with landscape structure. Here we link individual and population level models to test the implications of this omission. We apply this novel approach to a turtle species inhabiting wetlands which are patchily distributed across a tropical savannah, and whose distribution is threatened by two important synergistic drivers of global change: predation by invasive species and overexploitation. We show that projections of local range dynamics in this study system change substantially when movement behaviour is modelled explicitly. Accounting for movement behaviour in model simulations causes the estimate of extinction risk to increase, and predictions of range contraction to slow. We conclude that models of range dynamics that simulate behavioural patterns in movement can reduce an important source of bias in predictions of shifts in species distributions and abundances, especially for organisms whose dispersal behaviours are strongly affected by landscape structure.

The effects of Late Quaternary environmental change and isolation on the mammals of Kangaroo Island

Dr Matthew McDowell¹, Dr Gavin Prideaux¹, Dr Alexander Baynes¹, Dr Lee Arnold³, Dr Linda Aylliffe³, Dr Fiona Bertuch², Dr Geraldine Jacobsen⁴, Dr John Hellemston³, Dr Sander van der Kaars³, Mr Shaun Adams³
¹School of Biological Science, Flinders University, Adelaide, Australia, ²Department of Earth and Planetary Sciences, Western Australian Museum, Perth, Australia, ³School of Physical Sciences, University of Adelaide, Adelaide, Australia, ⁴Institute for Environmental Research, Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia, ⁵Research School of Earth Sciences, The Australian National University, Canberra, Australia, ⁶School of Earth Sciences, University of Melbourne, Melbourne, Australia, ⁷Centre for Palynology and Palaeoecology Geography and Environmental Science Monash University, Melbourne, Australia

Biography:
My recent research focuses on how the fauna of Kangaroo Island responded to climate change and isolation due to sea-level rise. My research has generated the longest near continuous multi-proxy environmental record on a land-bridge island anywhere in the world.

Quaternary climatic changes had dramatic effects on terrestrial landscapes and biotas. Impacts were likely especially intense on land-bridge islands where isolation due to rising sea levels greatly reduced potential for immigration and colonization. To date, however, studies of such islands have only been able to infer changes based largely on modern diversity due to the lack of long term fossil records. Here we examine late Quaternary faunal change in a near continuous cave assemblage on Kangaroo Island (KI), South Australia that spans at last 130 thousand years. Total species richness, evenness and composition did not vary greatly with time, but relative abundances of ecologically divergent species did. The relative abundance of several heath species declined from the Late Pleistocene into the Holocene, and-zone species numbers peaked around the LGM and the relative abundance of mallee woodland species increased during the Holocene. These patterns, supported by other records, correlate with the...
climatic transition from the relatively cool, dry Late Pleistocene, through the arid LGM and into the relatively warmer, wetter Holocene. Few mammals disappeared after KI was isolated by early Holocene sea-level rise. This supports an emerging view that southern Australia’s native fauna is resilient to climate change and isolation but suggests that most nature reserves are nowhere near large enough highlighting the importance of maintaining native mammal populations outside the reserve system to allow species dispersal and migration with habitat.

Holocene faunal records present alternative species reintroductions for conservation management on the Swan Coastal Plain

**Ms Kailah Thorn**

1 Flinders University, Bedford Park, Australia

**Behavioural Ecology and Evolution (1), Balcony Rooms 3-4, December 1, 2015, 10:30 AM - 12:30 PM**

**Biography:**

Kailah Thorn finished her thesis in 2013 on the fossil mammal fauna of Caladenia Cave on the Northern Swan Coastal Plain, and is now in academic limbo whilst deciding what to do for a PhD. To fill the time, she’s working at the Flinders University Palaeontology Laboratory as a research assistant.

Historical surveys of the mammal fauna of the Northern Swan Coastal Plain record 28 non-volant and 5 volant mammalian species. However, Holocene fossil deposits from Hastings, Wedges, Caladenia and Orchestra Shell Caves confirm at least 37 non-volant and 6 volant mammals once occupied the same area. Current prediction models and management plans for the Northern Swan Coastal Plain consider the conservation management of historically recorded species only. Addition of the Holocene records would offer a more accurate representation of the region’s original communities and carrying capacity. Decreased rainfall and increased Gnamgara aquifer extraction over the last 30 years are predicted to negatively impact the surviving 11 mammals, 3 of which are highly reliant on a consistent water supply. Locally extinct arid adapted species recorded in the Holocene fossil assemblages are a more suitable reintroduction choice than the historically recorded higher rainfall-dependent species, to rebuild native mammalian communities in the numerous national parks in the area. As these data are freely available from both primary and secondary literature e.g., the new Atlas of Prehistoric Australia, park management strategies should consider the inclusion of late Holocene fauna.

Human-megafauna interactions drove Late Quaternary megafauna extinctions in Australia

**Dr Frédérik Saltré**1, Ms Marta Rodriguez-Rey1, Prof Barry W. Brook2, Prof Christopher N. Johnson2, Prof Chris S. M. Turney3, Prof Corey J. A. Bradshaw1

1 Environment Institute, University of Adelaide, Adelaide, Australia, 2 School of Biological Sciences, University of Tasmania, Hobart, Australia, 3 School of Biological, Earth and Environmental Sciences, University of NSW, Sydney, Australia

**Behavioural Ecology and Evolution (1), Balcony Rooms 3-4, December 1, 2015, 10:30 AM - 12:30 PM**

**Biography:**

Frédérik Saltré is a Research Associate, in the Environment Institute at the University of Adelaide, developing new mathematical approaches to highlight mechanisms underlying the patterns of species extinction across various (temporal and spatial) scales in the aim to provide relevant insights to reduce future biodiversity losses.

Late Quaternary megafauna extinctions rapidly reduced the diversity of mammals worldwide, triggering a reorganization of global patterns of biodiversity. The causes of these extinctions in Australia (i.e., climate, human or some combination) are the most controversial, yet essential to resolve because this continent-wide extinction event presaged similar losses that occurred thousand of years later on other continents. Most Australian megafauna extinctions seem to have taken place at or beyond the limit of radiocarbon (14C) dating (50-40,000 years ago), which has made it difficult to construct an accurate chronology of species losses relative to major climatic or archaeological transitions. Here we apply a rigorous metadata analysis and new ensemble-hindcasting approach to 659 megafauna fossil ages along with analysis of several high-resolution climate records, to show that megafaunal extinctions were broadly synchronous among taxa and independent of climate aridity and variability over the last 120,000 years. Our results reject climate change as the primary driver of Australian megafauna extinctions, and instead show that they followed human arrival after a 12,000-year period of coexistence. This previously unidentified overlap suggests that the processes leading to the demise of megafauna in Australia were similar to those operating in other regions of the world. By highlighting the likely role of human impact in Late Quaternary megafauna extinctions in one of the world’s most controversial contexts, we present the first comprehensive approach incorporating uncertainty in fossil dates, extinction timing and climatology to quantify mechanisms of pre-historical extinction patterns worldwide.

The ecology of embryonic learning: costs and benefits of vocal tutoring in fragmented habitat

**Prof Sonia Kleindorfer**1

1 Flinders University, Bedford Park, Australia

**Behavioural Ecology and Evolution (1), Balcony Rooms 3-4, December 1, 2015, 10:30 AM - 12:30 PM**

**Biography:**

Kleindorfer is professor in animal behaviour at Flinders University and scientific director (2010 – present) for the Flinders Research Centre for Climate Adaptation and Animal Behaviour.
A key question to predict survival in rapidly changing environments is whether animals can learn to survive. Recent research shows that prenatal learning in songbirds predicts how well embryos learn to beg for food; embryos that do not learn this skill are rejected by their parents and more likely to die of starvation. In this study, we examine the ecological context of prenatal learning in the Superb Fairy-wren (Malurus cyaneus). The species has declined significantly in the native Stringybark Woodlands of the Mount Lofty Ranges: between 1999 and 2007, the number of sites with Superb Fairy-wrens has decreased by over 55%. Habitat clearance and the resulting fragmentation have increased edge effects and therefore the vulnerability to predation and egg parasitism. Long-term monitoring has shown that three species of parasitic cuckoo have increased in numbers in the Mount Lofty Ranges – including the Horsfield’s Bronze-Cuckoo, which predominantly parasitises on fairy-wrens. Our experimental study shows that fairy-wren mothers increased their vocal tutoring effort (call rate) of fairy-wren embryos in the presence of cuckoos, which increases the detectability of intruder cuckoos that do not learn as embryos. But females with higher call rate had higher egg predation from avian predators. We discuss the ecological context of prenatal learning using an evolutionary cost-benefit analysis under conditions of altered species composition in fragmented habitat.

Three strands of progress in plant trait ecology

Prof Mark Westoby1
1Macquarie University, Sydney, Australia

Biography:
Professor Mark Westoby has been an ESA member and at Macquarie University since 1975. Over the past 20 years his research has been mainly in plant ecological strategies.

Plant ecological strategy research changed gear in the 1990s with the suggestion that measurable species traits should be used directly as strategy dimensions. This opened a path to world-scale comparisons. And indeed over the past 20 years a satisfying quantitative picture has been built about the constellation of species ecologies worldwide. Yet meanwhile, major problems have been left unresolved. Recent progress is summarised on three of these. (1) Indicators of temperature preference have been lacking. Leaf size turns out to be related to temperature at high but not at low rainfall, via its influence on night-time cooling more than on daytime heating. (2) Consistent influences of traits on competition have been quantified in a synthesis spanning 3 million trees in 140,000 plots. The trade-off is strong whereby traits favouring fast growth during early succession render species less shade-tolerant during later succession. Trait dissimilarity is associated with weaker competition, but this effect is small by comparison. (3) Persuasive models are beginning to emerge for competition and community assembly of plant strategies as influenced by their traits. Fitness landscapes generated in these models include both sharp peaks and broad nearly-level surfaces, with implications for the niche vs neutral debate.

Seeing things in a different light: microbats respond to distinct spectral signatures in street lighting

Ms Joanna Haddock1, Dr Caragh Threlfall1, Dr Dieter Hochuli1
1The University of Sydney, Sydney, Australia

Biography:
Joanna Haddock is a PhD candidate at The University of Sydney studying the effect of artificial light on microbats and nocturnal fauna. She completed her BSc in Psychology and Neuroscience at The University of Sheffield, UK, and her MSc in Environmental Science at The University of Sydney.

Global concerns about the impact of artificial night lighting on biodiversity typically focus on how the presence, rather than type, of light affects nocturnal fauna. The emerging trend of replacing mercury vapour lighting with LED streetlights due to their improved energy efficiency has potential to significantly modify the ecological impacts of night lighting. While some microbial species forage on aggregations of insects around streetlights, the full impact of the changing of lighting technologies on insects and their bat predators is unknown.

We surveyed bats and flying nocturnal insects over a 38 day period at 11 independent sites; three dark control sites, three sites with LED streetlights, three sites with mercury vapour streetlights, as well as two sites where street lights were changed from mercury vapour to LED mid-way through the survey. We identified 16 bat species or species groups at our study sites. We found bat species richness was significantly higher at sites with LED streetlights, three sites with mercury vapour streetlights, as well as two sites where street lights were changed from mercury vapour to LED mid-way through the survey.

We identified 16 bat species or species groups at our study sites. We found bat species richness was significantly higher at LED sites. However, there was no difference in bat species richness or overall bat activity at sites that underwent t

Our results suggest that the bat assemblage may not immediately respond to the change from mercury vapour to LED streetlighting. However, there is a negative effect of LED lights on bat species richness when compared with mercury vapour lights. The ecological impact of new lighting technologies requires careful consideration, as LED lights may further degrade habitat in already depauperate urban landscapes for nocturnal fauna.

Temporal stability of the relationship between effective and demographic population size in continuously distributed populations
Biography:
Jennifer Pierson is a Research Fellow in the Fenner School of Environment and Society, at The Australian National University. She is a population ecologist interested in the interacting contributions of behaviour, demography and genetics to population dynamics.

Genetic monitoring of wild populations offers many advantages to traditional demographic monitoring, but widespread application is hindered by large uncertainty in the estimation and interpretation of target metrics such as contemporary effective population size, and its relationship to adult census size, commonly referred to as Ne/Nc ratio. We used four long-term genetic monitoring studies (>10 years) to evaluate the temporal stability of Ne/Nc ratios within populations. These case studies focused on continuously distributed mammals that are dispersal limited within the spatial scale of the study. Estimates of local, contemporary Ne were done with the linkage disequilibrium method and adult census size varied from mark-recapture estimates to coarse catch per unit effort. We found a high level of stability between Ne/Nc despite high uncertainty in estimates in both Ne and Nc. Estimates of contemporary effective population size varied widely within populations on critical values used to restrict rare alleles and the mating behaviour modelled (random mating or monogamy). These results suggest that contemporary effective population size could be a useful metric to monitor if the goal of the program is to detect temporal trends in either Ne or Nc. However, if the goal of the monitoring program requires accurate estimates of Ne, then caution must be used in interpreting the metric if there is high uncertainty surrounding mating systems or allele frequencies.

Windows of the past for predicting the future: a high-quality fossil database of the Sahul fauna

Biography:
Marta Rodriguez-Rey is a Research Associate at the Global Ecology Lab in the University of Adelaide. She manages the databases required for the study of Quaternary species extinctions. Her previous experience includes studying ecological factors related to the expansion of invasive species using species distributions models.

The fossil record has grown substantially over the last three decades, thus permitting more refined chronologies of major biological events and tests of their underlying causes. These chronologies provide palaeo-ecological insights into extinction and evolutionary processes that enable better predictions and management of factors driving biodiversity loss. However, more fossil data does not necessarily equate to higher information quality given uncertainties in dating that can lead to incorrect timing of ecological processes. Here we present the first quality-rated dataset of nonhuman vertebrate fossils for Sahul (Australia and New Guinea) through the Quaternary to the present. The dataset comprises 9,308 fossil records (20% from extinct species) excavated from 280 different deposits. Tight Entrance Cave (Western Australia), Cathedral Cave (South Australia), Cuddie Springs (Eastern Australia), Mount Cripps (Tasmania) and Airuba Rockshelter (New Guinea) are the five most representative deposits. Sahul covering most species diversity. Among the 478 different species found (215 genera, 27 from megafauna species), the birds Dromaius novahollandiae (emu) and Genyornis newtoni were the most frequent dated fossils (7 and 3% of the records, respectively), followed by the marsupial complex Macropus fuliginosus/giganteus/titan (3% of records). Only 23% of the full set of fossil ages were rated as ‘reliable’, so available ages must be carefully scrutinised before they can be used for building chronologies or timing inferences. We discuss multiple potential applications of this dataset for better understanding the past, present and future of Australia’s history of life.

Does personality affect reintroduction success of western quolls (DASYURUS GEOFFROI)?

Biography:
Melissa Jensen is a PhD student from the School of Biological Sciences at the University of Adelaide. She is studying the reintroduction of the western quoll (Dasyurus geoffroii) to the Flinders Ranges National Park.

Post-release survival of reintroduced mammals can vary dramatically between individuals, with some animals surviving for many months, whilst others die soon after release. Studies have found that post-release survival may be related to individual differences in behaviour, or personality. In particular, individuals that respond appropriately to potentially risky and stressful situations when tested in captivity prior to release, are more likely to survive following reintroduction.
We investigated individual variation in behaviour in 70 wild-caught western quolls temporarily housed in captivity, prior to their reintroduction to the Flinders Ranges National Park in April 2014 and May 2015. Behaviour was studied using a number of tests, including a novel object test, a predator scent test, a mirror test, and a giving-up density test. All quolls were radio-tracked following release to determine survivorship, dispersal and breeding success. Results from this study may assist future quoll reintroduction programs to target individuals most suitable for reintroduction.

Social and ecological characteristics of effective conservation covenants

**Ms Julie Groce**1, Dr Carly Cook1

1Monash University, Melbourne, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Julie Groce is a PhD candidate at Monash University in Melbourne. Her current focus on understanding the social aspects of biodiversity conservation comes after years of working as a wildlife researcher in the U.S.

Conservation on private lands is integral to halting the decline of biodiversity, allowing for landscape-scale approaches to protect remnant species and habitats. Establishing conservation covenants—in which landowners can permanently protect the ecological value of their land—is a popular option throughout Australia for protecting natural habitats. Conservation covenants cover 4.5 million hectares of land in Australia, yet there is little examination into whether or how these covenanted properties are able to achieve desired ecological outcomes. This research evaluates covenanted properties from both social and ecological perspectives, asking: (i) what are the covenants protecting (e.g., species, native communities, ecosystem function), (ii) to what degree is monitoring and management being used to provide protection, and (iii) what is the role of social networks in supporting landowners’ actions on their properties? Interviews conducted with landowners and program administrators will uncover their management strategies and communication networks and illustrate the ways in which social networks can influence their behavior in the context of conservation covenants. The results of this study will add greatly to our limited knowledge of the ways in which social connections can influence landowner knowledge and behavior, their management actions, and thus the conservation of ecological resources on covenanted properties.

Identifying resource utilisation to understand drivers of human-wildlife conflict

**Ms Naomi Evans**1, Associate Professor Jonathan Rhodes2, Professor Armando Apan3, Associate Professor Patrick Moss4

1University of Queensland, Brisbane, Australia, 2University of Queensland, Brisbane, Australia, 3University of Southern Queensland, Toowoomba, Australia, 4University of Queensland, Brisbane, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Naomi Evans is a PhD student in the Landscape Ecology and Conservation Group (LECG) at the University of Queensland. She is interested in ecological modelling, conservation, community and landscape ecology, and animal movement and resource utilisation patterns.

Minimisation of human-wildlife conflict depends on the ability to anticipate the behaviour of each party involved, as well as the timing and location of conflicts. Patterns of conflict in a number of carnivorous species have demonstrated that human-wildlife conflicts may be predictable. However, mitigation requires knowledge of the drivers of these conflicts, including patterns of landscape utilisation of the wildlife species involved. This information is lacking for the dingoes (Canis lupus dingo) on Fraser Island, Queensland. We investigated resource selection and landscape utilisation by Fraser Island dingoes by evaluating support for effects of habitat type, foliage projective cover, landscape diversity, landform, and distance to roads/tracks and areas of high human usage. We used resource utilisation functions (RUFs) to compare resource utilisation at the dingo population level, as well as individuals grouped by reproductive status and age class. Due to significant differences in home range and distance travelled between sexes and day phase, analyses were stratified according to these groupings. We show how resource utilisation is influenced by geographic factors (i.e. road density and variation in habitat), temporal influences (i.e. seasonal and diurnal) and population dynamics (i.e. sexes and age). These findings have direct management implications for reducing conflict between people and the dingoes of Fraser Island.

The Lambalk Glider: resolving the identity of the enigmatic northern Sugar Glider

**Prof Sue Carthew**1, Dr Teigan Cremona1, Prof Steve Cooper2, Dr Andrew Baker3

1Research Institute of Environment & Livelihoods, Charles Darwin University, Eelengowan Drive, Casuarina, Australia, 2Evolutionary Biology Unit, South Australian Museum, Adelaide, Australia, 3Science and Engineering Faculty, Queensland University of Technology, Brisbane, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Prof Sue Carthew’s research interests include mammal ecology, threatened species conservation, impacts of habitat fragmentation on fauna and pollination ecology. She is currently Pro-Vice Chancellor, Faculty of Engineering, Health, Science & Environment at Charles Darwin University, was previously Head of School at The University of Adelaide, and has held membership on environmental boards.

Although gliders have been well-studied across much of their range, the single petaurid species found in northern Australia is surprisingly unknown. Locally known as the Lambalk Glider, this taxon is currently classified as a sugar glider (Petaurus breviceps ariel), although preliminary molecular
work revealed that it has closer affiliations to Squirrel (P. norfolcensis) and Mahogany (P. gracilis) Gliders, both of which occur many 100's km away on the eastern seaboard. A broader investigation into the taxonomic identity, distribution and ecology of the Lambalk Glider is now underway, with the expectation of describing at least one new species of Petaurus. Over the past 2 years we have trapped at multiple locations across the Top End, collecting tissue samples and morphological measurements from 40+ live animals. We have also measured 298 petaurid skulls held in museum collections across Australia. Initial genetic and morphometric analyses support earlier indications that the Lambalk Glider is a new and undescribed species and that P. breviceps needs further taxonomic revision both in Australia and New Guinea. Of further significance is the suggestion that there may be two distinguishable species of Lambalk within northern Australia (NT and Kimberley). Elucidating the taxonomic identity and uncovering aspects of the ecology of this poorly-researched glider will enhance our understanding of the unique biodiversity of northern Australia. This is of particular interest in the wake of small marsupial mammal declines that are currently being experienced in this region.

Testing the decline of the threatened New Holland mouse in Wilson's Promontory National Park

Ms Phoebe Burns1,2, Dr Marissa Parrot3, Dr Kevin Rowe2
1University of Melbourne, Parkville, Australia, 2Museum Victoria, Carlton, Australia, 3Zoos Victoria, Parkville, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Phoebe Burns completed her masters on the fire response and long term persistence of the endangered smoky mouse in the Grampians National Park. Now in her PhD, Phoebe is assessing the status of the threatened New Holland mouse across its Victorian range.

Temporal dynamics of waterbirds in response to an environmental flow pulse in the Macquarie Marshes

Ms Andrea Fullagar1, Professor Richard Kingsford1, Dr Kate Brandis1, Dr Gilad Bino1, Dr Jennifer Spencer2
1Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, UNSW, Sydney, Australia, 2NSW Office of Environment and Heritage, Haymarket, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Andrea Fullagar completed her B.Env.Sc. (Hons) in 2010, after which time she was employed by the QLD Dept. of Natural Resources and Mines in water policy and planning (2011-2013). She began her MSc. by Research at UNSW in 2014, driven by a passion for bird conservation and water management.

Considerable knowledge gaps remain in our understanding of the response of waterbird communities and dynamics in response to a flow pulse in floodplain ecosystems. This is of particular importance for the management of environmental flows and the conservation of wetland ecosystem processes. We investigated how waterbird communities responded to a flow pulse in the Macquarie Marshes, Ramsar wetlands in central NSW. We surveyed waterbirds at 17 sites before (October), during (December) and after (January) an environmental flow release (2014-15). We compared waterbird response and dynamics across three wetland types; channels, floodplains (mixed marsh or river red gum), and lagoons. We found that wetland type was significantly related to waterbird abundance at all sites and times, with lagoons and floodplain mixed marsh supporting the highest numbers. We also found distinct dynamics in functional response groups where ducks dominated all wetland types (>50%) before the environmental flow pulse while shorebirds dominated floodplain mixed marsh (~70%). During the environmental flow pulse, large waders replaced shorebirds at floodplain mixed marsh sites (~80%). Following the environmental flow pulse, large waders comprised ~70% of species in floodplain mixed marsh sites and were the second most dominant functional group after ducks in lagoons. The composition of piscivores increased by (~20%) from during (December) to after (January) the environmental flow pulse at lagoons. Overall, there was a strong positive effect of flows on all waterbird species and communities. Observed waterbird responses reflected the underlying dynamics in resource availability required for each unique waterbird functional group.

Exploring the recovery capacity of a large freshwater crayfish following significant population loss

Dr Nick Whiterod1, Dr Sylvia Zukowski1, Mr Martin Asmus1, Dr Adam Miller1, Dr Charles Todd2
1Aquasave - NGT, Goowha Beach, Australia, 2NSW Department of Primary Industries, Narrandera, Australia, 3Arthur Rylah Institute, Heidelberg, Australia

Conservation Ecology, Balcony Rooms 1-2, December 1, 2015, 10:30 AM - 12:30 PM
preferences may hinder the identification of traps. We use our key findings to show how traps could be better studied and mana
the strength of their effects depends on how traps form, and the taxa they affect,
(2.) habitat preferences for traps and their fitness consequences are strongly, and n
better understanding and managing these important phenomena. We review the ecological traps literature to: (1.) extract infor
mation about where and which taxa studies have been undertaken, (2.) calculate effect sizes for fitness and habitat preference (the two key components of traps),
and (3.) assess the methods that have been used to measure fitness and preference. We highlight four key findings: (1.) there have been few studies of traps in aquatic ecosystems, (2.) habitat preferences for traps and their fitness consequences are strongly, and negatively, related, (3.) the strength of their effects depends on how traps form, and the taxa they affect, (4.) methods that provide ambiguous information about habitat preferences may hinder the identification of traps. We use our key findings to show how traps could be better studied and managed in the future, by highlighting modifications to current methods used to study them and fruitful avenues for future research.

Heterogeneous flows foster heterogeneous assemblages: relationships between functional diversity and flow variability in riparian vegetation

Mr James Lawson1, Associate Professor Kirstie Fryirs1, Professor Michelle Leishman1
1Macquarie University, North Ryde, Australia

Biography:
James Lawson’s PhD research uses a functional trait approach to understand how hydrology and other environmental variables template the ecology of riparian plant communities. He is especially interested in the role of environmental variability in producing and maintaining diversity in these systems.

Riparian ecosystems are biophysically complex and highly diverse taxonomically, structurally and functionally. While many environmental factors determine the structure and function of riparian vegetation communities, hydrology is thought to be the ‘master variable’. Flooding and variability in water availability are known to be key drivers of taxonomic diversity, but their influence on the functional trait diversity of riparian vegetation communities remains largely unexplored.

We collected data on species abundance, quantitative plant functional traits and hydrology from 15 sites distributed across south-eastern Australia to address the following questions: (a) Is functional trait diversity related to the frequency and magnitude of flooding disturbance? (b) Is functional trait diversity related to variability in seasonal water availability within the riparian zone?

We confirm that metrics describing both flooding disturbance and patterns of water availability exhibit strong relationships with functional trait diversity in riparian vegetation communities of south-eastern Australia. Our key finding is that functional trait diversity in these systems tends to be positively associated with variability in hydrological conditions and the intensity of rare, high-magnitude flooding events, rather than average patterns of flow. Our study highlights the importance of extreme flooding events and temporal patterns of water availability as determinants of diversity in riparian vegetation communities. These relationships may have significant consequences for plant communities experiencing alterations to hydrology caused by anthropogenic flow modification and the changing climate.

Ecological traps: current evidence and future directions

Dr Robin Hale1, Assoc. Prof Stephen Swearer1
1University of Melbourne

Biography:
Dr Rob Hale is a Research Fellow in the School of BioSciences at the University of Melbourne.

Ecological traps occur when animals exhibit maladaptive habitat selection in the face of rapid environmental change and have serious implications for conservation and management. We critically evaluate the current state of ecological traps research, with the aim of providing suggestions for better understanding and managing these important phenomena. We review the ecological traps literature to: (1.) extract information about where and with which taxa studies have been undertaken, (2.) calculate effect sizes for fitness and habitat preference (the two key components of traps), and (3.) assess the methods that have been used to measure fitness and preference. We highlight four key findings: (1.) there have been few studies of traps in aquatic ecosystems, (2.) habitat preferences for traps and their fitness consequences are strongly, and negatively, related, (3.) the strength of their effects depends on how traps form, and the taxa they affect, (4.) methods that provide ambiguous information about habitat preferences may hinder the identification of traps. We use our key findings to show how traps could be better studied and managed in the future, by highlighting modifications to current methods used to study them and fruitful avenues for future research.
Watsonia control: Effectiveness of 2,2-DPA, impacts on native flora and influence of a prescribed burn

**Mr Anthony Abley**

Department of Environment Water and Natural Resources, Athelstone, Australia

Impact of prescribed burns on the reproductive success of terrestrial orchids in South Australia

**Dr Renate Faast**

The University of Adelaide, Adelaide, Australia

Interactive effects of topography and fire severity on post-fire flora and vegetation structure

**Dr Steve Leonard**

La Trobe University, Bundoora, Australia

Biography:

I'm interested in the ecology of disturbance, in particular how fire, animal activities (e.g. herbivory) and vegetation interact. I'm currently working on projects exploring these issues in eucalypt forests and Mallee woodlands.

Fire is an important driver in ecosystems globally. Within fire events, impacts on biota are variable depending on variation in fire behaviour. This variation produces differences in the 'starting point' of post-fire recovery and so may have long term effects. An important question is to what degree biotic heterogeneity is maintained through fire events.

In this study we examined how variation in fire severity and topography affects post-fire heterogeneity in flora and vegetation structure. The study was carried out in eucalypt forest in Victoria Australia, 1.5-2 years after the 'Black Saturday' fires of 2009. Multivariate analyses were used to compare floristic composition and vegetation structure amongst fire severity classes and between gullies and slopes. Both composition and structure varied with fire severity and topographic position. Compositional differences between gullies and slopes were lower at sites that had experienced high severity fire, with this pattern apparently driven by greater abundance of 'weedy' species at these sites. There was no interactive effect of severity and topography on vegetation structure, with the characteristic structural elements of slopes and gullies mostly remaining present across the landscape.
severely classes. Our results suggest that topographically driven structural heterogeneity persists through even high severity fire. We expect that compositional variation between slopes and gullies will be restored to pre-fire levels as vegetation recovers.

**Impacts upon sandy-beach macrofauna of nourishment by sand-slurrying pipelines**

*Mrs Hayley Jessup-Case*¹, Professor Peter Fairweather¹

¹School of Biological Sciences, Flinders University, Adelaide, Australia

Disturbances (1), Suite 3, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Hayley Jessup-Case has just completed her Honours degree at Flinders University, Adelaide. Her study involved investigating the environmental impacts beach nourishment had on invertebrates living in the sandy sediment along Adelaide’s metropolitan beaches.

With increased pressure from human development and sea-level rise, beach nourishment programmes have been used to combat problematic sandy-beach erosion. However, there are still fundamental gaps in our knowledge about impacts upon macrofaunal organisms and communities, especially regarding new techniques of nourishment, such as sand-slurry piping. Ten sandy beaches (classified as either nourished or not) along an 11 km stretch of coastline in Adelaide, South Australia, were studied to investigate ecological impacts upon macrofauna from this new nourishment method. Species abundances and richness were investigated to assess ecological impacts, and relevant environmental variables were assessed to determine changes in characteristics of the surrounding habitat. Biological and physical monitoring occurred after a nourishment event, and then again three months later to examine short-term recovery of macrofauna or changes to the surrounding environment. Beach nourishment from sand-slurrying had a significant impact on the macrofaunal assemblage directly after nourishment, and negative biological impacts of reduced density and richness still remained after three months. In contrast, the physical environment exhibited few significant changes and any initial observed impacts were not obvious after three months. The overall recovery of animals appeared to be only weakly linked to physical measures and may have been more associated with life-history traits of dominant species. Such findings allow us to adopt a more ecological approach to beach management but future studies should incorporate information regarding macrofaunal life stages to gain knowledge of optimal timing of operations in relation to reproduction in dominant species.

**Long term effect of prescribed burning and logging on coarse woody debris in eucalypt forests**

*Mr Mitchell Stares*¹, Prof Kristine French¹, Dr Luke Collins², Dr Brad Law³

¹Centre for Sustainable Ecosystem Solutions, University of Wollongong, Wollongong, Australia, ²Hawkesbury Institute for the Environment, University of Western Sydney, Richmond, Australia, ³Forest Science Centre, NSW Department of Primary Industries, Parramatta, Australia

Disturbances (1), Suite 3, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Mitchell Stares is an honours student at the Centre for Sustainable Ecosystem Solutions, University of Wollongong. Mitchell’s honours research focuses on the effects of forest management practices on habitat provided by coarse woody debris and the use of coarse woody debris by fauna.

Coarse woody debris (CWD) is a vital habitat component within forest and woodland ecosystems. Forest management practices such as prescribed burning and logging can impact CWD, influencing its creation or destruction. This study examined the effect of prescribed burning and logging on (i) the abundance of hollow bearing CWD, (ii) the volume of CWD and (iii) the total length of CWD. Our study was conducted near Eden in south eastern Australia, at a long term (30 years) experimental site established to examine the interactive effects of frequent burning and logging on forest ecosystems. CWD was surveyed across seventy 25 m x 25 m sites. The abundance of hollow bearing CWD was significantly higher in logged areas than in unlogged areas, but unaffected by fire frequency. The volume of CWD in advanced stages of decay was significantly higher in logged regions than in unlogged regions and unburnt areas than in areas which experienced some prescribed burning. CWD length was not affected by fire frequency or logging. Increases in hollow and decayed CWD reflects a pulse input of unmerchantable timber left onsite following logging. However, this may represent a short-term benefit of logging, as modification of stand structure, specifically the loss of mature trees, will likely lead to reduced input rates of hollow and decayed CWD in the future. The absence of a fire frequency effect on CWD attributes is probably due to the low intensity and patchy nature of the prescribed burns.

**How has community ecology influenced restoration? A review of the experimental restoration ecology literature**

*Dr Claire Wainwright*¹, *Mr Timothy Staples*¹, *Dr Margaret Mayfield*¹

¹The University of Queensland, St Lucia, Australia

Disturbances (1), Suite 3, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Dr Claire Wainwright is a postdoctoral research fellow in the Mayfield Community Ecology Lab in the Ecology Centre at The University of Queensland. Her research focuses on using experiments address basic and applied questions in plant community ecology, with a particular emphasis on interactions between native and exotic species.
Community ecology theory has been increasingly suggested as a tool to supplement empirical knowledge in restoration situations. Much of community ecology theory is concerned with exploring the abiotic and biotic processes that shape and maintain natural communities, and the primary goal of restoration is often to re-establish these processes in degraded ecosystems. Of the restoration ecologists who carry out experimental research, some ground their study design or hypothesis generation in community ecology theory, while other studies are not ostensibly motivated by theory but relate findings to theory a posteriori, while others do not make use of theory relative to other sources of knowledge. To date, however, there have been no quantitative descriptions or critical analyses of how community ecology theory has influenced experimental restoration ecology as a whole, despite the acknowledged complementarity of these two fields.

To describe the flow of information from ecological theory to experimental restoration ecology, we conducted a literature review of over 1,000 peer-reviewed ecological restoration experiments spanning 25 years. Our study was guided by two basic questions: 1) How often does experimental community restoration invoke community ecology theory? and 2) When theory is invoked, what is the nature and strength of its contribution? (e.g. Was it the conceptual basis? Was it used to justify the interpretation of findings?).

In addition to answering these questions, we gauged the prevalence of certain theories in experimental restoration ecology over time, and determined whether theory is more commonly applied in certain systems.

Understanding fire regimes from short-term studies of planned or unplanned fires.

Mr Richard Loyni1, Mr Edward McNabb1
1La Trobe University, Viewbank, Australia

Disturbances (1), Suite 3, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Richard Loyn worked for the Victorian Government at the Arthur Rylah Institute, managing Community Ecology. He now continues his fire ecology work through La Trobe University, and runs Eco Insights with projects in Australia and PNG. He won the D.L. Serventy Medal in 2014.

This paper considers two studies of diurnal birds in Victorian foothill forests. An opportunistic study in Bunyip State Park compared bird abundances in 33 burnt and 33 unburnt sites after the Black Saturday bushfires in 2009. A long-term experiment examined planned burns on 25 sites in Wombat State Forest, applied at two frequencies and seasons since 1994 (see Tolhurst et al 1992).

In Bunyip SP birds were 23% as abundant on burnt than unburnt sites in the winter after severe bushfire. Some redistribution had occurred by the next spring (to 58%). In spring there was an unprecedented massive temporary influx of White-browed Woodswallows Artamus superciliosus to burnt sites where many bred, for the first recorded time in this forest.

In Wombat SF birds were 95% as abundant on burnt as on unburnt sites, and only a few species showed effects of burn season or frequency. It seems that planned burns can be conducted in spring or autumn every 3-10 years with only small effects on common forest birds, at least when conducted on small areas in forest with a history of disturbance. Wildfires can have much more dramatic short-term effects. Other studies suggest that these effects may be generally short-lived (<3 years). Retrospective studies will be very useful in assessing longer-term effects. Multiple approaches are needed to build an integrated understanding of fire regimes, so that they can be managed to reduce risk and conserve biodiversity.

Propagation from seed of native Australian species for restoration of abandoned farmlands

Ms Lorena Ruiz Talonia1, Prof Nick Reid1, Assoc Prof R D B (Wai) Whalley1, Mr David Carr2
1University of New England, Armidale, Australia, 2Stringybark Ecological, Armidale, Australia

Disturbances (1), Suite 3, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Lorena Ruiz Talonia is a PhD student at the University of New England. Some of her research interests include restoration ecology, germination ecology and physiology; species interaction; habitat fragmentation and its impacts; climate change upon species; population genetics and species selection for restoration.

Limitations to landscape-scale restoration are associated mainly with high money and time costs. Direct seeding can be a cost-effective alternative due to the less investment of work and material and permits the incorporation of a diverse seed mix. However, the success of direct seeding is also dependent upon the understanding of species biology and ecology, plus appropriate management practices. Therefore, one of the first questions to be answered before leaning towards direct seeding is to define whether the target species are suitable for direct seeding at the projected conditions. Here we present some initial indications of suitability for direct seeding of seeds of fifteen species obtained from studies made on seed physical characteristics, viability, germination and emergence under different environmental conditions. The target species are diverse forms of native plants that are important components of endangered communities and planned to be direct seeded in grey cracking clay vertosols. This with the objective to restore at large scale, abandoned farmlands from the Moree Plains, Narrabri and Gwydir Shires, situated in the North-West NSW, west of the Great Dividing Range.

Post-fire recovery of cockroaches (Blattodea) is limited by distance in sclerophyllous woodlands

Ms Kate Arnold1, Dr Heloise Gibb1, Dr Nick Murphy1
1La Trobe University, Bundoora, Australia
Biography:
I am a keen conservationist and cockroach enthusiast. Recently I completed my honours degree concerning dispersal after severe fire.

Critical to the maintenance of biodiversity and ecological processes, fire is a dominant force that is integral to the ecology of forests and woodlands in Australia. One of the primary consequences of fire is a decrease in the abundance and quality of leaf litter, which negatively affects decomposition and, consequently, detritivore communities. Litter-dwelling invertebrates, such as cockroaches (Blattodea), facilitate decomposition, so are key contributors to energy transfer and nutrient cycling. Despite their key role in litter decomposition, we know little of how invertebrate detritivores recover following fire and whether their recovery is limited by distance from unburnt habitats. We tested the effects of distance from unburnt habitats on cockroach assemblage composition and traits six years after a severe fire in the Kinglake/Murrindindi region of Victoria, Australia. Using novel artificial habitats comprised of egg cartons, cockroach abundances and habitat variables were measured across six replicate 5 km transects from unburnt to severely burnt herb-rich foothill habitat. A total of thirteen cockroach morphospecies from three families were identified. Distance from unburnt forest significantly influenced cockroach species composition in severely burnt forest, but the abundance of only Platyzosteria similis declined with distance. Neither habitat composition, nor cockroach traits were linked to distance from unburnt habitat. Our work shows that distance into a fire, a surrogate for fire extent, continues to be an important determinant of post-fire assemblages six years after fire. An increase in large-extent fires may limit the recolonisation potential of cockroach species, potentially limiting their functional importance in litter breakdown.

Using cerambycid beetles (Coleoptera: Cerambycidae) as bioindicators of environmental change associated with differing fire regimes

Mr Martyn Elliott, Mr Simon Lawson, Mr Tom Lewis, Mrs Valerie Debuse, Mr Andrew Hayes

1University of the Sunshine Coast, Sippy Downs, Australia, 2University of the Sunshine Coast - Forest Industries Research Centre, Sippy Downs, Australia, 3Griffith University - Queensland and Environmental Futures Centre, Brisbane, Australia, 4Department of Agriculture and Fisheries - Forest Industries Research Centre, Brisbane, Australia

Biography:
Martyn Elliott is an Honours student at the University of the Sunshine Coast, QLD, Australia. He was awarded the South East Queensland Fire and Biodiversity Consortium scholarship, which helped support my Honours project. He is interested in forest insect ecology and fire regimes, with a passion for biodiversity and conservation.

Insects are recognised as a reliable tool for monitoring environmental change due to their sensitivity to disturbance, diversity and abundance. Insect bioindicator research has historically focused on ants. However, ants have been found to respond poorly to some forms of disturbance or to disturbance in certain climatic zones. We aimed to test whether cerambycid beetles (Coleoptera: Cerambycidae) may be effective bioindicators in relation to changes in fire regime. We also aimed to: (1) determine whether there is a link between fire regime and the abundance and diversity of cerambycid beetles; and (2) determine whether forest health is associated with cerambycid composition. We sampled cerambycid beetles using flight intercept panel traps baited with two known cerambycid attractants (a pheromone and host odours) over a twelve week period within four long-term fire treatments (annually burnt, triennially burnt, unburnt and wildfire) at Bauple State Forest, Queensland. Vegetation structure surveys (including coarse woody debris, tree health) were also conducted within each treatment. We will discuss the link between forest health and the abundance of cerambycid beetles, and determine whether forest health and fire regime is associated with certain cerambycid functional groups. This will lead to a better understanding of the impacts of different fire regimes to guide improved forest management and will provide some indication of the potential role of cerambycid beetles as bioindicators of vegetation change.

New directions for effectively communicating urban ecology outcomes: New opportunities and challenges

Dr Mark McDonnell

1Australian Research Centre for Urban Ecology, Parkville, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Mark McDonnell’s research interests include vegetation dynamics and ecosystem change, landscape ecology, the structure and function of urban ecosystems, and the conservation and management of urban biodiversity. He has conducted pioneering research on the study of urban-rural gradients and the comparative ecology of cities and towns around the globe.

There is an unprecedented demand for relevant socio-ecological information, principles and concepts required to guide innovative resilient urban development and management around the world. The science of urban ecology as a discipline has grown significantly over the last 30+ years but for a variety of reasons, the discipline is currently unable to satisfy the growing demand for spatially and temporally pertinent academic and practical knowledge about urban ecosystems that is being called for by environmental conservationists, architects, planners, engineers, landscape architects, land managers and policy makers. To achieve its full potential, the discipline of urban ecology needs to continue to mature and develop as other
scientific disciplines have in the past by encouraging and supporting the publication of new ideas, methodologies, data and analytical techniques as well as the critical assessment of existing information and approaches regarding the study, design and management of urban ecosystems. This presentation will present examples of underutilized and new forms of knowledge that can enhance urban ecology knowledge, as well as exploring insights about how this information might begin to be shared within peer reviewed journals and other outlets that bridge the gap between science and practice.

How the UrBioNet Research Coordination Network (RCN) can enhance urban ecology science and practice

Dr Nicholas S. G. Williams1,2, Dr Myla Aronson3, Prof Charlie Nilon4
1The University of Melbourne, Richmond, Australia, 2Australian Research Centre for Urban Ecology, 3Department of Ecology, Evolution, and Natural Resources, Rutgers University, New Brunswick, USA, 4Fisheries and Wildlife Sciences, University of Missouri, Columbia, USA

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography: Dr Nick Williams' research seeks to understand urban biodiversity patterns and ecosystem processes and develop applied solutions to reduce negative impacts of urbanization such as biodiversity loss, excess urban heat, stormwater runoff and CO2 emissions.

An understanding of the global factors affecting biodiversity in cities is necessary to inform scientists, city planners, and managers how best to conserve and restore urban biota. Global comparative studies using multiple datasets are a valuable tool to achieve this but they are difficult to initiate and coordinate. UrBioNet is a United States National Science Foundation (NSF) funded research coordination network focused on urban biodiversity and practice that can help Australian urban ecology researchers participate in and conduct global comparative studies. UrBioNet has five primary goals: 1) engage scientists and managers to compile and synthesize urban biodiversity datasets with a focus on bats, birds, freshwater fish, insect pollinators and plants; 2) include data and participants from cities in regions with rapid urban growth such as Africa, South America, and Southeast Asia; 3) identify general patterns and processes shaping urban biodiversity across the world’s cities and to quantify the relative importance of physical, climatic, and social factors in driving patterns of urban biodiversity; 4) develop recommendations for monitoring biodiversity in urban areas; and 5) share findings with students and practitioners in land management, urban design, urban planning, and with policymakers. UrBioNet has over 99 participants from 22 countries. Key network activities include: regionally targeted and network-wide workshops, regular steering committee and working group meetings, and an online graduate course on urban biodiversity. This presentation will introduce UrBioNet and explore the role that international research coordination efforts, such as UrBioNet, can make in advancing ecological science and practice.

The NESP Clean Air and Urban Landscapes Hub: coordinated research at the national scale

Dr Kirsten Parris1
1The University of Melbourne, School of Ecosystem and Forest Sciences

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography: Dr Kirsten Parris is a Senior Lecturer in the School of Ecosystem and Forest Sciences at The University of Melbourne, and the Deputy Leader of the NESP Clean Air and Urban Landscapes Hub. Her research interests include urban ecology, amphibian ecology, conservation biology, bio-acoustics and ecological ethics.

The NESP Clean Air and Urban Landscapes Hub is a consortium of thirteen research groups across four universities, representing a diversity of fields including urban ecology, urban horticulture, atmospheric science, urban planning, urban systems, landscape architecture, hydrology, population health, environmental psychology, information technology and engineering. As a new consortium, we are implementing a program of inter-disciplinary, collaborative research to improve the way in which cities are constructed and managed – for the benefit of urban-dwelling humans, the urban environment and the other species with which we share our cities. Current projects include a study of air quality in western Sydney with a focus on particulate pollution, a series of activities to identify the current state of biodiversity, air quality, urban greenspace, urban systems and human wellbeing in Australian cities, a project on urban greening for liveability and biodiversity, and a study of the psychological benefits of interacting with nature in cities. The hub is supported by the Commonwealth Department of the Environment through its National Environmental Science Program, and will be funded for 6 years from 2015-2021.

Translating climate change adaptation research to on-ground action

Dr Jenni Garden1, Dr Mark Siebenritt2, Mr Zafi Bachar2, Mr Andrew West2, Dr Daniel Rogers3
1Seed Consulting Services, Adelaide, Australia, 2Natural Resources Adelaide and Mount Lofty Ranges, Adelaide, Australia, 3Science, Monitoring and Knowledge Branch, DEWNR, Adelaide, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Climate change impacts on biodiversity and implications for biodiversity management has been examined over recent decades using a range of approaches, methods and tools, focal species, regions and scales, explanatory variables, climate projections, and future scenarios. As climate projections are refined, modelling techniques expanded, and new information of species gained, such research is continually evolving. Given this diversity of climate change-biodiversity research projects, together with the lack of translation from scientific research to practical implementation, on-ground planners and managers face substantial challenges in identifying and accessing new research findings, determining the relevance of studies to their management area, and understanding how to implement on-ground actions based on learnings from scientific research. We present an overview of the challenges and approach taken from a recent practitioner project aimed at collating, summarising, translating and communicating a range of climate change-biodiversity research findings to one of Australia's largest natural resource management groups, Natural Resources Adelaide and Mount Lofty Ranges. This NRM group faces substantial challenges in managing and conserving biodiversity in a highly diverse landscape and in the face of climate change. We present our learnings and approach as a model for other practitioners and on-ground managers looking to translate and implement scientific research into practical application.

Time to storm the ivory tower? Integrating research in urban ecology with education and management

Assoc Professor Dieter Hochuli1
1The University of Sydney, The University of Sydney, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Assoc Professor Dieter Hochuli is head of the integrative ecology research group at the University of Sydney. His research focuses on the ecology of terrestrial invertebrates and their interactions with the environment, identifying how human impacts affect ecosystem health. He also has the best body condition index (mass/SV length) in his department.

The emerging discipline of urban ecology identifies how nature persists in highly modified environments. Despite the interdisciplinary nature of the field and its natural alignment of with managers and practitioners, research in urban ecology often persists in parallel universes, failing to integrate research among disciplines and rarely feeding into management. I discuss the barriers to connecting different approaches to urban ecology and identify how fundamental research in urban ecology can be the foundation for evidence-based approaches to management, education programs and engagement strategies. This fundamental research, based on decades of work around Sydney examining biotic responses to urbanization and the management of urban nature, provides a compelling body of work describing why managing nature in cities matters.

However, despite the cacophony of research strategies proclaiming the importance of interdisciplinary research, those involved in it routinely face challenges overcoming multiple (and competing) philosophies among disciplines to have the work recognised. The necessity of integrating disciplines further requires academics and leaders in urban ecology to engage with community, policy makers, and landscape managers. The perverse incentives to not collaborate, communicate and coordinate, particularly in the ivory tower, make these partnerships a challenge, even when all parties have the best intentions.

Nevertheless, the rise of numerous engagement and education programs in urban systems, many stemming from informal and serendipitous partnerships, provides a road map to not only identify and answer the key questions in urban ecology but provides the basis for evidence-based management in these vital ecosystems.

Building baselines to inform multifunctional eco-engineering designs

Dr Mariana Mayer Pinto1, Professor Emma Johnston1, Dr Ana Bugnot1, Mr Hayden Hurst1, Dr Tim Glasby2, Professor Laura Airoldi2, Dr Katherine Dafforn1
1University of New South Wales, Sydney, Australia, 2University of Bologna, Bologna, Italy, 3New South Wales Department of Primary Industries, Port Stephens, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom B, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Katherine Dafforn completed her doctorate in 2010 before taking up a research position at the University of New South Wales. Katherine’s research has focused on understanding and managing human impacts on marine communities. She is currently investigating the potential for engineering designs to reduce ecological impacts associated with marine urban structures.

Urban sprawl is increasing with more than half the global population expected to live in urban centres by 2030. The loss or modification of natural habitats with urban structures is among the largest threats to global biodiversity. Although there have been advances in the practice of combining ecological principles with the design of urban infrastructure, such practices still remain rare and are more common in terrestrial than marine systems. In order to design marine infrastructure that both minimizes adverse ecological impacts and provides multiple ecosystem functions and services, it is crucial that managers and regulators are provided with information that 1) identifies the habitats being directly/indirectly impacted, 2) quantifies the impact on associated communities using a range of targeted ecological measures and 3) links impacts to goals for mitigation strategies. Here, we...
use Sydney Harbour as an urbanized case study to provide examples of what to measure and the methods required to collect this baseline information. We highlight that studies focusing only on measures of biodiversity (e.g. species richness) mask key components of the community. For example, invasive species that may inflate estimates of biodiversity, habitat-forming species, rare species and ecosystem functioning are rarely considered in eco-engineering designs and evaluation. Using these measures we identify ecological targets for common urban structures in Sydney Harbour and link those to mitigation strategies to be used in the design of such structures. Building robust, quantitative baselines for urban structures and the habitats they replace is crucial to achieve specific multifunctional targets.

ESA Urban Ecology Research Chapter: A brief history and future directions

Prof Gary Luck1, Dr Amy Hahs2
1Charles Sturt University, Albury, 2Australian Research Centre for Urban Ecology, Melbourne,

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Professor Gary Luck’s research falls into two main categories: 1) the relationships between biodiversity and ecosystem services and the contribution of services to human well-being; and 2) the implications of socio-economic and human demographic change for biodiversity conservation in urban and rural landscapes.

This presentation covers briefly the history of the ESA Urban Ecology Research Chapter and outlines possible future directions. The talk will lead into a broader panel and audience discussion about how best to link urban ecology research with urban planning and community action. The Urban Ecology Research Chapter was established in 2012 at ESA Melbourne. Since then, the chapter has presented regular conference symposia, established an email distribution list, organised informal social events and built a strong network of urban researchers and managers. This presentation will encourage audience members to think about and discuss how to maximise the efficacy of urban ecology research in Australia using the three pillars of communication, collaboration and coordination. It will also challenge the audience to suggest avenues for moving urban ecology forward and building stronger networks with urban planners, managers and community groups to facilitate action.

Using latitudinal gradients to assess climatic adaptation

Dr Carla Sgro1
1Monash University, Melbourne, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Carla Sgro is an evolutionary biologist, interested in understanding the genetic basis of adaptation to environmental change. She uses a range of approaches, including clinal studies, experimental evolution and genomics, to do so. I am also interested in exploring how evolutionary processes can be explicitly incorporated into biodiversity conservation and management.

Studies of populations and species from across latitudinal gradients provide a powerful means of obtaining insight into the evolutionary processes that underpin climatic adaptation. I will discuss how intra- and inter-specific studies can be used to understand the physiological and molecular processes that limit, and enable, adaptive responses to climatic selection.

Can plants handle the heat? The implications of plant responses to climate change

Mr Michael Davies 1, Professor Kris French1, Assoc Professor Heath Ecroyd1, Professor Sharon Robinson1
1University of Wollongong, Wollongong, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Michael Davies studied an International Bachelor of Science (Honours) at the University of Wollongong majoring in Biological Sciences. He also received minors in Spanish and applied mathematics. He am very interested in the ecological implications of cellular and physiological processes.

Increases in heat waves and droughts, under climate change, are expected to have some of the most significant impacts across Australia. We assessed the potential of six native Australian grass species (three C3 and three C4) to tolerate the combined heat and drought stress imposed by heat wave events. Manipulative heat and drought stress treatments were carried out by simulating realistic heat-wave conditions in growth cabinets. For the first time in Australia, we investigated plant responses by measuring heat shock protein expression, which is a vital component in stress tolerance of all organisms. We also measured leaf sacrifice, fluorescence and relative leaf water content. The physiological parameters showed that C4 species had a much greater tolerance to the imposed stress treatments. Analysis of the heat-shock proteins was performed by immunoblotting and densitometry analysis and revealed strong differences in relative protein expression between species and within treatments. These results indicate that future global climates will influence native species very differently, likely imposing strong selective pressure towards those that are well adapted to hot-dry climates.
Inherent expression of water relation traits in eucalypts are strongly influenced by the environment

Prof Stefan Arndt¹, Mr Gregor Sanders¹, Ms Mareike Hirsch¹
¹The University of Melbourne, Richmond, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Professor Stefan Arndt's research focuses on the interface between plants and their environment. He is particularly interested to understand the physiological responses of plants to their abiotic and biotic environment and the role of plants in the functioning of ecosystems.

Physiological traits have been proposed as possible tools to predict vulnerability to tree drought mortality but these traits have only been studied in a few tree species. We investigated the vulnerability to hydraulic cavitation in leaves (P50leaf), turgor loss point (TLP) and osmotic potential at full turgor (OPFT) in 16 different eucalypt species from different environments in south-eastern Australia (300mm to 1500 mm of precipitation p.a.) in an arboretum. We observed strong correlations between all measured ecophysiological traits and the aridity of the environment of the origin of the species. The results indicate a strong genetic control over these physiological traits in eucalypts – trees from more arid environments lose turgor and hydraulic conductivity at lower water potentials and achieve these lower water potentials by having more osmotically active substances, even if they are not stressed. Measurement of traits in different seasons indicated plasticity of trait expression but all species followed similar trends in the expression of traits. This is the first time these strong correlations between physiological traits and aridity of the origin of the species have been observed. This is likely related to the fact that eucalypts follow a similar strategy and growth form (broadleaf evergreen with sclerophyllous leaves), indicating that physiological traits may be used as thresholds within a genus or a group of species with similar drought tolerance strategies.

Do upper thermal limits explain elevational distributions? Ants in the Australian Wet Tropics

Mrs Somayeh Nowrouzi¹,², Prof Alan Andersen², Prof Simon Robson¹
¹James Cook University, Townsville, Australia, ²CSIRO, Canberra, Australia, ³CSIRO, Darwin, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Somayeh Nowrouzi is a PhD student at James Cook University. Her interests include community ecology, biogeography and ecophysiology. She specifically studied ants in relation to environmental changes and conservation management. She is also part of two larger research groups, CSIRO, Land and Water Flagship, and Centre for Tropical Biodiversity and Climate Change.

Terrestrial ectotherms are likely to face increased periods of heat stress as mean temperatures and temperature variability increase under global climate change. Distributional patterns of diversity along environmental gradients have been linked to species' abilities to withstand a range of climatic conditions - the climatic variability or seasonality hypothesis. Thermal limits are used as measures of climatic tolerance that profoundly affect distributions of ectothermic animals. Some studies have revealed a strong relationship between the critical thermal maximum (CTmax) of insects and their latitudinal ranges, but such a relationship has been poorly documented across elevation. Here we consider the extent to which variation in the CTmax of ant species might be related to elevation. We tested CTmax and body mass of 20 ant species across an elevational transect (350 m to 1,000 m) in the World Heritage-listed rainforests of the Australian Wet Tropics. We found that the CTmax of ants tended to decrease at higher elevations. Variation of CTmax within a species was strikingly narrow, particularly at higher elevations. If the pattern of species tolerance assumed by the hypothesis is correct, an increase in elevational range with increasing elevation need not necessarily follow. We also found a particularly marked change in CTmax bellow and above 600 m, which coincides with a disjunction in ant community composition associated with an environmental threshold of moisture stability due to 'cloud stripping'. The elevation of cloud stripping is predicted to rise under climate change, which will likely exacerbate biotic change caused by rising temperatures alone.

An Isotopic TREND: Measuring water stress in South Australian flora

Mr Stefan Caddy-Retalic¹, Prof Glenda M. Wardle², Prof Andrew J. Lowe¹, Dr Francesca A. McInerney¹
¹University of Adelaide, Adelaide, Australia, ²University of Sydney, Sydney, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Stefan Caddy-Retalic is a multidisciplinary ecologist who combines biomolecular techniques (stable isotopes, metagenomics) with traditional survey methods to integrate species change from a population to biome level. Stefan has a background in environmental and research policy and is driven to improve the links between science and policy needs.

Water availability is a major influence on plant physiology and where plants can live in the environment. Plant distributions are therefore expected to shift under changed climates but a major barrier to predicting such shifts is our limited understanding of how plants respond to stress caused by increased aridity. A plant that is water-stressed will be forced to limit stomatal opening to reduce water loss by evapotranspiration. This also changes the flux of CO2 into the leaf, altering the carbon isotope composition of the leaves which provides a way to measure contemporary adaptation by plants to changing conditions. Measurement of stable carbon isotope ratios in leaves is an established methodology for detecting water stress but is seldom applied at a landscape scale. To investigate how plants respond to water stress, stable carbon isotope ratios were measured in the 161
species found at ≥4 of the 42 TREND sites established by TERN. These sites cover a strong bioclimatic gradient of >700km from the South Australian coast to the arid interior. Species tested reflect the diversity of the Australian flora, including trees, shrubs, forbs, yakkas, grasses, sedges, vines, chenopods, mistletoes and ferns; as well as native and introduced species.

Most of the 149 C3 species (including 33 of previously uncertain photosynthetic pathway) showed correlations between water availability and carbon isotope ratios. The 12 (including 1 previously unknown) C4 species predominated in the drier regions and did not show a clear correlation between aridity and carbon isotope ratios.

Genomic variation across an environmental gradient in three species in the southwest of Western Australia.

**Dr Tara Hopley**, Ms Lee Fontanini, Mr Andy Russell, Dr Margaret Byrne

1Department of Parks and Wildlife, Kensington, Australia, 2Warren Catchments Council, Manjimup, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Dr Tara Hopley is a research scientist for the Science Division of the Department of Parks and Wildlife with a broad background in population genetics. Her current research is focused on identification of patterns of adaptive variation to enable more informed approaches to maximise establishment and persistence of plants in revegetation programs.

Changing climates require a re-evaluation of appropriate seed sourcing strategies for revegetation and restoration of ecological function in degraded sites. Use of local seed may not provide adequate resilience to maintain ecological function under changing climates. An understanding of climate adaptation will provide a scientific basis to undertake best practice restoration and facilitate establishment of biodiverse plantings that maximise ecological function for enhanced persistence and resilience. Genotyping-by-sequencing was used to assess the genomic variation across twelve populations for three species along the Warren River and its tributaries where restoration of degraded sites is required to maintain ecological function. The three species differ in their habitat and distribution with Astartea leptophylla restricted to high flow river banks, Taxandria linearifolia present in disjunct populations often on flood plains and Callistachys lanceolata widespread across the landscape. The species occur in this catchment across an environmental gradient with annual rainfall from 560mm to 1130mm. Outlier analysis and environmental correlations were used to identify evidence for underlying local adaptation. Identification of patterns of adaptive variation will enable more informed approaches to species selection and seed sourcing to maximise biodiversity establishment and persistence using a climate adjusted provenancing approach.

Will life be tougher in the tropics? Latitudinal variation in vulnerability to climate change.

**Dr Charlene Janion-Scheepers**, Dr Carla Sgro, Prof Steven L. Chown

1Monash University, Clayton, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Dr Charlene Janion-Scheepers' previous research focused on investigating the diversity of Collembola of South Africa by combining morphological taxonomy and DNA barcoding techniques. Her current research will use Collembola as exemplars to test the adaptation and plasticity of species to climate change.

Combined with on-going habitat loss and over-exploitation, climate change is forecast to dramatically affect the distribution and abundance of species. Tropical species, which make up the vast majority of the world's biodiversity, are predicted to be most at risk from climate change, and extinction rates might increase. However, if species can evolve and adapt to climate change, then species extinction risks due to global change may be substantially reduced and the range changes of threatened species might be less severe than predicted. We investigate the variation in thermal acclimation responses across groups of Collembola (springtails) across a wide latitudinal gradient. Collembola were collected from localities along the eastern areas of Australia, encompassing the warm tropics of Far North Queensland extending down to the cool temperate zone of Tasmania. Critical thermal minima (CTmin) and critical thermal maxima (CTmax) were assessed for over 20 species following acclimation at four temperatures. We show variation in response to acclimation for CTmin, while the CTmax show reduced variation. These findings are discussed in line with assessments done for other groups of ectotherms.

Pushing the envelope: narrowly and widely distributed eucalypts differ in response to climate warming

**Ms Angelica Vårhammar**, Dr John Drake, Dr Mike Aspinwall, Prof. Mark Tjoelker

1Hawkesbury Institute for the Environment, University of Western Sydney, Sydney, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

**Biography:**

Angelica Vårhammar is a Research Assistant at Hawkesbury Institute for the Environment at University of Western Sydney. Her research interests include investigating patterns in species distributions and their responses to disturbance and climate change, in particular plant responses to global warming.
Nearly half of Australia’s eucalypts have native geographic ranges spanning <3°C of mean annual temperature. With climate warming, many narrow-ranging species will experience novel climatic conditions outside their current climate envelopes. Their capacity to adjust physiological and morphological traits to warming may therefore be vital for survival. This study examined whether narrow-ranging species have a constrained capacity to acclimate to warming relative to co-occurring wide-ranging species and whether this capacity differs among taxa from contrasting climates. To test this, seedlings of wide and narrow-ranging eucalypts from temperate and tropical Australia were grown under two temperatures (corresponding regional mean summer temperature and +3.5°C of warming). Leaf-level gas-exchange, sequential harvests and growth measurements allowed for allometric estimations of biomass along with modelling of acclimation potential and growth rates. Photosynthetic and respiratory acclimation to warming was nearly homeostatic and occurred irrespective of range-size and climate of origin. However, growth was mainly stimulated by warming with wide-ranging taxa responding more than narrow-ranging and temperate more than tropical taxa, which only showed limited responses. Relative growth rates were significantly increased by warming among temperate taxa, placing warned seedlings of temperate origin on a trajectory of larger biomass (wide: 53%, narrow: 47%) than their non-warmed counterparts. Our results suggest that many taxa, including those which climate envelopes are exceeded by warming, possess a broad capacity to physiologically acclimate. Growth responses to warming in these same taxa however, appears to differ with range-size and climate of origin which may have repercussions for future fitness and distributions.

The role of plasticity and local adaptation in the response of a widespread eucalypt species

Dr Shannon Dillon1, Dr Audrey Quentin2, Dr Milos Ivkovich1, Andrew Gock3, Dr Libby Pinkard1, Dr Owain Edwards3
1CSIRO Agriculture Flagship, Canberra, Australia, 2CSIRO Land and Water Flagship, Hobart, Australia, 3CSIRO Land and Water Flagship, Canberra, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Shannon Dillon’s research interests sit at the interface of population/quantitative genetics, and evolutionary adaptation. Her research focuses on the characterisation of genetic variation underpinning adaptive traits in plants, with the aim to promote capacity for adaptation in both agricultural and natural systems.

Forest trees are foundation species in many Australian ecosystems and their responses to environmental change will have far reaching consequences for terrestrial communities. Forest populations frequently exhibit genetic adaptations along environment gradients, which can inform our understanding of a species capacity for adaptation. Phenotypic plasticity facilitates a complementary mechanism for adaptation, of particular significance for long-lived plants, but its role has rarely been characterised in the context of species wide adaptation. An imperative goal in assessing species adaptive capacity should therefore focus on understanding the role of plasticity in adaptation, and the extent to which pre-existing genetic variations, including local adaptations to environment, influence the range of plastic responses in widespread natural populations. To address this goal we have examined transcriptome wide gene expression and phenotype responses of E. camaldulensis (river red gum) to altered CO2 regime in a diverse sample of 43 populations (500 genotypes) spanning the species natural distribution. We identified significant plasticity for growth, leaf chemistry and physiology traits as well as a suite of CO2 responsive genes. Quantitative analyses revealed gene by environment interactions in the response of phenotype and gene expression. Environment at population site of origin was implicated as a driver of genetic variation underpinning responsiveness, suggesting adaptive plasticity may be pervasive in this species. Finally association tests point to transcriptomic drivers of phenotypic response and locally adapted genomic (SNP) variation underlying variation in plasticity. Broad implications for adaptation of this species will be discussed in the context of rising atmospheric CO2.

Among species and population patterns of responses to the thermal environment in Tasmanian snow skinks

Dr Erik Wapstra1, Dr Mandy Caldwell2, Mr George Cunningham1, Mrs Luh Luh Yuni1, Dr Geoff White1
1University of Tasmania, University of Tasmania, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 1), Ballroom C, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Erik Wapstra is an ARC Future Fellow working the project “Climate change: bridging the gap between environmental induced phenotypic change, population dynamics and long-term evolution”. He has worked predominantly on terrestrial lizards combining field and laboratory studies to understand species, population and individual responses to thermal environments.

Snow skinks are a genus of largely endemic skinks from Tasmania that can be broadly divided into two groups: widespread species that occur from lowland to subalpine habitats and alpine species that are restricted to cold alpine habitats only. Over this altitudinal gradient, species show remarkable adaptations to their local environment. Within the widespread species, there is also clear evidence of life history and reproductive responses to altitudinal gradients that reflect a combination of local adaptation and plastic responses. Within populations, variation among years typically reflects behavioural and physiological plastic responses to the thermal opportunity. Using a series of laboratory and field studies among species, populations within species and among years within populations we will demonstrate the key influence of the thermal environment on shaping critical physiological traits (critical thermal limits), performance curves and life history responses. We will place this in the context of known restrictions on gene flow between populations which restricts the potential for local adaptation. Finally, we will use this data to predict species and population responses to predicted climate change.

A Vegetation Program perspective to undertaking landscape scale wetland and terrestrial restoration
Mr Hafiz Stewart1
1Department Of Environment, Water And Natural Resources South Australia, ,

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

The Millennium Drought had severe ecological and social impacts on the Coorong, Lower Lakes and Murray Mouth (CLLMM) landscape, including the agricultural and urban areas surrounding the lakes. In response, the CLLMM Recovery Project was funded by federal and state governments to improve and restore the ecological and community resilience of this iconic Ramsar wetland. The Vegetation Program is a key component of this five year funding, and over the past four and a half years it has implemented one of Australia’s largest revegetation and pest and weed control programs on a landscape-scale. This talk will deliver an overview to these terrestrial and wetland restoration activities undertaken by the program and it’s community and Indigenous partners, including: the planting of over five million native plants on 2,334 ha of private and public land; the planting of approximately one million sedges around the lakes edge; strategic pest plant and animal control on more than 6,000 ha of land; and extensive research and monitoring activities to provide ecological learnings and guide environmental recovery. It will put into context other presentations and posters that focus on work undertaken by the Vegetation Program and the CLLMM Recovery Project. Finally, the talk will provide valuable insights into how best to manage a landscape scale restoration program that provides terrestrial and wetland outcomes for the environment and community.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Restoring a wetland of international importance; is it just a matter of adding water, money and knowledge?

Mr Jason Higham1
1South Australian Department of Environment, Water and Natural Resources, ,

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

The wetlands of the Coorong, Lakes Alexandrina and Albert were declared internationally important in 1985 under the Ramsar convention. Resource development in the Murray-Darling Basin and the Millennium Drought severely affected the site, its values and its people. In response, a plan to invest up to $200M from the Australian Government was developed in conjunction with the local community. This plan compliments the Basin Plan and provision of environmental water to maintain the site as a healthy, productive and resilient wetland of international importance. Central to realising these objectives, was implementing interventions that protected the sites’ values. Actions that mitigated the acute effects of drought while also restoring ecological function and repair the degradation it had experienced. In doing so, the actions would also support the economic, social and cultural wellbeing of the local communities.

Interventions included the triaging and remediation of hazards to the site, maintenance of refuge habitats, restoring connectivity while also re-creating functional habitats to support species and communities. A brief history of the site, the development of the plan, the basis and range of measures implemented will be briefly presented as context for a number of presentations for the symposium. This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Managing pests and weeds to get long-term biodiversity outcomes around Ramsar Wetlands

Mr Ben Shepherd1
1Dept Environment Water and Natural Resources, ,

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

Pest management across a large landscape is challenging, but it is vital for maintaining and protecting revegetated and remnant areas in agricultural landscapes. Planning and prioritisation is an important step towards achieving strategic control of environmental pests and to facilitate follow-up control by stakeholders. This talk will discuss the development and implementation of a four year pest management program to protect the assets of a Ramsar listed wetland and surrounding terrestrial landscapes.

It will outline the process the Coorong, Lower Lakes and Murray Mouth (CLLMM) program followed to identify environmental pest management priorities across the CLLMM region and summarise the achievements of the program from 2012-15. Initially the talk will discuss the prioritisation process and stakeholder engagement undertaken to identify and strategically manage environmental pests across the CLLMM region. In particular, it will discuss how management focussed on maintaining remnant areas of native vegetation, protecting revegetation sites and preventing the spread of key environmental weed species across the region. The talk will then discuss the implementation of the program and identify the successes and lessons learned. This talk will be of interest to those who embark on landscape scale pest management and restoration activities. This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

The benefits of restoring reed beds in a Ramsar wetland

Dr Susan Gehrig1, Dr Sacha Jellinek2, Mr Thai Te2, Mr Hafiz Stewart2, Dr Jason Nicol1
1South Australian Research and Development Institute, Aquatic Sciences, Adelaide, Australia, 2Department of Environment, Water and Natural Resources, Adelaide , Australia
Building ecosystem health: prioritisation of wetland restoration to reduce shoreline erosion and maximize biodiversity

Mr James Thiessen1, Emma Eichter1, Dr Sacha Jellinek2, Dr Ronald S. Bonifacio2
1Vegetation Program, Department of Environment, Water and Natural Resources, , 2Science Monitoring and Knowledge, Department of Environment, Water and Natural Resources, ,

The Coorong, Lower Lakes and Murray Mouth (CLLMM) covers a number of wetlands of international importance, listed under the Ramsar Convention. Due to land clearing for agriculture, influences of long-term droughts and changes in water regimes the unique ecology of this system has increasingly come under threat with habitat quality declining and the shorelines of Lakes Alexandrina and Albert eroding severely. In response, the Department of Environment, Water and Natural Resources, through the CLLMM Vegetation Program, sought to improve ecosystem health by undertaking a wetland restoration project. In this presentation we will outline a prioritisation approach to reduce shoreline erosion around Lakes Alexandrina and Albert by planting a sedge species (River Club Rush – Schoenoplectus validus). It will outline the steps undertaken to identify eroding areas using GIS imagery and shoreline erosion monitoring data and strategically prioritise areas to restore on public and private land. This prioritisation helped to identify areas for the planting of approximately one million plants along 30 km of shoreline over 5 years to mitigate shoreline erosion and improve habitat quality and diversity around the lake edge. This talk will be valuable to natural resource managers planning to identify areas of shoreline erosion and methods to reduce wave attenuation to reduce erosion and maximise biodiversity benefits in internationally significant areas.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Sowing seeds of seagrass success. Translating science into large-scale restoration in the Coorong.

Mrs Kat Ryan1
1Department of Environment, Water and Natural Resources, South Australia, Adelaide, Australia

Biography:
Kat Ryan is an environmental project manager working as part of a team in the South Australian Government implementing a range of actions aimed at maintaining the site’s ecological character.

Scientific research informs environmental restoration projects. However the development from knowledge to practical application is often challenging. The Ruppia Translocation Project is helping to restore Ruppia tuberosa to the Coorong. R. tuberosa forms one of the critical component of the Ramsar sites ecological character, providing food for waterbirds and habitat for fish and invertebrates. Due to inadequate flows of fresh water to the region, prior to but especially during the millennium drought, the population of R. tuberosa in the Coorong was severely contracted and its seed bank depleted. This increased the chance that the species would be lost or unable to recover post drought. As a consequence a program was established to instigate restoration of the species in anticipation of improved conditions post drought.

Monitoring and research trials informed the project and recommended seed sediment be translocated from a nearby lake to specific water depth and salinity preferences in the Coorong. The management challenge was how to deliver this novel project at a large-scale in a sensitive and variable environment.

Threatening human processes around water bodies, particularly wetlands, has a detrimental impact on water quality and quantity, aquatic vegetation and associated wetland fauna. These threatening processes can often be exacerbated by natural phenomena such as droughts. Lake Alexandrina and Lake Albert are internationally significant Ramsar wetlands located at the terminus of the Murray River, Australia’s longest river system. Agriculture, water regulation and extraction and droughts have had a detrimental impact on native plant communities in the lakes. We studied the influence of young (<1 - 3 years) and old (9 - 11 years) plantings of a native sedge (bulrush) species, Schoenoplectus tabernaemontani, on aquatic plant community composition in comparison to remnant and control sites. We also measured how planting structure (height, stand width and stand density) changed with stand age in comparison to remnant sites. Results suggest that as plantings age they get substantially wider and have a greater maximum height, although do not reach similar stand widths by 11 years of age when compared to remnant areas. However, old plantings do not differ from remnant habitats in relation to aquatic plant species richness, abundance and community composition. Young plantings have substantially less abundant and diverse aquatic plant communities, but are developing on a similar trajectory to old plantings. It is likely that planting sedges along shorelines causes a breakwater effect that allows wetland plants to recolonise. Management agencies should consider replanting native sedge species to increase aquatic biodiversity, and potentially reduce erosion.
A collaborative approach was used in project planning, method development and implementation including scientific experts, traditional owners and commercial contractors. Over 60 hectares of Coorong mudflats were successfully treated with promising results on population re-establishment.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Applying pre-regulation hydrographic modelling to inform Indigenous-led management of the Sugar Shack Wetland Complex

Mr Ben Taylor1, Isobelle Campbell2
1DEWNR, 2Mannum Aboriginal Community Association Incorporated.

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

Sugar Shack Wetland Complex is a culturally and ecologically important floodplain on the lower River Murray. The Aboriginal owned floodplain is managed by Mannum Aboriginal Community Association (MACAI), and features four wetlands permanently inundated due to river regulation and artificially lowered sills, one of which is currently managed via a regulator.

Nominated for management under the Riverine Recovery Project (RRP), MACAI’s overarching management vision is that conditions should, as closely as possible, resemble those experienced by their ancestors.

The Robinson hydrographic model that hindcasts daily river stage for the period 1895 to 2009 under unregulated conditions was used to set target hydrographs for wetlands in the complex. The model outputs, 114 years of records of wetland connection events, have been incorporated into the MACAI-led wetland management plan for the complex, including a five year target hydrograph for each wetland in the complex. To improve its utility, we added new outputs to the Robinson model so as to exclude atypically long (major floods) and short (brief rises in river stage) connection events from the calculation of connection event percentiles.

MACAI propose to apply the target hydrographs to all managed wetlands in synchrony. Permanent, unmanaged waterbodies in the complex will provide refuge habitat for aquatic biota when managed wetlands are dry. The inclusion of two dry years within a five year period is a greater than natural frequency but is proposed for management of Common Carp. The health and wellbeing of the Ngarrindjeri is anticipated to improve in response to proposed management.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Restoration of iconic wetlands in SW Victoria: Long Swamp (proposed Ramsar site) and Brady Swamp

Mr Mark Bachmann1
1Nature Glenelg Trust, Mumbannar, Australia

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Mark Bachmann manages a relatively new not-for-profit environmental organisation called Nature Glenelg Trust. The organisation works in both Victoria and South Australia, and is delivering a wide range of on-ground initiatives across both public and private land, by using sound science to bridge the gap between research, policy and on-ground action.

This presentation encompasses two high-profile wetland restoration initiatives led by Nature Glenelg Trust across public and private land in SW Victoria, delivered with the support of a range of community and government partners over the past few years:

1) The Brady Swamp complex - a series of four floodplain wetlands of the upper Wannon River, near Dunkeld, south west Victoria, that straddle private and public land near the southern boundary of the Grampians National Park; and,

2) The Long Swamp complex in Discovery Bay Coastal Park - a 15km long stretch of nationally significant wetlands currently being assessed and considered by the Victorian and Australian Governments for Ramsar nomination.

Historic drainage activities have altered hydrology at both sites, imposing ongoing contemporary risk to the persisting ecological values of these wetlands. Local community support for restoration works has been strong for many years; however, despite this support, restoration works were delayed by uncertainty over (a) potential unintended impacts, (b) responsibility for the works and (c) the appropriate design criteria for achieving restoration.

To address these concerns, Nature Glenelg Trust brokered a solution between all parties that involved a restoration trial approach. The resulting adjustable geofabric sandbag weir structures were built with broad community support and rapidly lead to permanent works at the Grampians sites.
The presentation will explain how the project addressed the social aspects of wetland restoration, and provide a highly visual overview of the on-ground works completed to improve the ecological values of these iconic wetlands.

Drought, interventions and floods: ten year vegetation dynamics of an arid lowland regulated river floodplain

Dr Jason Nicol1, Dr Susan Gehrig1
1SARDI Aquatic Sciences, Henley Beach, Australia

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Jason Nicol is the Plant Ecology Sub-Program Leader at SARDI Aquatic Sciences and undertakes research into the ecology of aquatic, wetland and riparian vegetation. He has worked extensively throughout south eastern Australia and research interests include: seed banks, impacts of altered hydrological regimes, ecosystem water requirements and restoration ecology.

River regulation has severely impacted the lower River Murray causing reductions in the frequency, magnitude and duration of flooding, which has implications for floodplain vegetation. An understorey vegetation monitoring program was established on the Chowilla Floodplain in February 2006. Vegetation surveys were undertaken annually, and at the present, ten years of data have been collected. At commencement of monitoring, the Murray-Darling Basin was in extended drought and significant overbank flows had not occurred since 1996. During the monitoring program two watering interventions were undertaken in spring 2006 and 2009, a large overbank flood flooded 65% of the floodplain in 2010-11 and the Chowilla Environmental Regulator was constructed and operated for the first time in spring 2014. In 2006 the understorey plant community was dominated by terrestrial taxa and through time changes occurred in response to watering, flooding and regulator operation. In 2007 and 2010 there were increases in the abundance of flood dependent species in areas that were watered but the response was short-lived with these species absent the following survey. In areas that were not watered between 2006 and 2010 there was a decrease in species richness and increase in bare soil. There was a large increase in the abundance of flood dependent species after the 2010-11 flood but the response short-lived and by 2015 the plant community was similar to the community present during the drought, despite regulator operation in spring 2014. Although numerous interventions were undertaken, natural flooding provided the greatest benefit to the plant community.

First things first - To manage semi-arid wetlands you must understand their regional hydrogeological systems

Dr Sebastien Lamontagne1, Chris Turnadge1, Andrew Taylor1, Stan Smith1
1CSIRO, Waite Campus, Urrbrae, Australia

SYMPOSIUM: Landscape-scale restoration of a Ramsar wetland, Ballroom A, December 1, 2015, 10:30 AM - 12:30 PM

Biography:
Dr Sebastien Lamontagne has over fifteen years of experience studying groundwater-dependent ecosystems. He currently leads CSIRO’s Environmental Tracers and Applications team, which uses advanced techniques to characterise groundwater - surface water interactions, including groundwater-age dating tracers and geophysics.

In semi-arid regions, much about wetlands can be inferred by understanding where they are positioned in the regional hydrogeological system. For example, wetlands in regional recharge areas will tend to be fresher and with more pronounced water level variations at seasonal and annual scales. In contrast, wetlands in regional groundwater discharge areas may have more stable water levels but will be more susceptible to salinisation. Regional groundwater discharge can create whole wetland complexes through its role in the formation of deflation basins, lunettes, salt lakes and other common geomorphological features. Much about wetlands can also be predicted if we understand how changes in climate, land-use or water resources management will impact on regional hydrogeological systems. Here, we will demonstrate key features of the South Australian Tertiary Limestone Aquifer hydrogeological system and associated wetlands, with a focus on deflation basins. This will be used to illustrate why the regional hydrogeological template must be carefully considered when devising management plans for groundwater-dependent wetlands.

Late Holocene mammal fauna from southern Australia: rapid species declines and conservation implications

Ms Diana Fusco1, Dr Matthew McDowell1, Prof Gavin Prideaux1
1Flinders University of South Australia, Bedford Park, Australia

Behavioural Ecology and Evolution (2), Balcony Rooms 3-4, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Diana Fusco is a PhD candidate in Palaeontology at Flinders University, Adelaide, where she is researching faunal response to late Pleistocene and Holocene environmental change.

Although the ranges of most Australian mammals have contracted markedly since the arrival of Europeans in Australia, modern distributions are frequently used as baselines for conservation management and understanding ecological requirements. These can poorly reflect pre-European distributions, particularly in areas where biodiversity declines were rapid and occurred soon after European arrival. We use Holocene fossil assemblages to reconstruct the pre-European mammal fauna of the Murray Mallee, Fleurieu Peninsula, Kangaroo Island and Yorke Peninsula and
show that the loss of mammal diversity in the Murray Mallee and Fleurieu Peninsula is far greater than previously thought. Comparing faunal community composition reveals that the Holocene faunas of Fleurieu Peninsula and Kangaroo Island are closely associated with those of the Murray Mallee as well as the Naracoorte Coastal Plain. Fleurieu Peninsula evidently acted as a late Quaternary refugium for several small mammal species as aridity increased. These results demonstrate that biodiversity assessments based solely on contemporary records can mask the true status of Australia’s mammals and that pre-European baseline data should be consulted wherever possible. We also highlight the potential of Holocene fossil assemblages to provide ecological insights that have implications for the management of Australia’s biodiversity.

Fish movements among reefs within a temperate marine park: implications of movement data for spatial-management

Dr Nathan Knott1, Mr Adrian Ferguson2, Mr Lachlan Fetterplace3, Ms Teagan Marzullo4, Mr Nathan Bass5, Dr Colum Brown6, Prof Iain Suthers4, Prof Euan Harvey6, Dr Matt Taylor7

1DPI Fisheries NSW, Huskisson, Australia, 2University of Western Australia, Crawley, Australia, 3University of Wollongong, Wollongong, Australia, 4University of NSW, Sydney, Australia, 5Macquarie University, Sydney, Australia, 6Curtin University, Bentley, Australia, 7DPI Fisheries NSW, Port Stephens, Australia

Biography:
Nathan Knott is a Research Scientist with the Marine Ecosystems Unit in Fisheries NSW. His research position is based at the Jervis Bay Marine Park where he carries out a range of research programmes assessing ecological changes associated with NSW Marine Parks and threats to the NSW Marine Estate more generally.

Quantifying patterns of fish movements is essential to effectively manage marine biodiversity and fish stocks. Understanding the movement of fishes should assist greatly in identifying the spatial-scales that fish stocks should be managed and in determining whether spatial management such as marine protected areas could be useful. Here, we focus on the movements of fishes among 20 reefs separated by 100 – 3000 m and large areas of soft sediments (i.e. >100 hectares) within the temperate embayment of Jervis Bay (NSW, Australia). This bay is part of the Jervis Bay Marine Park and the reefs representatively cover both habitat protection zones and multiple sanctuary zones (no take zones) and are replicated within each zone. We quantified the movements patterns among these reefs for 5 fish species (luderick, bream, smooth rays, Port Jackson sharks and bluespotted flathead) using a combination of active and passive acoustic tracking over periods of 1.5 – 24 months. To date, this ongoing study has revealed a diverse range of movement patterns among species. Some species showed strong site attachment while others were highly mobile within the embayment. There was also considerable variation within-species with highly individualistic patterns consistently arising suggesting that within-species variation may be common.

Body size effects on long-distance migration evaluated using migratory tracks of Arctic breeding shorebirds

Ms Meijuan Zhao1, Mr Ken Gosbell2, Mr Clive Minton2, Mr Simeon Lisovski1, Mr Jon Coleman3, Prof Marcel Klaassen1

1Deakin University, Geelong, Australia, 2Victorian Wader Study Group, Melbourne, Australia, 3Australian Wader Study Group, Melbourne, Australia

Biography:
Meijuan Zhao is a PhD student at Deakin University. She has great interest in birds and ecology. Collaborating with Australian/Victorian Wader Study Group, she is investigating avian migration behaviors in space and time and its variation with size and environmental factors, using waders along the East Asian Australasian Flyway.

Migration is a common phenomenon across many animal taxa. Understanding how migration scales with size is fundamental in the development of migration theory and in making size-related predictions. Although aerodynamic theory has assisted greatly in generating such predictions for flying migrants, verifications of these scaling predictions have been limited by a lack of migration data across a range of body sizes. The recent advent of ultra-light tracking devices and its rapid application to migration now allows us to put theory to the test.

We used tracking data of seven species of closely related migratory sandpipers (family Scolopacidae) to compare their migratory behaviour towards the breeding grounds as a function of size (50-800 g). We found a, stronger than predicted, decline of migration speed (km/day) with size. Besides migration speed, the number of migratory legs, departure date from the non-breeding (i.e. wintering) ground and arrival date at the breeding ground also scaled negatively with size. Overall migration duration, migration distance, the number of days staying at stopover sites and the number of days in flight were not significantly related with size. Correction for phylogeny showed consistent results for all variables, with the exception of the number of migratory legs, which no longer scaled with size.

The strong scaling of migration behaviours with size improves our basic understanding of inter-specific variation in migration behaviours. Size differences affect the capabilities and constraints of migrants and may consequently have a bearing on their vulnerability to environmental disturbances en route.

Experimental insights into search image parameters of mistletoe-dispersing birds: context matters.

Ms Melinda Cook1, Prof David M. Watson2, Dr Brad R. Murray1, Dr Andrea Leigh1

1University of Technology, Sydney, Broadway, Australia, 2Charles Sturt University, Albury, Australia

Biography:
Ken Gosbell is a Research Scientist with the Marine Ecosystems Unit in Fisheries NSW. His research position is based at the Jervis Bay Marine Park where he carries out a range of research programmes assessing ecological changes associated with NSW Marine Parks and threats to the NSW Marine Estate more generally.

Vegetative propagules of mistletoes are dispersed by birds in search of suitable sites for planting. The ability of birds to locate such sites is crucial to the establishment success of these plant species. We used a combination of tracking devices and computer simulations to explore the visual search strategies of a range of waders to determine the parameters they use for detecting vegetation on and at the ground, which is required for effective seed dispersal.

Behavioral Ecology and Evolution (2), Balcony Rooms 3-4, December 1, 2015, 1:30 PM - 3:30 PM
More work may determine whether widespread seed banks have persisted despite c... that P. hirsuta’s long... moderate connectivity, although fine... among si... confirmed this, revealing greater genetic diversity within stands than might be expected for small populations (He = 0.633) a... germination in combination with a long... the edge of the Southern Highlands, NSW, but historically recorded more widely. We predicted that recent boom and bust cycle... microsatellites and AFLPs (Amplified fragment length polymorphism), populati... investigation for two plant species occurring in fire... microsatellites and AFLPs (Amplified fragment length polymorphism), population genetics and particularly gene flow via seed dispersal were... investigated for two plant species occurring in fire-prone Mallee ecosystems. The chosen study species are Triodia irritans, a re-sprouting grass and... Callitris verrucosa a serotinous obligate s... 1... 185... specific search images may variously be involved. We investigated... stimu... spatial memory over more complex visual cues. As mistletoe depends on avian frugivores for dispersal, our findings clarify the role of both... and trait expressed by each of the species at sites with various fire histories according to their particular plant life history trait expressed by each of the species. The results of this study will help to improve our knowledge and understanding on the resilience of these species to current and future fire regimes.

In the bank: conservation genetics highlights importance of seed banks in the fire-sensitive Persoonia hirsuta

Ms Alison Haynes1, Professor Kristine French1, Mr David Gregory2, Senior Professor David Ayre1
1University of Wollongong, Austiminer, Australia, 2South32, Illawarra Coal, Wollongong, Australia

Few studies have investigated the patterns and traits of foraging behaviour in fruit-consuming birds, or discerned their degree of dietary specialisation and foraging versatility. Depending on the nature of the food resource and the complexity of behaviours used to acquire and process them, spatial memory, visual orientation, recognition of species and season-specific search images may variously be involved. We investigated the behaviour of woodland birds foraging for fruiting mistletoe to determine how this patchy resource is located by those species foraging on the fleshy fruit. By cutting mistletoe from its host tree and moving it to one of three locations (replace-in-situ, new host and non-host) we were able to discriminate between spatial memory, associative memory and visual cue recognition in foraging birds. Observations of foraging birds were quantified by the number of visits and then sub-divided by dietary breadth: mistletoe specialist, generalist frugivore and all other species. The mistletoe replaced in-situ received significantly more visits by all birds than the two moved mistletoes, which did not significantly differ from one another. Generalist frugivores visited the replaced in-situ mistletoe almost exclusively. In contrast, the specialist and others showed no significant visitation pattern. Thus, generalist frugivores, whilst deemed primary dispersers of mistletoe chose to only visit known mistletoes, potentially utilising spatial memory over more complex visual cues. As mistletoe depends on avian frugivores for dispersal, our findings clarify the role of both generalist frugivores and mistletoe specialists in the distribution of mistletoes and their particular influence in maintaining mistletoe-host ranges.

In the Sydney basin 75% of the approximately 2000 plant species that occur in fire-prone habitats have large and persistent soil-stored seed banks that may be important buffers against loss of genetic diversity. While fire-sensitive species may exist as a few small and isolated above ground populations their seed banks can be far more widely distributed. Little is known about what determines the genetic structure in such species although gene flow may be enhanced when widespread fires periodically stimulate germination of neighbouring stands. We used microsatellite DNA markers to assess the genetic structure of Persoonia hirsuta (Proteaceae), a fire-sensitive plant, listed as endangered, found only at three sites on the edge of the Southern Highlands, NSW, but historically recorded more widely. We predicted that recent boom and bust cycles of fire-stimulated germination in combination with a long-lived seed bank may lead to reasonable genetic diversity and little geographic differentiation. Our results confirmed this, revealing greater genetic diversity within stands than might be expected for small populations (He = 0.633) and only moderate among site differentiation (FST = 0.132) for stands separated by 25 km. This suggests that populations experience little genetic drift and at least moderate connectivity, although fine-scale clustering of related individuals within sites implies predominantly localised seed dispersal. We conclude that P. hirsuta’s long-lived seed bank and at least some long distance pollen and seed dispersal has provided greater than expected resilience. More work may determine whether widespread seed banks have persisted despite current fire management practices.

Ms Bianca Dunker1, Prof Michael Bull2, Associate Professor Don Driscoll3, Prof Andrew Lowe1, Prof David Keith4
1The University of Adelaide, Adelaide, Australia, 2Flinders University, Adelaide, Australia, 3The Australian National University, Canberra, Australia, 4The University of New South Wales, Sydney, Australia

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Ms Alison Haynes1, Professor Kristine French1, Mr David Gregory2, Senior Professor David Ayre1
1University of Wollongong, Austiminer, Australia, 2South32, Illawarra Coal, Wollongong, Australia

Biography:

Alison Haynes is an Honours student in conservation biology with an earlier degree English and French law. She has a background in publishing, has written several books and more recently has worked as an RA in ecology, history and economics, as a writer and editor, GIS analyst and biology demonstrator.

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Red light or blue? Investigating the effects of light colour on fish observed at night

Ms Sasha Whitmarsh1, Professor Peter Fairweather2, Professor Euan Harvey2, Dr Charlie Huveneers1
1School of Biological Sciences, Flinders University, Adelaide, Australia, 2Curtin University, Perth, Australia

Behavioural Ecology and Evolution (2), Balcony Rooms 3-4, December 1, 2015, 1:30 PM - 3:30 PM

Video systems such as Baited Remote Underwater Video Stations (BRUVS) are useful for viewing fish assemblages. They can be used to reveal fish behaviour as well as provide estimates of abundance and diversity. One of the challenges of using such a visual medium during nighttime is having adequate illumination but minimising any potential biases each light source might have. Our study compared two light colours, red and blue, to further quantify the effects of light colour on marine fish assemblages recorded at night. Red was selected because it is theorised to be below the threshold of visibility for many fish species due to its fast retention in the water column, whereas blue was chosen because previous studies have suggested that it provides a bigger area of illumination without reflection issues caused by white light, thus making identification easier. The study was conducted across a range of habitats (seagrass, bare sediment, shipwrecks) and protected status levels, providing insights into how the effects of light colour might vary for fish assemblages influenced by these factors. Our study found some differences in the assemblages observed between light colours along with differences in how the light interacted with the water turbidity. Overall, it was found that BRUVS was a suitable method for assessing fish assemblages at night with multiple species seen for either colour. The results from this study will allow for more informed decision-making in regards to light colour and the effect it has on fish assemblages observed.

Attractively artificial: How the built environment influences community composition and the abundance of non-indigenous species

Ms Aria Lee1, Professor Emma Johnston1, Dr Katherine Daflorn1, Dr Pat Hutchings2
1UNSW Australia, Randwick, Australia, 2Australian Museum, Sydney, Australia

Biography:
Aria Lee is interested in subtidal ecology, in particular the reproductive biology and life history of sessile organisms. Her current research areas are investigating larval settlement preferences of native and invasive organisms, and research into invasive Sabellid polychaetes.

Invasive species and habitat modification are two of the most significant threats to biodiversity. Human activities, especially in urban areas, cause shifts in the structure of local ecosystems. Anthropogenic structures built from materials that do not naturally occur in a locale, either naturally derived or manufactured, occur in nearly every environment. Additionally, these artificial structures form rigidly geometric shapes with surfaces and orientations that are not found in nature. The way that organisms interact with these new materials and structures can impact on community composition. We investigated the interactive effects of substrate material and orientation on sessile community composition by deploying settlement plates attached to backing panels substratally, at two marinas in South Australia. Settlement plates were made of either turpentine timber, fibre cement or acrylic, because these are common building materials for wharves and piling. Plates were deployed either vertically, horizontally face-down or horizontally face-up. To investigate temporal patterns in settlement and to observe a representative sample of the communities, settlement plates were deployed over 6 months between December 2012 and June 2013. Plate orientation and substrate type caused significant shifts in the colonising community. Early results suggest that the invasive ascidian, Ciona intestinalis, recruited more to horizontal down or h

Understanding resource availability and competition to help us restore grassland diversity

Mr David Johnson1, Dr Jane Catford1, Assoc Prof Philip Gibbons1, Assoc Prof Don Driscoll1
1Australian National University, Canberra, Australia

Biography:
David Johnson’s professional background includes teaching and then IT work in Canberra. He managed a bush block for over twenty years and his curiosity about natural ecosystems led him to environmental studies at ANU in 2009. He is now doing a PhD on restoring ground-layer diversity.

Vast areas of diverse native grassland in Australia have been modified for agriculture or are poorly managed and require restoration. In order to achieve this we need to understand the mechanisms which determine floristic diversity. Competition for available resources within and between species is a key factor determining which plant species can co-exist in any ecological community. Most research relating to grassland competition focuses on the response of plant species and communities to treatments that manipulate resource availability in some way. We are conducting a field experiment to measure changes in two directions: firstly the changes in resource availability that occur as a direct or indirect result of
manipulations to a grassland community, and secondly plant community responses to changes in resource availability. The experiment is located in a Themeda triandra dominated native grassland in temperate south-eastern Australia.

We manipulated the competitive hierarchy between three broad plant groups within temperate grasslands: tussocks, exotic forbs and grasses, and native forbs. Treatments included tussock thinning, weed removal, and litter removal. Seed for 14 native forb species was added. We quantified changes in the availability of essential growth resources (nutrients, moisture and light) and changes in physical structure that occurred in a growing season. These results and plant group responses including seedling emergence of sown native and unsown exotic species will be discussed along with implications for the design of grassland restoration programs.

Funded by Environment and Planning Directorate, Australian Capital Territory Government.

**Climatic warming strengthens a positive feedback between alpine shrubs and fire**

*Dr James Camac*, Dr Richard Williams, Dr Carl-Henrik Wahren, Professor Amy Hoffmann, Assistant Professor Peter Vesk

1Department of Biological Sciences, Macquarie University, North Ryde, Australia, 2Tropical Ecosystems Research Centre, CSIRO, Winnellie, Australia, 3Research Centre for Applied Alpine Ecology, La Trobe University, Bendora, Australia, 4Bio21 Institute, School of BioSciences, The University of Melbourne, Parkville, Australia, 5School of BioSciences, The University of Melbourne, Parkville, Australia

Disturbances (2), Suite 3, December 1, 2015, 1:30 PM - 3:30 PM

**Response of primary and secondary rainforest flowers and fruits to a cyclone**

*Dr Annette Scanlon*, Dr Sophie Petit

1University of South Australia, Adelaide, Australia

Disturbances (2), Suite 3, December 1, 2015, 1:30 PM - 3:30 PM

**Effects of drought induced canopy collapse on vegetation structure and composition in a biodiversity hotspot**

*Ms Emma Steel*, Assoc. Prof. Treena Burgess, Prof. Giles Hardy, Dr Joe Fontaine

1Murdoch University, Murdoch, Australia

Disturbances (2), Suite 3, December 1, 2015, 1:30 PM - 3:30 PM
Mediterranean biomes represent five biodiversity hotspots worldwide and cover just 2% of the Earth’s land area; however, they support 20% of the Earth’s known plant diversity. The Jarrah forest of South West, Western Australia, represents one of these valuable biomes. Documented climate change in Western Australia shows 35 years of consistently less rainfall and higher temperatures, with an extreme drought event in 2011 resulting in mortality of 1.7% or 19,000 ha of Northern Jarrah forest. To assess drought impact on vegetation of the Northern Jarrah forest, sites were chosen with a steep gradient from areas of canopy collapse to healthy forest. This provided an opportunity to assess the forest vegetation across an ecotone using space for time substitution. Our objectives were: 1) to determine factors affecting drought /heatwave induced vegetation mortality and 2) to assess differences in species response to this event.

Results from this study show mortality of species occurs in zones on sites of drought induced canopy collapse in the Northern Jarrah Forest. Midstorey mortality is determined by soil depth. Results, indicate a complex interaction between plants with differing root functional traits and soil depth, determines the collapse response in an extreme drought event. There is an ongoing shift in the species composition and structure of the forest in and around areas of drought induced canopy collapse. We anticipate the use of presence /absence of midstorey, as a proxy for soil depth, and stand composition to predict areas of forest likely to collapse in the future.

Environmental values and perceived fire risk of Eucalypt plantings.

Dr Meaghan Jenkins1 Dr Luke Collins2 Dr Owen Price1 Dr Trent Penman3 Dr Phil Zylstra1 Ms Bronwyn Horsey1 Professor Ross Bradstock1
1Centre for Environmental Risk Management of Bushfires Biological Sciences, University of Wollongong, Wollongong, Australia, 2Hawkesbury Institute for the Environment, University of Western Sydney, Richmond, Australia, 3University of Melbourne, Melbourne, Australia

Disturbances (2), Suite 3, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dr Meaghan Jenkins is a research fellow at the University of Wollongong. Her research interests include on fire management, fire ecology, soil-plant interactions and the influence of climate on soil stored carbon.

Environmental planting and revegetation of the landscape has the potential to sequester carbon, provide habitat and increase biodiversity and connectivity. These environmental values are often offset by the perceived increased fire risk posed by revegetation. There is a need to understand the influence environmental planting have on landscape fire risk and behaviour and to determine how this changes as plantings age. This study aimed to develop an understanding of how environmental values, regenerative capacity, fuel loads, and potential fire behaviour changes with planting age. We assessed 57 sites across the Albury-Holbrook-Wodonga region. This included a range of plantation ages, remnants and pastures, including: Old (>20 yrs old) plantations, middle aged (10-20 yrs old) plantations, young plantations (<10 yrs), remnant vegetation and pastures. Carbon storage increased with age of planting, with largest C stores found in remnants (105 tC ha⁻¹), whilst habitat complexity peaked around 20 years, with no significant difference between middle aged, old plantations and remnants. Modeled rate of spread was significantly faster in pastures when compared to plantation and remnants, whilst flame height was higher in pastures than plantations and remnants under very high FFDI but this trend reversed under extreme and catastrophic conditions with flame heights greatest in plantations and remnants.

This research highlights the importance of environmental plantings in the landscape in terms of carbon storage and environmental values and indicates the perceived fire risk may not be justified. This study allows land managers to make informed decisions regarding the values and risks associated with revegetation.

How drought-induced forest die-off alters microclimate and increases fuel loadings and fire potentials

Dr Katinka Ruthrof1 Dr Joseph B. Fontaine1 Dr George Matusick1-2 Prof. David D. Breshears3-4 Dr Darin J. Law2 Ms Sarah Powell1 Prof. Giles Hardy1
1School of Veterinary and Life Sciences, Murdoch University, Perth, Australia, 2The Nature Conservancy, Fort Benning, USA, 3School of Natural Resources and the Environment, University of Arizona, Tucson, USA, 4Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, USA

Disturbances (2), Suite 3, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dr Katinka Ruthrof’s fields of interest include understanding the impacts of climatic extremes on plant populations and restoration of degraded ecosystems.

Forest die-offs associated with drought and heat have recently occurred across the globe, raising concern that associated changes in fuels and microclimate could link initial die-off disturbance to subsequent fire disturbance. Despite widespread concern, little empirical data exist. Following forest die-off in the Northern Jarrah Forest, southwestern Australia, we quantified fuel dynamics and associated microclimate for die-off and control plots. Sixteen months post-die-off, die-off plots had significantly elevated 1-hr fuels (11.8 vs. 9.8 tons ha⁻¹) but not larger activity fuel classes (10-hr and 100-hr fuels). Due to stem mortality, die-off plots had significantly greater standing dead wood mass (100 vs. 10 tons ha⁻¹), visible sky (hemispherical images analysis: 31% vs. 23%) and potential near-ground solar radiation input (measured as Direct Site Factor: 0.52 vs. 0.34). Supplemental, mid-summer microclimate measurements (temperature, relative humidity and wind speed) were combined with long-term climatic data and fuel load estimates to parameterize fire behaviour models. Fire spread rates were predicted to be 30% greater in die-off plots with relatively equal contributions from fuels and microclimate, highlighting need for operational consideration by fire managers. Our results underscore potential for drought-induced tree die-off to interact with subsequent fire under climate change.

Host preference and establishment of Lysiana exocarpi on parasitic and non-parasitic hosts

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Mr Mitchell Star-Jones1, AProf Jose Facelli, Prof Jennifer Watling1,2
1School of Biological Sciences, The University of Adelaide, Adelaide, Australia, 2Northumbria University, Newcastle, United Kingdom

Biography:
Mitchell Star-Jones is a PhD candidate in the School of Biological Sciences at the University of Adelaide. His research interests include land ecology and plant ecophysiology, with particular interest in parasitic plants and climate change.

Mistletoe are a unique and widespread group that affect community and ecosystem processes within Australia. They obtain their water and nutrients from another plant. They do this by attaching to the host vascular system and creating a water potential gradient. This allows them to extract sap from the host. The water potential gradient is maintained by having a high transpiration rate and by accumulating solutes within their cells. Some mistletoes can parasitise both non-parasitic and parasitic hosts. Little is known about why this strategy exists, does it provide an advantage? I aimed to determine whether parasitic hosts were preferred and if establishment was greater on parasitic hosts. Host preference and establishment were measured for Lysiana excorci growing on non-parasitic, root parasitic and aerial parasitic hosts at a high and a low rainfall site. At the wetter site more parasitic plants were infected than non-parasitic plants. There was also greater establishment on root parasitic hosts at the wetter site. This shows that there is an advantage to an epiparasite during the seedling stage however this disappears later in life.

Biological adaptation and adaptedness of organisms: expanding fundamental knowledge by studying urban environments

Dr Amy Hahs1,2, Dr Mark McDonnell1,2
1Australian Research Centre for Urban Ecology, Royal Botanic Gardens Victoria, Melbourne, Australia, 2School of Biosciences, The University of Melbourne, Parkville, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Amy’s research investigates spatio-temporal dynamics of urbanisation and their impact on the ecology and adaptation of organisms. She co-edited a recent Functional Ecology special feature on the ‘Ecology of Organisms in Urban Environments’ and believes research in urban landscapes can contribute to fundamental ecological knowledge and improved urban development.

Around the world the development and growth of cities and towns are having a significant impact on local and global biodiversity. Urban areas create environmental conditions that can exert considerable pressure on organisms, and often under accelerated timeframes compared to more natural environments. There is a growing interest in understanding the role of biological adaptation and micro-evolution in filtering the non-human species that persist in urban areas or which become locally extinct. Understanding the biological adaptations that allow organisms to persist in these landscapes has the ability to contribute not only to our understanding of urban ecological systems, but also to our fundamental knowledge around biological adaptations of organisms more broadly. This information will be critical if we are to design and manage urban environments under the pressures of global climate change and rapidly expanding urban development.

In this presentation we will review the existing evidence around biological adaptation and micro-evolution of organisms in urban environments, present a framework for approaching future research, and discuss how this knowledge might contribute to the development of urban landscapes that are better able to allow organisms to survive, adapt and persist. We also highlight the role that urban environments can play in expanding our fundamental ecological knowledge around adaptation and micro-evolution.

Lights, Camera, Predation

Mr Damon Bolton1,2, Dr Graeme Clark1,2, Dr Alistair Becker1,2, Prof Emma Johnston1,2
1The University of New South Wales, Kensington, Australia, 2Sydney Institute of Marine Science, Sydney, Australia, 3NSW Department of Primary Industries (Fisheries), Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Damon Bolton is interested in the use of video to measure predation behavior to better understand how altered predation pressure results in changing community structure. He currently lectures part time in Environmental Impact Assessment and Coastal Resource Management, while completing his PhD part time at UNSW.

Urban landscapes are inundated with artificial lighting, producing a significant source of light pollution. Light pollution has been increasing as urban centres have expanded, particularly in coastal regions. When coastal urban areas grow there is a concurrent growth of water-based infrastructure, such as piers, marinas, and commercial shipping facilities. This creates pockets of light in otherwise dark night-time landscapes, potentially affecting local ecological function. We investigated the effect of artificial lighting on fish behaviour and the structure of associated sessile invertebrate
communities. In particular, we were interested how fish predation on sessile invertebrate communities might change with artificial light. Over 19 days we filmed fish and sessile communities under 5 light treatments (Natural Day, Natural Night and Artificially-lit Night). Artificial lighting was installed under a wharf not previously lit at night, using an array of 10 LED spot lights. We used GoPro cameras to film during natural day and artificially-lit night treatments, and a Dual frequency IDentification SONar (DIDSON) to film during natural night treatments. There was significantly more fish predation during the day compared to the natural night, which was evident in the structure of sessile communities exposed to predation. Sessile communities from the artificially-lit night treatments were more similar to the day than the natural night treatments. Predation during artificially-lit nights was more likely to have occurred after 11pm, as fish abundance was seen to increase from this time onwards. We demonstrate the direct effect of artificial lighting on fish behaviour (predation) and indirectly on sessile community structure.

The birds next door. How do residents think about their avian neighbours?

Mr Brendan Champness¹, Dr Grant Palmer¹, Dr Dave Kendal³, Dr James Fitzsimons³
¹Federation University Australia, Buninyong, Australia; ³Australian Research Centre for Urban Ecology, University of Melbourne, Melbourne, Australia; ³The Nature Conservancy Australia, Melbourne, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Brendan Champness is currently undertaking his PhD, investigating the ways in which human values and behaviours interact with the vegetation traits and resource use by birds in urban landscapes. Brendan has previously completed a Bachelor of Applied Science and an Honours year at Federation University Australia.

Interest in how humans interact with and respond to fauna is increasing with awareness of the importance of human contact with nature in cities. However, little is known about how people conceptualise and think about faunal taxa, including birds. This study uses a photo-based multiple sorting technique to explore patterns in the way people think about birds. Participants sorted photographs of well-known local and international bird species, as well as several less familiar local woodland birds. Each participant undertook two undirected sorts, in which the birds were sorted into groups according to a feature important to the participant. The most common groups included “type of bird”, colour and place of origin (Australian versus non-Australian species). A multi-dimensional scaling ordination showed that participants discriminated between birds primarily based on size and origin (local vs international). There were several clear features of birds that were important to people. Small, native woodland passerine species were grouped together, while small non-native passerines also formed a well-defined group. Participants also sorted by less visual features such as ecology and behaviour. However, some groups of birds that are clearly distinct to ornithologists, such as raptors, were not grouped together. These results indicate that people do think about birds in terms of a range of characteristics, such as nativeness, size, behaviour and appearance; however, it also suggests that in some cases a lack of knowledge may influence the way people think about birds and this can differ from the way scientists classify species.

Community Perceptions of the Pygmy Bluetrog Lizard: Does knowledge and experience lead to behavioral change?

Ms Dawn Hawthorn-Jackson¹, Professor Mike Bull²
¹Emu Consulting, Flagstaff Hill, Australia; ²Flinders University, Bedford Park, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dawn Hawthorn-Jackson is the owner and Director of Emu Consulting: a business which specialises in environmental management, Aboriginal Cultural Awareness, communications and community engagement. Dawn is an alumni of Flinders and Adelaide Universities and is committed to conservation collaborative management.

As an endangered species found primarily in isolated populations, on pastoral land, the Pygmy Bluetrog Lizard is continually dependent on decisions made by farmers, industry project managers, conservationists and the broader community for its survival. To help us better understand how to address matters relating to the conservation of the Pygmy Bluetrog Lizard, we developed two surveys to measure community perceptions using the KAB (knowledge, attitude, behaviour) model.

The first survey was held prior to participants attending an event whereby they participated in on-ground Pygmy Bluetrog Lizard educational activities. For this first survey participants were asked to provide answers based on their current (pre-event) knowledge, without seeking further knowledge. A second survey was then offered to the same participants, after this event. The aim was to determine if participant’s knowledge, attitudes and behaviour changed after their exposure to the event.

Responses received from the surveys are being used to:
a) better understand how community attitudes and actions change in response to educational and in-field experience stimuli and;
b) inform policy, on-ground management and educational institutions about the importance of community perceptions and behaviours.

The pivotal role of Australian cities for threatened species conservation
Although urbanisation impacts many species, there is little information on the patterns of threatened species occurrences in urban relative to non-urban areas. By assessing the extent of threatened species distributions across all Australian cities, we investigated the currently under-utilised opportunity cities present to contribute to national biodiversity conservation. We evaluated the distributions of Australia’s 1,643 terrestrial threatened species and the extent to which they overlapped with 99 cities (of > 10,000 people), with all non-urban areas, and with simulated ‘dummy’ cities which covered the same area and bioregion as the true cities but were non-urban. We found that Australian cities support substantially more nationally threatened animal and plant species than all other non-urban areas on a unit-area basis. Thirty percent of threatened species were found to occur in cities. Threatened animals were generally distributed across multiple cities, while more individual plant species were found in each city with a greater proportion of their distributions occurring in urban areas. Individual cities tended to comprise unique suites of threatened species, and especially plants. The analysis of true versus dummy cities demonstrated that, even after accounting for factors such as net primary productivity and distance to the coast, cities still consistently supported a greater number of threatened species. This research highlights that Australian cities are important for threatened species conservation, and that the species assemblages of individual cities are relatively distinct. National conservation policy should recognise that cities play an integral role when planning for and managing threatened species.

Beyond the luxury effect: Inequality in urban tree density and implications for people and biodiversity

Dr Caragh Threlfall1, Dr Melanie Davern3
1The University of Sydney, Sydney, Australia, 2Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne c/o School of BioSciences, University of Melbourne, Carlton, Australia, 3McCaughhey Unit for Community Wellbeing, Centre for Health Equity Melbourne School of Population and Global Health University of Melbourne, Carlton, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dr Caragh Threlfall is a post-doctoral researcher in urban ecology. Her research is focussed on understanding the impact of urban form on biodiversity, measuring the services biodiversity provides across urban landscapes, and assessing the effectiveness of urban greening for biodiversity conservation.

Urban vegetation is often distributed unequally along a socioeconomic gradient. This has been attributed to a ‘luxury effect’, where residents with greater access to economic resources or income can move to greener areas or afford to plant a higher abundance and diversity of vegetation. However, much of this research has been conducted in highly inequitable societies such as the United States and South Africa, or in cities that require significant inputs to establish and maintain vegetation, e.g. desert cities such as Phoenix, AZ. In addition to decisions made by residents, the decisions of public land managers also directly shape the composition, structure and abundance of trees in cities. Some political ecologists have suggested that inequality in urban vegetation is the consequence of the unequal provision of trees by public land managers. In a natural experiment, we examine the distribution and diversity of 700,000 public trees within and between nine local government areas (LGA) in Melbourne, Australia. A multilevel model was used to test the relative effects of an index of relative socio-economic advantage and disadvantage (IRSAD) and LGA on the distribution and diversity of trees. Our results suggest that inequality is being driven by the unequal public provision of trees as there was a significant LGA effect. This information can be used to inform public policy to improve equality of access to trees in urban landscapes, potentially reducing mental and physical health inequalities and increasing possibilities for disadvantaged people to engage with nature in cities.

Exploring ecological theories within cities: do urban ants conform to the size-grain hypothesis?

Mr Alessandro Ossola1, Dr. Michael Nash2,3,4, Dr. Fiona Christie1, Dr. Amy Hahs4, Dr. Stephen Livesley1
1Department of Ecosystem and Forest Sciences, The University of Melbourne, Richmond, Australia, 2South Australian Research and Development Institute, Unbrea, Australia, 3School of BioSciences, The University of Melbourne, Parkville, Australia, 4School of Agriculture, Food and Wine, The University of Adelaide, Unbrea, Australia, 5Australian Research Centre for Urban Ecology, Royal Botanic Gardens Victoria c/o School of BioSciences, Parkville, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dr Michael Nash is currently improving control of snails and slugs with the South Australian Research and Development Institute Entomology unit, focusing on what influences rates of population growth. Michael’s aim is to conserve the unseen windmills in productive landscapes by highlighting ecology in systems dominated by man.
Habitat complexity plays a critical role in shaping structure and diversity of ant assemblages. The size-grain hypothesis predicts bigger ants to be advantaged in less complex habitats compared to smaller ants. Habitat complexity can therefore act as an “environmental filter” for ant species based on their size and morphological traits. The size-grain hypothesis has been derived and tested in natural and semi-natural ecosystems, where ecological succesions, fire or grazing are major determinants of habitat complexity. In urban ecosystems, human management creates and sustains habitat structures and complexities with rare or no counterparts in natural and semi-natural ecosystems. This provides alternative experimental settings to test whether ant species conform to the size-grain hypothesis and its implications under novel environmental conditions.

We sampled urban ants in parks and woodland remnants differing for habitat complexity asking: i) are ant abundance and species richness enhanced by habitat complexity?, ii) do ant assemblages differ between low- and high-complexity habitats? and iii) are smaller species living in more complex habitats? We found that habitat complexity decreased ant species richness but not abundance, in contrast with evidence from numerous studies in natural and semi-natural ecosystems. Ant assemblages were significantly different between low- and high-complexity habitats. Nonetheless, ant morphological traits and habitat complexity variables were not related. No support for the size-grain hypothesis was found in the urban habitats investigated. This suggests that environmental filtering of urban ant based on species morphological traits is likely not to be the dominant driver in structuring urban ant assemblages.

A rainfall simulation study on the erosion-reducing potential of ferns on soil slopes

Mr Ngai Lung Chau1, Dr Lee Man Chu1
1The Chinese University of Hong Kong, Hong Kong.

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Chau Ngai Lung is the PhD candidate of School of Life Sciences in the Chinese University of Hong Kong. His research is to investigate values of ferns for the bioengineering of soil slopes. This includes assessing the erosion-reducing potential and propagation methods of ferns on soil slopes.

Bioengineering of slopes has grown in importance in promoting sustainable development of a city. It can provide environmental services such as erosion control. In Hong Kong, this role is particularly significant due to the hilly topography and high precipitation. Grasses and trees have been widely studied to assess their erosion-reducing potential. Besides these two major plant types, ferns are potentially useful owing to their great abundance and strong adaptation to soil slopes. However, there is a paucity of information on their effectiveness on erosion control. This study aimed to assess the performance of various fern species to control erosion on soil slopes. To select fern species for the study, a groundcover vegetation survey was carried out on forty soil slopes. Their coverage and frequencies were measured to assess their abundance. Five common native fern species, namely Blechnum orientale, Cyclosorus parasiticus, Dicranopteris pedata, Nephrolepis auriculata and Pteris vittata were chosen. They were grown to reach over 80% coverage of soil boxes filled with completely decomposed granite (CDG), which were placed onto an adjustable frame tilted to 50° slope gradient. Rainfall intensity of 100 mm/h was applied to the soil boxes using a rainfall simulator. The surface runoff was collected to evaluate the performance of ferns in erosion control. The results showed that the presence of ferns could remarkably reduce the runoff volume by 62% and sediment yield by 95%. Field investigations regarding the use of ferns in erosion control are encouraged to confirm their role in the bioengineering of soil slopes.

Practitioners and experts – the joys of collaboration. Sydney’s Salty Communities – increasing biodiversity resilience

Ms Fiona Shadbolt1, Dr Michael Dunlop2, Mr Geoff Withycombe1
1Sydney Coastal Councils Group, Sydney, Australia, 2CSIRO, Canberra, Australia

SYMPOSIUM: Advances in urban ecology and research practice; solutions through communication, collaboration and coordination (part 2), Ballroom B, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Fiona Shadbolt works for a Coastal Management ROC and focuses upon building councils adaptive capacity and the resilience of coastal habitats, responding to urban pressures and climate change. She has experience in environmental sustainability and related fields supported by science, environmental and local government law, CSR, and carbon management studies.

Sydney Coastal Councils Group (SCCG) through its Commonwealth funded Sydney’s Salty Communities (SSC) program, is working with its 15 member Councils, a panel of academics and experts and with CSIRO to achieve evidence-based biodiversity management in the coastal zone of Metropolitan Sydney.

The program delivered a Main Grant round to support projects which increase the resilience of varied ecosystems. The focus of the Supplementary Grant round has been on encouraging collaboration. Firstly practitioners have been encouraged to work with academics and other experts to a) find clear evidence for the existence of a need/problem to be solved and b) increase the measurable quality and effectiveness of a solution which could be funded through our grant program. This collaboration has been effected through targeted thematic projects which are applicable to several council areas.
Additionally, practitioners are asked to workshop their grant proposals with two other expert groups: 1) the CSIRO to use their Climate Ready Tool to develop thinking which is adaptive to a rapidly changing climate and; 2) the Metropolitan Local Aboriginal Land Council to increase awareness and involvement of indigenous practice and peoples in NRM.

To facilitate this collaborative working we held a grant development workshop where practitioners were introduced to and learned with experts. Attendees commented on the success, efficiencies and opportunities which emerged as a result. This presentation explores the structuring of and results from that meeting.

Species and gene turnover along environmental gradients - windows into the future

**Prof Andrew Lowe**¹, Dr Greg Guerin¹, Mr Stefan Caddy Retalic¹, Mr Matthew Christmas¹

¹University of Adelaide, Adelaide, Australia

**SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM**

**Biography:**

Professor Andrew Lowe is Chair of Plant Conservation Biology, and Director of the Centre for Conservation Science and Technology at the University of Adelaide. His research applies ecological and genomic analyses to understand, monitor and better manage biodiversity, particularly adaptation in the face of habitat fragmentation, invasive species and climate change.

Understanding how biodiversity responds and adapts to global change is vital for developing effective strategies for ecosystem management. A powerful approach to study and understand the mechanisms of climate change impacts and adaptation is to establish large-scale transects across major bioclimatic gradients for assessments of phenotype and genotype turnover within species, combined with assessments of turnover and resilience within biological communities. Here we provide an overview of the utility of using transect research to understand climate impacts and adaptation by drawing on a range of examples from the South Australian TREND transect and other work of the TERN Australian Transect Network. In particular the ability to link community turn over with species level adaptational drivers provides tremendous promise to understand the adaptation limits and likely rate and trajectory of change of biological communities. We discuss opportunities for enhancing transect-based research, including the use of novel tools and approaches from frontier areas such as genomics and next generation ecological modelling. The effective use of bioclimatic transects as platforms for studying climate change impacts and adaptation will improve ecological outcomes in the face of global change by helping conservation scientists better connect theory to the on-ground design and implementation of measures to protect biodiversity.

**Adaptation to climate in widespread eucalypt species**

**Dr Margaret Byrne**², Dr Dot Steane¹, Dr Elizabeth McLean¹,³, Dr Suzanne Prober³, Professor William Stock⁴, Professor Rene Vaillancourt², Professor Brad Potts²

¹Science and Conservation, Department of Parks and Wildlife, Perth, Australia, ²School of Plant Science, University of Tasmania, Hobart, Australia, ³CSIRO Land and Water Flagship, Perth, Australia, ⁴Centre for Ecosystem Management, School of Natural Sciences, Edith Cowan University, Perth, Australia

**SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM**

**Biography:**

Dr Margaret Byrne’s research is focused on genetics to inform conservation strategies for rare and threatened plants as well at landscape scales in relation to remnant viability, restoration, identification of refugia and understanding evolutionary patterns. Her current research interests are in application of genomics for developing climate change adaptation strategies.

Southern Australia is predicted to become increasingly arid due to global climate change. This will significantly impact Australia’s iconic eucalypt forests and woodlands and is already challenging the resilience of tree planting initiatives for biodiversity restoration and carbon assimilation. Many widespread Eucalyptus species are able to grow under a range of climatic conditions and some populations may possess adaptations that could be utilised to improve climate resilience of restored ecosystems or carbon plantings. Widespread species can colonise a range of environments by diverging into adaptively specialised populations and/or through high phenotypic plasticity. We examined genetic divergence and phenotypic plasticity in three eucalypt species in eastern and western Australia to determine the nature of adaptation to aridity in these species. Combining data from a NGS-based genome-wide screening method (DArTseq) with physiological and morphometric data collected from reciprocal transplant field trials where available, we found evidence of genetic adaptation across an aridity gradients, with significant correlations between outlier loci, climatic variables and phenotypic traits. We recommend a climate adjusted provenancing approach to seed sourcing to capture adaptive variation within species as a resource for facilitating climate adaptation and maintaining broader evolutionary flexibility in planted vegetation.

**Patterns of phenotypic plasticity and divergence in Australian Pelargonium species**

**Dr Adrienne Nicotra**, Dr Jose Alberto Ramirez-Valiente, Ms Niccy Aitken, Dr Veronica F. Briceño Rodriguez

¹Australian National University, Canberra, Australia

**SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM**

**Biography:**
Adrienne Nicotra is a plant ecologist whose research focuses on the evolution and functional significance of plant response to environment, or phenotypic plasticity. Among other things she is interested in the evolution of leaf form and in alpine ecology.

Phenotypic plasticity has been proposed to be a buffer effects of natural selection by broadening tolerance limits of organisms, and to contribute to diversification of lineages by exposing novel phenotypic combinations to selection. Yet these are seemingly contradictory processes. If plasticity buffers effects of selection then closely related species might express similar ranges of plasticity and similar trait values in response to variation in environment, and further the plasticity itself should contribute to fitness across the taxa. Alternatively, if plasticity contributes to divergence then closely related species may express different patterns of plasticity with more specialized species with restricted ranges showing reduced plasticity and less evidence of adaptive plasticity. The Australian Pelargonium are a small but widespread group of herbaceous plants in which plasticity and morphological overlap among species complicates species identification and in which plasticity to water availability has an adaptive component. The species are found throughout southern Australia and occupy a diverse range of environments: coastal, montane and arid. We examined patterns of trait plasticity in response to water availability in populations of six species of Pelargonium grown under controlled conditions to determine the extent, direction and adaptive value of plasticity for each species. All populations showed strong plastic responses but the extent and adaptive value of that plasticity varied markedly. We next used Genotype-by-Sequencing approaches to describe patterns of genetic structure among and within species. Finally we assessed the relative importance of genetic distance and environmental distance in determining patterns of plastic response to water availability.

Evolutionary potential and adaptation to recent climate change of Banksia attenuata in Southwest Australia

**Dr Tianhua He**1, Dr Sim Lim1, Haylee D’Agui1, Prof Neal Enright2

1Department of Environment and Agriculture, Curtin University, Perth, Australia, 2School of Veterinary and Life Sciences, Murdoch University, Perth, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM

Biography:

Dr Tianhua He heads Plant Ecology and Evolution Group at Curtin University with research focusing on origin and evolution of plant functional traits, evolutionary adaptation to climate change, fire ecology, and seed dispersal.

Significant climate changes are evident across Australia with declining rainfall and rising temperature, in conjunction with more frequent fire. Significant species loss and range contractions have been predicted, however the validity of these predictions is uncertain with critical gaps remaining in our understanding of the intrinsic capacity of species to respond to climate change. We quantified genome wide adaptive genetic variation in populations of Banksia attenuata, a prominent woody plant of multiple vegetation types in southwest Australia, evaluated the impact of declining rainfall, rising temperature and shortened fire intervals on population adaptive genetic variation. We characterised candidate genes associated with rainfall gradients, temperature, and fire interval through environmental association analysis. Population adaptive genetic variation was significantly impacted by shortened fire intervals, while declining rainfall and rising temperature have not had detectable influence so far. Candidate genes associated with rainfall and high temperature are diverse, with polymorphic alleles present in populations, while genes associated with specific fire intervals are fixed in one allele. Gene annotation further revealed four genes with function in stress tolerance, regulation of stomatal opening and closure, energy use, and morphogenesis with adaptation to climate and fire interval. B. attenuata, and perhaps other species with similar life history and distribution, may tolerate some further change in rainfall and temperature through evolutionary adaptation based on their adaptive genetic variation. However, the capacity to survive future climate change may be compromised by change in fire regime, and the capacity to survive more frequent fire and further environmental fluctuations is uncertain.

Local adaptation in germination traits: implications for evolutionary responses to climate change in fire-prone ecosystems

**Prof David Keith**1,2 Dr Peter Myerscough3

1Centre for Ecosystem Science, UNSW, Sydney, Australia; 2NSW Office of Environment and Heritage, Hurstville, Australia; 3University of Sydney, Sydney, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM

Biography:

David’s research interests in population and community ecology are directed at improving ecosystem management for biodiversity conservation. He has worked with national parks in NSW for many years and now has a joint position at the University of NSW.

Many plants in fire-prone environments have limited dispersal ability and thus rely on in situ mechanisms such as evolutionary responses to persist through climate change. Adaptive genetic diversity is key to evolutionary responses, yet remains largely unexplored. The regenerative phases of plant life cycles are critical to defining species’ environmental niches because these are exposed to greater selection pressures than established phases. Heritable variation in traits that regulate seed dispersal, germination and seedling establishment could therefore exert major influences on the evolutionary potential of fire-prone plant species under climate change. To investigate this, we quantified population-level variability in the thermal germination niche of a widespread fire-prone species complex, the Banksia spinulosa group. We sampled seeds from 12 populations spanning seven degrees of latitude and 1100 metres elevation and tested germinability over a range of incubation temperatures in a common garden experimental design. Thermal germination niches varied appreciably among populations, suggesting strong patterns of local adaptation. Some of this variation was explained by current taxonomic boundaries, but germination responses also varied within recognised taxa and within
Genetic dispersal and environmental adaptation during range-expansion

**Dr Rachael Dudaniec**

Macquarie University, Sydney, Australia; Lund University, Lund, Sweden

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

Dr Rachael Dudaniec is a Lecturer in Conservation Biology at Macquarie University (commenced mid 2015) and leads a research program focused on applying landscape genomics to conservation issues. Dudaniec was previously a post-doctoral researcher in Canada, Queensland, and Sweden, with a PhD from Flinders University in Adelaide.

Within today’s rapidly changing world, species are faced with great challenges to their dispersal and adaptive capacities, which together underlie the persistence of biodiversity. New ways of combining spatial and genetic information are needed to aid conservation of species’ connectivity, to understand range expansion potential and to assess evolutionary persistence. Using landscape genomics techniques, we can explore the spatial genetic processes that govern the potential of species to move and adapt when challenged by threats such as habitat degradation and climate change. With genomic data spanning six degrees of latitude along the distribution of a range-expanding damselfly (Ischnura elegans) in Sweden, I ask: how do landscape features and climatic variables limit or facilitate gene flow and adaptation? With thousands of SNP markers derived from a RAD sequencing approach of damselfly breeding populations, I test for signatures of selection in relation to environmental and morphological parameters, and examine landscape effects on gene flow. Different patterns of local adaptation are found at the range edge compared to the southern ‘core’ region and reveals patterns of adaptation during range expansion and under ongoing gene flow. This work demonstrates the value of landscape genomics for understanding evolutionary processes across diverse landscapes, where species must move and adapt to novel conditions.

Is the temperature needed to break seed dormancy altered by maternal experience?

**Ms Alice Hudson**

University of Wollongong, Wollongong, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

Alice Hudson is currently a PhD candidate at the University of Wollongong, researching maternal effects and phenotypic variation in the physical dormancy trait of the obligate seeding species Acacia suaveolens from fire prone habitats.

Maternal environmental effects can result in transgenerational phenotypic plasticity, whereby the environment the maternal plant experiences can modify the phenotype of the offspring. These interactions can influence a number of seed-related traits, which can have direct consequences on recruitment from the soil seed bank. In fire-prone ecosystems, many species rely on recruitment from the soil seed bank for population persistence. We therefore asked how the recruitment dynamics in such ecosystems might be altered if climate change modifies the maternal environment during seed production.

Acacia suaveolens plants were grown under common garden conditions from seed collected at 9 populations along two climatic gradients. Prior to flowering, plants from each population were divided into one of two temperature treatments representing current and future projected conditions. Flowering and ripening phenology, seed output and seed weights were recorded. F1 seed was tested for temperature required to break dormancy. Flowering duration, pod ripening, number of seeds per pod and seed weight were all significantly influenced by maternal environment and home population. Seed from cooler maternal conditions was more dormant than seed from warmer maternal conditions. All seeds germinated best at 80°C, but germination was higher for seed produced under cooler maternal conditions.

Climate change has the potential to alter several aspects of seed production and dormancy loss in A. suaveolens, but the effects are likely to differ between populations. These results suggest that climate change has the potential to modify the temperatures required by seeds to break dormancy through maternal environmental effects.

Do hotter and drier regions harbour adaptive variation for climate change?

**Dr Paul Rymer**

Hawkesbury Institute for the Environment, Penrith, Australia; Department of Parks and Wildlife, Bentley Delivery Centre, Australia

SYMPOSIUM: Biological adaptation along environmental and bioclimatic gradients (part 2), December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

2000 PhD University of Wollongong.
2005 Postdoctoral University of Oxford.
2007 Marie Curie IIF RBG Kew & Imperial College London.

2007 Marie Curie IIF RBG Kew & Imperial College London.

Do hotter and drier regions harbour adaptive variation for climate change?
Understanding the capacity of trees to respond to climate change is essential for the maintenance of biodiversity, forest health and productivity. In south-west Australia, climate change has increased the frequency and intensity of droughts, which has resulted in tree death and negatively affected essential ecosystem services. Adaptive land management is urgently needed to mitigate the risk of large-scale drought mortality in a rapidly changing climate.

This research utilises the natural climatic variation and diversity of plant genotypes in south-western Australia to explore the capacity of plants to adapt to climate change. Populations of Marri (Corymbia calophylla) from ‘warm’ northern and ‘cool’ southern regions incorporating wet and dry sites were grown under three different temperature regimes, reflecting the climate of origin. Plant growth, functional traits, physiology and gene expression have been intensively sampled through drought cycles to determine their sensitivity and resilience to climate change. This study tests two major hypotheses (1) Plants growing under temperature and water regimes found in their native source population will outperform plants from different climates (‘local-is-best’). (2) Populations from warm and dry climatic origins will have higher resilience to drought stress. It provides a detailed understanding of the importance of genetic adaptation and physiological tolerance for the maintenance of biodiversity.

A scientific basis for the adoption of assisted gene migration in climate change adaptation strategies to ensure drought-resilience in future forests.

Population dynamics of koalas at Mt Eccles National Park: An integrated modelling approach

**Dr David Ramsey¹, Dr Dave Forsyth¹, Dr Charles Todd¹, Dr Matt Wood²**
¹Arthur Rylah Institute, 123 Brown Street, Heidelberg, Australia, ²Australian Ecological Research Services, Portland, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**
Dr Dave Ramsey is a senior scientist at the Arthur Rylah Environmental Research Institute, where he works primarily on the population dynamics of mammals and the epidemiology of wildlife disease.

Koalas were re-introduced into Mt Eccles NP, south-west Victoria in the early 1970's. By 1996, the population had increased causing severe defoliation of the manna gum forest. In response, Parks Victoria initiated an intensive sterilisation program in 2004 involving implanting female koalas with a contraceptive hormone containing the GnRH agonist, deslorelin. In addition to the sterilisation program, koala populations were monitored annually and the condition of manna gums were also intensively monitored every two years recording data on canopy condition and tree mortality. Hence, there now exists an opportunity to examine the effectiveness of the sterilisation program not only on reducing koala numbers, but also the corresponding effects on the condition of the manna gum forest. We combined multiple sources of data including koala abundances, capture-mark-recapture data, and tree canopy condition data using an integrated population modelling (IPM) approach to make inference on the population dynamics of koalas and forest condition at Mt Eccles NP. Sterilisation effectively reduced koala reproduction and koala densities have declined significantly since the start of the sterilisation program. The koala decline has also been associated with some evidence of recovery of the manna gum forest, especially in larger trees that have been subject to heavy defoliation pressure. IPM models offer a powerful framework for integrating multiple sources of monitoring data that, when analysed jointly, can provide insights on aspects of population dynamics that cannot be estimated by any single data source alone.

Halting cane toad spread in arid Australia: closing the knowing-doing gap

**Darren Southwell¹, Dr Reid Tingley¹, Dr Michael Bode¹, Dr Emily Nicholson², Dr Ben Phillips¹**
¹School of BioSciences, The University of Melbourne, Parkville, Australia, ²School of Life and Environmental Sciences, Deakin University, Burwood, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**
Dr Reid Tingley is a Research Fellow in the ARC Centre of Excellence for Environmental Decisions (CEED) at The University of Melbourne. His research focuses on understanding and predicting how species traits and environmental change influence geographic range limits in amphibians and reptiles.

Quantitative models can inform conservation decisions, yet are often under-used by practitioners. This ‘knowing-doing’ gap can reflect poor communication by modellers and/or lack of trust in model predictions by practitioners. Here, we attempt to narrow the ‘knowing-doing’ gap that stands in front of a proposal to halt the spread of one of the worst invasive species in Australia, the cane toad (Rhinella marina). A previously published academic model of cane toad spread predicted that the invasion could be contained by managing artificial water points in a range of fixed budgets and alternative management scenarios. We found that toad spread could be contained for all of the scenarios tested and that a barrier could cost $9M over 50 years (2015 AUD). Practitioners concerns were borne out, with the most cost-effective location for a barrier being sensitive to the available budget, alternative management objectives, and whether toads can be excluded from dwellings. Active engagement with practitioners led to productive model revisions and greater confidence in model
Accounting for imperfect detection in the management of emerging exotic species

Mr Pablo Garcia-Diaz1, Assoc Prof Joshua Ross1, Dr David Ramsey2, Assoc Prof Phillip Cassey1
1University of Adelaide, Adelaide, Australia, 2Arthur Rylah Institute, Melbourne, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

Biography:

Pablo Garcia-Diaz graduated from the University of Salamanca with a Master’s degree that informed the conservation of the Iberian desman (Galaxias pyrenaicus) in the mountains of Central Spain. His current PhD studies within the Invasion Ecology Laboratory (University of Adelaide) focus on exotic vertebrate risk analysis and invasion pathway modelling.

The management of exotic animals relies on their detection. For example, it is necessary to detect a new incursion to trigger management actions, and ceasing to detect a species after conducting an eradication program is the key stage for declaring the species successfully eradicated. However, imperfect detection of animals is commonplace and adds uncertainty to environmental decision making. Hence, accounting for imperfect detection is paramount for the management of exotic species across the biosecurity continuum (from new incursion to eradication / control of established populations). Imperfect detection can be naturally handled and estimated using hierarchical statistical models. Here, we develop robust statistical hierarchical models for two case examples at the two extremes of the biosecurity continuum: the early detection of new incursions of exotic reptiles on Christmas Island and the eradication success of Red-eared slider turtles. These two case studies reveal the factors that affect detection probabilities of exotic reptiles, but also highlight the sampling effort needed to confidently declare the absence of an exotic species. We provide robust rules and guidance for environmental managers aiming to minimize the likelihood of falsely declaring an exotic species absent. It is critical to consider imperfect detection in exotic species management, and our research makes available evidence-based rules for accounting for imperfect detection of emerging exotic species in Australia.

Avoiding perverse outcomes from species introductions: ecosystem-wide modelling at Booderee National Park

Mr Christopher Baker1, Dr Eve McDonald-Madden2, Dr David Lindenmayer3, Mr Nick Dexter4, Dr Michael Bode1, Mr. Sean Maxwell2, Ms Claire Foster2, Mr Christopher MacGregor2, Ms Yi Han2, Ms Zoe Knapp4
1The University of Melbourne, Melbourne, Australia, 2The University of Queensland, Brisbane, Australia, 3Australian National University, Canberra, Australia, 4Parks Australia, Canberra, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

Biography:

Chris Baker is a PhD student at The University of Melbourne working on mathematical models to assist in invasive species eradication. He has a background in applied mathematics, and he now uses these skills to help in the management of ecological systems.

Translocations are a critical and increasingly used part of the conservation toolkit. But, they must proceed with care because any introduction will have impacts on other species in the recipient ecosystem. Broader ecosystem level impacts of an introduction gone wrong can be disastrous, but predicting them is notoriously difficult. Here, we present a novel modelling approach where we use generalised Lotka-Volterra equations to model the abundance of a large group of species to scope out possible outcomes of reintroductions in Booderee National Park. This is an iconic protected area in Australia’s south-east, which supports key populations of endangered species. The park has a history of unexpected outcomes of management actions – most notably, a feral fox control program resulted in the local extinction of an arboreal mammal, the greater glider. The large number of parameters in our model (over 400) makes it a lifetimes work to estimate each directly. Instead we use a ‘backcasting’ method, where we generate candidate parameter values at random and accept only those which re-create the past dynamics observed at Booderee. Using the acceptable parameter sets allows us to scope out possible outcomes from different species re-introductions. Between 1998 and 2005 there was a two-fold increase in the number of conservation translocations, and our project offers scientific innovation by delivering the first ecosystem-wide risk assessment approach for enabling decision-makers to make wise choices about when to translocate a species and when the risks of collateral impacts are too high.

Dynamics of a recovering Arctic bird population: importance of climate, density dependence, and site quality

Dr. Jason Bruggeman2, Mr. Ted Swem3, Professor David Andersen2, Professor Patricia Kennedy4. Ms. Debora Nigro4
2Oregon State University, Union, United States, 3University of Minnesota, St. Paul, United States, 4US Fish & Wildlife Service, Fairbanks, United States, 5US Bureau of Land Management, Fairbanks, United States

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

Biography:

Professor Patricia Kennedy is a Professor of Wildlife Biology at Oregon State University. She is on sabbatical leave in Australia for 2015. She spent 4 months at the University of Tasmania and is currently splitting her time between Environmental Science at Murdoch University and Plant Biology at University of Western Australia.
Arctic peregrine falcons (Falco peregrinus tundrius) have a limited and northern breeding distribution, including the Colville River Special Area (CRSA) in the National Petroleum Reserve-Alaska, USA. We quantified influences of climate, topography, nest productivity, prey habitat, density dependence, and interspecific competition affecting Arctic peregrines in the CRSA by applying the Dall-Madsen model to estimate abundance and vital rates of adults on nesting cliffs from 1981 through 2002. Arctic peregrine abundance increased throughout the 1980s, which spanned the population’s recovery from DDT-induced reproductive failure, until exhibiting a stationary trend in the 1990s. Apparent survival rate (i.e., emigration; death) was negatively correlated with number of adult Arctic peregrines on the cliff the previous year, suggesting effects of density-dependent population regulation. Apparent survival rate and arrival rate (i.e., immigration; recruitment) were higher during years with earlier snowmelt, milder winters, and warm summers. Arrival rate was positively correlated with previous year’s productivity and initial abundance was positively correlated with cliff height. Higher cliffs with documented higher productivity are a priority for continued protection from potential nearby development and disturbance to minimize population-level impacts. Climate change may affect Arctic peregrines in multiple ways, including through access to more snow-free nest sites and a lengthened breeding season that may increase likelihood of nest success. Our work provides insight into factors affecting a population during and after recovery, and demonstrates how the Dall-Madsen model can be used for any unmarked population with multiple years of abundance data collected through repeated surveys.

Life form explains consistent temporal trends across species: the application of dynamic factor analysis

Mr Vuong Nguyen1, Professor Glenda Wardle1
1Desert Ecology Research Group, School of Biological Sciences, University of Sydney, Sydney, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Vuong Nguyen is a recent PhD graduate of the University of Sydney, with research focusing on plant population modelling and addressing uncertainty.

Long-term survey data are best for detecting trends and guiding management decisions, however in practice, such data are scarce. Thus to improve ecological inferences an attractive option is to borrow information about population parameters from multiple data sources, including other species. If species respond similarly across space or time then it is possible to understand trajectories at the aggregate level and manage accordingly. Dynamic factor analysis (DFA) is ideal for comparing multiple time series data sets as it retains the temporal order of the observations. Importantly, by identifying if any trends over time are shared among species, the temporal dynamics of a large number of species can be simplified to fewer trends. An added advantage is that these common trends reveal the potential to share information across species that are less well sampled. Here we apply DFA models to time series data (9 years) of abundance for multiple plant species (27-30) across multiple sites (4) in arid central Australia and search for patterns related to life form. Five common trends were identified and they were strongly associated with life form. Forbs and grasses showed high levels of synchrony in response to rain events, but this was less pronounced for shrubs and subshrubs. Interestingly, these life form responses differed across sites, at large (>20km) spatial scales. We can recommend to managers that plant life form reasonably predicts temporal responses, but only for local spatial scales – offering some justification for borrowing strength to supplement data for poorly sampled species.

Population growth, control and future management of the feral ungulate assemblage of Kakadu National Park

Mr Stewart Pittard2, Professor Michael Lawes1, Dr Clive McMahon2
1Charles Darwin University, Darwin, Australia, 2Sydney Institute of Marine Science, Mosman, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Stewart Pittard is a PhD student working on the ecological impacts of feral buffalo and other ungulates in Kakadu National Park. The project is part of an ARC linkage project involving the Research Institute for the Environment and Livelihoods at CDU and Parks Australia.

Expanding populations of large feral ungulates in the Top End of the Northern Territory is a key land management issue facing the region, being both threats to native ecosystems and an important resource for local communities. Feral buffalo, horse, cattle, donkeys and pigs now roam across large areas of the north, impacting sensitive wetlands, woodlands and cultural sites. In-line with other management agencies in the region Kakadu National Park is preparing to reassess their feral ungulate populations and control strategies for the future.

This study will evaluate the population dynamics of the feral ungulate assemblage of Kakadu and model future management scenarios using population estimates and culling data collected over the past 15 years. Park-wide aerial surveys were conducted on two occasions during this period, spanning 2001/2003 and 2008/2009, with another survey to be conducted in August of this year (2015). Population estimates and growth rates will be calculated over this period and will be further analysed using newly developed spatiotemporal wildlife management models incorporating growth, control and environmental correlates. Landscape impacts captured by remotely sensed imagery over the same period will be used to add depth and provide a more accurate indicator of management effectiveness than number of animals culled.

Growth and the effect of management actions on population trends and landscape impacts will be modelled over this 15 year period and simulated into the future. Competing management strategies will be assessed in a cost-benefit analysis and recommendations for future feral ungulate management in Kakadu will be made.
A feral resource: modelling goat population dynamics and management in the South Australian rangelands

**Dr Thomas Prowse**, Dr Steven Delean, Assoc Prof Phill Cassey

1University of Adelaide, Adelaide, Australia

**SYMPOSIUM:** Linking data to wildlife management through complex ecological models (part 1), Ballroom A, December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

Dr Thomas Prowse is a post-doctoral research associate in the School of Biological Sciences at The University of Adelaide. He develops applied ecological models to inform the management of terrestrial and marine systems.

Human control of predators to defend livestock produces new problems, necessitating further wildlife control because populations of native and feral species increase. Throughout the Australian rangelands protected by the dingo fence, dingoes are intensively managed (poisoned, shot) and feral goats can proliferate in the absence of predation pressure. In South Australia, goats are a declared pest that landholders are required to control to limit their impacts on pastoral lands and native vegetation. However, mustering and selling goats for meat is profitable so there is an economic incentive to maintain goat populations. Using aerial survey data, we first show that feral goat populations have increased in the South Australian rangelands, with evidence of accelerated population growth since the breaking of the Millennium Drought. We then develop and validate models of goat population dynamics for the region that incorporate spatio-temporal data on climate, vegetation, stocking rates, herbivore density, dingo-baiting intensity, goat harvesting/culling and goat demographics. Using these models, we critically evaluate current goat control measures and their capacity to limit total grazing pressure, and we contrast the ability of different culling options to maintain goat populations below target densities.

**Incorporating Aboriginal use of plants and animals into water resource planning in Lake Eyre Basin**

**Melissa White**, Arthur Ah Chee, Marilyn Ah Chee

1Department for Environment, Water and Natural Resources, Adelaide, Australia, 2Chair of Irwanya Aboriginal Corporation, Adelaide, Australia

**SYMPOSIUM:** Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

Melissa White has lived and worked in South Australia for the last 10 years, with a focus on aquatic ecosystems in the arid areas.

A desktop study was undertaken in 2014 using literature and heritage databases as a tool to identify Aboriginal, pastoral and social values in the Lake Eyre Basin Rivers Monitoring project. Most commonly sites associated with or identified as an aquatic ecosystem e.g. waterholes, springs, lakes etc. were collectively ‘valued’ due to their importance as conservation, tourism, recreational, pastoral and heritage sites. The desktop study also explored a way of using Indigenous resource-use of plants and animals as food, medicine, artefacts etc. as a way of identifying another aspect of Aboriginal values. Using the 112 plants and 56 animals identified in the desktop study as being associated with aquatic ecosystems and are used as an Indigenous resource in the region, in 2015 we have undertaken a case-study with the Irwanya Aboriginal Corporation who co-managed Witjira National Park in South Australia. Working with the Lower Southern Arrernte and Wangkangurru people, the objective of the 2015 case-study is to propose a method to integrate cultural knowledge and value of plants and animals into water resource planning and Aboriginal planning and management of Witjira National Park.

**Birriliburu Indigenous Protected Area: Cross-cultural conservation in a desert landscape**

**Lena Long**, Rita Cutter, Dr Vanessa Westcott

1Bush Heritage Australia, Geraldton, Australia, 2Central Desert Land and Community, Perth, Australia, 3Mungarlu Ngurraranjatja Rirraunkaja (Aboriginal Corporation), Wiluna, Australia

**SYMPOSIUM:** Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

**Biography:**

Lena Long and Rita Cutter are senior Birriliburu traditional owners. They have played a leading role in the development of the Birriliburu Ranger Program. Vanessa Westcott is the Regional Ecologist at Bush Heritage Australia based in Geraldton. She has a PhD in fire/plant ecology from the University of Adelaide. The Birriliburu Indigenous Protected Area (IPA), home of the Martu people, consists of 6.6 million hectares of desert country north of Wiluna in Western Australia.

The Birriliburu Ranger Program has been established in response to the IPA Plan for Country prepared by traditional owners. The rangers undertake a wide variety of tasks including land management, ecological monitoring, tourism management, infrastructure maintenance, cultural heritage management and knowledge transfer.

Bush Heritage Australia has formed a partnership with traditional owners to further develop the ecological component of the Program. Through cross-cultural collaboration, using traditional ecological knowledge and western science, the rangers now undertake a variety of best-practice conservation activities across the IPA.

Fire (Waru): Using fire scar mapping and careful planning the rangers burn areas within prescribed priority fire management areas with the aim to maintain a mosaic of fuel ages and protect fire-sensitive areas (cultural or ecological).

Bilbies (Muntulnaku): The rangers have expert knowledge of bilby habitat and behaviour and undertake regular monitoring of burrow systems.

Marsupial Moles (Kakarratul): The rangers have learned new skills in monitoring of moles using a series of trenches and measuring mole holes.
Working with Rangers surveying the Monsoon Vine Thickets of Bunuba limestone country

Dr Stephen Reynolds1, Dr Malcolm Lindsay1, Ms Ilse Pickerd2, Ms Kylie Weatherall1, Bunuba Rangers2

1Enviros Kimberley, Broome, Australia, 2Bunuba Rangers, Fitzroy Crossing, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Dr Steve Reynolds completed his Zoology degree at UWA and then worked as an ecological consultant conducting vertebrate fauna surveys. He moved to Darwin and completed his doctorate on the ecology and water relations of frogs. He is now a member of the Kimberley Nature Project working with Rangers managing issues on country.

Bunuba Rangers and Enviros Kimberley have been working together on weed control, locating populations of the Endangered western subspecies of the Purple-crowned Fairy-wren (Malurus coronatus coronatus), and surveying Monsoon Vine Thickets (MVTs) of the limestone ranges in Bunuba country, central Kimberley. We surveyed the floristics, extent and environmental issues (primarily fire, cattle, and weeds) associated with MVT patches in the Napier and Oscar Ranges, a declared Priority 1 Ecological Community (PEC) in Western Australia. Following aerial photo mapping of potential patches we visited 28 sites and prepared PEC forms for the Department of Parks and Wildlife (WA) for 15 sites. Patches existed above scree slopes at the base of cliffs, amongst rock caverns, ravines and behind large boulders in limestone labyrinths, and in minor valleys in association with drainage lines. Approximately 58 MVT plant species were recorded, including trees and shrubs (30 spp.), herbs (12 spp.) and numerous vines (16 spp.). Plants were designated as vine thicket species (58 spp.), riparian (16 spp.), or associated species on limestone substrates (c. 50 spp.). At times this categorisation was not clear; various edaphic, topographic, landform and fire-related factors, in addition to historical considerations, may determine local species distribution. There was a change in species composition from north to south (following a rainfall gradient), and some species are at the limit of their distribution in the area. We also encountered cultural sites and caves, and collaborative work on this and other projects continues in Bunuba country.

Managing and monitoring Bardi Jawi traditional oola (water) places from a cultural perspective

Michelle Walker1, Bardi Jawi Oorany Rangers2; Dr Julian Clifton1, Dr Paul Close2, Rebecca Dobbs3, Prof Sandy Toussaint3,4

1School of Earth and Environment, University of Western Australia, Crawley, Australia, 2Bardi Jawi Oorany Rangers, Kimberley Land Council, Ardyaloon (One Arm Point), Australia, 3Centre of Excellence in Natural Resource Management, The University of Western Australia, Albany, Australia, 4School of Social Sciences, The University of Western Australia, Crawley, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Michelle Walker is a PhD candidate of the University of Western Australia, based at One Arm Point (Ardyaloon) community on the Dampier Peninsula, Western Australia. The Bardi Jawi Oorany Rangers are an Indigenous women’s ranger group supported by the Kimberley Land Council, who work to maintain Bardi Jawi country.

Bardi and Jawi people of the Dampier Peninsula, Kimberley region of Western Australia, collectively known as Bardi Jawi, recognise, value and use a variety of freshwater sources, known as traditional “oola” (water) places. This research explores how to develop management priorities and monitoring protocols for traditional oola places in a way that is based in Bardi Jawi cultural perspectives. The research approach is a collaboration between the researcher (PhD student) and the Bardi Jawi Ranger group, in particular the Bardi Jawi Oorany Rangers (women rangers). The first stage of the research involved documenting Bardi Jawi perspectives about traditional oola places. We conducted semi-structured interviews of Bardi Jawi elders and custodians, often at the site of traditional oola places, to investigate why these places are important, whether their condition has changed and why, and how they can be maintained. The second stage of the research asked Bardi Jawi elders and custodians to evaluate the health or condition of key oola place characteristics or values. This collaborative process helped to identify, from a Bardi Jawi perspective, which traditional oola place characteristics are in most need of management intervention. The research findings suggest that management and monitoring to maintain or restore traditional oola places requires a combination of conventional ecological techniques and methods that draw upon Bardi Jawi knowledge and practice. Some examples will be presented that exemplify differences and similarities between Bardi Jawi and conventional ecological management and monitoring aspirations for freshwater ecosystems.

Nyul Nyul knowledge and conventional science: two models of freshwater ecosystems on Nyul Nyul country

Michelle Walker1, Nyul Nyul Rangers2; Dr Julian Clifton1, Dr Paul Close2, Rebecca Dobbs3, Prof Sandy Toussaint3,4

1School of Earth and Environment, University of Western Australia, Crawley, Australia, 2Nyul Nyul Rangers, Kimberley Land Council, Beagle Bay, Australia, 3Centre of Excellence in Natural Resource Management, The University of Western Australia, Albany, Australia, 4School of Social Sciences, The University of Western Australia, Crawley, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
The Nyul Nyul Rangers are an Indigenous ranger group, supported by the Kimberley Land Council, who work to maintain Nyul Nyul country. The Rangers have a diverse work plan to manage hundreds of kilometres of beach and inland areas, including freshwater springs on the Dampier Peninsula.

Nyul Nyul people of the Dampier Peninsula, Kimberley region of Western Australia, have a strong association with fresh water sources on their traditional land. The Nyul Nyul Rangers have initiated and actively participated in several research projects aimed at investigating these freshwater sources and ecosystems. One project used scientific water monitoring techniques, in combination with Nyul Nyul knowledge, to better understand the ecology of key freshwater ecosystems. The second used social science techniques to investigate in more depth the Nyul Nyul knowledge, values and practices associated with freshwater sources. The Nyul Nyul Rangers and a PhD candidate, who has been involved in both projects, have applied research findings to create two models of freshwater ecosystems that demonstrate associated values and management aspirations. One model draws on diverse perspectives from young and old members of the Nyul Nyul community. The other model draws on conventional scientific, conservation and natural resource management frameworks. The two models help to clarify where differences and similarities exist between Nyul Nyul and conventional approaches to protecting and managing freshwater sources and ecosystems. The two models also help to identify the context within which the Rangers may wish to apply Nyul Nyul or conventional natural resource management approaches, or a combination of both, to achieve particular objectives. Representatives of the Nyul Nyul Rangers will discuss the different models and how they draw on both to inform their own activities to monitor and protect freshwater and associated values.

Applying pre-regulation hydrographic modelling to inform Indigenous-led management of the Sugar Shack Wetland Complex.

Mr Lachlan Sutherland1, Ms Isobelle Campbell2

1Department of Environment, Water and Natural Resources, Adelaide, Australia, 2Mannum Aboriginal Community Association Incorporated, Mannum, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Ben Taylor is a senior ecologist in the Department of Environment, Water and Natural Resources with extensive wetland ecological experience. Isobelle Campbell is a senior Ngarrindjeri custodian of the mid-Murray region and chair of the Mannum Aboriginal Community Association Incorporated. MACAI is a founding member of the Ngarrindjeri Regional Authority.

Sugar Shack Wetland Complex is a culturally and ecologically important floodplain on the lower River Murray. The Aboriginal owned floodplain is managed by Mannum Aboriginal Community Association (MACAI), and features four wetlands permanently inundated due to river regulation and artificially lowered sills, one of which is currently managed via a regulator.

Nominated for management under the Riverine Recovery Project (RRP), MACAI’s overarching management vision is that conditions should, as closely as possible, resemble those experienced by their ancestors.

The Robinson hydrographic model that hindcasts daily river stage for the period 1895 to 2009 under unregulated conditions was used to set target hydrographs for wetlands in the complex. The model outputs, 114 years of records of wetland connection events, have been incorporated into the MACAI-led wetland management plan for the complex, including a five year target hydrograph for each wetland in the complex. To improve its utility, we added new outputs to the Robinson model so as to exclude atypically long (major floods) and short (brief rises in river stage) connection events from the calculation of connection event percentiles.

MACAI propose to apply the target hydrographs to all managed wetlands in synchrony. Permanent, unmanaged waterbodies in the complex will provide refuge habitat for aquatic biota when managed wetlands are dry. The inclusion of two dry years within a five year period is a greater than natural frequency but is proposed for management of Common Carp. The health and wellbeing of the Ngarrindjeri is anticipated to improve in response to proposed management.

Changes in Fire Regimes through Warlpiri and Gurindji Fire Management in the Tanami Desert

Clayton Namatjira1, Josephine Grant1, Ben Kaethner1

1Central Land Council, NT

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (1), Balcony Rooms 1-2, December 1, 2015, 1:30 PM - 3:30 PM

Biography:
Clayton and Josephine work as senior Mutu-Warinyi-Ankkl Rangers for the Central Land Council in Tennant Creek. Fire management is a large part of their work, and they perform the important role of working in both contemporary and traditional contexts.

Fire management in the Warlpiri and Gurindji country of the Tanami Desert is characterised large, inaccessible fire-prone landscapes. Since 2008, Traditional Owners and Rangers employed by the Central Land Council have built a unique program in the region that has extended fire management to the most remote areas. By focussing on areas of biological and cultural significance, a landscape that was largely unmanaged for the last 60 years is now regularly burned by the Traditional Owners. As an example, the Hanson River region of the eastern Tanami is a site of conservation significance that has been subject to annual aerial prescribed burning since 2009. The fire management planning for the area has...
been done by Traditional Owners with consideration given to conservation and contemporary fire management techniques and. The deliberate application of fire to the landscape during the cooler months has altered the fire regime from one of large, hot summer bushfires to one of smaller fires occurring throughout the year. Tanami Desert fire management is aimed at achieving the widely-held goal of a spatially and temporally heterogeneous, or ‘traditional’ fire regime through a combination of traditional and contemporary knowledge and practice. It is unclear, however, whether the recently-altered fire regime in the Tanami has improved biodiversity conservation. Further work is needed to determine the conservation benefits of this strategy.

Itinerant species are better dispersers than residents, but dispersal traits poorly reflect effective dispersal

Dr Jill Lancaster1, Prof Barb Downes1
1University of Melbourne, Parkville, Australia

Knowing how far and how often organisms disperse is necessary to answer many ecological questions. Quantifying dispersal is difficult for many organisms so, instead, proxy ecological traits that reflect dispersal potential are often used. Whether such traits reflect actual dispersal often lacks empirical support: many individuals may not achieve maximum dispersal distances and many dispersal events may be unsuccessful (dispersal without subsequent recruitment). For insects, many habitat patches harbour ‘resident’ species that are present as both larvae (largely sedentary) and adults (winged and dispersing), and ‘itinerant’ species present only as adults that have dispersed from distant locations and fail to reproduce. We hypothesize that itinerant species are better dispersers than residents and test whether species in these two groups differ in wing morphology, which is strongly associated with flight performance. Over three years and at multiple locations in Hughes Creek, Victoria, we sampled larvae and adults of caddisflies in a single genus, Ecnomus, to classify species as residents or itinerants, and to test for differences in wing morphology. On average, itinerant species were more similar to residents than have traits associated with a capacity for long-distance dispersal. Itinerant species were larger than residents (wing area and length). Wing shape differed between species, but the magnitude of these differences was small and did not differ systematically between residents and itinerants. For this genus, wing morphology is associated with actual dispersal of some individuals, but not effective dispersal (dispersal and reproduction). Morphological traits may thus be a poor proxy for actual dispersal.

Group-living on the rocks: thermal consequences of habitat use of a subsocial huntsman spider

Ms Francesca van den Berg1, Mr Jacob Hurst2, Dr Linda Rayor3
1School of Biological Sciences, The University of Sydney, Sydney, Australia, 2Plant Science Department, California State University, Fresno, USA, 3Department of Entomology, Cornell University, Ithaca, USA

Knowing how far and how often organisms disperse is necessary to answer many ecological questions. Quantifying dispersal is difficult for many organisms so, instead, proxy ecological traits that reflect dispersal potential are often used. Whether such traits reflect actual dispersal often lacks empirical support: many individuals may not achieve maximum dispersal distances and many dispersal events may be unsuccessful (dispersal without subsequent recruitment). For insects, many habitat patches harbour ‘resident’ species that are present as both larvae (largely sedentary) and adults (winged and dispersing), and ‘itinerant’ species present only as adults that have dispersed from distant locations and fail to reproduce. We hypothesize that itinerant species are better dispersers than residents and test whether species in these two groups differ in wing morphology, which is strongly associated with flight performance. Over three years and at multiple locations in Hughes Creek, Victoria, we sampled larvae and adults of caddisflies in a single genus, Ecnomus, to classify species as residents or itinerants, and to test for differences in wing morphology. On average, itinerant species were more similar to residents than have traits associated with a capacity for long-distance dispersal. Itinerant species were larger than residents (wing area and length). Wing shape differed between species, but the magnitude of these differences was small and did not differ systematically between residents and itinerants. For this genus, wing morphology is associated with actual dispersal of some individuals, but not effective dispersal (dispersal and reproduction). Morphological traits may thus be a poor proxy for actual dispersal.

Prescribed burning decreases den site habitat of the yellow-footed Antechinus

Mrs Anna Flanagan-Moodie1, Dr Greg Holland2, Prof Michael Clarke2, Prof Andrew Bennett2
1Deakin University, Burwood, Australia, 2La Trobe University, Bundoora, Australia

Biography:
Anna Flanagan-Moodie is undertaking a PhD at Deakin University, Melbourne. She is particularly interested in fire ecology and management having worked as a firefighter and forest manager prior to undertaking a PhD.
Large trees and logs are essential for the persistence of many species of small mammal but may be threatened by regular prescribed burning. Here, we studied the use of den sites by a small-marupial, the yellow-footed antechinus Antechinus flavipes, during prescribed burning of a box-ironbark forest in central Victoria. To measure changes in habitat use before and after burning, we used radio telemetry to observe habitat selection for den sites by ten individuals of A. flavipes and measured habitat variables in 24 plots across two burn areas (each ~100 ha). Dermal locations of A. flavipes were frequent in large trees (>60 cm diameter), large logs (>40 cm diameter) and dead trees; yet these features were rare in the forest. Dermal den sites were reduced by patchy prescribed burns (<50% burn cover), with 48% of known den logs and 17% of den trees no longer present after these autumn burns. Slow growth rates (large trees >120 years old) and limited numbers of falling limbs and trees indicate lengthy replacement times for these habitat features. Regular prescribed burns (<20 years) are likely to deplete den site habitat features at a greater rate than their natural replacement and therefore indirectly affect the long-term status of A. flavipes. From these findings, we make recommendations relating to the frequency of burning in box-ironbark forests and highlight areas for further research relating to seasonal burning.

Hot, hotter, too hot: thermoregulatory behaviour and microhabitat use of military dragons (Ctenophorus isolepis)

Ms Eveline Rijksen, Prof Christopher Dickman, Dr Mathew Crowther
School of Biological Sciences, University of Sydney, University of Sydney, Australia

Biography:
Eveline Rijksen is a PhD student at the Desert Ecology Research Group at University of Sydney. Her current research investigates the effect of predation on the behaviour and habitat use of desert agamids. She is particularly interested in whether predation pressure can drive behavioural divergence.

Most studies predicting large-scale patterns in the thermal tolerance of ectotherms use air temperature, often mean annual or seasonal, measured at a height of 1-2m, to index thermal environment. These temperatures are readily available but poorly reflect the environmental conditions experienced by individual ectotherms, especially in variable climates. We measured temperature of individual components in the micro-habitat of the spinifex covered sand-dunes of the Simpson Desert. Especially temperatures in exposed habitats far exceeded the physiological thermal limits of most ectotherms. They must therefore rely on behaviour to avoid overheating during the warmest times of the day. Using temperature sensitive VHF transmitters, we recorded animal temperature and constructed a fine-scale overview of micro-habitat use of military dragons (Ctenophorus isolepis), on both a temporal and spatial scale. We show that military dragons do not have sufficient physiological tolerance to survive in open habitat and rely on behavioural shifts to exploit local habitat heterogeneity to reduce their body temperature. Shaded areas and burrows are essential in providing refugia from extreme heat. Using maximum or mean air temperature simplifies the reality of the thermal conditions experienced by terrestrial ectotherms and underestimates the importance of behavioural thermoregulation, including the importance of refugia for survival.

Herbivore release drives predictable evolutionary divergence patterns in invasive plant phenotypes

Dr Akane Uesugi, Dr. Andre Kessler
School of Biological Sciences, University of Sydney, Australia

Biography:
Dr Akane Uesugi is a postdoctoral researcher in chemical ecology and invasion biology at the School of Biological Sciences, Monash University. He has previously worked as a postdoc at Cornell University studying plant-herbivore interaction. Dr Uesugi received his PhD from the University of Michigan.

Herbivory can drive rapid evolution of plant defensive and competitive traits. At a geographic scale, invasive plant populations that escape selection from their ancestral herbivores may evolve decreased defense and increased competitiveness. While contrasts between native and invasive populations lend support to this hypothesis, such experiments cannot establish causal links between herbivory and evolved invasive phenotypes. Here, we conducted native-invasive contrasts, and coupled these with long-term selection experiments that directly test for evolutionary responses to herbivore-exclusion. In common gardens, we contrasted Solidago altissima genotypes that were historically exposed or protected from herbivory across two experimental timescales: 1) a 12-year manipulative experiment where herbivores were removed with insecticides, and 2) a natural experiment where a plant population evolved without herbivory for ~100 years. In both experiments, plant populations responded to herbivore-release by evolving increased inter-specific competitive ability against Poa pratensis, possibly mediated by increased production of root allelochemicals. We also observed parallel shifts in leaf secondary metabolite and protease inhibitor production, which may confer resistance to diverse herbivore species. Observed evolutionary convergence for multiple plant traits, between the natural and manipulative experiments, emphasises the role of insect herbivores as key drivers of plant adaptation and geographic differentiation.

Consistent behaviour of intertidal scavengers: the forgotten foraging strategy?

Prof Peter Fairweather
Flinders University, GPO Box 2100 Adelaide, Australia

Biography:
Prof Peter Fairweather is a marine ecologist with a particular interest in intertidal spiders, algae, and corals. His research focuses on understanding the ecological and evolutionary consequences of interactions between marine invertebrates and microorganisms. Dr Fairweather received his PhD from the University of Melbourne.
Biography:

Professor Peter Fairweather has been studying various aquatic ecosystems since the 1980s and is most interested in ecological processes and how they interact with human activities. He was ESA President 2005-7.

Ecological texts are full of cases of predators, herbivores or filter-feeders, and yet the consumption of freshly-dead animal carcasses is less often studied. This consumption of carrion, termed scavenging or necrophagy, is nevertheless widespread across animal taxa. Indeed some human activities, like dead-bait angling, rely upon opportunistic scavenging by taxa that are nominally in other feeding groups. In intertidal marine waters of southern Australia, there is a guild of species that seem to be dedicated to scavenging as a way of feeding rather than being facultative. Study of these gastropods and crustaceans has revealed many characteristics of scavenging as a foraging strategy. A series of sampling and experiments has revealed: a consistent response to carrion; quite low background levels of apparent density and activity alternating with frenzied but short periods of approaching and feeding upon carrion, once it is made available and perceived via long-distance chemoreception; once fed to satiation most of these snails and crabs withdraw from the carrion, often burying, and can stay inactive for periods up to months while they digest their meal; responses to carrion are attenuated after feeding but gradually return over days to weeks; and the unpredictable arrival of carrion into the intertidal pools where these scavengers rest is fully utilised. In many ways, this is the ultimate sit-&-wait foraging strategy, akin to many site-attached spiders, but is very effective at handling bulk carrion that arrives due to catastrophic events like summer-heat die-offs or mass strandings onshore of floating animals like salps or jellyfish.

Speciation and adaptation of the green ashes in the Greater Blue Mountains World Heritage Area

Ms Susan Rutherford1,2, Associate Professor Stephen Bonser1, Dr Maurizio Rossetto2, Dr Peter Wilson2
1University of New South Wales, Sydney, Australia, 2National Herbarium of New South Wales, Royal Botanic Gardens Sydney, Sydney, Australia

Biography:

Susan Rutherford is a PhD candidate at UNSW and is working on a joint project between UNSW and the Royal Botanic Gardens Sydney. Her research focuses on the use of recent advances in molecular techniques in combination with distributional, morphological and ecological data to better understand plant evolution.

The Greater Blue Mountains World Heritage Area is a centre for eucalypt diversity (c. 100 species). Many different eucalypts are represented and one group is the ‘green ashes’. The green ashes are found in SE Australia, with some species occurring in tall, fertile mountain forests and others as mallees on sandstone. The group includes Eucalyptus regnans (tallest flowering plant in the world); the timber species, E. obliqua, and the rare mallee, E. cunninghamii. Previous studies, primarily based on morphology, suggest the green ashes form a monophyletic group. However there has been disagreement concerning the divergence and differentiation of taxa. We used phylogenetic and population genetic analyses based on Diversity Arrays Technology (DArT) to reconstruct the evolutionary history of the species relations. A glasshouse experiment was then conducted to investigate how seedling response to variable resource availability is associated with evolutionary events across species. Twelve taxa were selected from different habitats and growth forms. Seedlings were exposed to high and low nutrient and water availability in a factorial experiment. We found the green ashes represent a group with multiple evolutionary shifts from an ancestral habitat (trees in mid-mountain, sandy soils) to trees in tall open forests on basalt substrates, and mallees in shrublands and woodlands on low nutrients. These evolutionary shifts had significant effects on seedling growth and plasticity. Overall, our results demonstrate important relationships between the diversification of an iconic Australian group, and how major evolutionary shifts impact the capacity for seedlings to adapt to new and variable environments.

The development of fertile islands under the small clonal tree Alectryon oleifolius.

Dr Graeme Hastwell1, Dr Jose M. Facelli2
1Independent consultant, Adelaide, 2Dept. Ecology & Environmental Science, University of Adelaide, Adelaide

Biography:

Dr Graeme Hastwell is an independent consulting ecologist and data analyst. Plant-plant and plant-soil interactions, and the ability of plants to locally modify abiotic conditions, continue to fascinate him.

The existence of fertile islands - areas of soil with elevated nutrient levels that occur below the canopies of long-lived woody plants - has been widely reported from arid and semi-arid ecosystems. Several mechanisms have been proposed to explain the development of fertile islands; these include erosion of inter-canopy spaces, physical capture of water- or wind-transported detritus by plant canopies, and biotic concentration and cycling of nutrients by long-lived plants. We conducted a detailed survey of a chronosequence of Alectryon oleifolius trees to examine the relationships between canopy dimensions, below-canopy shrub cover, leaf litter accumulation, and soil resources (as organic carbon) at Koonamore Station in the pastoral zone of South Australia. There was little indication of fertile island development under small Alectryon canopies, but below-canopy shrub cover, leaf litter density and soil organic carbon levels all increased with canopy size once canopy height exceeded approximately 3.5 m. However, there was evidence of a decoupling of the relationship between shrub cover and leaf litter density when canopy height approached 5 m. These results imply that soil nutrient accumulation in fertile islands may be affected by shrub-leaf litter interactions, and that patch dynamics in this ecosystem may oscillate between high and very low shrub cover at multi-decadal timescales, with corresponding pulses in nutrient accumulation.
Multiple stressor effects: non-additive effects of nutrient enrichment and physical disturbance on estuarine meiobenthos.

Mrs Ramila Furtado1, Mr Joseph Kenworthy1, Dr. Melanie Bishop1
1Department of Biological Sciences, Faculty of Science and Engineering, Macquarie University, NSW 2109, NORTH RYDE - 2109, Australia

Biography:
Ramila Furtado, lecturer and researcher, originally from India. Currently aspiring to be an aquatic ecologist, a Phd student at Macquarie University investigating coastal and estuarine benthos.

Environmental stressors rarely occur singularly in nature, but the majority of ecological studies have investigated their impacts in isolation of one another. This is problematic because the effects of multiple stressors cannot necessarily be predicted from the effects of singular stressors: when combined, stressors may have additive, subtractive or synergistic effects. In estuarine ecosystems, among the most prevalent stressors are nutrient enrichment from diffuse and point sources and physical disturbance of sediments from activities such as bait digging, propeller scarring and storm events. The effects of such disturbances on larger organisms have been studied but little is known about their singular and combined effects on meiofaunal communities (<500 micron to >45 micron organisms), which are omnipresent in estuarine sediments, playing crucial roles in nutrient cycling and in transferring nutrients and energy to higher trophic levels. Experimental manipulations examining the independent and interactive effects of various levels of nutrient enrichment and physical disturbance on meiofaunal communities were conducted in two estuaries of NSW, Australia. At neither site was there an effect of either nutrient or physical disturbance alone on meiofaunal communities. Instead, there were weak site-specific interactive effects of the two stressors when applied together. The results indicate not only that effects of multiple stressors are complex and cannot be inferred from the effects of individual stressors, but also that effects of stressors are highly context-specific. Experiments are now needed that disentangle how aspects of the biotic and abiotic setting influence stressor impacts.

Ant responses to cattle grazing in tropical savannas of northern Australia

Ms Gabriela Burle Arcoverde1,2, Dr Alan Andersen2, Dr Samantha Setterfield1
1Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, Australia, 2CSIRO Tropical Ecosystems Research Centre, Darwin, Australia

Biography:
Gabriela Burle Arcoverde is a Charles Darwin University PhD student based at CSIRO in Darwin, working on responses of ant communities to grazing along rainfall gradients in Australia and Brazil. She completed her Masters in Brazil on the impact of disturbance in ant-plant interactions.

Globally, grazing is one of the most widespread forms of disturbance, and it is especially important in tropical savannas. High levels of grazing can markedly change vegetation structure, biotic composition, and ecosystem structure and function. Ants have been widely used as bioindicators of the ecological impacts of grazing, and in a recent review four general ant response patterns were identified: (1) soil and vegetation type have a far bigger impact on ant community composition than does grazing; (2) grazing modifies species composition but often not total ant richness and abundance; (3) a species’ response often varies between habitats; and (4) between 25-50% of the species that can be statistically analysed are significantly affected by grazing. Here we test the extent to which these patterns hold at two stations in different rainfall zones in Australia, Lakefield (1000 mm mean annual rainfall) and Henbury Station (280 mm mean annual rainfall). We used cross-fence comparisons of areas of different grazing intensities in the higher rainfall zone, and distance from water source as a surrogate for grazing pressure in the lower rainfall zone. In each station we covered two land systems. Ant community composition differed markedly between land systems, but ant communities were highly resilient in relation to grazing in both rainfall zones, with <17% of species that could be statistically analysed being significantly affected. Such high resilience may be explained by the evolutionary history of the Australian savanna ant fauna, which, unlike other savanna ant faunas, is dominated by arid-adapted taxa.

Movement patterns and resource selection of swamp wallabies (Wallabia bicolor) in a fragmented landscape

Ms Manuela Fischer1,2, Dr Duncan Sutherland2, Associate Professor Graeme Coulson1, Dr Julian Di Stefano1
1University of Melbourne, Melbourne, Australia, 2Phillip Island Nature Parks, Summetlands, Australia

Biography:
Before I came to Australia, I have been studying carnivores in Germany, Borneo and Africa. With a high interest in spatial ecology and human-wildlife conflict I am now investigating the spatial ecology, foraging effect and human-wildlife interactions of an abundant swamp wallabies population in human-modified landscapes.

Broad-scale habitat fragmentation is a visible result of human land-use throughout the world, often resulting in deleterious ecological outcomes. The ability of fauna to persist in fragmented landscapes is influenced by their capacity to move and access important resources such as food, water and
shelter. When resources are depleted and spatially heterogeneous, identifying high quality habitat patches and understanding how individuals move between them is critical for effective faunal conservation and management.

Phillip Island is a highly modified and fragmented landscape that contains patches of native vegetation amongst a matrix of pasture and urban developments. The island supports an abundant population of swamp wallabies (Wallabia bicolor), but little is known about how individuals move through this landscape. We present a high-resolution dataset of swamp wallaby movements to determine the habitat characteristics that impede or promote movement. Customised GPS wildlife trackers have recorded location data at 15 minute intervals which enable modelling of how wallabies move both within and between landscape features such as vegetation patches, linear strips, pasture and potential boundaries such as roads and fences. We highlight features that facilitate movement and others that represent movement barriers and identify resource selection in different habitat types. Information about movement patterns and resource selection generated by the analysis will inform and improve the conservation of swamp wallabies in human-modified and fragmented landscapes by implementing effective management actions and more generally enhance our understanding of the challenges faced by fauna in changing environments worldwide.

Floods and famine: climate-induced collapse of a tropical predator-prey community

Prof Thomas Madsen1,2,3, DR Beata Ujvari2
1University Of Wollongong, Wollongong, Australia, 2University of Sydney, Sydney, Australia, 3Deakin University, Geelong, Australia

Biography:
Impact of climate change on predator-prey demography. Evolutionary and population demographic effects of invasive toxic exotic prey on native naive predator populations. Population and conservation genetics. The evolutionary significance of female multiple matings. Host-parasite interactions, immunocompetence and immunosenescence

1. Will climate change threaten wildlife populations by gradual shifts in mean conditions, or by increased frequency of extreme weather events?
2. Based on long-term data (from 1991 to 2014), the aim of the present study was to analyze and compare the sensitivity of predator-prey demography to extreme climatic events versus normal, albeit highly variable, annual deviations in climatic conditions in the Australian wet-dry tropics.
3. From 1991 to 2005, predators (water pythons, Liasis fuscus) and their main prey (dusky rats, Rattus colletti) showed significant climate-driven fluctuations in numbers.
4. These fluctuations were, however, trivial compared to the impact of two massive but brief deluges in 2007 and 2011, which virtually eliminated the dusky rats. The two floods resulted in the pythons experiencing an unprecedented famine in 7 out of the last 8 years causing a massive shift in python demography i.e. a significant reduction in feeding rates, reproductive output, growth rates, relative body mass, survival, mean body length and numbers (from 3173 in 1992 to 96 in 2013).
5. Our results demonstrate that attempts to predict faunal responses to climate change, even if based on long-term studies, may be doomed to failure. Consequently, biologists may need to confront the uncomfortable truth that increased frequency of brief unpredictable bouts of extreme weather can influence populations far more than gradual deviations in mean climatic conditions.

Microclimate buffering in mallee tree holes

Mr Christopher O’Connell1, Dr Gunmar Keppel
1University of South Australia, Mawson Lakes, Australia

Biography:
Chris O’Connell completed Honours in sustainable environments in 2013. His research interests include bats, microclimates and reptiles.

Approximately 15% of native Australian fauna make use of, or rely upon, tree holes; using them for multiple purposes including roosting, protection, rearing young and foraging. Mallee are species of Eucalyptus which are characterised by reduced growth height (8-10 m maximum), multiple stems and a subterranean swelling, called a lignotuber. In order to determine the extent to which mallee holes can mitigate ambient climatic conditions, we recorded the temperature and humidity within four tree holes at 10 cm depth intervals over a period of 27 days. We found that tree holes provided the most significant buffering at higher temperatures, the maximum difference between ambient and internal conditions exceeded 15°C. Similarly, tree holes provided warmer conditions during the night (2-3°C mean). Humidity values were also more stable within the tree holes. Our findings highlight the importance of tree holes as mitigators of extreme weather conditions; which will become even more significant in the future with projected anthropogenic climate change resulting in an increase in the frequency and severity of high temperature days.

Fine-scale variability in vegetation structure determines habitat quality for a threatened bird in Fleurieu Swamps

Mr Tim Fearon1, Assoc Prof David Paton1, Ms Rebecca Duffield2,3, Mr Marcus Pickett3
1The University of Adelaide, Adelaide, Australia, 2The Conservation Council of SA, Adelaide, Australia

Biography:
Disturbances (3), Suite 3, December 1, 2015, 4:00 PM - 5:30 PM
Fleurieu Swamps are highly dynamic wetland vegetation communities home to a number of unique and threatened flora and fauna. Processes such as disturbance and succession occur at multiple scales within swamp patches, producing complex mosaics of vegetation sub-associations within a single swamp patch. Disturbances regimes maintain complexity within a patch, leading to high intrinsic floristic and structural diversity. Consequently, changes to disturbance regimes lead to lower patch-scale structural and floristic diversity and reduced overall productivity, with consequences for resident fauna with specific habitat requirements.

The fine-scale habitat use of the Mount Lofty Ranges Southern Emu-wren Stipiturus malachurus intermedius was studied to investigate spatio-temporal variability in habitat quality within a swamp patch containing several age-class vegetation sub-associations. It was found the habitat use was highest at the interface between mid to late successional age-class units, where structural and floristic diversity was highest. Areas of lower use were found to correspond to either; a) early successional vegetation, b) late-successional monotypic vegetation, and c) mid-successional vegetation with low vertical density from 0 – 1 m. Despite being suspected to be the main driver of habitat use, invertebrate prey abundance was not shown to differ significantly between areas of low and high use, suggesting that fine-scale variation in vegetation structure is the key driver of habitat quality for S. m. intermedius in Fleurieu Swamp habitat.

Combined with controlled disturbances, this study may help guide future management of swamps to achieve maximum biodiversity outcomes for both flora and fauna.

**Mapping areas of dieback in critically endangered wetlands of Fleurieu Peninsula, South Australia**

**Dr Dorothy Turner**, Dr Victoria Marshall, Dr Bertram Ostendorf, Dr Megan Lewis

1The University of Adelaide, Adelaide, Australia

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

Biography:

Dr Dorothy Turner is a Research Fellow at the University of Adelaide in the School of Biological Sciences. She specialises in remote sensing and GIS analysis, spatial simulation modelling and spatial decision support for natural resources management. Her research includes fire regimes in desert Australia, wetlands and vegetation condition monitoring.

The densely vegetated Fleurieu Peninsula Swamps south of Adelaide are listed nationally as critically endangered. They are key elements in landscape function, providing ecosystem services and supporting a range of threatened species.

A rapid and progressive dieback of swamp vegetation has been observed in a number of these wetlands, but the causes are unknown. An overview of the extent of dieback across the entire region will be critical to improving our understanding of the aetiology of this phenomenon, its potential impacts, and management implications.

We used Landsat satellite imagery (30 metre resolution, 1988-2015) and spatial analysis to investigate historical patterns and trends in swamp dynamics. Observed changes in NDVI (an index of ‘greenness’) are largely due to spatio-temporal differences in the pattern of annual rainfall of the preceding year. Of particular interest however, are individual wetlands showing declining NDVI trends over a number of consecutive years, sometimes contrasting with neighbouring wetlands. From this, we recommend several wetlands for further investigation.

Despite the dendritic geometry of the wetlands, (with many wetlands only one to two Landsat pixels wide), results showed potential to detect dieback at regional scale. Landsat imagery is however limited in its ability to detect small or mixed patches of dieback. Once an area of potential dieback has been identified, a supervised classification of high spatial resolution aerial photography can more accurately define the extent of the potential dieback.

**HCAS: Developing a nationally consistent assessment of natural habitats for biodiversity using remote sensing data**

**Dr Tom Harwood**, Dr Randall Donohue, Dr Simon Ferrier, Dr Kristen Williams, Dr Tim McVicar, Dr Matt White, Dr Graeme Newell, Mr Michael Doherty, Dr Eric Lehmann, Mr Randal Storey, Ms Fiona Dickson, Mr Peter Lyon

1CSIRO, Canberra, Australia, 2Arthur Rylah Institute for Environmental Research, Melbourne, Australia, 3Department of the Environment, Canberra, Australia

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

Biography:

Tom Harwood is a spatial ecological modeller at CSIRO, applying fine scale (250m) national (1km) global models of biodiversity response to land use and climate change in support of effective conservation policy making.
The condition of habitat across most of Australia cannot be directly measured, and yet effective conservation decision making requires reliable estimation at relatively fine resolution. Here we present a new approach to national measurement using best-available sources of local habitat condition and the information content of MODIS time series remote-sensing. The Habitat Condition Assessment System (HCAS), a collaboration between CSIRO and the Department of the Environment, models the remotely-sensed signal of reference sites representing various condition dynamics as a continuous function of environment (climate, soils, landform) compared with test sites. Conceptually, HCAS treats habitat condition as the capacity of an area to support the persistence of species that would be expected at that location in a natural state. This approach differs from traditional remote-sensing calibration by accounting for the natural dynamics and disturbance regimes and recovery (drought, climate cycles, fire and flood) accounting for a range of possible natural condition states at any location over time. By avoiding discrete classifications of habitat types, we sidestep the problem of misclassifications such as degraded forest characterised as open woodland in good condition. A successful pilot study for Australia at 1km resolution demonstrated the utility of this approach. Work has commenced on refining the algorithm, improving input data in consultation with regional experts and more extensive validation and quantification of uncertainty. The result will be a repeatable national habitat condition dataset at 250m resolution.

Malcolm Lindsay1, Alexander Watson2 and the Yawuru Country Managers, Nyul Nyul, Karajarri and Gooniyandi Indigenous Rangers

1. Environs Kimberley, PO Box 2281 Broome WA, 08 9192 1922, malcolm@environskimberley.org.au
2. WWF Australia, awatson@wwf.org.au

The Kimberley Bilby Project: regional collaboration of Aboriginal Rangers and ecologists to fill a critical knowledge gap

Dr Malcolm Lindsay1, Alexander Watson2, and the Yawuru Country Managers, Nyul Nyul, Karajarri and Gooniyandi Indigenous Rangers

1Environs Kimberley, Broome, Australia, 2WWF Australia,

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

The vulnerable Greater Bilby (Macrotis lagotis) is an important ecosystem engineer of cultural importance to many Indigenous communities. Historically, Greater Bilbies ranged across 70% of Australia but predation by foxes, competition from rabbits and habitat loss, has resulted in a significant reduction in their range towards the North West. Populations located in the northern Great Sandy Desert, southern Kimberley and northern Tanami Desert are recognised as important wild refugia due to the low density or absence of foxes and rabbits. As a consequence, populations in these areas are thought to have suffered a slower decline and therefore retain higher populations of Bilbies than elsewhere. Despite significant resources allocated to Greater Bilby management nationally, there have been no extensive surveys across the southern Kimberley or northern Sandy Desert to investigate occurrence, population trends or ecology of this species. To help fill this critical knowledge gap, the Kimberley Bilby Project will conduct landscape-scale surveys with seven Aboriginal Ranger groups across the southern Kimberley and northern Sandy Desert, with preliminary results to be presented from four groups. This project draws on significant Indigenous Ecological Knowledge and is beginning to describe the occurrence, diet and habitat preferences of Greater Bilbies in the region. Ultimately, this knowledge will be used in fire and feral animal management programs undertaken by the Rangers to provide better landscape-scale conservation management of Greater Bilbies and other cultural and ecologically important species.

Direct and indirect facilitation are common outcomes of competitive interactions in Western Australian wildflower communities

Dr Margaret M Mayfield1, Dr Daniel B Stouffer2

1The University of Queensland, Brisbane, Australia, 2University of Canterbury, Christchurch, New Zealand

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

Biography:

Dr Margaret Mayfield is an Associate Professor of plant ecology at the University of Queensland. Her research focuses on understanding the processed driving patterns of plant diversity at local to landscape scales. Her work spans theoretical and applied aspects of community ecology.

The role of interspecific competition in maintaining plant communities has fascinated ecologists for over a century. In the last decade, there has been resurgence in the study of interspecific competition and its role in local-scale coexistence. One important aspect of local competition is the notion of ‘alpha’: the relative difference in a species’ fitness when grown in competition with another species compared to when grown with no competition. Historically, it was well appreciated (and documented) that alpha can be positive or negative - competitive or facilitative. Recent efforts to quantify coexistence, however, ignore or exclude the possibility that facilitation (negative alpha values) may drive coexistence. Indirect interactions are often mentioned as a potentially important aspect of coexistence but have also been poorly explored in this context. We use over 800 focal plants (from six focal species) surrounded by individuals from a pool of 37 additional competitor species in the York Gum woodland wild...
flower communities of southwest Western Australia to assess how common direct and indirect facilitative effects actually are in real communities. We do so by estimating alpha values for pairs of species within local interaction neighborhoods. We found that at least 20% of interspecific interactions are facilitative. Moreover, we found strong evidence that indirect effects resulting in net positive and net negative interactions are also common. Results from this study provide evidence for widespread facilitation among co-occurring species, suggesting that this type of interaction outcome may be more important for coexistence than previously appreciated.

Public evaluations of management actions in urban conservation reserves: A case study of Melbourne’s grasslands

Ms Alison Farrar1, Dr. Dave Kendall1,2, Assoc Prof. Kathryn Williams1
1University of Melbourne, Parkville, Australia, 2Royal Botanic Gardens Victoria, Melbourne, Australia

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Alison Farrar is currently undertaking a Master of Philosophy (Science) at the Australian Research Centre for Urban Ecology in the School of BioScience at the University of Melbourne. Alison’s research is focused on understanding public perceptions and the ecological outcomes of management actions in the temperate native grasslands of Melbourne.

The Victorian Volcanic Plain Grasslands is among Australia’s most endangered ecosystems. Important remnants are being surrounded by rapidly expanding human settlements, yet little is known about public perceptions of this ecosystem. We assume that the degradation of Melbourne’s grassland estate is, in part, a result of low levels of community appreciation for treeless ecosystems, and public concerns over fire as a management tool. To test this, we examined the values, beliefs and attitudes of nearby residents for grasslands and their management (removing woody vegetation, allowing woody vegetation to grow and prescribed burning). A psychometric questionnaire was posted to households within 100 meters of 38 grassland reserves in Melbourne. A factor analysis (n=477) was used to identify concepts underlying people’s values and beliefs. Six dimensions of values for nature in cities were identified (culture and heritage, commercial, natural, social, active use, experiential), and four dimensions of beliefs of the consequences of prescribed burning and allowing woody vegetation to grow (positive social benefits, negative social consequences, positive benefits to nature, positive environmental benefits). Attitudes to grasslands and prescribed burning were generally positive, although there was a segment of the community with strongly negative views. There were also relationships between people’s beliefs about environmental benefits and acceptance of prescribed burning, as well as strong relationships between values for nature, beliefs about positive social benefits and acceptance of allowing woody vegetation to grow. This information will enable grassland managers to understand public perceptions of management, thus improving communication avenues between managers and residents.

Ecosystem services as a rationale for ecological restoration in Australia

Dr Kerrie Wilson1, Dr Virginia Matzek2, Dr Marit Kragt3
1The University of Queensland, The University of Queensland, Australia, 2Santa Clara University, Santa Clara, United States of America, 3University of Western Australia, Perth, Australia

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Dr Kerrie Wilson is a conservation biologist and an ARC Future Fellow at The University of Queensland. She is a Chief Investigator on the Australian Research Council Centre of Excellence for Environmental Decisions.

Habitat restoration has long been motivated by conservation of biological diversity, but increasingly, it is also called on to restore or protect the flow of ecosystem services (ES) to humans. We examined perceptions of the relative importance of ES and biodiversity as a rationale for ecological restoration projects in Australia, where government funding priorities have alternately favored biodiversity and ES goals for restoration on public and private lands. First, we queried the MERIT database of Commonwealth-funded natural resource management projects, to quantify the frequency of ES and biodiversity goals in >250 restoration and revegetation project summaries. Second, undertook 30 semi-structured interviews with land managers charged with implementing restoration projects all over Australia, to understand the role that ES provision and biodiversity conservation played in justifying projects to landowners, funders, and other stakeholders. Third, we developed a survey for members of the general Australian public, to understand what value they place on ecosystem services and biodiversity as goals of restoration. As part of this survey we also explore the connection between people’s underlying values and their willingness to pay for different types of restoration projects. The data analyzed so far quantify a trend of increasing importance of ES goals in motivating restoration projects in Australia. However, the largest and best-funded projects appear to have conservation of endangered species as their principal goal.

Remote sensing requires more than Lidar heights to accurately predict the occurrence of hollow-bearing trees

Dr Chris McLean1, Dr Rod Kavanagh1, Dr Ross Jenkins1
1Nichie Environment and Heritage, Parramatta , Australia

Policy and Decision Making, Ballroom B, December 1, 2015, 4:00 PM - 5:30 PM
Predicting the distribution of hollow-bearing trees (HBTs) is important in order to identify areas with high conservation values for hollow-dependent fauna. One recent development includes the use of remote sensing to predict forest maturation and HBT occurrence. We thus attempted to assess, using Lidar, correlations between remotely sensed parameters and the occurrence of HBTs at both the individual tree and stand scales. The accuracy of these correlates was tested using ground-based observations in urban forest patches in Lake Macquarie, NSW. We found that tree diameter at breast height (DBH) was strongly correlated with the presence of hollows in most tree species, however, DBH and the presence of hollows was not associated with tree height. Analyses at the stand level showed that measures of forest maturity (average stand DBH, basal area; BA and measures of canopy height) were not positively correlated to the density of HBTs, with BA having a negative relationship to the density of HBTs. These results are partly counter-intuitive but may reflect the long-term, low intensity, opportunistic logging history that has occurred in the study area. Demonstrating that smaller, and often suppressed, trees in these logged forests were more likely to contain tree hollows. Furthermore, Lidar failed to identify the shorter, senescing trees that are more likely to contain hollows for wildlife. Complementary remote sensing approaches should be investigated that are capable of recognising the amount of dead wood in tree canopies and in better characterisation of the size and extent of individual tree canopies using automated processes.

Wildlife-vehicle collisions: predicting where to mitigate with a conceptual modelling framework

**Mr Casey Visintin**1, Dr Michael McCarthy1, Dr Rodney van der Ree1

1University of Melbourne, Parkville, Australia

**SYMPOSIUM**: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**

Casey Visintin is a PhD candidate studying the impacts of urbanisation and infrastructure on ecosystems. One of his primary interests is developing methods for identifying and mitigating impacts to native wildlife. Currently, he is developing spatio-temporal statistical models to predict wildlife-vehicle collisions for assisting road managers and educating the public.

One of the greatest threats of roads and traffic to wildlife is mortality due to wildlife-vehicle collisions. In some cases, the collision mortality rate can be a main driver of local population extinctions. The economic and ecological costs of wildlife-vehicle collisions are significant, and governments globally are faced with the challenge of knowing where best to install mitigation, such as crossing structures and fencing. Computer modelling can assist road management by predicting high-risk areas across temporal and geographic space. For models to be effectively incorporated, they must be conceptually simple, flexible to changing data or environments, and adaptable for a range of species.

Our research predicts collision risk to seven mammal species across the state of Victoria with the conceptual idea that risk is the product of exposure and threat. Our model framework uses three sub-models to predict: (1) exposure of species as probability of occurrence, (2) threat as predicted traffic volume, and (3) threat as predicted traffic speed. We model reported collisions with logistic regression using outputs from all three sub-models as explanatory variables.

We demonstrate that collision risks can be modelled using a simple conceptual framework. Past research has developed singular models for predicting wildlife-vehicle collisions, however, the use of a hierarchical framework and separate sub-models enables targeted scrutiny for bias, uncertainty, and spatial autocorrelation, and subsequent tuning and improvement. Our work presents an opportunity for managers to simulate collision risk on road segments by changing planned speed limits or traffic volumes during road planning exercises.

How to save your dragon: forecasting Komodo dragon range dynamics in a changing world

**Dr Alice Jones**1, Dr Tim Jessop2, Professor Barry Brook2, Dr Claudio Cioffi3, Mr Deni Purwandana4, Mr Achmad Ariefandy4, Dr Damien Fordham5

1University of Adelaide, Adelaide, Australia, 2 Deakin University, School of Life and Environmental Sciences, Australia, 3 University of Tasmania, Faculty of Science, Engineering and Technology, Australia, 4 University of Florence, Department of Biology, Italy, 5 Komodo Survival Program, Denpasar, Indonesia

**SYMPOSIUM**: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**

Dr Alice Jones completed her PhD in marine spatial ecology at the National Oceanography Centre in Southampton (UK), where she also worked for a year on marine habitat mapping. She now works as a Research Associate in ecological data analysis at Adelaide University. Alice is driven to undertake applied research for conservation.

It is generally acknowledged that isolated or island populations are far more extinction prone than large or connected populations. This is the result of insular populations having low adaptive potential in the face of challenging conditions such as harsh environmental events, Allee effects, demographic stochasticity and inbreeding. The Komodo dragon has persisted as the apex predator on five small islands in eastern Indonesia since the early Miocene. However, likely future climate change, sea level rise, increasing habitat fragmentation, land-use change and prey depletion now threaten the persistence of this iconic and Vulnerable (IUCN) species.
We combined presence-absence and capture-mark-recapture data with stochastic simulation models to forecast the range dynamics of the Komodo dragon under contrasting climate and landscape change scenarios. In order to assist with the conservation management of the species, we have included a number of realistic, future management scenarios in our model; including the creation of new protected areas on the island of Flores, where the species is thought to be at most risk from anthropogenic impacts.

Our results show the potential for future environmental conditions and management choices to impact on the persistence of Komodo dragons throughout their range. The results also highlight the importance of considering future spatio-temporal changes in habitat suitability before assessing the long-term efficacy of conservation management choices. The results will help to inform the management of the species for the 21st Century.

Integrated modelling of spatio-temporal biodiversity patterns

**Dr Steven Delean**

*University of Adelaide, Adelaide, Australia*

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**

Dr Steven Delean is a Lecturer in Biostatistics and Ecology in the School of Biological Sciences and Environment Institute at the University of Adelaide. His research examines spatio-temporal biodiversity responses to identify the most vulnerable systems and regions.

There is an urgent need to assess quantitatively how biodiversity is changing in response to the synergistic effects of global change, anthropogenic resource use and invasive species. Quantitative assessment of biodiversity change is often based on ad hoc indices of diversity that lack theoretical justification. The absence of a coherent statistical framework for estimating the drivers of biodiversity change at different scales, and specifically for making predictions of future changes, including their uncertainty, can result in misleading analysis and spurious interpretations of ecosystem impacts. These, in turn, affect our capacity to manage for positive biodiversity outcomes, which are key to maintaining ecosystem services into the future.

The Coorong, Lower Lakes and Murray Mouth (CLLMM) wetland system of the Murray-Darling Basin is a RAMSAR wetland of critical importance for waterbird populations, supporting globally important populations of some taxa. The maintenance of significant waterbird communities is dependent on adequate and suitably-timed flows of water from the Murray-Darling basin, and so this provides a model ecosystem with which to evaluate the ecological consequences of human impact on wetlands.

We extend the use of a novel, integrated modelling approach that simultaneously relates spatial and temporal change in biodiversity to complex biotic and environmental drivers, the multinomial diversity model, to examine biodiversity changes in the CLLMM ecosystem. The outcome is a uniform statistical framework for quantifying and projecting ecological diversity that simultaneously retains information about individual species relationships and ecosystem processes.

Prioritising threat management for biodiversity across Victoria

**Dr Tracey Regan**

*Dr Jim Thomson*, **Matt White**, **David Parke**, **Dr Nevil Amos**, **Teigan Allen**, **Fiona Ferwerda**, **Raquel Ashton**, **Adrian Bloch**

*The Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Australia; †Department of Environment, Land, Water and Planning, East Melbourne, Australia*

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**

Dr Tracey Regan is a senior scientist at the Arthur Rylah Institute for Environmental Research. Her research interests are broad encompassing ecological modelling, risk assessment and decision theory. She develops decision support tools to guide the allocation of resources in an optimal way to maximize benefits to biodiversity.

Conservation management at a landscape scale that aims to maximize benefits to biodiversity is complex because threats are unevenly distributed, species respond to threats differently and the effectiveness of alternative management interventions for different species and locations vary. Limited conservation resources also require decision-makers to prioritise conservation efforts to gain the highest return on investment. In this study we develop a decision support tool to guide conservation investment decisions across Victoria. The aim is to rank the cost-effectiveness of investment by location and action through an integrated assessment of biodiversity values, key threats to biodiversity and effective on-ground conservation management.

All known terrestrial mammals, birds, amphibians, reptiles and vascular plants across Victoria were considered in the analysis. Fourteen key threats to biodiversity were initially trialled, and associated management interventions and their effectiveness for different taxa were evaluated and costed. Actions were prioritised initially at the local scale, with local benefits weighted by their contribution to state-wide conservation objectives. Best actions for each location were then prioritised spatially across Victoria to identify areas where action will provide the largest benefit to biodiversity per unit cost.

Results suggest a combination of actions are needed to conserve biodiversity across Victoria. Priorities are dependent on a complex interaction between the cost of actions and the effectiveness for different types of species. Feedback from on-ground managers and further testing and
Spatial Modelling the Northern Quoll in the Pilbara: Informing Conservation Management of an Isolated Population

Dr Shaun W. Molloy1, Dr Robert A. Davis1, Dr Eddie J.B. Van Etten1, Ms Judy Dunlop2
1Edith Cowan University, Joondalup, Australia, 2Department of Parks and Wildlife (Western Australia), Woodvale, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Dr Shaun Molloy is a post-doctoral research fellow with the School of Natural Sciences at Edith Cowan University. Although Shaun has a broad background in conservation management, his recent work has concentrated on the spatial modelling the impacts of climate change and landscape fragmentation on Australian Biota.

The northern quoll (Dasyurus hallucatus) is a medium-sized marsupial carnivore once widespread across northern Australia, but now restricted to several disjunct populations within its former range. There has been severe decline in many of its strongholds across the top-end. Subsequently, it is now classified as an endangered species. The Pilbara population differentiates strongly from other populations because: 1) It is an isolated and disjunct population, 2) there are marked genetic, behavioural and ecological differences from other populations, and 3) it has been spared the devastation that cane toad invasion has brought to other populations. Known threats to this population are feral predators (predominantly cats) and development (in particular mining activities). Assumed threats are altered fire regimes and grazing from introduced species (both domestic and feral). Potential threats are cane toads and climate change.

In this project we have used a variety of spatial modelling tools to develop a predictive model identifying quoll refugia within the Pilbara and to determine how impacts such as proposed mining activities, cane toad invasion and climate change will impact on northern quoll refugia. We find that northern quoll have been relatively easy to model using a suite of geomorphic, floristic and bioclimatic variables. Climate change models suggest a potential shift in the potential distribution of this species. Finally, there is a strong possibility that cane toads may be able to persist in the Pilbara, however, delaying their introduction for as long as possible should diminish their impact on this northern quoll population.

The role of intraguild competition on the stability of an Australian food web

Dr Miguel Lurgi1, Dr Damien Fordham1, Dr Euan Ritchie2, Dr Arian Wallach3
1University of Adelaide, Adelaide, Australia, 2Deakin University, Melbourne, Australia, 3Charles Darwin University, Darwin, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Miguel obtained his PhD in Terrestrial Ecology from the Autonomous University of Barcelona, where he studied the effects of climate change on the dynamics and structure of complex food webs. He also investigated the effects of including different interaction types on a food web context.

Community stability is mainly determined by food web dynamics. These dynamics are in turn highly dependant on the structure of the food web, and can be particularly affected by strongly interacting species embedded within the network of ecological interactions. Those network ‘motifs’ or sets of closely interacting species sometimes embark upon interactions different from trophic ones, but which are very relevant for the stability and persistence of the whole community. Using a dynamical food web model, we study the effects of predator-mesopredator interactions on the persistence and stability of an Australian food web composed of, among other species, the dingo, fox, cat and rabbit. We show how the strength of competitive interactions among predators affects ecological dynamics when embedded in a food web context. These results shed light on the effects of intraguild competition on food web dynamics and can additionally inform conservation and management strategies for native and invasive species that are part of the ecological community.

Modeling species distribution from high spatial density, automatically classified photographs of complex coastal communities.

Mr Kingsley Griffin1, Dr Luke Hedge1,2, Prof Emma Johnston1,2, Dr Manuel Gonzalez Rivero3, Prof Ove Hoegh-Guldberg3
1Applied Marine and Estuarine Ecology (AMEE) Laboratory, University of New South Wales, Kensington, Australia, 2Sydney Institute of Marine Science, Mosman, Australia, 3Global Change Institute (GCiQ), University of Queensland, St Lucia, Australia

SYMPOSIUM: Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Kingsley Griffin is a PhD candidate in the Applied Marine and Estuarine Ecology (AMEE) Lab at UNSW, using photogrammetry, machine learning and remote sensing tools to approach Marine Ecological studies at a range of temporal and spatial scales.
Species distribution modeling has been utilised to great success to interrogate the broad influence of climatic or environmental gradients on species range. When operating at a fine scale, ecologists are often confined by a paucity of biological data and yet are dealing with highly dynamic, heterogeneous systems. Habitat maps have often failed to represent this inherent variability due to small sets of low-detail point-data abstracted across broad spatial areas. Species distribution models can predict distribution across space based on the same point data, but respond to a suite of environmental factors.

This study trained machine learning software to classify 6000+ images collected during ~11 km of coastal habitat surveys around Sydney Harbour. From the resulting species and community-level data, we were able to observe the effects of environmental gradients, and build fine-scale species distribution models for key habitat-forming species.

Although the Sydney coastline is relatively iconic, and central to Australia’s largest city, this study will provide a uniquely detailed assessment of the distribution and condition of key habitat. The outcomes from this project are an example of improvements in our ability to assess and monitor the distribution and condition of marine habitats at a fine scale, given recent technological developments.

Modelling the spatial distribution of waterbird habitat using Bayesian belief networks linked to GIS.

**Dr Nadine Kilsby¹, Dr Jody O’Connor¹, Dr Daniel Rogers¹**

¹DEWNR, Adelaide, Australia

**SYMPOSIUM:** Linking data to wildlife management through complex ecological models (part 2), December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**
Dr Nadine Kilsby has worked as an ecologist focussing on the River Murray since finishing her PhD on river hydraulics and fish ecology. Her work has included wetland management, hydro-ecological relationships and GIS modelling.

The Coorong, Lakes Alexandrina and Albert wetland is ranked as one of Australia’s most important wetlands for shorebirds, and regularly supports over 100,000 waterbirds. To assist in the management of the site’s ecological character, managers require tools to understand the response of waterbirds to a range of environmental drivers. Given the Coorong and Lakes is at the terminal end of the Murray-Darling Basin, water resource managers are particularly interested in understanding the response of waterbirds to alternative water management scenarios.

Bayesian belief networks (BBNs) have become increasingly used to model ecological responses to environmental change. BBN models were developed for a number of waterbird species that utilise the Coorong and Lakes, initially to characterise relationships between physical drivers and species’ ecological responses. The BBN models were then linked to spatial data for key hydrological variables in the site (salinity and water depth), to generate predictions of the spatial distribution of waterbird habitat under various hydrological scenarios. The predictions generated using these mechanistic BBNs were then tested using available spatially-explicit survey data for the Coorong and Lakes. While the predictive power of the models varied between species and locations, the models generally predicted the distribution of waterbird species at coarser temporal and spatial scales.

The linked spatial-mechanistic tool developed here can be used to forecast the spatial distribution of waterbird habitat quality based on eco-hydrological scenarios. Application of the tools will permit site managers and water holders to better consider possible effects on the ecological character of waterbird habitats.

**Changes in Fire Regimes through Warlpiri and Gurindji Fire Management in the Tanami Desert**

**Mr Benjamin Kaethner¹**

¹Central Land Council, Alice Springs, Australia

**SYMPOSIUM:** Sustaining and protecting Indigenous Ecological Knowledge (2), Balcony Rooms 1-2, December 1, 2015, 4:00 PM - 5:30 PM

**Biography:**
Ben works with Indigenous ranger groups and Traditional Owners throughout Central Australia to increase the capacity and reach of Indigenous fire management for both conservation and cultural purposes.

Fire management in the Warlpiri and Gurindji country of the Tanami Desert is characterised large, inaccessible fire-prone landscapes. Since 2008, Traditional Owners and Rangers employed by the Central Land Council have built a unique program in the region that has extended fire management to the most remote areas. By focussing on areas of biological and cultural significance, a landscape that was largely unmanaged for the last 60 years is now regularly burned by the Traditional Owners. As an example, the Yinapaka (Lake Surprise) region of the central Tanami is a site of conservation significance that has been subject to annual aerial prescribed burning since 2009. The fire management planning for the area has been done by Traditional Owners with consideration given to conservation and contemporary fire management techniques. The deliberate application of fire to the landscape during the cooler months has altered the fire regime from one of large, hot summer bushfires to one of smaller fires occurring throughout the year. Tanami Desert fire management is aimed at achieving the widely-held goal of a spatially and temporally heterogeneous, or ‘traditional’ fire regime that benefits biodiversity, but it is unclear whether the recently-altered fire regime in the Tanami has achieved this. Further work is needed to determine the conservation benefits of this strategy.

The identity of the ‘Witchetty Grub”
Mr Conrad Bilney

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (2), Balcony Rooms 1-2, December 1, 2015, 4:00 PM - 5:30 PM

Scientific uncertainty surrounds the identity of the ‘Witchetty Grub’, a common name for the taxonomically classified Endoxyla leucomochila. In Australia, this large, white Lepidopteran larvae of an unidentified Cossus and/or Hepialidae Moth, is the only edible larvae that exists in the scientific knowledge base. By researching past documentation about the Aboriginal entomophagy, it was found that a number of misinterpretations and misunderstandings of different Aboriginal languages by early explorers and others exists. This included the emergence of the name ‘witchetty’. Scientific evidence regarding the identity of the Witchetty will utilise DNA technology to make the genetic link between adult and larval species. The DNA samples will be taken from larvae that Aboriginal people have identified as being edible. Anecdotally, there may be up to 30 different species that have remained uncovered.

Ngarrindjeri Partnerships and describing the character of Yarluwar-Ruwe

Mr Lachlan Sutherland, Mr Lachlan Sutherland, Mr Steve Hemming

1Ngarrindjeri Regional Authority, Murray Bridge, Australia, 2Department of Environment, Water and Natural Resources, Adelaide, Australia, 3Flinders University, Adelaide, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (2), Balcony Rooms 1-2, December 1, 2015, 4:00 PM - 5:30 PM

Biography:

Clyde Rigney is a Ngarrindjeri man and Deputy Chairperson of the Ngarrindjeri Regional Authority (NRA). Clyde is also coordinator of the NRA’s Yarluwar-Ruwe Program and responsible for managing Ngarrindjeri engagement in natural resource and cultural heritage management in the Ngarrindjeri Nation. Clyde also coordinates business development for NRA’s commercial arm.

Ngarrindjeri partnerships in reviewing the ecological character of the Coorong, Lakes Alexandrina and Albert Ramsar site provide a case study in negotiating space for Ngarrindjeri interests and philosophies in natural resource management (NRM).

Ngarrindjeri have a unique philosophy regarding the connectivity of country / body / spirit. Ngarrindjeri Ruwe/Ruwar (country / body / spirit) reflects Ngarrindjeri rights and responsibilities reinforcing that all things are connected. In contrast, the dominant NRM and science discourses have regarded these as separate, effectively removing institutional support and recognition of Ngarrindjeri interests, and regarding Ngarrindjeri knowledge not as its own system of understanding, but as a source of facts to be collected to complement existing understandings.

This process has affected Ngarrindjeri ability to engage in NRM and Ruwe/Ruwar. The Ngarrindjeri Regional Authority (NRA), the peak Ngarrindjeri representative body, and the Department of Environment, Water and Natural Resources (DEWNR) have established a partnership to investigate how to better include Ngarrindjeri interests and philosophies in the review of Ramsar Ecological Character Description (ECD).

Through the development of a Statement of Commitment, the partners are implementing joint initiatives to influence the application of the Ramsar ECD guidelines, and negotiate the use of Ngarrindjeri Cultural Knowledge. Our approach merges the ECD framework with Ramsar Resolutions accounting for cultural values of wetlands, and better understanding the relationship between Ngarrindjeri values and the wise use principle.

This partnership challenges NRM to value and respect different understandings and include Ngarrindjeri interests in wetland policy to support long-term Ngarrindjeri Caring for Country objectives.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Enhancing and maintaining Traditional Indigenous ecological knowledge of 7 clans in SE Arnhem Land, NT through local and national approaches

Maritza Roberts1,2, Pollyanne Ponto3, Dr Emilie Ens3

1Yugul Mangi Rangers, Ngukurr, Australia, 2Ngukurr Language Centre, Ngukurr, Australia, 3Department of Environmental Sciences, Macquarie University, Australia

SYMPOSIUM: Sustaining and protecting Indigenous Ecological Knowledge (2), Balcony Rooms 1-2, December 1, 2015, 4:00 PM - 5:30 PM

The seven Aboriginal clans of SE Arnhem Land have experienced significant disruption and loss of their traditional ecological knowledge over the last century with most languages now considered highly endangered if not extinct. Over the last year the Yugul Mangi Rangers and Ngukurr Language Centre have worked on a collaborative project with Macquarie University ecologists to collate and record traditional names and uses of flora and fauna in the proposed SE Arnhem Land Indigenous Protected Area. The project has multiple aims including to enhance use of traditional names and knowledge of flora and fauna by the Rangers and community and raise the profile of traditional knowledge in the Rangers day to day work plans. The team have worked to achieve this by conducting biodiversity surveys on Country with young and old people (and sometimes linguists) and conducting research into traditional names and uses of flora and fauna. We are nearing completion of a local multi-lingual flora and fauna field guide that has been collaboratively produced by the team which has also enhanced local use of computers and recording technologies.

In addition, we have uploaded some cross-cultural biodiversity information into the Atlas of Living Australia to raise awareness of Indigenous biological knowledge and language on a national level. This project is ongoing and in the next stage we will continue to conduct on-Country cross-cultural biodiversity surveys with Rangers, young people and elders and record more traditional names and stories about species we find. We are also continuing our collaboration with the Atlas of Living Australia to demonstrate to other Indigenous communities how they can use and add their own knowledge to this powerful resource and bring scientific and Indigenous knowledge side by side.
Altered life history of Golden orb weaving spiders along an urbanisation gradient in Sydney

Ms Elizabeth Lowe1, Dr Shawn Wilder2, Dr Dieter Hochuli1
1The University of Sydney, Sydney, Australia, 2Oklahoma State University, Stillwater, USA

Biography:
Lizzy Lowe is a PhD student studying the effects of urbanisation on the species composition, morphology, life history and behaviour of spiders.

Gradients of anthropogenic disturbance are the foundation of urban ecology. While the majority of studies examining the effect of urbanisation on biota focus on shifts in species distributions and abundance, changes in the morphological, behavioural and physiological traits of urban dwelling species along an urban gradient provide enormous opportunities to examine biological adaptation to varying degrees of disturbance. When quantifying the impact of urbanisation on species adaptation it is important to consider a range of environmental measures at multiple spatial scales, as cities are often a heterogeneous matrix of land uses and coarse categorisations can mask fine scale variation.

We measured a suite of environmental variables in parks, remnant vegetation patches and bushland sites, and combined these into an index of urbanisation to examine the morphology, development and persistence of Golden orb weaving spiders (Nephila plumipes) along an urban gradient in Sydney. We found that as urbanisation increased spiders grew larger and survived longer, especially when located in sites with more impervious surfaces and less vegetation cover. This research demonstrates that urbanisation can have a positive impact on these spiders, possibly due to warmer climates and increased food resources. Investigating landscape modification along a gradient, and the scale at which these changes have the most impact, allows for better management of biodiversity and ecosystem function in urban systems.

Functional trait changes in floras of 11 cities across the globe in response to urbanisation

Estibaliz Palma1, Jane A. Catford1,2,3, Richard T. Corlett4, Richard P. Duncan5, Amy K. Hahs1,6, Michael A. McCarthy1, Mark J. McDonnell1,6, Ken Thompson1, Nicholas S. G. Williams1,5, Peter A. Vesk1
1School of BioSciences, The University of Melbourne, 2Department of Ecology, Evolution and Behavior, University of Minnesota, 3Department of Ecology, Evolution and Behavior, University of Vienna, 4Department of Ecology, Evolution and Behavior, University of Sydney, 5,6,7Institute for Applied Ecology, University of Canberra, 8Australian Research Centre for Urban Ecology, Royal Botanical Gardens Victoria, 9School of Animal and Plant Sciences, University of Sheffield, 10School of Ecosystem and Forest Sciences, The University of Melbourne, 11Department of Animal and Plant Sciences, University of Sheffield, 12School of Ecosystem and Forest Sciences, The University of Melbourne

Biography:
Estibaliz Palma is a PhD student within the Quantitative and Applied Ecology Group (School of BioSciences, University of Melbourne). She explores how invasiveness, invasibility and propagule pressure interrelate to give rise to plant invasions.

Environmental change from urbanisation can cause species extinctions and invasions, alteration of plant community composition, and potentially biotic homogenization between cities. Here, we examined whether urban environments consistently select for or against plant species with particular traits and discuss our results in terms of functional homogenization. We hypothesised that: i) in contrast to extinct native plants, exotic and extant native species share common characteristics that allow persistence, and ii) exotic plants have particular characteristics that promote invasion.

We categorised plants recorded in eleven cities around the globe as invader (non-native), persistent or extinct native species. We analysed variation in ten traits, linked with plant responses to environmental conditions, among these groups. We independently compared invaders with persistent plants, and with extinct plants using individual city-level Bayesian logistic regressions. We used meta-analysis of city-level results to assess consistency of traits across urban areas.

On average, urban invaders had heavier seeds, and were taller and more often annual species, especially when compared to extinct urban plants. They also showed unspecialised nutrient requirements more often than persistent (but not extinct) urban plants. In urban areas, plant persistence and invasion seem to be promoted by different ecological strategies that involve longevity, stature and seed mass. This leads to common patterns of functional change in urban plant communities, with invasion being the main force on flora’s functional change. Given the growing rates of urbanisation around the world, this work may improve the knowledge of invasion and extinction that are expected to become increasingly prevalent.

Intercity Ibis: foraging behaviour, abundance and climatic responses of an urban coloniser

Mr Matthew Chard1, Prof Kris French1, Dr Richard Major2, Dr John Martin3
1University of Wollongong, Kiama Downs, Australia, 2Australian Museum, Wollongong, Australia, 3The Royal Botanic Gardens and Domain Trust, Sydney, Australia

Biography:
Matthew Chard is a student at the University of Wollongong completing a Bachelor of Conservation Biology (Honours). His interests include: urban ecology, conservation ecology, animal behaviour, invasive species management and long walks on the beach.
Over the last 40 years the population of Australian white ibis, a wetland specialist, has dramatically increased in urban centres. Because urban ibis forage both naturally and by scavenging on human foods, we were interested to determine whether rainfall was a driver of their foraging choices. A 7-year data set was analysed to determine how the number of birds in an inner-Sydney park fluctuates in relation to rainfall intensity, and how this varies seasonally. We also measured foraging rates (consumption) of ibis in four urban parks under varying rainfall regimes to determine whether rainfall influenced the availability of natural foods. For all thresholds of rainfall tested, ibis abundance significantly decreased after a rainfall event in the park where ibis were predominantly scavengers. Higher rainfall was found to increase this response, with a 46% decline of ibis abundance following rainfall events of >60mm (n = 13). During the non-breeding period for ibis (Jan-June) we found ibis abundance to decrease after rainfall for higher thresholds (10-59.9mm and >60mm). Foraging success suggests that ibis consume food more readily after rainfall events. Our results indicate that rainfall influences the ibis distribution in urban centres either by: decreasing anthropogenic food supplied to the birds, forcing the birds to relocate to forage or increasing the amount of natural food available elsewhere - or a combination. We found that increased rainfall intensifies this response. Our results demonstrate the importance of climatic processes on the distribution of urban birds.

Do Floral Traits Explain Butterfly Use of Gardens in Urban Landscapes?

Ms Jessica S. Kurylo1, Dr. Caragh Threlfall2, Dr. Karl Evans3, Dr. Nicholas S. G. Williams1
1School of Ecosystem and Forest Sciences, University of Melbourne, Richmond, Australia, 2School of Biological Sciences, The University of Sydney, Sydney, Australia, 3Department of Animal and Plant Sciences, University of Sheffield, Sheffield, England

Urban Ecology, December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Jessica is working on a PhD in Urban Ecology at the Burnley Campus, University of Melbourne. Her current interest is in the value of the residential matrix for wildlife, such as butterflies.

Wildlife gardening has become a popular mechanism through which local communities can become engaged with biodiversity conservation in urban areas. It is potentially a powerful tool as a large proportion of urban green-space is managed by individual householders. However, there are few empirical assessments of the effectiveness of wildlife gardening at promoting biodiversity. Butterflies are a useful indicator group that responds to the structure and composition of botanical assemblages, but the floral traits of that botanical assemblage can limit its useability for butterflies. To assess if wildlife gardens are beneficial to butterflies, and the mechanisms through which any benefits arise, we surveyed 108 gardens (27 wildlife gardens, 27 traditional gardens nearby to wildlife gardens, and 54 traditional gardens not nearby) in Melbourne’s south-east suburbs. Within these gardens we quantified butterfly richness and abundance, floral abundance, and their traits. We recorded 12 butterfly species representing, about 20% of the species present in the surrounding region. Wildlife gardens provided more floral resources than non-wildlife gardens, but their butterfly assemblages were similar in terms of species composition and abundance to those of non-wildlife gardens. Rather butterfly richness and abundance appears to be linked to factors operating at larger spatial scales including the intensity of urbanisation in the surrounding area. Further work examining the traits of flowering species within gardens is expected to help explain variation in butterfly assemblage structure across gardens providing much needed information to underpin evidence-based wildlife gardening programs.

Two decades of vegetation change across a critically endangered temperate grassland ecosystem

Mr Ben Zeeman4, Assoc Prof Mark McDonnell5, Dr Dave Kendall6, Dr John Morgan7
4La Trobe University, Bundoora, Australia, 5The Australian Research Centre for Urban Ecology, Royal Botanic Gardens Victoria, Melbourne, Australia

Urban Ecology, December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Ben Zeeman is currently undertaking his PhD in the Department of Ecology, Environment and Evolution at La Trobe University, Melbourne. Ben’s PhD research is focused on understanding the trajectory and drivers of ecological change in the critically endangered temperate native grassland’s of south-eastern Australia.

Habitat fragmentation is a threat to ecosystems across the globe, with biotic homogenisation a key predicted outcome. However, alternative outcomes are also possible. We examined changes in the floristic composition of native temperate grasslands in Victoria, Australia over the past two decades. We compared 63 rural grasslands with a long history of frequent burning, to 29 grasslands within the urban agglomeration area of Melbourne, where intense urbanisation has coincided with declines in fire frequency. Temporal change was explored against three alternative models:

1) Biotic homogenisation: similarity between remnants increases over time;
2) Biotic differentiation: similarity between remnants declines over time; and
3) Clustered differentiation: similarity between remnants remains unchanged, but composition shifts from the historical state.

The biotic homogenisation hypothesis was supported in urban grasslands. This was strongly driven by changes in exotic composition, with an increase in the occurrence rate of commonly shared exotic species. The most urbanised sites were the most invaded in both the current and historical data sets. However, site-level changes in exotic composition over the past two decades were largest in the least urbanised sites. In addition, the overall composition of urban sites was made up of taller species then in the past. In frequently burnt rural grasslands, neither the similarity between sites, nor overall composition changed significantly over the previous two decades. These results highlight the importance of urbanisation as a driver of biodiversity change, with increases in the intensity of plant competition following disturbance regime change the likely driver of biotic homogenisation.
The biodiversity benefits of pop-up parks

Dr Luis Mata1,2, 1Interdisciplinary Conservation Science Research Group, School of Global, Urban and Social Studies, RMIT University, Melbourne, Australia, 2Centre for Urban Research, School of Global, Urban and Social Studies, RMIT University, Melbourne, Australia

Urban Ecology, December 1, 2015, 4:00 PM - 5:30 PM

Biography:
Dr Luis Mata is a Research Fellow with RMIT University’s Interdisciplinary Conservation Science Research Group. He works as part of the National Environmental Science Program. His research focuses on the biodiversity and social co-benefits of urban green space and the ecology and conservation of native wildlife in cities.

Pop-up parks (PUPs) are increasingly prevalent in cities, driven by the recognition of the value of green space close to where people live, work and play, and the difficulty of securing large new areas of green space. While evidence mounts for the biodiversity benefits of urban green spaces, few studies have explored the benefits associated with PUPs or other temporary green spaces. Using a pilot study conducted in the heart of Melbourne, we present evidence of the biodiversity benefits of PUPs. We investigated the insect community of an installation that transformed the State Library of Victoria’s forecourt steps into a native grassland. We studied whether the PUP’s short lifespan and limited size would provide habitat for insects and, if so, whether these species would increase the site’s gamma diversity or simply mirror that of the permanent ornamental beds. Herbivores, predators, parasitoids and pollinators were monitored, and we fitted community hierarchical models to the data. We detected 111 species, 27 unique to the ornamental beds and 52 to the PUP. Results indicated that the PUP was rapidly colonised by a large and functionally-diverse insect assemblage, which distinctly increased the site’s gamma diversity of key functional guilds. With the majority of the human population living in urban environments, small-scaled and short-lived public green spaces such as PUPs play an increasingly important role in creating green space and connecting people with nature. It is therefore crucial to understand their role as providers of biodiversity benefits and how to maximise their ecological contribution.

When it comes to urban ecology it pays to be popular

Dr John Martin1,2, 1Richard Major3, 2A/Prof Charlotte Taylor3, 3Adrian Davis3

Biography:
Dr John Martin is an ecologist researching invasive and native plants and animals, including human ecological awareness.

Citizen science, as the name suggests, relies upon people. We all know that people can be fickle, and this presents a scenario where projects can fail to engage their target audience. Here we present an example of human favouritism, comparing the reporting rates of Sulphur-crested Cockatoos and Australian White Ibises fitted with numbered wingtags in Sydney. No prizes for guessing which species was reported more frequently. We discuss the role of the birds and the humans’ behaviour producing this bias.

A nice place, but rather crowded: balance between patch quality and density in arid lands.

Dr Alexandra Bowman1, 1The University of Adelaide, Adelaide, Australia

Community Ecology (1), Balcony Rooms 3-4, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Associate Professor Jose M Facelli has over 20 years of experience in arid land ecology, and is particularly interested in factors that structure plant communities, particularly the roles of spatial and temporal variability.

Resource heterogeneity is a well-established pattern in arid lands, creating patches of favourable conditions for annual plant growth. While conditions may favour individual plants (i.e. nutrient accumulation and moderated soil temperatures), resource patches also favour higher densities of annual plants (i.e. through accumulated seeds and higher emergence). We query how these two effects balance: is there an overall increase in fitness for the individual plant? Several studies have recently focused on the effects of temporal pulses of resources on plants, yet studies looking into the spatial availability of resources on competition and community structure of annual plants are noticeably absent. In this study we used spatial heterogeneity associated with fallen logs, coupled with high and low watering regimes, to look into the effects of spatial variation of resources on annual plant communities. Our studies were conducted over two consecutive years, encompassing two growing seasons. In the field we found strong evidence that community structure of annual plants changes with spatial heterogeneity and water availability. There was some evidence of competition among annual plant communities in the glasshouse, but not in the field. We found very different results across the two growing seasons, suggesting that both temporal and spatial heterogeneity of resources in arid lands are important determinants of annual plant communities. Overall we found that resource patchiness does indeed put the balance in favour of the individual plant.
Loss of resistance to gradual and abrupt abiotic change: when compensatory mechanisms fail

**Ms Giulia Ghedini**,1 Prof Bayden Russell1, Prof Sean Connell1
1School of Biological Sciences, The University of Adelaide, Adelaide, Australia, 2Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong, China

**Biography:**
Ghedini’s broad interest as an ecologist is understanding the response of natural communities to disturbance, with particular focus on human impacts. The aim of her PhD is to identify mechanisms that underpin community resistance and the extent to which such processes can maintain community stability along with resilience processes.

By recognising the extraordinary capacity for compensatory processes to absorb the effects of disturbance, ecologists have recently started to broaden their understanding of how communities may resist abiotic change to maintain stability and avoid shifts to contrasting states. A key uncertainty centres on the extent to which extreme events weaken resistance. To date, models of compensation are mostly derived from studies of slow, gradual abiotic change. We tested whether compensatory responses could maintain their strength when faced with abiotic disturbances associated with slow change (ocean warming and acidification), abrupt change (heat wave) and their combination. This assessment was made within a model kelp forest system where disturbances drive the expansion of algal turfs and displacement of kelp, but such turf expansion can be compensated by herbivory. Trophic compensation by herbivores absorbed the expansion of algal turfs under slow abiotic change and during abrupt change imposed on top of contemporary conditions. This mechanism failed when gradual change combined with a heat wave. Compensation failed because these combined conditions drove turfs to expand at their greatest rate whilst consumption by herbivores was suppressed. Whilst compensatory mechanisms might be robust to differential rates of change, the limits of compensation may be rapidly breached when gradual and abrupt disturbances combine. Hence, extreme events in the near future have greater potential to create windows of rapid, non-countered change by causing compensatory mechanisms to fail.

The intricate relationships between macrofauna and habitat characteristics in subtropical mangroves of Queensland, Australia

**Dr S Shuhaida**,1 Assoc Prof Greg Skilleter2
1Universiti Sains Malaysia, Minden, Malaysia, 2University of Queensland, St Lucia, Australia

**Biography:**
Shuba is currently a lecturer at Universiti Sains Malaysia, Penang, Malaysia. Dr Shuba’s research interests include understanding dynamics of different types of disturbance in interaction with multiple internal and external stressors, and mangrove ecology. At present, Dr Shuba is studying the diversity of macroinvertebrates in tropical mangroves of North Malaysia.

Deforestation, aquaculture and reclamation have led to serious decline in mangrove diversity, causing deterioration in mangrove ecosystem function. Despite the enormity of mangrove destruction in this context, links between macrofaunal diversity and the mangrove habitat remain in certain aspects, unclear. The significance of relationships between macrofauna comprising gastropods, bivalves and crabs with habitat characteristics involving pneumatophore densities, macroalgae and organic matter biomass, and nitrogen (N) and phosphorus (P) concentrations, was examined in the subtropical mangroves of Moreton Bay, Queensland. Relationships were predicted to be affected by habitat complexity and specific spatial scales utilised by macrofauna. Therefore, the sampling of macrofauna and habitat characteristics were conducted based on a detailed, hierarchical sampling design which included comparisons among different mangrove forests, intertidal heights and sites ranging from the centimetre to kilometres. Macrofaunal species abundances and habitat characteristics were affected by spatial variability at the larger scale of kilometres between forests. However, spatial variation patterns were undetected for gastropods and bivalves categorized into feeding groups, suggesting loss of information caused by the use of functional groups instead of high taxonomic resolution at the species level. Although relationships between macrofauna and habitat characteristics were weak, concentrations of N and P in either the porewater or sediment were recurring factors that were correlated with the patterns of spatial variation in macrofaunal assemblages. Findings from this study shows the intricate patterns of macrofauna with the complex mangrove habitat, and the detailed approaches which must be involved in isolating these patterns with minimal confounding effects.

Microclimate or accumulation of resources: which is the main driver for plant communities in patchy systems?

**Dr Alexandra Bowman**,1 AProf Jose M. Facelli1
1The University of Adelaide, Adelaide, Australia

**Biography:**
Alexandra completed her PhD this year titled “Fallen logs: creating patchiness in chenopod shrublands of South Australia”. Alexandra is a member of the local organising committee for ESA 2015 in Adelaide.
The importance of patchiness in arid ecosystems has been well established, but while many studies have established the different components which constitute a patch, few studies have decoupled these components to determine their relative importance for plant communities. We measured soil temperature and soil volumetric water content associated with patches created by logs. We then conducted a soil core swapping experiment to separate soil microclimate conditions from any resource accumulation and increased seed abundance in a patch to assess which is more important in determining annual plant communities. We found that logs created an insulation effect on soil temperature, with cooler maximum temperatures and warmer minimum temperatures than open space soils. We also found that patches next to logs had lower soil volumetric water content and dried faster after a rainfall event than open spaces. Our soil core swapping experiment showed that complex interactions between microclimate conditions and soil characters affected the annual plant community. Annual plant numbers were lower when open space soils were transplanted next to logs than controls grown next to logs. However, biomass was highest when soil from next to logs was grown in open spaces. We found species richness to be higher in soils from next to logs than open space controls. Additionally diversity was lowest in control plots than in open spaces. We found that a complex array of resource availability and conditions are modified by the presence of logs, and that annual plant community respond in a complex way to these.

Slippery slope or gentle descent: Using zeta diversity to understand the processes driving community structure

Associate Professor Melodie McGeoch1, Dr Guillaume Latombe1, Ms Mariona Roige2, Professor Cang Hui1
1Monash University, School of Biological Sciences, Australia, 2Bio-Protection Research Centre, Lincoln University, New Zealand, 1Department of Mathematical Sciences and Centre for Invasion Biology, Stellenbosch University, South Africa

Community Ecology (1), Balcony Rooms 3-4, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Melodie A. McGeoch’s research focuses on spatial and community ecology and its application to the study of biological invasion, climate change impacts and biodiversity monitoring, particularly in protected areas.

Spatial turnover in species composition is one of the key properties for assessing the relative conservation value of landscapes. Along with total richness and measures of uniqueness (such as endemism and phylogenetic distinctiveness), turnover captures one of the components of heterogeneity that constitutes biodiversity. For example highly biodiverse floristic regions, such as the Cape Floristic Kingdom or Southwest Australian Region, are characterised by high compositional turnover by comparison with Boreal habitats. The recently proposed metric for quantifying spatial turnover in species composition, zeta diversity (the average number of species shared across multiple sites or habitats), provides an opportunity to better understand the properties of communities with high and low rates of turnover. For example, the rate at which zeta diversity declines with the addition of new sites (zeta decline) may be informative about the processes driving biodiversity pattern. An exponential decline in zeta is hypothesized for largely stochastically driven communities, whereas a power law form of decline is driven by niche differentiation processes. Using data for over 250 different communities, from molluscs to birds and trees, we examine more closely the characteristics of communities described by exponential versus power law forms of zeta diversity decline. Stochastic establishment of individuals occurs, for example, where strong disturbance gradients drive establishment patterns. Niche-driven communities are characterised by occupancy patterns that are related to the relative abundance of species in the community. Zeta diversity decline shows promise for testing hypotheses about the ecological processes that structure communities.

Higher, faster, stronger? The pros and cons of molecular data for assessing diversity and function.

Prof Emma Johnston1, Melanie Sun1, Dr Mark Brown1, Professor Donald Baird2, Dr Anthony Charlton3, Simone Birrer1, Dr Stuart Simpson1, Dr Brendan Kelaher4, Dr Rohan Williams5, Jaimie Potts2, Dr Peter Scanes6, Professor Peter Steinberg1,6, Professor Sanjay Swarup5, Professor Staffan Kjelleberg5, Dr Katherine Dafforn1
1UNSW & SIMS, Sydney, Australia, 1University of New Brunswick, Fredericton, Canada, 1CSIRO, Lucas Heights, Australia, 2Southern Cross University, Lismore, Australia, 3Nanyang Technological University, Singapore, 4NSW Office of Environment and Heritage, Sydney, Australia

Community Ecology (1), Balcony Rooms 3-4, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Emma Johnston is Professor of ecology and ecotoxicology at the University of New South Wales. She has conducted research from the tropics to the poles. Her group have identified new drivers of invasion success, indirect effects of environmental stress, novel stressor interactions, molecular bio-functional tools and evolutionary responses to toxicants.

Ecological observation is dependent on matching the scale and quality of biological data with associated physicochemical information. Until recently, the scale and quality of biological observation has failed to match data generated through physical or chemical platforms due to constraints of cost and taxonomic resolution. With the advent of next-generation sequencing platforms, generating 'Big Data' scale observations of biological assemblages across a wide range of phylogenetic groups is now a reality. Here we illustrate the potential of these new data sources for enhancing our observation of ecological change. When faunal community composition from estuarine sediment surveys derived using morphological and molecular approaches were compared, the molecular approach allowed for greater discrimination between estuaries. Apart from higher taxonomic resolution, there was also an order of magnitude more taxonomic units recorded in the molecular approach relative to the morphological. Furthermore, information provided by molecular techniques was more sensitive to a range of well-established drivers of benthic ecology and the fracturing of community connectivity was clearly detectable within microbial communities. In novel field experiments, we combined metagenomic and metatranscriptomic approaches to compare structural and functional responses of microbes to organic enrichment & metal toxicants. Significant differences in mRNA sequences revealed changes to a range of processes that were consistent with direct measures of function. Our research
suggests that molecular approaches are now sufficiently advanced to provide not just equivalent information to that collected using traditional morphological approaches, but rather an order of magnitude bigger, better, and faster data.

**Birds in Black Box: Avian community drivers in floodplain woodlands**

*Mr Thomas Hunt*1, Assoc. Prof. David Paton2, Dr Daniel Rogers3
1The University of Adelaide, Adelaide, Australia, 2The University of Adelaide, Adelaide, Australia, 3Department of Environment, Water and Natural Resources, Adelaide, Australia

**Biography:**

Thomas Hunt is a PhD candidate in the School of Biological Sciences at the University of Adelaide. His research interests span ornithology, terrestrial ecology and ecological processes. His research is based in the Riverland of South Australia and looks at the role Black Box woodlands play in avian community ecology.

The Black Box woodlands of the Murray River floodplains are thought to play a unique role for woodland birds in the region, providing key resources seasonally and during drought. These woodlands are threatened through modified flood regimes, and the current MDBA plan is unlikely to deliver enough environmental water to maintain them.

To determine the consequences of this for birds, we surveyed and compared avifaunal assemblages at 36 sites in the Riverland region of South Australia. Sites were divided between healthy and degraded Black Box and adjacent Red Gum and mallee woodlands, surveyed seasonally from 2013-2015 using 2ha 30 minute area searches.

Analysis showed that each woodland type supported a unique bird assemblage over each season, though there was greatest similarity between healthy Black Box and mallee communities. Degraded Black Box supported the least consistent bird assemblage, and the lowest species diversity and abundance. Certain bird species, particularly honeyeaters, pardalotes and whistlers, showed shifts in abundance between woodland types, following changes in seasonal resources (eucalypt flowering, invertebrate abundance); in effect showing a temporal habitat complementarity.

Healthy Black Box woodlands do play an important ecological role in the landscape, sustaining unique bird assemblages and providing resources that drive seasonal bird movements and abundance between woodland types. Critically, there is a considerable deterioration of the bird community as Black Box degrades, with implications for woodland birds regionally if hydrological deficiencies are not addressed.

**Distribution of riparian species across a shifting rainfall gradient in south western Australia**

*Ms Helen White*1,2, Dr John K. Scott1,2, Professor Raphael K. Didham1,2
1UWA School of Animal Biology, Crawley, Australia, 2CSIRO Land & Water Flagship, Floreat, Australia

**Biography:**

Helen White is a PhD student with UWA and CSIRO Land and Water Flagship. Her doctoral research is investigating the impacts of climate change on riparian ecosystems, aiming to develop adaptation strategies for restoration and management.

The south-west of Western Australia has one of the highest levels of floral diversity and endemism in the world. Geographic isolation, climatic stability and heterogeneous geomorphology throughout the region are believed to underpin the diversification of the flora. However, global climatic change, principally declining rainfall, is now predicted to shift the local climates of these geographically isolated communities away from optimal conditions. To understand how changing rainfall patterns might influence the flora of the region, we first need to understand the climatic constraints on local species and communities. The Warren River is located in the Karri and southern Jarrah forests of WA. While extensive research exists describing the floral communities in the adjacent upland forests, the regions riparian and wetland communities remain largely undescribed. Systematic vegetation surveys of the Warren River riparian zones were carried out to map the occurrence of trees and shrubs along what was historically a 600 – 1400 mm per annum rainfall gradient. These vegetation surveys were then augmented with LiDAR-captured elevation models to help identify potential limits of species distributions relative to local flow regime and regional climatic gradients. In this study we (1) present the first comprehensive description of the vegetation communities of the Warren River riparian zone, and (2) investigate and model the distribution of riparian species and age classes across local and landscape-scale gradients. Our findings will provide baseline information for land managers to develop climate adaptation scenarios for restoration, rather than relying on ‘historical’ restoration targets based on past climates.

**Where does the fox go? GPS tracking reveals individual variation in a generalist invasive predator**

*Ms Bronwyn Hradsky*1, Mr Ray Alexander2, Dr Euan Ritchie2, A/Prof Alan York1, Dr Julian Di Stefano1
1School of Ecosystem and Forest Sciences, University of Melbourne, Creswick, Australia, 2Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Bunwook VIC, Australia

**Biography:**

The south-western Australia has one of the highest levels of floral diversity and endemism in the world. Geographic isolation, climatic stability and heterogeneous geomorphology throughout the region are believed to underpin the diversification of the flora. However, global climatic change, principally declining rainfall, is now predicted to shift the local climates of these geographically isolated communities away from optimal conditions. To understand how changing rainfall patterns might influence the flora of the region, we first need to understand the climatic constraints on local species and communities. The Warren River is located in the Karri and southern Jarrah forests of WA. While extensive research exists describing the floral communities in the adjacent upland forests, the regions riparian and wetland communities remain largely undescribed. Systematic vegetation surveys of the Warren River riparian zones were carried out to map the occurrence of trees and shrubs along what was historically a 600 – 1400 mm per annum rainfall gradient. These vegetation surveys were then augmented with LiDAR-captured elevation models to help identify potential limits of species distributions relative to local flow regime and regional climatic gradients. In this study we (1) present the first comprehensive description of the vegetation communities of the Warren River riparian zone, and (2) investigate and model the distribution of riparian species and age classes across local and landscape-scale gradients. Our findings will provide baseline information for land managers to develop climate adaptation scenarios for restoration, rather than relying on ‘historical’ restoration targets based on past climates.

**Where does the fox go? GPS tracking reveals individual variation in a generalist invasive predator**

*Ms Bronwyn Hradsky*1, Mr Ray Alexander2, Dr Euan Ritchie2, A/Prof Alan York1, Dr Julian Di Stefano1
1School of Ecosystem and Forest Sciences, University of Melbourne, Creswick, Australia, 2Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Bunwook VIC, Australia

**Biography:**

The south-western Australia has one of the highest levels of floral diversity and endemism in the world. Geographic isolation, climatic stability and heterogeneous geomorphology throughout the region are believed to underpin the diversification of the flora. However, global climatic change, principally declining rainfall, is now predicted to shift the local climates of these geographically isolated communities away from optimal conditions. To understand how changing rainfall patterns might influence the flora of the region, we first need to understand the climatic constraints on local species and communities. The Warren River is located in the Karri and southern Jarrah forests of WA. While extensive research exists describing the floral communities in the adjacent upland forests, the regions riparian and wetland communities remain largely undescribed. Systematic vegetation surveys of the Warren River riparian zones were carried out to map the occurrence of trees and shrubs along what was historically a 600 – 1400 mm per annum rainfall gradient. These vegetation surveys were then augmented with LiDAR-captured elevation models to help identify potential limits of species distributions relative to local flow regime and regional climatic gradients. In this study we (1) present the first comprehensive description of the vegetation communities of the Warren River riparian zone, and (2) investigate and model the distribution of riparian species and age classes across local and landscape-scale gradients. Our findings will provide baseline information for land managers to develop climate adaptation scenarios for restoration, rather than relying on ‘historical’ restoration targets based on past climates.
Although red foxes Vulpes vulpes are notorious killers of Australian wildlife, there is little information available on their behaviour in forested landscapes or their responses to habitat modification. For example, do roads provide foxes with easy access to dense forest? Are foxes attracted to edges or recently burnt areas? Using GPS tracking collars, we investigated fox resource selection, activity patterns and ranging behaviour in the Otway Ranges, south-eastern Australia. Vegetation types varied along a rainfall gradient from heathland to wet forest, while time-since-fire ranged from <6 months to >75 years. We obtained more than 14,000 location data points from 13 individuals, including males, breeding and non-breeding females, and dispersing sub-adults. All foxes were caught within the forest, but numerous animals had home ranges that overlapped towns or farmland, with some foxes travelling up to 14 km a day. Home range size, movement behaviour and activity patterns differed substantially between individuals, even when resource availability was similar. In general, foxes did not select for particular resources at a broad scale, but strongly differentiated between habitats at a fine movement scale, selecting for habitats with high tree cover during the day and more open and edge habitats at night. Some individuals, however, consistently avoided or selected for open areas, or strongly selected resources at both broad and fine scales. Roads often promoted faster travel speeds. A better understanding of how foxes use forested and human-modified landscapes and how behaviour varies between individuals will help improve invasive predator management for biodiversity conservation.

Trends in new vertebrate detections in Australia

**Dr John Virtue¹, Associate Professor Phillip Cassey², Dr Michelle Christy²**

¹Primary Industries & Regions South Australia, Adelaide, Australia, ²University of Adelaide, Adelaide, Australia, ³Invasive Animals Cooperative Research Centre, Perth, Australia

**Biography:**
Manager of Natural Resources Management Biosecurity (weeds, pest animals, aquatic pests) in Biosecurity South Australia. Background in weed ecology, impacts, risk assessment and control. South Australian representative for the Invasive Plants and Animals Committee and the Marine Pests Sectoral Committee.

**Pathways to new, exotic vertebrate species establishing in Australia include stowaways and smuggling from overseas, and escapes or releases from deliberate or illegal keeping within Australia. A review of exotic vertebrate incursions and interceptions in Australia for the ten years to 2010 found a wide diversity of species posed risks as future pests (Henderson et al. 2011). Data collated from all governments in the five years since indicates similar propagule pressure, with all five classes of vertebrates continuing to be detected. Reptiles and amphibians are the most frequently intercepted vertebrates at the border. Of these, Asian spined toad represents a significant threat. Within Australia, reptiles are again the most frequently detected, such as red eared slider turtle, corn snake and boa constrictor, all of which are illegal to keep without a permit. Fish are probably under-reported, with limited surveillance occurring of illegal keeping and considerable variability in noxious status between jurisdictions.**


Rapid changes in intraspecific conflict during a biological invasion–suppression effects of larval cane toads

**Dr Michael Crossland¹, Dr Simon Ducatez¹, Dr Jayna DeVore¹, Prof Richard Shine¹**

¹University of Sydney, Sydney, Australia

**Biography:**
I am interested in the ecology and impact of invasive species, and application of ecological knowledge for conservation. My research has focused on invasive cane toads, and has led to the discovery of chemical interactions (attraction and suppression) that are currently being developed to control cane toads in several countries.

Many species rely on the production of chemical compounds for important processes such as communication, defence, and competitive interactions. However, the evolution of the production of, and sensitivity to, such compounds has seldom been investigated in vertebrates. Biological invasions provide us with a unique opportunity to investigate how these systems evolve as organisms colonise new environments. The larvae of many anuran species interact via such chemical compounds. One example is species-specific chemical(s) released by cane toad tadpoles that reduce growth, development and survival of conspecific embryos. We show that this suppression interaction has diverged substantially among cane toad populations in the course of their 80-year invasion of Australia. Embryos from long-colonised areas are significantly less sensitive to suppression cues, and their tadpoles produce weaker suppression effects in developing embryos, compared to conspecific populations from the invasion front. In Hawaii, the source population for cane toads in Australia and itself a long-colonised invasive population, suppression effects are also minimal. Our results illustrate how rapidly the intensity of chemical interactions can develop as species colonise new environments.

Secondary invasion on Christmas Island: a definition and demonstration of the concept

**Mr Luke O’Loughlin¹, Dr Pete Green¹**

¹La Trobe University, Melbourne, Australia
Biography:

Luke’s research interests include biological invasions, novel species interactions and community assembly. His PhD research has focussed on the determinants of invasion success and indirect facilitation between invaders in the context of invasional meltdown processes occurring on Christmas Island.

Biological invasions are a significant threat to all ecosystems and considerable research effort is focussed on determining the mechanisms of invasion success. Increasingly, positive interactions between alien species have shown to increase impacts and potentially facilitate other exotic species to enter the system. This phenomenon of secondary invasion is a key aspect of the invasional meltdown hypothesis but is rarely the focus of research and is poorly expressed in the ecological literature. We define secondary invasion as the scenario whereby the invasion success of one exotic species is contingent on the presence and influence of another exotic species. Clearly defining secondary invasion is important for two reasons; 1) for clarity, the term secondary invasion is used loosely and interchangeably with other terms to describe multiple aspects of biological invasions such as secondary spread, and 2) for ecological theory: defining the phenomenon allows researchers to consider these kinds of interactions when developing ideas on the drivers of invasion success. On Christmas Island, mutualism between invasive yellow crazy ants and honeydew-secreting scale insects has led to population explosions of both, dramatically altering the rainforest understory by causing the local extinction of omnivorous red crabs. We tested the hypothesis that by deleting red crabs, the ant-scale mutualism facilitates the secondary invasion of rainforest by a variety of non-native landsnails. Using results from our experiments on Christmas Island, we highlight secondary invasion as an important phenomenon in refining our understanding of the determinants of invasion success.

Managing multiple interacting threats – prioritising invasive plant management in the Australian Alps National Park

Dr Joslin Moore

Joslin works with practitioners to address invasive species management problems using decision theory, population models and other quantitative tools.

Most threatened species, communities or protected areas are subject to multiple threats, and the distribution of these threats varies in space and time. How do we decide which threats to address first and in which locations? Existing decision frameworks can be helpful when choosing between actions targeting threats to different species or locations. However, they rarely account for potential interactions among threats and do not account for future losses associated with threats left unmanaged. Interdependencies and unattributed losses are important considerations when allocating resources to the management of a specific population, community or national park facing multiple threats.

We present recent work that identifies management priorities that take account of both the benefit of taking action and the cost of failing to act when multiple processes threaten a single population or region. The framework considers the potential impact of current and future threats and accounts for the combined benefit associated with managing a suite of threats while also accounting for the consequences of unmanaged threats. We apply the framework to a case study of prioritising management of introduced plant species in two areas within the Australian Alps National Park. The framework identifies the amount of effort to allocate to each species for a given budget and shows how the threat context affects how resources are best allocated. This approach is suitable when seeking to prioritise management for any location or population facing multiple interacting threats.

Tipping the woody-grass balance: invasive Buffel Grass limits tree seedling recruitment in arid floodplain habitat

Dr Catherine Nano, Dr Chris Pavey, Dr S. Raghu

Dr Catherine Nano is a senior scientist with the NT Government in Alice Springs. Her research areas include threatened species recovery and tree-grass dynamics in fire-prone arid systems.

Recruitment in arid systems is highly episodic, being limited by abiotic influences such as climate and fire, and biotic competitive and trophic interactions. The nature of these biotic influences is changing globally in arid systems with the invasion of exotic grasses into many habitats, most notably through the impacts of the grass-fire cycle. While the exacerbation of fire in relation to grass invasions is increasingly well understood, other potential impacts of grass encroachment on the woody component of arid systems are poorly known. In particular, the extent to which invasive grasses can limit tree/shrub seedling recruitment requires further investigation. This information is key to predicting the resilience of arid systems,
especially in the context of changing climate and land-use parameters. To address this knowledge gap, we designed a field experiment to examine the impact of an invasive C4 grass (Cenchrus ciliaris; buffel grass) on seedling recruitment in a range of woody native species within a productive (= floodplain) arid system. Specifically, in the post-high rainfall phase when woody recruitment occurs, we examined the influence of presence of invasive grass and cattle grazing impacts on germination of four key woody species with contrasting life-history strategies (Acacia murrayana, A. salicina, A. victoriae and Hakea divaricata). Our results show that recruitment of these species is influenced by both grazing and the presence of invasive grasses, with the latter being the dominant negative influence. We interpret these findings from the perspective of the conservation and management of arid floodplain environments.

Priority threat management of invasive animals to protect biodiversity under climate change

Dr Jennifer Firn1, Dr. Ramona Maggini2, Dr Iadine Chades2,3, Dr Sam Nicol2,3, Ms Belinda Walters4, Dr. Andrew Reeson2, Dr. Tara Martin2,3, Prof. Hugh Possingham5, Dr. Jean-Baptiste Pichoncourt4, Dr. Rocio Ponce-Reyes6, Dr. Josie Carwardine2,3
1Queensland University of Technology, Brisbane, Australia, 2CSIRO, Brisbane, Australia, 3ARC Centre of Excellence for Environmental Decisions, NERP Environmental HUB, Centre for Biodiversity and Conservation Science, University of Queensland, Brisbane, Australia

Unwanted weeds or unique new Australians? A study of rapid evolution in introduced plants.

Ms Claire Brandenburger1, Professor Angela Moles1
1University of New South Wales, Sydney, Australia

Managing resources for an endangered species, Carnaby’s cockatoo, in a fire-prone landscape

Dr Leonie Valentine1, Dr Barbara Wilson2, Dr William Stock3, Dr Patricia Fleming4, Prof. Richard Hobbs1
1,2 Queensland University of Technology, Brisbane, Australia, 3University of New South Wales, Sydney, Australia, 4ARC Centre of Excellence for Environmental Decisions, NERP Environmental HUB, Centre for Biodiversity and Conservation Science, University of Queensland, Brisbane, Australia

Climate change is a major threat to global biodiversity and its impacts can act synergistically to heighten the severity of other threats. We develop a prioritization framework to assess strategies for managing threats to biodiversity under climate change and apply it to the management of invasive animal species across the Lake Eyre Basin. We collected information from key stakeholders and experts on the impacts of invasive animals on 148 of the region’s most threatened species and 11 potential strategies. Assisted by models of current distributions of threatened species and their projected distributions, experts estimated the cost, feasibility and potential benefits of each strategy for improving the persistence of threatened species with and without climate change. We discover that the relative cost-effectiveness of invasive animal control strategies is robust to climate change, with the management of feral pigs being the highest priority for conserving threatened species overall. Complementary sets of strategies to protect as many threatened species as possible under limited budgets change when climate change is considered, with additional strategies required to avoid impending extinctions from the region. Overall we find that the ranking of strategies by cost-effectiveness was relatively unaffected by including climate change into decision-making, even though the benefits of the strategies were lower. Future climate conditions and impacts on range shifts become most important to consider when designing comprehensive management plans for the control of invasive animals under limited budgets to maximize the number of threatened species that can be protected.

The introduction of thousands of plant species to new environments all over the world has had many damaging consequences, but has also provided an unprecedented opportunity to study the process of rapid evolution. Many previous studies have grown plants from across the range of a native population alongside introduced plants in common-garden experiments. But sampling across the range brings in a large amount of unnecessary variation and could hinder the detection of evolutionary change.

Using the results of a genetic study we located the actual source population of the South African beach daisy and then grew these plants alongside four introduced Australian populations. Reducing the other sources of variation is a novel and more powerful approach, and has aided in the discovery of an astonishing array of evolutionary changes. The introduced plants are longer and sprawling compared to the upright source plants, and the young plants have a larger percentage of above-ground biomass. Their leaves have evolved a different shape, and are thicker and smaller with many more leaf hairs underneath. The introduced plants make more flowers and more seeds with a higher rate of germination, and have even evolved the ability to produce seeds without pollinators. Remarkably, current work is also showing that they start flowering many weeks before their source population.

With so many evolutionary changes, could these unwanted weeds be evolving into a unique Australian species? This exciting idea has never been tested before - and could potentially revolutionise the way we consider and manage introduced species.

Managing resources for an endangered species, Carnaby’s cockatoo, in a fire-prone landscape

Dr Leonie Valentine1, Dr Barbara Wilson2, Dr William Stock3, Dr Patricia Fleming4, Prof. Richard Hobbs1
1,2 Queensland University of Technology, Brisbane, Australia, 3University of New South Wales, Sydney, Australia, 4ARC Centre of Excellence for Environmental Decisions, NERP Environmental HUB, Centre for Biodiversity and Conservation Science, University of Queensland, Brisbane, Australia
Granite Island has increased significantly from 0.54 fledglings per breeding pair in 1990 to 1.50 in 2013. Breeding site was abandoned and pre-performance and return rates of little penguins on Granite Island for 17 years in relation to patterns of population decline. But to date, the role of these variables is still not fully understood. To fully understand population decline, it is important to disentangle mortality of adults (which decrease population size) versus mortality of offspring (which suppress population dynamics). Over the past decade, populations of little penguins (Eudyptula minor) have been seriously declining across South Australia. A number of factors have been suggested to explain this decline such as mortality at sea, emigration to other sites, low reproductive success and/or poor juvenile survival. But to date, the role of these variables is still not fully understood. In this study, I investigated breeding performance and return rates of little penguins on Granite Island for 17 years in relation to patterns of population decline. I focused on the impacts of human disturbance, breeding site, abandon and predation on breeding success. Despite drastic population decline since 2001, breeding success on Granite Island has increased significantly from 0.54 fledglings per breeding pair in 1990 to 1.50 in 2013. Breeding site was the main factor affecting...

Landscape management activities, such as prescribed burning, manipulate habitat and alter the abundance and distribution of resources for species. Conservation management utilizing fire is particularly complex in fragmented peri-urban/rural habitat, where there are multiple, often conflicting objectives. Consequently, a critical element for successful threatened species recovery is to understand how fire management affects resource availability. We examined how fire can influence food resources for the endangered Carnaby’s cockatoo (Calyptorhynchus latirostris) of south-western Western Australia, a fragmented fire-prone landscape. Our study area supports the largest population of Carnaby’s cockatoo, a large, mobile parrot that principally feeds upon seeds. Tree density and seed productivity of dominant plant species, Banksia attenuata and B. menziesii, was compared across 44 sites of varying post-fire aged habitat. The seed productivity of both plants was strongly influenced by fire. Banksia attenuata produced more seed at sites aged 10 – 30 years since fire, while seed productivity for B. menziesii was highest in old sites (> 35 years since fire). Using the bird’s energetic requirements and seed energy content, we predicted higher numbers of Carnaby’s cockatoo could be supported in habitat aged between 14 – 30 years since fire, peaking in habitat aged 20 – 25 years since fire. However, >60% of the study area was burnt within the last 7 years. While human and asset protection is a priority for prescribed burning, management of landscapes to restore resources for threatened species is also important and complex trade-offs will have to be considered.

Sex and death in the Australian bush: Understanding reproductive success of the semelparous northern quoll

The northern quoll (Dasyurus hallucatus) is a medium-sized (approx. 1 kg) predatory marsupial previously common across the entire top-end of Australia. It is the largest known semelparous mammal in the world; mating is highly synchronous, characterised by total male die-off soon after the mating season and female survival up to three years. Such population-wide male die-offs are presumably due to the physiological stress of procuring copulations and intense fighting among males during breeding. Given the one off, short breeding period (approx. 2 weeks), the ability to find and secure mates is of critical importance. As such we would expect high levels of promiscuity and selection for the qualities that increase reproductive success in northern quolls; however there is no published field data to confirm this. We explored this idea using a mark-recapture study of more than 300 individual northern quolls located within a 128ha area on Groote Eylandt. For each individual, we measured the morphology, growth, movement and 6 performance measures used to determine overall ‘performance quality’. Using microsatellite DNA from pouch young of known mothers, we identified the most likely father of over 1000 wild caught northern quoll young from 158 litters over three field seasons. Promiscuity was prevalent in both male and females, however, the factors that increased promiscuity and reproductive success varied depending on sex. This is the first study to demonstrate multiple paternity in the northern quoll and identify the qualities that may drive reproductive success.

Why are little penguins declining? A long-term study of the Granite Island population

The northern quoll (Dasyurus hallucatus) is a medium-sized (approx. 1 kg) predatory marsupial previously common across the entire top-end of Australia. It is the largest known semelparous mammal in the world; mating is highly synchronous, characterised by total male die-off soon after the mating season and female survival up to three years. Such population-wide male die-offs are presumably due to the physiological stress of procuring copulations and intense fighting among males during breeding. Given the one off, short breeding period (approx. 2 weeks), the ability to find and secure mates is of critical importance. As such we would expect high levels of promiscuity and selection for the qualities that increase reproductive success in northern quolls; however there is no published field data to confirm this. We explored this idea using a mark-recapture study of more than 300 individual northern quolls located within a 128ha area on Groote Eylandt. For each individual, we measured the morphology, growth, movement and 6 performance measures used to determine overall ‘performance quality’. Using microsatellite DNA from pouch young of known mothers, we identified the most likely father of over 1000 wild caught northern quoll young from 158 litters over three field seasons. Promiscuity was prevalent in both male and females, however, the factors that increased promiscuity and reproductive success varied depending on sex. This is the first study to demonstrate multiple paternity in the northern quoll and identify the qualities that may drive reproductive success.

Why are little penguins declining? A long-term study of the Granite Island population

Population Ecology, December 2, 2015, 10:15 AM - 12:15 PM
breeding success, but I also found a negative impact of predation and human disturbance. However, I found that both fledgling and adult return rates were extremely low, suggesting little survival between years – perhaps due to low survival from parasites, starvation, or marine predators.

Do dormancy-breaking temperature thresholds change with aging of seeds in the soil seed bank?

Mrs Ganesha Liyanage1, Dr Mark Ooi1
1Centre for Sustainable Ecosystem Solutions, School of Biological Sciences, University of Wollongong, Wollongong, Wollongong, Australia

Biography:
Ganesha Liyanage is a PhD candidate at the University of Wollongong, researching physical dormancy variation and its ecological role. Her recently published paper in Annals of Botany; Intra-population level variation in thresholds for dormancy-breaking temperature, she and Dr. Ooi discuss the physically dormancy variation in fire-prone ecosystems.

In fire-prone ecosystems, germination studies of physically dormant seeds are usually done by focusing on the role of fire-related heat as a dormancy-breaking cue, but using only fresh seeds. In natural environments, persistent seed banks play a significant role in post-fire recruitment via seed germination. Seeds held within soil seed banks are likely to experience seasonal temperature fluctuations, physiological changes and physical deterioration when compared to fresh seeds, which could change the way seeds respond to dormancy-breaking over time. Previous research has also shown that for some species, the dormancy of fresh seeds is not broken by heat treatments representing soil temperatures that typically occur during fire, leading to the assumption that very high temperatures (> 80°C) are needed to break dormancy of fresh seeds. Therefore, we suggested that a sequence of processes, and/or time, may change the dormancy-breaking requirements of physically dormant seeds. We tested the dormancy of seeds, both buried in the field and under laboratory storage conditions, for four physically dormant species from fire-prone south-eastern Australia; Acacia linifolia, Bossiaea heterophylla, Viminaria juncea and Aotus ericoides. Replicate samples were retrieved after 6 and 18 months to test germination responses after heating at temperatures ranging from 40 to 100 °C. Field burial caused an increase in germination response over time, effectively reducing the dormancy-breaking temperature thresholds required for fresh seeds. Germination response of laboratory stored seeds indicated that storage time alone was the driver of change for some species, but that other contributing factors drove changes under field conditions.

Accounting for uncertainty in estimating Australia’s mammal extinction rate

Ms. Natasha Cadenhead1, AProf Brendan Wintle1, Dr. Michael Bode1
1The University of Melbourne, Melbourne, Australia

Biography:
Natasha Cadenhead is a research assistant in the Quantitative and Applied Ecology group at Melbourne University. She recently finished her masters on modelling uncertainty under future fire regimes for threatened species management in central Australia. She works on spatial conservation problems and is interested in using modelling to aid conservation decision-making.

Australia famously has the globe’s worst mammal extinction rate - in the short time since European settlement, 29 endemic mammal species have disappeared from the continent. Our estimate of this rate depends crucially on knowing which mammals are extinct, and secondarily on knowing when those extinctions occurred (to estimate how extinction rates are changing). But extinction is usually a process inferred, rather than observed, making assured claims of extinction difficult. Mis-estimates have material consequences. There is a cost to erroneously declaring a species extinct – they no longer receive funding or protection. Such errors may prove self-fulfilling prophecies. There is also, arguably, a reputational cost to conservation when species thought to be extinct are rediscovered. We use recently developed Bayesian methods to systematically infer the post-1788 extinction status and dates of Australia’s endemic mammals, using data compiled in the Australian Mammal Action Plan. Using certain (e.g., museum specimens) and uncertain (e.g., recorded observations) sighting records, we (1) construct confidence bounds around the status and extinction date of species thought to be extinct, and (2) estimate the probability that critically endangered species are in fact extinct. The results give a more nuanced, and less certain, impression of the rate and extent of Australia’s recent mammal extinctions. Specifically, although our uncertainty about extinctions operates in both directions (species thought to be extinct may in fact be extant; species classified as critically endangered may actually be already extinct), the net effect is that there have likely been fewer extinctions than previously thought.

Are Tiwi Island small mammal populations safe from decline?

Mr Hugh Davies1, Dr. Brett Murphy2
1University of Melbourne, Melbourne, Australia, 2Charles Darwin University, Darwin, Australia

Biography:
Hugh Davies is researching how and why small mammal populations might have changed over the past 15 years, focusing on the Tiwi Islands, one of the last areas in Australia still considered as supporting an intact assemblage of small mammals.
Despite the massive declines of small mammal populations recorded across mainland northern Australia, the mammal populations on the Tiwi Islands have long been regarded intact. However after an extensive trapping program 15 years ago, there has been little monitoring of small mammal populations on the Tiwi Islands since. Here we describe a live-trapping program targeted at determining how and why small mammal populations have (or haven’t) changed over the last 15 years. Results reveal a significant decrease in the detectability of species, as well as a decrease in overall trap success, especially for the Brush-tailed Rabbit-rat, a species now extinct from Kakadu National Park. These findings provide the first indication that the small mammal fauna of the Tiwi Islands may currently be experiencing decline and therefore can no longer be considered intact or safe.


**Dr Simon Ducatez**, Pr Rick Shine
*University of Sydney, Sydney, Australia*

**Biography:**
Dr Simon Ducatez has the following qualifications:
2008-2011: PhD (MNHN Paris) on the evolution of dispersal in butterflies
2011-2015: PhD (McGill University, Montreal) on variation in cognition in birds.
2014-present: postdoc (University of Sydney) on the evolution of cane toads’ developmental plasticity with invasion history, and on the predictors of invasion success and extinction risk in vertebrates.

Understanding why species differ in their risk of extinction is crucial for conservation. The IUCN red list has been extensively used to investigate predictors of species extinction risk. Extinction risk however does not consider the mechanisms driving species to extinction and is difficult to translate into effective management. Using data from the IUCN for over 23,000 species, we investigated whether the criteria used to determine extinction risk (population trend, population size or distribution range) and the threat types affecting terrestrial vertebrates differed across Classes (birds, mammals, amphibians and reptiles), and whether sensitivity to a specific threat category predicted sensitivity to others. Amphibians and reptiles’ extinction risk was mostly determined by range size, whereas population size and trend were important criteria in birds and mammals.

Differences in average distribution range size across Classes likely explain this pattern. Habitat alteration affected the largest proportion of species within the four classes. Amphibians were also particularly sensitive to invasive species (including diseases), mammals to hunting, and birds were the most sensitive to climate changes. Sensitivity to habitat alteration, invasive species and hunting were strongly associated, species affected by one of these categories being more likely to be affected by the others. Sensitivity to climate change was independent. These results show that different mechanisms drive extinction risk in the four Classes, and underline the importance of considering a range of threats in conservation plans. We will conclude by exploring the link between intrinsic traits and sensitivity to the different threats across and within vertebrate Classes.

**Estimating population density: a comparison of methods using the Northern Quoll (Dasyurus hallucatus)**

**Dr Skye Cameron**, Ms Morgan Rubanow, Ms Jaime Heiniger, Mr Jeremy Rigma, Dr Robbie Wilson
*University of Queensland, University of Queensland, St Lucia, Australia*

**Biography:**
Dr Skye Cameron’s research focuses on how organisms respond to environmental variation; seasonal and long-term temperature change, and the costs of these responses. Currently she examines interactions between behavioural, physiological and morphological traits to further our understanding of how an organism’s performance relates to population-level processes, enabling better conservation practices.

Effective approaches for the management and conservation of wildlife require a comprehensive knowledge of population demographics. Historically, population density estimates have been primarily obtained through costly and labour intensive mark-recapture programs. However, wildlife monitoring technology is advancing rapidly and the use of remote sensors, such as camera traps, have become increasingly popular. The main benefits of camera trapping methods are that they are more cost and labour effective than live trapping and allow for surveys of population demographics to be conducted over greater spatial and temporal scales. The most frequently used camera trapping method is capture-recapture studies. This requires individual recognition of animals with identifiable markings. Alternatively, density can be estimated using random encounter models, predicting the expected encounter rate for a given density based on the species life history traits. This method is unique in camera trapping in that it does not require natural identifiable markings on individual animals. However, the relative effectiveness of these two camera-trapping methods versus mark-recapture programs at predicting population density has been little studied and requires further investigation. This study for the first time directly compares density estimates from mark-recapture with camera based capture-recapture techniques and random encounter models in a population of endangered but locally abundant northern quolls (Dasyurus hallucatus) within a 128-hectare trapping area on Groote Eylandt, NT. The results of this study will enable further development of a robust sampling method of camera trapping for population demographic studies adding in the effective management and conservation of threatened and endangered species.

**Variation of Serotonin in Callichitris preissii related to fire and climate in Western Australia**

**Dr Xiaoying Zhao**, Dr Philip G. Ladd, Dr Neal Enright, Dr Joe Fortaine
*School of Life Science, Xinjiang Normal University, Urumqi, China, School of Veterinary and Life Sciences, Murdoch University, Perth / Murdoch, Australia*
Delayed seed release (serotiny) is a syndrome of adaptive significance in a randomly fluctuating environments such as fire-prone and arid ecosystems. Selective forces involving fire, rainfall and seed predators have been suggested as factors influencing serotiny. Callitris preissii is a conifer in the Cupressaceae found only in Australia and New Caledonia and it is regarded as “fire sensitive”. It has excellent potential for erosion control of sandy, alkaline coastal sites and has been used in revegetation in many region in Western Australia. We compared the degree of serotiny among different populations and related this to fire history, climate and seedling predators. The relative ages of cohorts of closed cones were determined on trees in populations ranging from arid interior sites to islands with much higher annual rainfall. The individuals with the greatest serotiny grow at inland sites (Kalgoorlie and Lake Grace), while the plants with the lowest serotiny were recorded at island sites. Seedling recruitment after fire at Boorabbin National Park burnt in 2007 was dense and at Cape Le Grand National Park near the south coast of Western Australia a patchy fire produced many seedlings in burnt areas. However in both areas seedlings were absent from unburnt sections. The strong serotiny at these sites ensures an abundant seed rain after fire kills adult plants. The weaker serotiny at the island sites might be thought to relate to the possibility that there is interfere recruitment of the plants.

Small mammal decline in northern Australia from the perspective of a marsupial glider.

Ms Alyson Stobo-Wilson1, Dr Teigan Cremona1, Dr Brett Murphy1, Prof Sue Carthew1

1RIEL, Charles Darwin University, Box 41, Red Building 1, Ellengowan Drive, Australia

Rapid and catastrophic declines of a broad array of small mammals across northern Australia have been well documented in recent decades. These declines have been linked to predation by feral cats and changed fire regimes. The northern marsupial glider (currently designated as Petaurus breviceps ariel) in northern Australia. Prior to this opportunity, I worked as a Research Assistant at Charles Darwin University and completed a Bachelor of Science with Honours at the University of Tasmania in 2014.

Small mammal decline in northern Australia from the perspective of a marsupial glider.

Jill Landsberg: greatest hits 1980-2005

Dr Sue McIntyre1

1CSIRO and Fenner School ANU, Canberra, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Sue McIntyre is a plant ecologist with 35 years research experience at the University of Melbourne, University of New England and CSIRO. Sue is currently a Fellow at CSIRO and the Australian National University in Canberra. She is working on the floristic restoration of temperate woodlands and forest.

In her 25 years as a professional ecologist, Jill Landsberg was a pioneer of biodiversity research in production landscapes. With CSIRO colleagues, Jill explored the effects of grazing intensity on arid plant communities through natural experiments provided by remotely spaced watering points in rangelands. Her work led to the realization that increasing the density of stock watering points to better utilize pasture could be a problem for biodiversity; grazing-sensitive plants and animals would no longer be protected by their large distance from water.

Jill’s post-graduate research with David Lamb, Ross Wylie and then Ian Noble identified the underly...
No less important was Jill’s work for the ESA Executive, including the organization of three annual meetings, when attendance grew six-fold. She also worked on a large number of governmental advisory groups relating to endangered species protection. These areas of work are relatively low-profile, but are a reminder to us of the crucial role of professional service in the advancement and application of ecological knowledge.

Does vegetation composition vary along a time-since-grazing chronosequence?

Dr Sally Kenny1, Ms Claire Moxham1
1Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water & Planning, Heidelberg, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Sally Kenny is a Senior Scientist at the Arthur Rylah Institute for Environmental Research. Her research interests include grazing, semi-arid ecosystems, fire, invasive species and landscape ecology.

One of the most common native vegetation management interventions in the agricultural landscape is fencing of remnant vegetation to exclude stock and facilitate recovery from degradation caused by stock grazing. Successful vegetation recovery is usually measured by comparing a fenced remnant to: (1) an unfenced remnant grazed by stock, (2) the pre-fencing condition of the fenced remnant, or (3) to a local ‘reference’ site with no history of stock grazing.

Fifty sites were established in remnant vegetation across the Victorian Mallee in grazed and ungrazed remnants. Sites were stratified on grazing level: grazed, recently ungrazed (< 10 years since grazing) or long ungrazed (> 10 years since grazing), and within three vegetation communities: Saltbush Mallee, Dry Woodland, Inland Plains Woodland. Information collected at each site included species richness and direct percent cover of species and substrate (bare ground, litter, cryptogams). Non-metric multidimensional scaling ordination and generalised linear models were used to investigate the relationship between species composition and time-since-grazing.

Vegetation communities differed along the time-since-grazing chronosequence. While a clear pattern of grazed to recently ungrazed to long ungrazed does not exist within these sites, grazed and long ungrazed sites were different to each other. Drought and vegetation type were also important drivers of vegetation composition. This was not an unexpected result and it highlights the importance of understanding how factors other than time-since-grazing influence vegetation composition and abundance. Vegetation changes and improvements in condition after release from stock grazing is most evident 10 or more years post-grazing.

The impact of grazing domestic stock on rangeland vertebrate fauna in tropical Australia

Dr Alex Kutt1, Dr Teresa Eyre2
1ARCUE, School of BioSciences, University of Melbourne, Australia, 2Queensland Herbarium, Toowong, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Associate Professor Alex Kutt has 25 years experience working as a wildlife ecologist eastern Australia, with a large stint in northern Queensland. Dr Teresa Eyre has 25 years experience working as a wildlife ecologist in eastern Australia, with a large stint in southern Queensland.

Rangelands dominate the Australian land mass, and the grazing of cattle is the dominant agricultural land use. Recently the Australian Government has released two key policies for agriculture; Our North, Our Future: White Paper on Developing Northern Australia and the Agricultural Competitiveness White Paper. Both support increased investment in agricultural infrastructure and land and water use intensification. These have implications for fauna in our tropical rangelands; therefore it is timely to review our current understanding of the ecology and management of tropical rangelands with respect to fauna. In the past the artificial watering points, stocking rates, clearing for exotic pasture, and exotic species and landscape ecology.

Monitoring rangelands in northern Australia – some new approaches

Prof David Gillieson1
1James Cook University, Cairns, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:

Monitoring change in northern rangelands takes place in the face of increasing climatic variability, increased stocking rates and reduced availability of funding in both public and private sectors. These factors combine with the large size of grazing properties in the north to mandate the use of remotely sensed data at multiple spatial and temporal scales, coupled with targeted on-ground data. New satellite sensors provide data sources, some free, that have increased spatial, temporal and spectral resolution. These provide pertinent data for change detection at scales from individual paddocks up to whole regions. Initiatives in carbon farming, especially on Indigenous owned lands, require accurate and repetitive fire scar mapping. Pasture condition monitoring requires appropriately scaled estimates of projected foliage cover and green cover. The challenge is in how to integrate remotely sensed, modelled and on-ground data sources into products that are relevant, conservative, unequivocal and cost-effective. Using examples drawn from regional and local monitoring schemes, I review progress in rangeland monitoring using remotely sensed data that is validated by on-ground measurements and models of vegetation structure and its seasonal variation.

Eucalyptus dieback in the Monaro region, NSW

Ms Catherine Ross1, Dr Cristopher Brack
1Australian National University, Acton, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Catherine Ross is a PhD student at the ANU Fenner School, studying the impact of reintroduced native marsupials on ecosystem processes. Her honours research investigated Eucalyptus dieback in the Monaro region of NSW. Catherine also has experience working for Greening Australia on restoration projects in agricultural landscapes.

Widespread decline of tree health in agricultural landscapes, also known as rural dieback, has occurred widely throughout rural Australia and may be caused by a range of interacting factors. In the Monaro region of NSW, substantial numbers of Eucalyptus viminalis have been observed as declining in health over the last decade. Based on a systematic road survey, the affected area is estimated to cover around 2000km², with almost all E. viminalis within that area either dead or severely affected. Field observations include widespread infestation of an endemic weevil (Gonipterus sp.).

Although superficially similar to other episodes of rural dieback, this ‘Monaro dieback’ does not appear to follow patterns observed elsewhere. Despite large differences in structural elements and overall complexity, the level of dieback was consistently severe across the range. There does not appear to be sufficient evidence to conclude that changed land management practices, recent fire history or declining levels of structural complexity are responsible for the Monaro dieback.

If the dieback continues at the current rate it seems inevitable that E. viminalis will disappear entirely from the Monaro region. As E. viminalis is the dominant species in many areas, such disappearance will have very serious consequences on the ecology of the region. Circumstantial evidence suggests that the dieback may be related to changes in climate or rainfall patterns, however further work is required to confirm this. Rehabilitation efforts should include trials of potential replacement species that are able to cope with future climate change scenarios.

Managing grazing landscapes for ground dwelling herpetofauna

Ms Stephanie Pulsford1
1The Australian National University, Acton, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Stephanie Pulsford is a PhD student at the ANU and is currently researching the influence of management actions on reptile and frog population in grazing landscapes in SE NSW. She has interests in landscape ecology and post disturbance ecosystems.

Simple methods of managing the grazing matrix can have large positive impacts on native animals. Little is understood about how to manage the matrix for animal with low mobility such as reptiles and frogs. As food demand increases and agricultural landscapes are pressured to produce more, we need to better understand how to manage highly patchy and fragmented landscapes.

I will present my research which shows important findings about reptile and frog movement in grazed landscapes. The first major finding is that planted trees can be highly beneficial for these small ground dwelling species. The second is finding provides further evidence that the simple and easy management action of leaving downed timber in place in paddocks can be an effective way of managing the matrix for native reptiles.

I used a field survey of reptile and frog populations in Box Gum Grassy Woodland grazing country in NSW to examine the influence of different management actions on the populations of these native ground dwelling animals. Four matrix treatments were investigated in this study: business as usual grazed paddock, addition of course woody debris to a grazed paddock, fence line and linear tree planting. Each treatment was compared to
adjacent patches of remnant woodland. Two grazing regime categories were also examined – whether the site was conventionally or rotationally grazed.

Is grazing and biodiversity conservation compatible in the semi-arid rangelands of NSW?

Ms Sarah McDonald 1,2, Prof Nick Reid 3, Dr Rhiannon Smith 1, Dr Cathy Waters 2, Dr John Hunter 3, Mr David Tongway 1, Dr Romina Rader 1

1 School of Environmental and Rural Science, University of New England, Armidale, Australia, 2 NSW Department of Primary Industries, Trangie, Australia, 3 School of Behavioural, Cognitive and Social Sciences, University of New England, Armidale, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Sarah McDonald is a PhD student at the University of New England, Armidale. Current research interests include grazing management for biodiversity conservation and the ecology and management of arid and semi-arid rangelands.

Domestic livestock grazing is often seen as a threat to biodiversity conservation. Although there is evidence to suggest that appropriately managed grazing is compatible with maintaining biodiversity and conservation objectives, little research has been undertaken in western NSW to confirm this. This project is exploring the implications of commercial grazing management for biodiversity conservation and landscape function, with the aim of determining the potential to integrate livestock production and biodiversity conservation in the NSW semi-arid rangelands. Full floristic surveys and Landscape Function Analysis were undertaken across paired sites throughout north-western NSW, comparing areas under nature conservation (ungrazed), traditional grazing management and alternative (eg, high-intensity, short-duration, long-rest) grazing management. Initial analyses revealed no significant differences in species richness, diversity and turnover between the different conservation and grazing treatments. Multivariate analysis showed strong floristic differences between soil types and site locations, with recent and long-term rainfall important drivers of composition as well. Total groundcover was higher under conservation in spring, but there were no differences in the following autumn. Similarly, there were no differences between grazing treatments in soil stability, infiltration or nutrient cycling. Analyses of functional composition and presence of rare species will be made, and additional surveys and experiments undertaken over the next 18 months. If there are few differences in floristic diversity and landscape function between the grazing strategies compared, appropriate grazing management may be compatible with conservation in semi-arid NSW.

Putting a price on stocking rates conducive to Eucalyptus coolabah recruitment

Dr Nerissa Haby 1,2

1 Wid R&D, Umbrae, Australia, 2 Natural Resources SA Arid Lands, Port Augusta, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (1), Ballroom A, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Nerissa Haby is passionate about conducting research to improve conservation activities and natural resource management. Over 15 years, she has accomplished investigations relating to the effectiveness of landscape recovery programs, species range dynamics, methods of species detection, and species' ecology (interactions, resource selection, seed persistence).

The Warburton-Diamantina floodplains provide some of the most productive country for pastoralism in the South Australian rangelands. Elevated stocking rates can limit recruitment in Eucalyptus coolabah: a locally important species for biodiversity and carbon storage. This investigation aimed to identify maximum stocking rates that avoid browse on coolabah recruits (<1.6m), a carbon incentive value, and palatable species indicating grazing levels conducive for the growth and development of recruits. In Autumn 2014, 15 nested transects were used to sample herbivore sign, coolabah browse (100 x 4m), and understorey species (100 x 2m). Stocking rates were calculated as 10-year average stocking densities attributed to the 'floodplain' area (within 8km of natural watering points). Less than 10% of recruits were browsed when floodplain stocking rates averaged 0.92 cattle/km2, compared with 25 to 100% with 1.82 cattle/km2, indicating a carbon incentive of $30.95/km2 would make reducing stocking rates on floodplain financially viable (based on 15% profit on a $227.20 heavy steer). Up to 34% of the variance in understorey composition was explained by cattle browse, cattle scat and rabbit browse indices (NMS ordination). Under lower grazing intensity (>53 scats/ha), eight palatable or sensitive species were identified: Calotis hispidula, Cullen spp., Dactyloctenium radulans, Eragrostis spp., Salisia australis, Sclerolea dicaranya, Triarapis mollis, and Zygophyllum spp. (ISSA IV 61.3 -100.0, P<0.05). Overall, reducing stocking rates to 0.92 cattle/km2, in conjunction with rabbit control, is likely to encourage the growth and development of coolabah recruits and other palatable or sensitive species, and support biodiversity in these areas.

Fire and fire-adapted lineages in the Australian Cretaceous: is there a fossil record?

Dr Ray Carpenter 1,2

1 University of Tasmania, Hobart, Australia, 2 University of Adelaide, Adelaide, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Professor Ray Carpenter is a behaviour ecologist whose research is focussed on exercise and physical activity programming in older adults. His work is internationally recognised for the development of the first novel exercise program for older adults and has contributed to the development of evidence-based programs for older adults, children and dis-enfranchised groups.
The Cretaceous period is characterised by global burning, which coincides with the rise to terrestrial vegetation dominance by angiosperms. The fossil pollen record shows the presence of angiosperms in Australia over 110 million years ago, and perhaps the most striking aspect of this record is the apparent abundance and diversification of Proteaceae during Santonian–Maastrichtian times (~86–72 Ma). These plants are envisaged to have ‘invaded’ the prevailing austral gymnosperm forests that were dominated by Podocarpaceae and Araucariaceae. Proteaceae are a key group in interpreting the evolution of fire-adapted lineages, being strongly represented in extant open, regularly burnt, sclerophyll heathlands. Unfortunately, the pollen record is of very limited use in detecting whether fire was an evolutionary driver for any of the Proteaceae radiations, and until recently, there was virtually no fossil record of plant remains other than pollen for the latest Cretaceous. Here I show from newly discovered leaf remains that a highly diverse proteaceous flora was present in the Late Cretaceous of central Australia, and that there is powerful evidence for open, sclerophyllous vegetation and fire. These findings are consistent with molecular evidence for early origins of fire-adapted traits in Proteaceae, and raise the question of whether such traits in other lineages are similarly ancient, and indeed whether whole Australian communities were fire-adapted in the Cretaceous and throughout the apparently wet, rainforested Paleogene. So far, for instance, there is no evidence for Eucalyptus in the Cretaceous.

Open vegetation without fire – an ancient component of the biota

Dr Greg Jordan

University of Tasmania, Hobart, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Greg Jordan is an evolutionary biologist, palaeobotanist and ecologist with a particular focus on the functional links between plants and environment (especially climate). Part of this relates to developing tools for working out how climates have changed and how plants have responded. Works as a research and teaching academic at the University of Tasmania.

Fire has such a huge influence on the structure of modern Australian vegetation that it can obscure the significance of other factors. In particular, it is tempting to accept that the mesic biota follows a simple dichotomy between “fire-free” rainforest (closed forest) and “fire-prone” vegetation that includes persistent open sclerophyll and grassland communities. Exceptions to this rule are considered as trivial. Here I present evidence that, in evolutionary terms, these exceptions are non-trivial. I present show that some modern open sclerophyllous vegetation that not only has deep history but is also strongly associated with fire-free conditions. I further present fossil evidence for fire-free, open vegetation containing sclerophyllous plants from clades that are major components of the modern fire-dependent sclerophyll flora. I therefore argue for a more complex view of the Australian flora than the old paradigm that the fire-prone biota evolved in the Neogene from rainforest ancestors or the more recent paradigm that fire-prone open vegetation existed in parallel to rainforest since the Cretaceous. Instead I propose a multiple filter model in which Cretaceous fire-adapted vegetation underwent massive filtering during warm, very wet, low fire environments in the Eocene (about 50 million years ago). At this time rainforest flourished, but open vegetation survived in areas of very low nutrients. The persistence of some sclerophyll groups such as eucalypts may (or may not) have been facilitated by the ongoing presence of fire, but this is not necessary or parsimonious for other groups such as Proteaceae, Ericaceae and some monocots.

The macrofossil record of the eucalypts

Prof Bob Hill1, Ms Yelarney Beer, Dr Kathryn Hill, Ms Elizabeth Macinans, Mr Myall Tarran, Mr Christopher Wainman

University of Adelaide, ,

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Professor Bob Hill is Executive Dean of the Faculty of Sciences at the University of Adelaide and Director of the Environment Institute. His research focuses on the evolution of the Australian vegetation over the last 60 million years, when most major aspects of the living vegetation came into existence.

Eucalyptus sensu latu dominates the Australian vegetation today in way that is rarely matched by a single genus anywhere else on Earth. In many ways Eucalyptus defines Australian vegetation. The sparseness of the Australian eucalypt macrofossil record is therefore surprising. At present the oldest and most spectacular eucalypt macrofossils are from the Early Eocene of Argentina. Combined with convincing records of Miocene leaves and fruits in New Zealand, this is clear demonstration of a much broader range for the genus in the past. However, the convincing Australian record is sparse, and generally much more recent than the Argentinian record, although there are possible early records that are tantalizingly close to Eucalyptus, but not well enough preserved to allow a certain identification. Eucalyptus first appears relatively commonly in the Oligocene on the east coast of Australia, where most of the known plant fossil record is concentrated, and there are signs of a mosaic of diverse rainforest interspersed with eucalypt-dominated vegetation. However, nowhere in the fossil record is there any evidence of the kind of eucalypt domination that we see in the living vegetation.
Fire in the southeastern Australian Tertiary mega peat swamps: evidence from pollen, macrofossils and charcoal.

Dr Ian Sluiter1,2, Dr David Blackthorn2, Dr Guy Holdgate4, Ms Vera Korasidis4, Dr Malcolm Wallace4

1Federation University Australia, Mt Helen, Australia, 2Ogyris Ecological Research, Birdwoodton, Australia, 3The University of Adelaide, Adelaide, Australia, 4The University of Melbourne, Melbourne, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Ian Sluiter is an ecologist who has published widely in the field of Australian Tertiary vegetation history. More recent work and publications have focussed on landscape ecology, rare or threatened plant and animal conservation biology and mine rehabilitation in the semi-arid and arid lands of southeastern Australia.

Peat swamps and swamp forests covered vast areas of low coastal plains of southeastern Australia during periods of high sea level through the Eocene to Miocene period. The swamps developed as very thick accumulations of peat, not dissimilar, but appreciably more expansive than those occurring within Indonesia and Malaysia at the present day. Over the past 15-45 million years, these peat swamps have subsided within the Gippsland Basin, have been compressed and are now present as massive brown coal seams, in places over 100m thick. The vegetation occurring on these ancient peat swamps was largely swamp forest dominated by angiosperms and conifers related closely to present day Australasian rainforest plants. The presence of abundant charcoal within occasional bands or lithotypes of the coals provides compelling evidence of past swamp wildfires. Fossils related to modern sclerophyllous plants with known fire associations at the present day are found within charcoal coal lithotypes. This paper outlines the pollen and macrofossil plant assemblages that characterize the Tertiary brown coal lithotypes which contain common charcoal. We also examine how these plant assemblages have changed over the Eocene to Miocene period.

Fire, people and ecosystem change in late Pleistocene Australia

Prof Chris Johnson1

1University of Tasmania, Hobart, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Chris Johnson studies conservation science and the ecology of current and past environments.

When humans arrived in Australia around 50,000 years ago, they occupied environments that had already been conditioned by fire over many millions of years. Two questions on the impact of fire-wielding people on Australian environments have long been controversial. Did they cause substantial shifts in fire regimes and, consequently, the structure and composition of vegetation? And did such shifts in fire and vegetation cause significant changes to fauna, contributing to extinction of Pleistocene megafauna in particular? Research on both questions has intensified over the last ten years. On the first question, it has been difficult to demonstrate widespread effects of early humans on fire regimes. Step changes in fire activity linked to human arrival are rare; subtle shifts in fire pattern may have occurred but are difficult to demonstrate. On the second, most evidence on megafaunal extinction points to direct human impact, not habitat change due to fire, as the main cause. On the other hand, the removal of large herbivores by people may have resulted in increased fire and substantial shifts in vegetation, in some environments but not in others.

Fire in Australia: the last 70,000 years

Dr Janelle Stevenson1

1Australian National University, Canberra, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Janelle is a palaeoecologist with experience working in Australia, Southeast Asia and the Pacific. She has a particular interest in understanding Quaternary climate and landscape change and the intersection of this with human activities.

It is known from ethnographic observation, historical documentation and oral tradition that fire is an important aspect of Indigenous landscape management in Australia. Possibly overwhelming this fine grained use of burning however, are the large scale climatic drivers of fire revealed by a compilation of sedimentary charcoal records covering the last 70,000 years from across Australia. This compilation suggests that colder periods are characterized by less fire and warmer intervals by more burning. While the composite record for the region shows considerable millennial-scale variability, there is no apparent change in fire regime corresponding to the arrival of humans in Australia at around 50,000 years ago and no correlation between archaeological evidence of increased human activity and biomass burning for the last 40,000 years. However, changes in biomass burning over the last 200 years may have been exacerbated or influenced by people.

The 'lost' plains of Northern Victoria - evidence from the historic record of pyrogenic grassland

Mr Paul Foreman1
The complex interrelationships between climate, soils, fire and humans in the biogeography of grasslands has long been debated in Australia. Enumeration of the detailed interactions will not be possible without critical assessment of the historic record. In this study, I reconstruct a detailed pre-colonial grassland distribution map for much of northern Victoria using early survey plans corroborated by the journals and testimony of explorers and pioneering pastoralists, some of whom noted traditional Aboriginal burning on plains for staple roots like Yam Daisy. The composite map showed extensive natural grasslands in unexpected locations, especially in parts of central and north-east Victoria, where contemporary native vegetation mapping presumes the dominance of trees. Targeted field sampling revealed numerous remnants across the study area and cluster analysis showed evidence of a poorly known, higher rainfall, Riverine grassland dominated by Kangaroo Grass. Spatial analysis showed clear distribution patterns around prominent landscape features like major watercourses and ranges that were or likely were important places for Aborigines. Comparison with detailed soil maps showed striking bioregional divergence, with a strong correlation in the lower rainfall north-west, but little spatial association in the east and south. It is suggested this divergence, along with the unique spatial patterns and historic accounts is evidence of pyrogenic grassland instigated by humans. And it is hypothesised, reintroducing frequent fire – in effect, reviving traditional burning practices – will be a critical aspect of protecting and restoring the composition and function of a hitherto ‘lost’ form of a nationally, critically endangered ecosystem.

Fire and a rare rainforest conifer (Wollemi pine)

Ms Heidi Zimmer1, Dr Tony Auld2, Prof Lesley Hughes3, Dr Cath Offord4, A Prof Patrick Baker1

1University of Melbourne, Bundoora, Australia, 2Office of Environment and Heritage, Hurstville, 3Macquarie University, North Ryde, 4Australian Botanic Garden, Mt Annan,

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Heidi Zimmer is an ecologist doing her PhD on the Wollemi pine.

Rainforests were once thought to be highly sensitive to fire, but recent research suggests otherwise.

Fire is listed as a key threat to Wollemi pine, a critically endangered conifer with a population of only 83 mature individuals remaining in the wild. Wollemi pine occurs within rainforest in a small canyon system in the Blue Mountains, north of Sydney. Many Wollemi pines have fire scars, and a multi-stemmed habit that suggests a capacity to resprout.

We experimentally burnt Wollemi pine and co-occurring Coachwood and Lilly Pilly seedlings in single fires of up to ~600 C. All species re-sprouted, and resprouting height and growth rate decreased with increasing temperature. In a further experiment we compared the flammability of Wollemi pine litter with mixed litter from the rainforest angiosperms. Wollemi pine litter was more flammable.

The relationship between Wollemi pine and fire is more complex than simply threatened species and threat. Wollemi pine habitat is considered a fire refuge, with less fire relative to the surrounding landscape. However, Wollemi pine can survive some fire and indeed may resprout more vigorously than co-occurring species. The flammability of Wollemi pine litter may have led to increased fire in the vicinity of mature Wollemi pines. Potential implications of this include removal of competing seedlings, promotion of multi-stemmed habit, and severe fire could even result in canopy gaps and increased light levels at (surviving) seedlings.

Are mallee trees smart? Spacing influenced by bushfire and the hydric environment.

Dr Georgia Koerber1, Professor Wayne Meyer1, Dr Elena Kondrlova2, Dr Ramesh Raja Segaran1, Mr Adam Kilpatrick1, Dr Kenneth Clarke1, Mr Qiaoqi SUN1, Professor Megan Lewis1, Associate Professor Lian Pin Koh1

1School of Biological Sciences, University of Adelaide, Adelaide, Australia, 2Department of Biometeorology and Hydrology, Slovak University of Agriculture, Nitra, Slovakia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
My PhD measured salt and drought tolerance ecophysiology of a natural hybrid of Eucalyptus largiflorens, called Green Box. My postdoctoral research formed carbon budgets for vegetable production in the UK, Spain and Uganda from soil respiration. I am interested in plant adaption, carbon and water ecosystem balance.

Understanding drivers of spatial distribution of mallee trees, may benefit revegetation regimes, biomass farming, and cropping on former mallee soils. In June 2014, we flew a multirotor unmanned aerial vehicle (UAV), over a 1Ha burnt Ausplot (burn January 2014; burn area = 52713.5 Ha, perimeter 140 km) adjacent to the Calperum Mallee Flux Tower. Mapping results indicate that regrowth of trees occurred in a random pattern,
average spacing 2.58m. We repeated UAV surveying and canopy distribution calculations in April 2015 over this same burnt ridge, as well as adjacent unburnt ridge and unburnt swale sites. Concurrently, water potential was measured at each site; pre-dawn results show a significant difference between the ridge sites and the swale site (2.3, 2.8 MPa; P = 0.007 and 0.000 respectively). However by midday, hydraulic pull by the canopies was apparent and significant at the two unburnt sites (ridge and swale), compared to the burnt ridge site (3.4, 3.3, 2.7 MPa; P = 0.039 ridge versus tower). Additionally, change in hydraulic pull from pre-dawn to midday was lower in the swale site, possibly due to differences in mallee tree distribution. We can now make conclusions about the interplay between bushfire and the hydraulic environment on the spatial distribution of mallee trees.

The Pulse-and-Shift model: Rainfall driven relaxation of fire-age requirements for species in boom-and-bust systems

Mr Simon Verdon1, Dr Simon Watson1
1La Trobe University, Melbourne, Australia

SYMPOSIUM: Fire in Australia; how was the biota prepared for human occupation?, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Simon Verdon is a PhD candidate working on colonisation processes and patch dynamics as they relate to the endangered mallee emu-wren in north-western Victoria. He is particularly interested in the shifting nature of habitat area and connectivity through time.

In fire-prone semi-arid ecosystems, many species show preferences for particular post-fire successional states. For such species, fires result in a constantly shifting distribution of available habitat across the landscape. In addition, populations of many species fluctuate with inter-annual climate variability (e.g. rainfall). Using long-term pitfall data, we show that in years of above average rainfall the post-fire-age preferences of pygmy possums broadens, with individuals occurring across a wider range of post-fire habitats.

Rainfall induced “relaxation” of species’ post-fire-age specialisation highlights that habitat area and connectivity change through time. Boom periods have potential to act as windows in time for species to access otherwise isolated patches of habitat of appropriate post-fire-age.

We propose a Pulse and Shift model which describes the process of colonisation and range expansion facilitated by a population boom and subsequent contraction to spatially disparate habitat patches. Rainfall induced connectivity between habitat patches of appropriate post-fire-age vegetation has important implications for our understanding of colonisation processes, isolation metrics and the shifting nature of refugia in space and time.

An introduction to synthesising restoration outcomes in agricultural and mined landscapes

Dr Rachel Standish1, Dr Sacha Jellinek2
1Murdoch University, Perth, Australia, 2Department of Environment, Water and Natural Resources, Adelaide, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Rachel Standish is a plant ecologist with a broad interest in ecology and its application to ecosystem management. Her research is grounded in theory but driven by an interest in developing practical outcomes for ecosystem management in a rapidly changing world.

Revegetation activities that seek to restore agricultural and mine sites often have different goals, and as such may provide different restoration outcomes for ecological communities. Agricultural areas are often revegetated with trees and shrubs to reduce water and wind erosion of bare soils, reduce salinity and provide shelter and windbreaks for livestock and crops, thereby increasing agricultural productivity. Conversely, mine site restoration is often undertaken primarily to stabilise the mined area or the mined solid waste, with the restoration of native flora and fauna habitat sometimes a secondary objective. It can include the revegetation of mine tailings with seedlings and tubestock, to the translocation of existing native vegetation to the mined area. The matrix around agricultural and mined areas is also different, with agricultural areas usually located in highly fragmented landscapes and mines being surrounded by native vegetation, allowing native animals and plant propagules to more easily reach restored mines. This talk will provide an introduction to this symposium topic, outline the similarities and differences between agricultural and mine site restoration, and provide examples of some of the ecological outcomes that these different restoration activities deliver. It will present an overview of the preceding talks, and at the end of the symposium a synopsis of the lessons learned from comparing these landscapes and ways forward to increase the synergies between the fields of research and to maximise the biodiversity benefits in these landscapes.

SERA’s National Standard for the Practice of Ecological Restoration in Australia

Kingsley Dixon1, Peter Erskins1, Dr David Freudenberger1,2, Mr Justin Jonsson1,3, Dr David Lamb1,4, Vern Newton1, Dr Tein McDonald1
1Society for Ecological Restoration Australia Standards Working Group, . . ; 2Australian National University, Canberra, Australia, 3Threshold Environmental, Australia, 4University of Queensland, Brisbane, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM
The Society for Ecological Restoration Australasia (SERA) is in the process of finalising a national Standards document whose purpose is to increase the quality and quantity of restoration outcomes across Australia. While each restoration challenge is unique, all restoration projects have a common need for (a) conceptual frameworks that reflect sound ecological principles and (b) workable protocols for planning, implementation and monitoring. The SERA Standards recognise that there has been high variability in restoration outcomes across the continent to date and draws on the experience of twelve not-for-profit Partner organisations to emphasise the central roles of managing threats, identifying appropriate locally indigenous reference ecosystems (including appropriate species and genetics), building on existing resilience, optimising connectivity and scale and ensuring the identification of clear objectives and measurable targets. Ecological research is highlighted as a tool for overcoming unique recovery barriers. A key challenge for the Working Group was to find a framework that would be inclusive of the variety of efforts used to assist the recovery of ecosystems, without lowering standards for full recovery (i.e. ecological restoration) where this is desirable and achievable. Central to the usability of the Standards is its inclusion of a ‘recovery scale’. This is designed to track the degree an ecological restoration project is achieving full recovery relative to its locally indigenous reference model over time. The same scale can be used, however, to encourage highest practicable recovery at sites (e.g. in some production or mining landscapes) where something other than full recovery is the intent.

Plant a tree or a fence? The cost-effectiveness of habitat restoration in agricultural landscapes

Mr Dean Ansell1, Dr Nicola Munro1, Dr David Freudenberger1, Assoc. Prof. Philip Gibbons1

1Australian National University, Canberra, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dean Ansell is a PhD Scholar at the Fenner School of Environment and Society, The Australian National University. His PhD focuses on the cost-effectiveness of biodiversity conservation in agricultural landscapes, including on-ground evaluation of ecological restoration projects in farmland in southeast Australia.

Habitat restoration provides a key strategy in the conservation of biodiversity in agricultural landscapes. The two main approaches used in grazing-dominated systems include passive restoration of woodland remnants, typically through exclusion of livestock by fencing, and the active restoration of habitat through revegetation of cleared land. These approaches typically differ widely in economic cost and level of effectiveness. Understanding this variation in cost-effectiveness is a key step in developing restoration strategies that maximise the biodiversity benefits that can be achieved with available resources. We compared the cost-effectiveness of revegetation and remnant protection approaches in the restoration of bird habitat in the Boorowa region in southern New South Wales. This study was designed to measure the conservation gain associated with different restoration treatments, so we surveyed the bird communities and measured the habitat structure and landscape context at 42 restoration sites—each matched with a control representing the counterfactual (i.e., 84 sites in total). Despite little difference in the absolute richness of bird species between the two restoration approaches, conservation gains are significantly greater in revegetation sites, including increases in woodland-dependent species. Analysis of restoration costs reveals substantial differences between the two approaches, with revegetation projects costing 4-5 times more per hectare than remnant protection. As a result, there was little difference in overall cost-effectiveness, as the higher costs of revegetation offset the increased biodiversity gains. We identify key design factors that restoration practitioners can target to increase the cost-effectiveness of habitat restoration in agricultural landscapes.

Implementing the ‘chain-of-seed-use’ concept improves mine site restoration success

Dr Todd Erickson1,2

1School of Plant Biology, The University of Western Australia, Crawley, Australia, 2Kings Park and Botanic Garden, Botanic Gardens and Park Authority, Kings Park, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Todd Erickson received a PhD at the University of Western Australia investigating seed dormancy and germination patterns in the Pilbara region of Western Australia focussed on mine site restoration. He is currently the Project Manager for the Restoration Seed Bank (RSB) Initiative working on an integrated restoration program in the same biome.

Restoring landscapes that have been disturbed by mining activity is complex, and to be successful, significant engineering and environmental solutions are required. For instance, successful establishment of the target plant community requires the addition of high diversity seed mixes to maximise the chances of plant survival and consequently the re-establishment of rich floristic communities. However, evidence suggests that up to 90% of seeds broadcast to a site fail to establish into a plant, and common plant community metrics such as plant diversity, cover, and density are not being adequately achieved.

To overcome these seed recruitment barriers, significant step changes are needed in the way seeds are collected, handled, stored, processed, and returned to site. This seed management approach, called the chain-of-seed-use, has recently been adopted and implemented in open-cut mine restoration programs located in the northern arid zone of Western Australia. Since its inception, considerable improvements in perennial plant establishment are evident, especially in the key framework grass genus Triodia. In this presentation, the chain-of-seed-use concept will be broken down into each core area and examples provided of how seed-use can be made more efficient and implemented into large-scale seeding programs.
Landform heterogeneity: a new approach to improve broad-scale post-mine ecological rehabilitation

Dr Anand Datar1, Prof. David Mulligan1
1Centre for Mine Land Rehabilitation, The University of Queensland, St. Lucia, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Anand Datar completed his Ph. D. from Centre for Mine Land Rehabilitation, UQ this year. His educational background also includes Masters in Geology and Masters in Environmental Management. He is a Geo-Ecologist and his current research interest is improving understanding of the linkages between physical and biological components of rehabilitating ecosystems.

The extractive phase of broad-scale mining involves significant alteration of topography and associated ecosystems. Post-mining ecological rehabilitation typically starts with reconstructing topography using landforms such as plateaus, terraces, and gentle slopes for stability. However, this approach leads to uniform landforms that do not reflect natural landscapes. Previous research in undisturbed and agricultural landscapes shows that ecological attributes and diversity in microclimates is positively correlated with landform heterogeneity. The objective of this study was to investigate if those findings are still valid at post-mining rehabilitating landscapes using mineral sands mine rehabilitation at North Stradbroke Island, Australia. Landform heterogeneity was measured using remote sensing and GIS through variance in landform characteristics, and ecological patterns were represented by ecological indicators (e.g. species richness) measured through field surveys. The results showed correlations between landform heterogeneity indices and ecological indicators with sensitivity to spatial scale of investigation and rehabilitation history. In some cases landform heterogeneity contributed to up to 77% of the variance in particular ecological measures. When some of other dominant drivers of ecological patterns in rehabilitation (e.g., rehabilitation practices, soil characteristics, seed mix) were included in the analysis, landform heterogeneity stood out as a major significant contributor. Thus, while some of the primary drivers of post-mining ecological rehabilitation (e.g., climate, substrate) are difficult to control over extensive temporal and spatial scales, landform heterogeneity may provide a simple and effective tool to improve rehabilitation outcome in broad-scale post-mining landscapes, and in ecological restoration projects that have a capacity to influence landform shape and dynamics.

Landscape Scale Ecological Restoration in Gondwana Link: Tangible Outcomes in the Southwest Australian Floristic Region

Mr Justin Jonson2
2Threshold Environmental, Albany, Australia, 3Centre for Excellence in Natural Resource Management, The University of Western Australia, Albany, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Justin Jonson, as Managing Director of THRESHOLD ENVIRONMENTAL, has 10 years experience planning, managing, implementing and monitoring over 800 hectares of ecological restoration in Gondwana Link. He's a board member of the Society for Ecological Restoration Australasia, and Honorary Research Fellow at the Centre for Excellence in Natural Resource Management, UWA.

Gondwana Link is Australia's oldest and most advanced landscape-scale restoration initiative. Located in the Southwest Australian Floristic Region, a top 25 Global Biodiversity Hotspot, it serves as exemplary example of how to achieve ecological restoration at scale. Ten years on, substantial progress has been made on the ground with over 3000 hectares of marginal agricultural lands being replanted to native vegetation. In the course of implementing this work, many lessons have been learned, and the gap between theory and practice has been bridged in a number of key areas. Steady progress to improve the practice and standards of on-ground works have evolved alongside the rapidly developing field of ecological restoration. This talk will present many of the restoration achievements realised to date in the Fitz-Strling operational corridor of the greater Gondwana Link initiative. Conditions that support successful on ground results will be highlighted, in addition to areas in which project aspirations have fallen short. Issues related to capacity, funding availability, continuity and the requirement for innovative approaches for delivery at all institutional levels will also be presented. Challenges of working on large-scale ecological restoration projects within a biodiversity hotspot will be addressed, to suggest how practitioner capacity, institutional constraints, and limited funding can be overcome in practice.

Plant functional responses to thinning in a recovering endangered ecosystem

Dr John Dwyer1, Miss Riah Mason2
1The University of Queensland, St Lucia, Australia, 2CSIRO Land and Water Flagship, Dutton Park, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM
However, little is known about what proportion of revegetated native plants survive in restoration projects, or what abiotic restoration has been proposed as a mechanism to help conserve native flora and fauna in the face of these and other environmental stressors. Land clearing, habitat fragmentation, and landscape degradation are major factors causing the loss of biodiversity throughout the world. Habitat restoration has been proposed as a mechanism to help conserve native flora and fauna in the face of these and other environmental stressors. However, little is known about what proportion of revegetated native plants survive in restoration projects, or what abiotic and biotic factors influence the implied, and occasionally explicit, goal of many revegetation programs is the re-establishment of a self-sustaining and generally resilient plant community, often using a reference area as template. In many cases, revegetation management actions implemented against that goal are context specific site preparation, propagule addition and, sometimes, follow-up work. The Coorong, Lower Lakes and Murray Mouth Vegetation Program (VP) aimed to enhance the ecological resilience of the Coorong and Lower Lakes landscape through revegetation of priority ecosystems. A large proportion of this work followed the general goal and management actions outlined above. Best remaining examples of local ecosystems were used as reference areas to build species lists that were then passed through a feasibility filter (seed availability, seed viability, germination techniques, cost) to grow tubestock that was planted into appropriately prepared sites. We report here on the initial results of this work (up to five years post-planting) at a patch-scale from a functional ecology and resilience perspective by comparing functional and response diversities of remnant and revegetated sites within several key terrestrial ecosystems targeted by the VP. While our results can be used to directly improve the general resilience of VP sites, the approach has wider applicability to revegetation programs anywhere. The benefits of this approach are more likely to be realised when implemented at the planning phase of a revegetation program.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Identifying drivers to revegetation success and failure in a landscape-scale restoration project: The Coorong and Lower Lakes, South Australia

Dr Sacha Jellinek
Department of Environment, Water and Natural Resources, Adelaide, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Sacha Jellinek currently works on a large restoration program in South Australia and previously completed a PhD at the University of Melbourne. He studies the ecological benefits of habitat restoration in agricultural and urban landscapes, and landholder attitudes to natural areas. He has worked throughout Australia and in Southeast Asia.
the persistence of planted flora. We assessed a landscape scale restoration project in the Coorong, Lower Lakes and Murray Mouth region of South Australia, undertaken by the Vegetation Program, DEWNR, where over 2,000 ha of land at 127 sites was revegetated. We evaluated restoration sites planted over 3 years (2012 - 2015), surveying revegetated areas 2 months (spring) and 9 months after planting (summer). We found that although there was no difference in planting survivorship amongst years, survival significantly decreased between spring and summer survey periods. Initial results also suggested that soil type played an important role in influencing restoration results, with plantings on calcareous loam soils surviving substantially better than those on deep sand. Similarly, planted grassy woodland communities persisted better than mallee or samphire ecosystems. Our results have important implications for natural resource management agencies undertaking landscape scale revegetation programs.

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

Practices for Restoring Myall/Mallee Woodland and Chenopod Shrubland after Mining

Mrs Tina Law1, Ms Joanne Lee1
1Iluka Resources, Kent Town, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 1), Ballroom C, December 2, 2015, 10:15 AM - 12:15 PM

Biography:
Tina Law and her co-author are Rehabilitation Specialists at Iluka Resources. Over the last two years they have overseen rehabilitation earthworks activities and implemented research and monitoring programs at the Jacinth-Ambrosia (JA) mine site to better understand how the environment at JA recovers from disturbance.

Following mining of mineral sands, Iluka Resources aims to restore a resilient and self-sustaining ecosystem in the myall/mallee woodland and chenopod shrubland of its Jacinth Ambrosia operations. The mine is located approximately 800 km north west of Adelaide within the Yellabbin and Nullarbor Regional Reserves. This arid area is dominated by chenopod shrubland plains and open myall woodlands interspersed with myall/mallee sand rises and ephemeral creeks. The plant interspaces are well stabilised with thick and diverse biological soil crusts. A total disturbance footprint of approximately 1,300 ha is anticipated. Since operations commenced in 2009 approximately 600 ha has been disturbed including 170 ha of open pit area. Approximately 20 ha has been rehabilitated in conjunction with mining operations. Lease conditions for the mine, developed by the Department of State Development in consultation with the Department of Environment, Water and Natural Resources, require that the post mining ecosystem and landscape function should be resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved. Knowledge of this ecosystem’s response to disturbance associated with mining is limited. To improve rehabilitation outcomes, numerous trials and research projects have been developed and carried out by Iluka staff and in collaboration with the University of Adelaide, Adelaide Botanic Gardens and University of Queensland. This presentation will summarise the learnings from some of the trials established in the first three years of rehabilitation activities, particularly those examining potential impacts of stockpile ageing and varying methods of soil profile return.

Disease ecology during the breeding season in the endangered Litoria verreauxii alpina and management implications

Ms Laura Brannelly1, Dr. David Hunter2, Mr Daniel Lenger3, Dr. Ben Scheele4, Dr. Laura Grogan5, Ms. Rebecca Webb1, Dr Lee Skerratt1, Dr. Lee Berger1
1James Cook University, Townsville, Australia, 2Office of Environment and Heritage, Albury, Australia, 3Tulane University, New Orleans, United States, 4Australian National University, Canberra, Australia, 5Griffith University, Brisbane, Australia

Community Ecology (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Laura Brannelly is PhD candidate in amphibian disease. Her research interests include wildlife disease, endangered species, conservation, and chytridiomycosis. She is exploring the amphibian immune system, focusing on critically endangered species and investigating immune mechanisms which can be selected for in captive breeding and reintroduction programs for such endangered amphibians.

Amphibians are currently experiencing the greatest biodiversity decline of all vertebrate taxa, and one of the major drivers of this loss is the fungal disease chytridiomycosis. We studied chytridiomycosis dynamics during the breeding season to improve our understanding of how remnant populations persist with endemic infection, and to inform disease management. We monitored two populations during their ten-week breeding season through capture-mark-recapture analysis. We found that infection prevalence and intensity increased throughout the breeding season in both sites, but infection prevalence and intensity was higher at the site that had higher population density, suggesting that Bd transmission is density dependant. There was low recovery from infection in L. v. alpina, which was lower when the animals were heavily infected with Bd.

With high infection intensity at the end of the breeding season and low recovery from infection, population survival of this species is dependant on high recruitment. We further explored how disease may affect reproductive output by investigating gametogenesis in a laboratory based infection experiment. We found that in both males and females gametogenesis increases when animals are infected with Bd. If infected
animals are increasing reproductive efforts and producing more offspring before succumbing to disease, it is possible that population level selection for disease resistance or tolerance is minimised. In the absence of population level disease resistance or tolerance, conservation and management efforts for endangered species should focus on habitat management to support recruitment.

Ecological literacy: how much do we know about nature?

Dr Sheryn Pitman1,2
1Department of Environment, Water and Natural Resources, , Adelaide, Australia, 2University of South Australia, Adelaide, Australia, 2 South Australian Museum, 

Community Ecology (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
With a multidisciplinary background in environmental management, education, writing and communication, Sheryn currently manages the Inspiring South Australia Program, connecting the community with science, for the South Australian Museum. For the past eleven years she has managed the South Australian Green Infrastructure Project, a multi-agency partnership that brings together diverse stakeholders to integrate the planning and design of green spaces and water systems that underpin the health and sustainability of towns and cities.

Critical to the health and survival of any human society is knowledge and understanding of the natural ecological systems that underpin and support life. Ecological literacy encompasses the capacity to know and understand places as ecological systems including how they function and connect with other systems. It is argued that changed relationships between many human societies and the natural world have affected the capability of many communities to make well-informed decisions about how to live sustainably. This presentation discusses the findings of an ecological literacy assessment and survey of over 1000 South Australian adults from industry, government, non-government, business and volunteer organisations. Eco-literacy scores varied significantly with a range of socio-demographic factors and life contexts and experiences. This research has led to valuable findings in relation to factors associated with levels of individual and community knowledge and understanding of ecological systems, and provides insights into the challenges and opportunities for developing greater ecological literacy within our citizenry and governing bodies.

A paradigm shift in the intertidal mollusc assemblages due to disturbances in Penang Island, Malaysia

Ms Syazreen Sophia Abdul Halim1, Dr Yahya Khairun1
1School of Biological Sciences, Universiti Sains Malaysia, Georgetown, Malaysia

Community Ecology (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Syazreen Sophia Abdul Halim is a postgraduate student, major in (Aquatic Biology) of Universiti Sains Malaysia.

In a context of delivering a fundamental baseline for sustainable coastal zone management of tropical intertidal areas, present study describes the consequences of anthropogenic disturbances on sandy shore community. Mollusc was selected in this study because they are omnipresent, relatively sedentary and reflect site-specific conditions, as well as indicators to environmental degradation. Intertidal areas are dynamic environments and provide a multiple variety of habitats that support a great diversity of living forms. Many intertidal areas in Penang Island (Malaysia) are currently being subjected to urban development and this impact could threat the intertidal biodiversity. The significance of this study is to verify the significant differences in intertidal mollusc community structures at different site and resultant stress in the communities corresponds accordingly with magnitude of human disturbances. Those impacts were tested in low-, mid-, and high- intertidal area by random sampling method at five study localities. Multivariate techniques were used for investigating community abundance with respect to the disturbances. Multivariate cluster analysis and nMDS plots completely separated the sampling site at ordinal scale. The SIMPER analysis showed that the most dominant species found in the stress status were Cerithidea cingulata. This was further confirmed by PERMANOVA test with significant different of (P = 0.001) among study localities. Present findings strongly support the research outcomes in compiling the diversity and study the abundance of mollusc by spatial distribution patterns and determine the effects of habitat change due to disturbances.

Keywords: intertidal mollusc, disturbances, diversity, Penang Island

Measuring the effects of reduced snow cover on Australia’s alpine invertebrates

Ms Rachel Slatyer1, Dr Michael Nash1,2, Prof Any Hoffmann1
1University of Melbourne, School of Biosciences, Parkville, Australia, 2South Australia Research and Development Institute, Entomology Unit, Umbrae, Australia

Community Ecology (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Rachel Slatyer is a final-year PhD student at the University of Melbourne, studying the evolution and ecology of alpine insects in Australia and the USA. She is particularly interested in adaptations to snow-covered environments.
Snow is a defining feature of the alpine environment and a critical component of the ecology of these regions. Already, snow seasonally covers just 0.15% of the Australian continent and both the depth and extent of snow cover are diminishing rapidly. The space under the snowpack is an important winter refuge for a diverse array of small arthropods, providing a climate buffered from large temperature fluctuations and frost. Removal of the insulating snow layer dramatically increases temperature fluctuations, exposure to cold extremes and the frequency of freeze-thaw cycles. We tested the effects of reduced snow cover on winter-active arthropod communities, using a field experiment replicated over two mountains in the Australia’s alpine zone. Representatives from 16 arthropod taxa were active beneath the snowpack during the winter. Of these, Collembola were numerically dominant, accounting for 80% of the individuals collected during the winter. This group was also sensitive to snow removal, which reduced the number of individuals collected by 75%. Despite this, there was no consistent shift in community composition or species richness in response to reduced snow cover, suggesting that all taxa avoid snow-free areas during the winter. Our results suggest that snow loss will have a strong and immediate effect on species that are active under the snowpack. In an adaptive framework, climatic buffering by snow means that winter-active species might be more temperature-sensitive than their summer-active counterparts and thus vulnerable to changes in winter snow conditions.

Challenging the status quo: Reforming, changing and innovating native vegetation management in SA

Ms Melanie Carson1, Mr Adam Schutz1, Mr Russell Seaman1
1Native Vegetation Management Unit, DEWNR, Adelaide, Australia

Biography:
Melanie Carson is currently employed within the State Government working with a wide range of public and private organisations, individuals and not-for-profit organisations. Working predominately in the areas of policy, governance and strategy - attuned to current environmental issues with a strong knowledge and experience of the Native Vegetation Act 1991.

Native vegetation management into the future faces a number of challenges - The Native Vegetation Council and DEWNR are currently making strong advances in native vegetation management in SA through reform, change and innovation. Implementing new science and good practices that challenge the traditional status quo will help to ensure that native vegetation (and biodiversity) is conserved and managed in ways which provide future assurity to all South Australians. Innovations to support the repair of landscapes and improved regulatory requirements will provide multiple benefits.

Reform, change and innovation are being implemented progressively through a number of projects including:

- SEB Policy and metrics Review
- NV Regulation Review
- New Accreditation and training courses
- On-line automation of processes
- New Rangelands assessment methodology

The session will focus on three key components that will be introduced through the projects and have been identified as the most essential to the success of the reform, change and innovation, being:

1. Risk based approach
2. Property Based Management Plans
3. Third Party SEB Offsets

Of particular importance will be insights and feedback drawn from the audience. The session will consider the components effectiveness and appropriateness at the local level.

Conservatism vs. adaptation: Functional diversification under contrasting seasonality in three Australian rainforest communities

Dr Stephanie Stuart1,2, Dr Craig Coston1,4, Dr Darren Crayn1, Dr David Ackerly5
1Macquarie University, Macquarie University, Australia, 2University of Western Sydney, Richmond, Australia, 3Smithsonian Institution, Washington, United States, 4James Cook University, Cairns, Australia, 5University of California, Berkeley, United States

Biography:
Dr Stephanie Stuart’s research program focuses on how short-term temporal patterns affect long-term evolutionary trends. This includes the development of seasonal climates during the deep past, and expected changes in the future. Dr Stuart completed her PhD at the University of California, Berkeley, and currently holds an NSF International Fellowship.

Using a unique system of related rainforest communities, this project examined (1) whether greater functional diversification occurs in response to environmental stresses; (2) whether new communities are formed through local adaptation, or by filtering out potential community members with lower fitness (niche conservatism). Three different forest communities were contrasted: one temperate rainforest (Mt. Field, Tasmania) with high rainfall and warm-to-cold seasonality through the year, one seasonally dry tropical rainforest (40 Mile Scrub, Queensland), and one everwet tropical rainforest (Daintree Rainforest Observatory, Queensland). Greater functional diversity was consistently found at the temperate than the wet tropical
site, and levels of functional diversity at the seasonally dry tropical site were generally more similar to the temperate than the wet tropical site. This pattern was found in spite of much higher taxonomic diversity at the wet tropical site. Across this broad (~3,000 km) scale, we found evidence for both an underlying pattern of conservatism, particularly in stem-related traits such as wood density, and local adaptation, particularly in leaf-related traits such as specific leaf area (SLA). This study adds to evidence suggesting that higher functional diversity is not a correlate of higher species richness. Although it does not distinguish between alternative possible mechanisms, such as narrower niche breadths or tighter niche packing, it can help falsify the proposition that the tropics are more diverse because of constant niche breadth and a wider trait gradient.

**The influence of biogeographic barriers on eastern South Australia’s rocky intertidal communities**

*Mr Nicholas Thyer*, **Prof Peter Fairweather**, **Mr Ryan Baring**

1School of Biological Sciences, Flinders University, Adelaide, Australia

**Biography:**

Nicholas Thyer is an honours student at Flinders University, Adelaide. His research focuses on rocky intertidal ecology and the influence of biogeography on community structure and recruitment along eastern South Australia’s coastline.

The availability of suitable rocky substrate is crucial for the settling of post larval recruits of many rocky intertidal species. As such, long stretches of sandy beach have been described as potential biogeographic barriers that could restrict the distributions of these rocky intertidal species. Both Encounter and Discovery Bays are long stretches of unbroken beach that break up eastern South Australia’s predominantly rocky coastline. This study aimed to investigate the spatial variation in rocky intertidal communities either side of these potential biogeographic barriers. Spat collectors were deployed at 12 rocky shores between Victor Harbour, South Australia and Portland, Victoria to collect the post larval recruits arriving at the different shores situated either side of the Discovery Bay and Encounter Bay barriers. Furthermore, photo-quadrat and video-transect surveys were conducted at each site to compare the already established invertebrate communities and their corresponding algal coverage. The results show a difference in rocky intertidal communities either side of both barriers, with three sites located around Portland on the eastern side of Discovery Bay being the most distinct. Differences in rock type may also be contributing to some of the variation in the established communities on different shores; however, the variation in recruitment either side of the barriers demonstrates the inability of certain species to disperse across the barriers. These results further enforce the importance of understanding a coastline’s biogeography when trying to define different bioregions based on varying community structures.

**Environmental variability and phytoplankton dynamics in a South Australian inverse estuary**

*Mr Jan Jendyk*, **Mr Deevesh A. Hemraj**, **Assoc. Prof. Melissa H. Brown**, **Prof. Amanda V. Ellis**, **Dr. Sophie C. Leterme**

1School of Biological Sciences, Flinders University, Bedford Park, Australia, Flinders Centre for Nanoscale Science and Technology, School of Chemical and Physical Sciences, Flinders University, Bedford Park, Australia

**Biography:**

Jan Jendyk is currently in the final year of his PhD in marine biology and ecology, focusing on the impact of environmental changes, particularly salinity, on phytoplankton communities in the Coorong wetlands. Further interest include molecular biology, as well as statistical modelling of data collected in the Coorong.

Estuaries are widely viewed as hotspots of primary productivity. The Coorong, in South Australia, is an inverse estuary divided into two lagoons, extremely important to the associated riverine, lacustrine and marine environments. It is characterized by a steep, lateral salinity gradient which intensifies considerably during years of drought. Here, we analysed the abundance and distribution of primary producers over two years (August 2011–2013) and investigated the biogeochemical factors driving observed changes. The phytoplankton community was numerically dominated by chlorophytes in the North Lagoon with Chlorohormidium sp. and Oocystis sp. being the most abundant species. In the South Lagoon, diatoms dominated the community, with Cylindrotheca closterium, Cyclotella sp. and Cocconeis sp. being the most prevalent species. Finally, cryptophytes and dinoflagellates were found to be present throughout both lagoons but in comparatively much lower abundances. Salinity was the most important driver of phytoplankton communities and ranged from 0.15 to 72.13 PSU between August 2011 and August 2013. Chlorophytes were found to be most prolific in freshwater areas and abundances rapidly declined laterally along the Coorong. Beyond a salinity threshold of 28 PSU, extremely limited numbers of Crucigenia sp. and Oocystis sp. were observed, but abundance were seven to ten-fold lower than in freshwater areas. Our findings suggest that the overall ecological health of the Coorong is directly dependent on the availability of freshwater and management plans need to be enacted to facilitate continued biodiversity, particularly throughout the freshwater reaches of the estuary.

**How does shrub encroachment affect the foraging success of ants?**

*Miss Gabriella Radnan*, **Associate Professor David Eldridge**, **Dr Heloise Gibb**

1University of New South Wales, Sydney, Australia, 2La Trobe University, Melbourne, Australia

**Biography:**

Gabriella Radnan is an Honours student in the School of Biological Sciences, Flinders University, Bedford Park, Australia. Her research is investigating how shrub encroachment affects the foraging success of ants in the SE. A 10x10m plot was established in Flinders University's Boyd Park and was categorized into 5 m x 10 m quadrats. Foraging success was calculated as the number of ants passing through a pitfall trap containing sucrose solution within a certain time frame. Data was collected using the pitfall trapping method. Gabriella’s research aims to contribute to the understanding of the ecological impact of shrub encroachment on ant biodiversity.
Shrub encroachment alters the structural complexity of the original grassland by increasing vertical complexity and reducing soil surface complexity as bare soil replaces grass cover. Although the composition of ant assemblages is known to be affected by encroachment, the mechanisms driving ant responses are poorly understood.

We asked if habitat and microhabitat complexity affect ant foraging efficiency, body size and monopolisation rate. We hypothesized that 1) complex environments will hinder ant movement resulting in slower bait discovery 2) ant body size will decrease with increasing habitat complexity as small gap size obstruct the movement of large species and 3) resource monopolization will be more prevalent in shrublands, compared with grasslands as resources are easier to defend in simple environments. We used 18 paired grassland and shrubland sites to compare landscape complexity. Microhabitat complexity was manipulated by altering the amount of leaf litter and woody debris in experimental chambers, creating low and high complexity treatments and a bare control. Ant foraging activity was monitored at baits within the chambers for 10 hours.

Grasslands supported higher ant richness than shrublands. Ants took longer to locate resources in more complex microhabitats. Ant body size decreased with increasing microhabitat complexity. Resources were monopolized more often in shrublands than grasslands. Our work suggests that encroachment alters ant assemblages through its effects on habitat complexity: we showed that reduced ground-level complexity favours large bodied, fast-moving, aggressive (dominant) species. This suggests that habitat-driven changes in competitive ability may be the mechanism shrub encroachment alters ant assemblages.

Can common woodland birds be used as a rapid assessment tool in fire prone landscapes?

Ms Diana Kuchinke

Biography:
Diana Kuchinke is a PhD candidate whose research has focused on the effects of time-since-fire and fire frequency on the woodland birds of western Victoria.

Australian woodlands have for decades been fragmented due to urban expansion. In recent times we have seen prescribed burning periods extended from autumn and spring prescribed burns to spring/summer along with summer/autumn burns. Fragmentation and burning protocol changes combined place enormous pressure on our native birds. Add to this the issue of a changing climate.

The State of Australia’s Birds Report July 2015 has highlighted that quite frighteningly; some of our most common and in some cases iconic of species are declining in abundance.

In this research, birds were monitored on 64 woodland sites in Victoria over two spring/summers and two winters. Modelling incorporated predictor variables of time-since-fire age classes and fire frequency, run independently against response variables of individual species and foraging guilds. Simper analyses indicated the same group of 11 species driving >75% of the variations.

Can we take this group of 11 species as a surrogate, to represent the general 'health' of the woodland assemblage? We could consider the reasons for selecting these birds as indicator species to fall under categories of: 1) Most common 2) Sensitive to fire 3) Indicating extended from autumn and spring prescribed burns to spring/summer along with summer/autumn burns. Changes combined place enormous pressure on our native birds. Add to this the issue of a changing climate.

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Can we take this group of 11 species as a surrogate, to represent the general 'health' of the woodland assemblage? We could consider the reasons for selecting these birds as indicator species to fall under categories of: 1) Most common 2) Sensitive to fire 3) Indicating particular environmental condition, and 4) Iconic species. The Laughing Kookaburra is one species that is driving the patterns in our woodlands and it has been highlighted in the State of Australia’s Birds Report as being in decline along the east coast of Australia. Can we begin to undertake rapid assessments of woodlands using these 11 species as a tool in determining some meaningful results?

Interaction networks are more robust to community collapse when accounting for sampling bias

Ms Michaela Plein1, Dr Michael Bode1, Mr Christopher M. Baker1, Assoc. Professor Peter A. Vesk1, Dr Melinda L. Moir2, Ms Bridget Johnson2, Professor Michael A. McCarthy1

Biography:
Michaela is a PhD student at the University of Melbourne where she investigates the importance of species interactions in conservation decision-making. Her diverse project allows her not only to study and photograph the rich flora and fauna of south-western Australia, but also to immerse into the depths of computational ecology.

Extinction cascades occur when the loss of one species triggers the extinction of multiple dependent species. As more interaction network data become available, studies have concluded that extinction cascades are a common and serious problem for ecosystem functioning. However, these conclusions are biased because interaction networks are snapshots in time and space: many interactions and even entire species are missed when phenology and study period do not overlap or when species are rare.
In this study, we assess how this sampling bias affects predictions about extinction cascades. We use dynamical ecosystem models to simulate extinction cascades in two sets of networks: empirical networks from observations of interactions between species, and the same networks corrected for sampling bias. We construct the corrected networks by estimating the probability that two species interact with each other, using a hierarchical model that analyses the empirical network and accounts for sampling effort.

We find that the use of empirical networks consistently and considerably overestimates the fragility of ecosystems to extinction cascades, and produces pessimistic estimates of the time of collapse. Many other important ecosystem processes are understood to result from network structure and it is conceivable that our understanding of their dynamics is also biased due to sampling issues. When corrected for standard empirical issues like sampling effort, ecological communities prove to be much more robust than we previously believed.

From beta to zeta diversity partitioning: a new common currency for quantifying species turnover

**Prof Cang Hui**1,2, Dr Guillaume Latombe3, Ms Mariona Roigé4, Prof Melodie McGeoch2

1Stellenbosch University, Stellenbosch, South Africa, 2African Institute for Mathematical Sciences, Cape Town, South Africa, 3Monash University, Melbourne, Australia, 4Lincoln University, Lincoln, New Zealand

Ecological Modelling (1), Balcony Rooms 1-2, December 2, 2015, 2:15 PM - 5:30 PM

**Biography:**

Professor Cang Hui is a South African Research Chair (SARChI) in Mathematical and Theoretical Physical Biosciences. His interests lie in proposing models and theories for explaining emerging patterns in ecology, especially on patterns related to species distributions, ecological networks, adaptive traits and biological invasions.

Although spatial variation in the compositional diversity, or species turnover, underpins the study of biodiversity, no single measure connects the range of assemblage patterns constructed from species presence-absence data. Compositional dissimilarity is often measured by beta diversity for pairwise comparisons of individual assemblages. When comparisons of three or more assemblages are involved, the average of the pairwise similarities is used. However, none of the metrics of pairwise species turnover is able to calculate all components of diversity partitioning. We propose zeta diversity as a metric that captures all diversity components produced by assemblage partitioning (Hui & McGeoch 2014 American Naturalist 184:684-694). Zeta diversity is the average number of species shared by any number of sites or habitats. It can be used to calculate a broad range of existing diversity metrics, and to quantify continuous change in biodiversity over landscapes. It reconciles existing descriptors of species incidence and compositional turnover, and further relates to hierarchical beta diversity partitioning, the distance decay of similarity, and incidence-based assemblage patterns. By providing a common currency, the metric of zeta diversity provides significant advantages for modelling and understanding the mechanistic basis of spatial patterns in diversity (e.g., examining if environmental change affects rare and common species differently, or testing hypotheses about the relative importance of niche-based versus neutral processes in generating patterns in biodiversity). As such, the use of zeta diversity may provide new insights about the drivers of species composition and turnover, and the consequences of environmental change for biodiversity.

Identifying and quantifying the best climatic predictors

**Dr Martijn Van De Pol**1,2, Liam Bailey1, Nina McLean1, Laurie Rijndijk1,2, Callum Lawson2, Lyanne Brouwer1

1Australian National University, Acton, Australia, 2Netherlands Institute of Ecology, Wageningen, Netherlands

Ecological Modelling (1), Balcony Rooms 1-2, December 2, 2015, 2:15 PM - 5:30 PM

**Biography:**

Dr Martijn Van De Pol’s lab at ANU focuses on long-term studies of a variety of bird species to further our understanding of the eco-evolutionary dynamics in a changing environment. He is also an honorary Senior Researcher at the Netherlands Institute of Ecology and an Associate Editor of Journal of Animal Ecology.

Ecologists relate variation in physiological, behavioral, life-history, demographic, population and community traits to variation in weather. However, identifying which climate variables (e.g. rain, temperature, El Niño index), over which time period (e.g. recent weather, spring or year-round weather) and in what ways (e.g. mean, cumulative, threshold of temperature) they affect the expression of traits is by no means trivial, particularly when traits are measured or expressed at different times among individuals. Possibly as a consequence, most studies still use rather crude measures of climate, often based on limited competing hypotheses founded on unfilled a priori assumptions. This is worrying because studies that investigate the nature of climate signals in detail, typically suggest that signals can be complex. Using suboptimal or wrongly identified climate signals may lead to unreliable projections and is an inefficient use of biological data. We developed a four-step approach that is easily implemented with our new R package ‘ClimiWin’, which will allow for more rigorous identification and quantification of climatic drivers. We compare our methodology with more conventional approaches. Furthermore, we show by means of simulations how low sample size and amounts of (un)explained variation can lead to underestimated the effect size and duration of the critical period, and how cross-validation can overcome this. More focus on each of these aspects of weather signals and our proposed systematic approach should lead to more reliable predictions on how individuals and populations respond to climate variability and facilitate comparison among studies.

Rules of thumb for managing metapopulations

**Mr Thomas Stephens**1

1University of Melbourne, Melbourne, Australia
Determining the optimal strategy to manage a metapopulation requires detailed knowledge of species behaviour and whereabouts. In practice, land managers seldom possess the resources needed to obtain this knowledge. Previous researchers have formulated rules of thumb that simplify the decision process, but these rules don't consider all possible management actions. I developed rules of thumb for choosing between four management actions: increasing colonisation; decreasing local extinction; adding a new empty patch; and translocating to an existing empty patch. Simulation results indicate these rules can work as well as, or better than existing decision tools, while reducing the number of parameter estimates and computation required. Using these rules of thumb should lead to better management outcomes for metapopulations, especially under budgetary constraint.

Determining the appropriate spatial unit scale of fisheries management

Dr Nao Takashina1, Prof Marissa Baskett2
1University of the Ryukyus, Motobu, Japan, 2University of California, Davis, Davis, United States

Determining the appropriate spatial unit scale of management is critical to the success of ecosystem-based fisheries management. For any managed region, managers must decide how much to subdivide the area under concern: from implementing a uniform approach across the region to considering a unique approach in each of hundreds patches and everything in between. However, there is no general theory for how spatial scale affects management outcomes such as optimal fisheries profit and the population biomass. To explore this question, we develop a mathematical model that follows the population dynamics of a harvested species in a patchy environment connected by larval dispersal. In the model, the spatial scale of management determines the number of managed units in the region, within which the fishing effort level is chosen to optimize the net fisheries profit in the focal region. Assuming no management cost to subdividing the region (e.g., implementation cost of marine protected areas [MPAs]), we find that the net profit increases with the number of segments. If patches are randomly distributed without spatial autocorrelation, then the net profit increases almost linearly with the number of segments. However, if patches are positively autocorrelated (i.e., the characteristics of one habitat are similar to its neighboring patches), then the net profit increases with diminishing returns as the number of segments increases. Therefore, if management cost increases with the number of segments and the patch distribution is spatially autocorrelated, an intermediate spatial scale of management is likely to maximize net management profit.

Quantifying ecosystem quality by modelling multi-attribute expert opinion.

Dr Steve Sinclair1, Dr Peter Griffioen2, Dr David Duncan3, Ms Jessica Millett-Riley1, Mr Matt White1
1Arthur Rylah Institute, Heidelberg, Australia, 2Econometrics, Monteryony, Australia, 3University of Melbourne, Parkiville, Australia

The evaluation of ecosystem ‘quality’ or ‘condition’ is inherently subjective, requiring decisions about which variables to measure, and how these variables are aggregated. Despite the central role of human judgement, few evaluation methods address the subjectivity that is inherent in their design. There are, however, advantages to constructing indices directly around opinion data; including stakeholder inclusion. We created an ‘expert system’ (i.e. model) to express the quality of a grassland ecosystem in Australia. We used an ensemble of bagged regression trees trained on calibrated expert preference data to model the perceived quality of grassland, using a set of eight site variables as inputs. The model provided useful predictions of grassland quality, producing predictions similar to real expert evaluations of synthetic test sites. We applied the model to real grassland sites ranging from pristine to highly degraded, and confirmed that the model ordered the sites according to their degree of modification. We demonstrated that the use of too few experts produces relatively poor results, and show that for our problem the use of data from over twenty experts is appropriate. The scaling approach we devised to calibrate between-experts was shown to be an appropriate mechanism for aggregating the opinions of multiple experts. The resultant model will be useful in many contexts; either to evaluate real sites, or as a means of evaluating predicted changes. The basic approach demonstrated here is applicable to any ecosystem, and we discuss the opportunities and limitations of its wider use.

Modelling Species Distributions and Conservation Priorities for Small Mammals on the Tiwi Islands

Dr Steve Sinclair is a Masters of Science student in the School of Biosciences, Quantitative and Applied Ecology Group. He is interested in improving decision-making in a metapopulation context.

Biography:
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Mr William La Marca¹, Dr Tracey Regan², Dr Brett Murphy³, Dr Jane Elith¹, Dr Emily Nicholson²
¹University of Melbourne, Melbourne, Australia, ²Deakin University, Burwood, Australia, ³Charles Darwin University, Darwin, Australia, 4Arthur Rylah Institute for Environmental Research, Heidelberg, Australia

Biography:
William La Marca is a Masters student in the Quantitative & Applied Ecology Group at the University of Melbourne. William has a broad range of interests regarding the study of animals and ecosystems, with a particular focus on the conservation of endangered and threatened species.

The Tiwi Islands represent a stronghold for small mammals that have suffered catastrophic declines on mainland Australia. Whilst the conservation value of these islands is highly significant, current understanding of species assemblages and the constraining factors on distributions is poor.

In this study we examine the differences between site-specific and broad-scale distribution models for small mammal species, and the trade-offs inherent in the ability to make predictions over geographic space. Through the development of site- and island-based Boosted Regression Trees (BRTs) and Generalised Linear Models (GLMs), we were able to identify the key drivers of species distributions at both localised and broad scales for seven small mammal species: Black-footed Tree-rat (Mesembriomys gouldii), Brush-tailed Rabbit-rat (Conilurus penicillatus), Common Brush-tail Possum (Trichosurus vulpecula), Delicate Mouse (Pseudomys delicatulus), Grassland Melomys (Melomys burtoni), Northern Brown Bandicoot (Isodon macrourus), and Pale Field Rat (Rattus tennentii).

A secondary aim of this study was to quantify the implications of different decisions surrounding agricultural and forestry development, and their impacts on small mammal populations. This was achieved through the identification of priority areas for conservation using the decision support tool Zonation, and via comparisons between areas of high conservation value in the existing landscape and under differing scenarios of proposed development.

Incorporating ecological processes into biodiversity projections through metacommunity modelling

Dr Karel Mokany¹
¹CSIRO, Canberra, Australia

Biography:
Dr Karel Mokany’s research is focused on developing, testing and applying new macroecological modelling approaches to improve understanding and management of biodiversity under scenarios of global change. He is particularly interested in better incorporating important ecological processes into macroecological modelling techniques.

Biodiversity outcomes under global change will be influenced by a range of ecological processes, and these processes are increasingly being considered in models of biodiversity change. However, the level of model complexity required to adequately account for important ecological processes often remains unclear. Here I assess the degree to which considering realistically complex ecological processes alters our understanding of likely future outcomes for biodiversity and the most appropriate management responses. Recently developed macroecological modelling techniques were applied to project current and future plant diversity for both Tasmania and the Australian Wet Tropics, incorporating complex dispersal processes, genetic adaptation to changing environments, and community assembly processes. These analyses indicate that accounting for complex ecological processes can substantially change projections of the future status of biodiversity under global change scenarios, and result in different biodiversity management approaches being identified as most beneficial in retaining biodiversity. The outcomes of ecological interactions and processes are often complex and difficult to model, yet my findings highlight the importance of accounting for such complexities if we are to improve our capacity to understand and respond to the influence of global change on biodiversity.

Distribution modelling of Koala (Phascolarctos cinereus) across the Central Slopes NRM regions of Australia

Dr Uttam Babu Shrestha¹, Dr. Kate Reardon-Smith, Kellie Goodhew, Professor Geoff Cockfield
¹University of Southern Queensland, Toowoomba, Australia

Biography:
Dr Uttam Babu Shrestha joined the University of Southern Queensland as a Vice-Chancellor’s Research Fellow in May 2014 after he completed a PhD in Environmental Science from the University of Massachusetts Boston, USA. Dr. Shrestha also worked at Harvard University, the University of Massachusetts Boston and the Technical University of Munich.

Koala (Phascolarctos cinereus) populations across much of eastern Australia have undergone significant decline due to historical and ongoing destruction, fragmentation and modification of habitat, urbanisation, bushfire, disease and dieback of Eucalyptus in combination with drought and climate change. Species distribution modelling will help to inform conservation strategies to minimise the risk of future koala habitat loss and maximise protection of important refugia under changing climate conditions. We modelled koala distribution across the Central Slopes Natural
Resource Management (NRM) region of inland northern NSW and southern Qld under current and future climates using species occurrence points collected from various sources and higher resolution (1 km2) bioclimatic, vegetation cover, soil type, drainage and road density layers. This study was conducted at the NRM regional group level to support regional NRM bodies in making plans for the conservation and management of koalas. Annual precipitation, isothermality and annual mean temperature were major contributing factors for the predicted model of koala habitat. Our model suggests that 24.31% of the Central Slopes region is potential suitable koala habitat under current climatic conditions and that the area of suitable habitat will reduce with future climate change (RCP4.5). The model predicts that 1.33% (1,497 km2) of current suitable koala habitat will be lost in this region by 2030, increasing to 3,535 km2 (3.15%) and 4,068 km2 (3.63%) of current habitat under predicted 2030 and 2050 climates, respectively. The importance of riparian areas in maintaining koala populations in these inland landscapes is apparent in the model visualisations.

How alpine plant communities have responded to wildfire: a fourth-corner solution

**Dr Susanna Venn**, Andrew Letten, Prof Catherine Pickering

_Australian National University, Acton, Australia; University of New South Wales, Kensington, Australia; Griffith University, Gold Coast, Australia_

*Ecological Modelling (1), Balcony Rooms 1-2, December 2, 2015, 2:15 PM - 5:30 PM*

**Biography:**

Dr Susanna Venn’s research interests span from plant regeneration to ecosystem ecology; specifically, how environmental factors influence plant community patterns and processes through species life-history and recruitment traits. Her current research is focused on snow-shrub interactions and how these may affect alpine shrub regeneration and encroachment.

Simple floristic surveys after wildfire can help to unravel the processes of succession. However, an extension to floristic surveys for documenting vegetation change lies in the utility of plant functional traits. In this way, we can link quantitative measures of plant species physical characteristics, for example morphological leaf traits or life form, with species occurrences in order to reveal the ecological processes that drive the patterns in vegetation composition after disturbance. However, in order to fully utilise a functional traits approach, we need to directly associate species traits and species abundance with environmental predictors. This task is known as the fourth-corner problem; where the aim is to combine matrices of environmental data, species abundance or presence/absence data and trait data in order to determine a matrix that describes the trait-environment relationship. A modelling approach can be used; whereby a predictive model is fitted for species abundance as a function of matrices of environmental data and species traits. Coefficients quantify the strength and direction of the associations between traits and the environment in order to identify which environmental and trait variables drive species abundance. This method promises to bridge a gap between species distribution modelling and multivariate analyses in ecology, thereby providing an improved analysis tool in future species-trait-environment research. Here, we use a fourth-corner model to explain differences in alpine plant community responses to fire and investigate the key environmental drivers of vegetation change over nine years since fire.

Temporal seedling emergence patterns from semi-arid habitats

**Ms Alicia Cook**, Dr Andrea Leigh, Dr Samantha Capon, Dr Scott Rayburg

_School of Life Sciences, University of Technology Sydney, Sydney, Australia; Australian Rivers Institute, Griffith University, Nathan, Australia; Centre for Sustainable Infrastructure, Swinburne University of Technology, Hawthorn, Australia_

*Individual Responses to the Environment, Suite 3, December 2, 2015, 2:15 PM - 5:30 PM*

**Biography:**

Alicia Cook is a PhD Candidate with a passion for understanding how plants survive under extreme environmental conditions. Previous work has focused on plant responses to flooding and drought while current work looks at variation among arid plants ability to tolerate and recover from extreme high temperature stress.

The presence of water in semi-arid environments is both spatially and temporally unpredictable, creating a pulse driven environment. When present, water stimulates seed germination; however, seedlings must establish while conditions are favourable if they are to survive. While studies have examined the influence of flooding on germinating soil seed banks’ characteristics, the role it has on seedling emergence patterns through time in these pulse environment has rarely been examined. We looked at the role of wetting regime on seedling emergence along a flood frequency gradient in a semi-arid floodplain wetland complex.

In a glasshouse seedling emergence experiment, soil seed bank samples from five habitats were exposed to three wetting treatments, “rain”, “saturated”, and “flooded” and seedling emergence was counted weekly. Through histogram Entropy analysis, three unique seedling emergence strategies were characterised as early, continuous and pulse strategies. Drier habitats stimulated only the early emergence strategy, a high risk response that maximises the chance of seedlings completing their life cycles where water availability is unpredictable. Wetter habitats exhibited multiple emergence strategies (including early, continuous and in rare cases pulse emergence), showing adaptations to both water limitation and inundation. Habitat was an important driver of temporal emergence characteristics, with the wetting treatment becoming important when it was ecologically relevant to that habitat. This novel study demonstrates that the strategies and patterns of temporal emergence in semi-arid environments are closely linked to habitat type and hydrologic regime.

Hotter nests produce hatchlings with lower thermal tolerance

**Mr Buddhi Dayananda**
Landscape genomics to understand climate adaptation in Eucalyptus trees

**Dr Megan Supple**¹, Dr Jason Bragg¹, Dr Rose Andrew², Dr Adrienne Nicotra¹, Dr Margaret Byrne³, Dr Linda Broadhurst³, Dr Justin Borevitz¹

¹The Australian National University, Canberra, Australia
²University of New England, Armidale, Australia
³Department of Parks and Wildlife, Perth, Australia
⁴CSIRO, Canberra, Australia

**Biography:**

Dr Megan Supple received her PhD in Biomathematics from North Carolina State University. She conducted her dissertation research at the Smithsonian Tropical Research Institute in Panama examining the genetic basis and evolutionary history of divergence and mimicry in Heliconius butterflies. She is currently a postdoctoral fellow at the Australian National University.

The rapid pace of climate change is threatening the survival of many species. Especially vulnerable are long lived species with slow migration rates, which have a limited ability to move with favorable climatic conditions. We are using landscape genomic techniques to understand the spatial distribution of genetic variation in two Eucalyptus species, E. marginata (jarrah) and E. melliodora (yellow box). Using genotype by sequencing methods, we have genotyped hundreds of samples across the distributions of each species. Using these genetic data we can explore the population structure of each species and identify genotypes associated with various climate conditions. This association is suggestive of adaptation,

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**Elevation Influences Aciphylla glacialis Survival, Growth and Frost Resistance: An Open Top Chamber Experiment**

**Ms Sonya Geange**¹, Dr Veronica Briceno Rodriguez¹, Ass. Prof Adrienne Nicotra¹

¹Australian National University, Canberra, Australia

**Biography:**

Sonya Geange is a PhD Candidate at Australian National University, conducting comparative ecological studies on phenotypic plasticity in plant water use traits. In addition, she also researches Australian alpine plant ecology, in particularly responses to increasing temperatures, and reduced water availability across elevation gradients.

Alpine ecosystems are particularly vulnerable to climate change, and climate projections indicate that future snow depth will decrease and snow will melt earlier. These will expose plants to a greater frequency of extreme of temperature events than would previously have occurred under the moderating influence of snow. Thus paradoxically, despite increasing temperatures, we expect frost to emerge as a major factor in determining plant survival and development under global change. Here we assess the impact of maternal environment during seed development on survival, growth and freezing resistance of seedlings in both ambient and simulated climate change scenarios. We established a field transplant experiment using the Australian alpine herb, Aciphylla glacialis, where seedlings from both late and early snow melt (ESM) provenances were planted at a common elevation in the field, under either warmed (Open Top Chambers, OTC) or ambient conditions. We hypothesized that seedlings from ESM sites would display greater tolerance to extreme temperature events and thus, have higher survival and growth in the field under OTC's. Preliminary results show high overall seedling mortality. The highest survival was in seedlings from ESM sites, although survival did not decrease linearly with between provenances. Warmed plants were taller, yet did not necessarily have more leaves. Finally, plants under ambient treatments displayed higher freezing resistance in general, with those from ESM sites in particular freezing at lower temperatures. Our study highlights that potential for selective survival in the face of a changing alpine climate, and the need for greater understanding of within-species responses.

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**Biography:**

Buddhi Dayananda is interested in Herpetology and wildlife management

Climate change is predicted to cause higher temperatures inside lizard nests, and these changes could threaten lizard populations. Nest temperatures can influence a hatchlings sex, body size and shape, behaviour and locomotor performance. The thermal regimes that lizards experience during incubation may also influence their thermal tolerance after hatching. Critical thermal maximum and critical thermal minimum provide an indication of the range of temperatures across which organisms can survive. To determine how increases in nest temperatures might affect the thermal tolerance of hatchlings, we genotyped hatchlings Oedura lesueuri, I incubated eggs at two fluctuating temperature regimes to mimic current ‘cold’ nests (mean = 23.2°C, range 10-33°C) and future ‘hot’ nests (27.0°C, 14-37°C). Hot- incubated hatchlings were smaller, and hatched 27 days earlier than cold-incubated hatchlings. Hatchlings from hot-temperature incubation had a lower critical thermal maximum and a higher critical thermal minimum than hatchlings from cold-temperature incubation. After they emerge from communal nests, hatchling velvet geckos shelter under sun-exposed rocks that can exceed their critical thermal maxima during summer. Potentially, the lower critical thermal maxima of hot incubated lizards may negatively affect their survival. My results suggest that future increases in nest temperatures may negatively affect hatchling body size and thermal tolerance. Thus, climate change may generate novel challenges for oviparous lizards.
Resource-use strategies of native and invasive species in response to elevated CO2 and water availability

Ms Varsha Pathare¹, Dr Oula Ghannoum¹, Prof David Ellsworth¹
¹University of Western Sydney, Hawkesbury Institute for the Environment, Richmond, Sydney, Australia

Biography:
Varsha Pathare started working with Hawkesbury Institute for the Environment, UWS, as a PhD student under the supervision of Prof David Ellsworth and Dr Oula Ghannoum. The aim of her research is to elucidate the eco-physiological responses of native and invasive plants species to elevated CO2 and interacting environmental factors.

Invasive plants pose an enormous threat to the biodiversity of Sydney’s native vegetation. Invasive plants can be stimulated by a variety of environmental enhancements and there is concern that rising atmospheric CO2 (eCO2) might be one of the important factors. Why some invasive plants are more responsive to eCO2 is still not clear. The theory of fluctuating resource availability states that, “A plant community becomes more susceptible to invasion whenever there is an increase in the amount of unused resources”. This indicates that resource demanding invasive species will be able to colonise low resource environments only after disturbance (e.g. climate change) thus leading to the generalisation that high resource environments tend to accumulate more invasive plants than low resource environments. However, many invasive plants do occur in low resource environments like forest understories, but the exact mechanisms involved in the invasion of low resource environments are poorly understood.

Though a few evidences indicate that efficient resource-use strategy enables the invasive plants to succeed in low-resource environments, no study till date evaluates the importance of this mechanism in response to eCO2 and water availability for a resource-limited ecosystem.

The main aim of our on-going project is to investigate whether the invasive species out-compete the natives by virtue of their efficient resource use strategies under eCO2 and water-limited conditions. We compare the eco-physiological traits associated with resource acquisition and conservation in 6 native and invasive species from the resource-poor and endangered Cumberland plain woodland ecosystem.

Biography:
Dr Brendan Choat obtained his BSc (Hons) in 1997 (JCU) and his PhD in 2003 (JCU). After completing two postdoctoral fellowships in the USA he took up a Senior Lectureship at the Hawkesbury Institute for the Environment (UWS).

The xylem tissue performs two vital functions in woody plants; delivery of water and nutrients to the canopy at a rate that allows for a net positive carbon balance, and mechanical support of the plant that facilitates adequate competition for light resources. The rate at which water can be supplied to the leaves through the xylem is largely set by dimension and arrangement of the hollow tubular conduits (vessels and tracheids) that constitute the plant hydraulic system. This is reflected in the close coordination of stem and leaf functional traits that has now been observed across a range of environments. Here we present a data synthesis examining the functional diversity of xylem traits using a database of over 1000 woody species. The database encompasses root and shoot level traits for angiosperms and gymnosperms across a broad range of biomes and physiographic affinities. The relationships we present illustrate the coordination of xylem functional traits across a broad environmental and taxonomic range. This quantitatively demonstrates the central role of xylem conduit anatomy in mediating trade-offs in hydraulic efficiency, water stress tolerance, mechanical strength, and construction cost. Despite fundamental differences in xylem anatomy between angiosperms and gymnosperms, the core relationships between structure and function are remarkably similar in these two groups. This continuum of xylem traits has direct implications for the growth and survival of woody plants, and their distribution across environmental gradients.

Impact of salinity on the uptake of trace metals by diatoms

Ms Emily Crawley¹, Dr. Rachel Popelka-Filcoff¹, Dr. Sophie Leterme², Dr. John Bennett², Mr. Attila Stopic³
¹School of Chemical and Physical Sciences, Flinders University, Bedford Park, Australia, ²School of Biological Sciences, Flinders University, Bedford Park, Australia, ³Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia

Biography:
Emily Crawley has completed a Bachelor of Science and is nearing completion of Honours in Chemistry at the Flinders University of South South Australia before beginning a PhD. This presentation represents her honours research for the past year.
Phytoplankton accounts for 40% of the primary production in the coastal ocean and plays an important role in the global carbon cycle. Research has shown that diatom silica cell walls are modified under fluctuating salinity conditions and that micronutrients such as trace metals could impact the productivity and/or species composition of phytoplankton communities. Changes in productivity and/or species composition would then impact the structure of the food chain up to fish. Drought conditions and associated rising salinity were observed in the Coorong wetlands during the 2004-2009 drought. Here we investigated the impact of those conditions on the trace-metal uptake by phytoplankton. In particular, diatoms from the Coorong wetlands were used as a case study as their silica-based cell walls display a high affinity for a range of aqueous metal cations. Under different salinity conditions (i.e. 36, 44 and 52 PSU), the trace metal (i.e. Cr, Mn, Fe, Zn) adsorption of the diatom species was quantified by neutron activation analysis (NAA) using the OPAL research reactor operated by the Australian Nuclear Science and Technology Organisation (ANSTO) at Lucas Heights, NSW. This study allowed the development of a novel application of NAA for the elemental analysis of experimentally cultured diatoms. This research demonstrated that the salinity levels used in the study did not have a statistically significant impact on the trace metal adsorption of diatoms. The development of techniques for sample preparation as well as irradiation procedures also facilitates further research on other related organisms.

Warmer maternal environment during seed production reduces offspring seedling performance in a post-fire recruiting Bossiaea

Dr Mark Ooi
University of Wollongong, Northfields Ave, Australia

Individual Responses to the Environment, Suite 3, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Dr Mark Ooi studies plant ecology, with a strong focus on seeds and the drivers of variation in dormancy mechanisms, seed bank dynamics and recruitment. He runs the Seed Ecology lab at Wollongong and is an Associate Editor of Seed Science Research, with research interests in disturbance-prone ecosystems around the world.

The dynamics surrounding seeds are key to population persistence in fire-prone ecosystems. To fully understand how populations may persist, and in particular to predict the impacts of changing climatic conditions, we need to develop a clearer picture of the ecological consequences of variation in germination and seedling recruitment. In this study, I investigated the effects of increased maternal environment temperature on subsequent seed offspring and seedling vigour. Ten Bossiaea heterophylla (Fabaceae) plants from a single population were grown from seed to maturity in a common garden over a two year period. Upon the onset of flowering, the group was divided between control conditions or a warmed greenhouse approximating a 4°C mean temperature increase and maintained until seed dehiscence. Germinated seeds from each maternal environment group were then sown and seedling survival and growth measured for 3 weeks, followed by a drought stress treatment. Seed weight and seedling performance were compared between the two groups. While no differences were found for seed weight, seedling performance differed considerably. Seeds developed under warmed conditions producing slower growing seedlings with less resilience to drought, reflecting similar findings of seed vigour loss reported due to maternal environment warming for agricultural species. These results show that the combination of warmer temperatures during seed development and loss of resilience by seedlings to dry conditions combine to limit potential recruitment success under future conditions.

Is Australia Weird?

Dr Habacuc Flores-Moreno, Ms Gordana Popovic, Dr William Cornwell. Many many others, Prof Angela Moles
UNSW, Sydney, Australia, University of Minnesota, Minneapolis, USA

Individual Responses to the Environment, Suite 3, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Professor Angela Moles’ main research interests are: 1) Quantifying large scale patterns in ecology, and understanding the biotic and abiotic factors underlying these patterns, and 2) Studying rapid evolution in introduced species. Angela is the Vice President of ESA, in charge of the student affairs portfolio.

"[I]… was reflecting on the strange character of the animals of this country as compared to the rest of the World. An unbeliever in everything beyond his own reason, might exclaim “Surely two distinct Creators must have been [at] work…”"

[Charles Darwin’s Beagle Diary, describing NSW.]

It is often suggested that the biotic and abiotic features of Australia are different to those found in the rest of the world. However, these assertions are generally anecdotal. We used global databases to determine whether the climate, soil, plant traits, vertebrate life history traits and ecological processes of Australia differ to those found in North America, South America, Europe, Asia and Africa. There are some differences between Australia and elsewhere. For instance, the Australian flora tends to sit towards the slower end of the leaf economic spectrum, and has a high proportion of N-fixers. Australian vertebrates tend to have slower development, and Australian birds have unusually long lifespans. However, all of the continents had some unique features. There was no significant difference between Australia and the other continents in terms of climate, productivity, marine herbivory, or litter decomposition rate. Multivariate analyses demonstrate that Australia’s extant flora and fauna are not functionally more distinct than in any other continent. Australia is not the outlier it has been made out to be.

Assessing the Conservation Value of Regrowth Vegetation: 17 Years On
In 1998, a review was undertaken on the conservation value of regrowth native vegetation for the NSW Scientific Committee (Doherty, 1998). This was to assist the Committee in its deliberations when considering threatened ecological community definitions, listings and status. It was also undertaken to investigate the assertion from proponents of clearing that many areas unable to be cleared because of legislative changes were only regrowth and were of little or no conservation value. When the review was undertaken, little specific research had been undertaken in Australia. However, it was readily apparent that areas which had at some stage been cleared or disturbed in some way still retained varying levels of conservation value. Indeed, because remnants of many threatened ecosystems are in production or urbanising landscapes, they have almost always been cleared or thinned at some point in the past 200 years. The best available best on offer examples of many threatened ecosystems are in fact regrowth stands. The review highlighted conflicting ways in which conservation values can be assessed involving interactions between history, scale, context, extent, condition, rarity, representativeness, disturbance and naturalness. After revisiting the original review, I will evaluate where we have come since 1995 in defining, documenting and measuring the conservation value of regrowth native vegetation. I will discuss the dynamic social and political context within which conservation values are contested, focussing in particular, but not exclusively, on the Cumberland Plain in western Sydney.

Agricultural intensification and restoration: consequences for native ground layer diversity

Ms Shana Nerenberg1, Dr Sue McIntyre2, Dr Jane Catford1, Prof David Lindenmayer1, Assoc Prof Philip Gibbons1
1Australian National University, Canberra, Australia, -CSIRO Ecosystem Sciences, Canberra, Australia

Agricultural intensification directly threatens native ground layer diversity when native pastures are converted to exotic sown pasture or crops, eliminating most native plant diversity from the matrix. Conservation of native ground layer diversity must then occur outside the matrix but for intensively used agricultural landscapes, the most common areas set aside for conservation are for planting trees. Tree plantings are protected from livestock but the ground layer is not replanted or managed for conservation. If we are to understand how agricultural intensification will impact native ground layer diversity, we need to quantify the ground layer diversity supported by tree plantings and how agricultural intensification might influence restoration outcomes. We surveyed native ground layer diversity across nine landscapes in the south west slopes of NSW using 54 replicate sites of three treatments: fenced remnants, plantings with no cultivation history, and plantings with a past history of cultivation. Our data showed previously cultivated plantings to have the lowest native species richness per site (~5 spp., uncultivated plantings ~9 spp., remnants ~17 spp.). Cultivated plantings also supported the lowest total species richness across all sites (~55 spp., uncultivated ~80 spp., remnants ~130 spp.). Our results link cultivation with an ~45% reduction in ground layer richness compared with uncultivated plantings and show that cultivated plantings overall support far fewer native species. We conclude that agricultural intensification can depress ground layer diversity, not only via direct effects, but also by increasing the prospect of poor restoration outcomes.

Net outcomes of ecological interactions between arthropods and crops

Dr Manu Saunders1, Prof Gary Luck1
1Institute for Land Water & Society, Charles Sturt University, Albury, Australia

Conservation of animal communities that provide ecosystem services (ES) is critical to sustaining ecosystem function in agroecosystems. Here, we quantify the net outcome of multiple animal activities (pollination, fruit damage, biological control) by calculating the number of undamaged fruit at harvest as a proportion of the number of blossoms (i.e. potential fruit yield). Net outcomes were quantified for two separate branches on each focal tree, one netted to exclude vertebrates and one exposed. We consider animal activity across the entire growing season and within environmental contexts. Vertebrate exclusion resulted in lower fruit set and higher levels of insect damage but did not affect net outcomes. Net outcome on both
Managing Native Vegetation in Kangaroo Island's Agricultural Landscape - Successes and Challenges

Mr Grant Flanagan1
1Natural Resources Kangaroo Island, Kingscote, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Grant Flanagan's working life began at Northfield Agricultural laboratories on biological control of Lucerne Aphids. He subsequently worked on Dung Beetles for CSIRO in South Africa, then biological control of weeds in the Northern Territory. Grant has worked in native vegetation management and sustainable production on Kangaroo Island since 2002.

Kangaroo Island is well known for its extensive native vegetation, over 21,000 ha of which has been protected by farmers (excluding Heritage Agreements). The extent of Kangaroo Island's native vegetation has increased over the last 25 years, most of this on private land. GIS analysis shows patch size and connectivity of protected vegetation are increasing. This has been a joint partnership between landowners, State and Federal authorities. In addition a number of activities including but not confined to, the reintroduction of fire, re establishing threatened plant habitat, goat near eradication, Glossy Black Cockatoo recovery and Koala management have improved vegetation condition or reduced threats to that condition at a range of scales across the Island's agricultural estate. Despite these successes, challenges remain. These include balancing the public safety and threatened species habitat management in traffic corridors, minimal capture of high quality agricultural land in the pursuit of increasing biodiversity resilience and balancing the biodiversity benefits and agricultural impediments that are single paddock trees.

This presentation will quantify these successes and describe the metrics, strategies and policies that have produced them and those being developed for our future issues.

Impact of grazing on the endangered pygmy bluetongue lizard

Mr Torben Nielsen1, Prof C. Michael Bull1
1Flinders University, Bedford Park, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Torben Nielsen is a PhD candidate at the School of biological sciences at Flinders university. Research interests are focused on the interactions between human activities and animals in terrestrial as well as marine environments, and how to manage the effects of these activities.

The pygmy bluetongue lizard (Tiliqua adelaidensis) is an endangered scincid lizard, endemic to native grassland, in the Mid North region of South Australia. Today only a few isolated patches of this formerly widespread habitat remain. These areas are all privately owned and almost exclusively used for grazing, mainly by sheep. Grazing can be used to manage invasive plants and keep areas between grass tussocks clear for the lizards to bask and detect prey. The downside to grazing is that a reduction in plant biomass can lead to fewer grasshoppers, an important food source for the pygmy bluetongue lizard. In this study we investigated the effect of different levels of grazing on pygmy bluetongue lizards. We found that in paddocks with heavy grazing, there were fewer and smaller grasshoppers. We also found that lizards in paddocks with heavy grazing had reduced body condition, and produced smaller litters in late summer. Although this species has persisted for many decades in natural grasslands grazed by sheep, future management will require careful monitoring of the level of sheep grazing.

Insect diversity on alternatively managed livestock grazing properties in the New England region, northern NSW

Ms Rachel Lawrence1
1University of New England, Armidale, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Rachel Lawrence is currently a PhD candidate at the University of New England in NSW. Rachel has worked as an entomologist in a number of forestry, cropping and grazing related areas. Rachel’s major interest lies in the integration of agricultural production with improved ecological outcomes.

Landscape degradation and biodiversity loss from livestock grazing is common. However, there are alternative approaches to grazing management that claim biodiversity benefits as well as reduced land use impacts. We compared contrasting management styles of livestock grazing on 16 properties (eight pairs). One property in each pair was managed using a form of high intensity, short duration grazing with extended pasture rest
(HISD), while the comparison property was managed conventionally, in a way more typical of the region, usually continuous grazing, or with extended grazing periods. Unimproved pastures on each property were assessed for soil stability, water infiltration, nutrient cycling capacity and perennial grass cover, while parasitoid hymenopteran abundance and diversity were assessed as potential indicators of insect diversity.

All measures of landscape function and hymenopteran abundance were higher on properties managed under HISD grazing. Differences were significant for stability, infiltration and nutrient cycling capacity assessments, perennial plant surface cover and for parasitoid hymenopteran species richness.

Greater landscape function values indicate a greater capacity for soil to support plant growth with increased perennial grass cover further improving landscape function (and potentially increasing soil carbon and organic matter levels). Increased insect diversity will enhance the provision of important ecosystem services including pest control, pollination, dung burial and nutrient cycling and provide food resources for native animals. This research suggests that there may be improvements in several ecological functions associated with HISD grazing and this may have benefits both for production and potentially for the conservation of native fauna in the landscape.

Plant-flower visitor networks and bee body size

Ms Michelle Yates1, Dr Romina Rader2, Professor Jane Memmott2
1University of NewEngland, Armidale, Australia, 2The University of Bristol, Bristol, United Kingdom

SYMPOSIUM: Advances in the ecology and management of production landscapes (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography: Michelle Yates is conducting her PhD in agro-ecology at UNE and has a lot of experience in entomology. She enjoys skiing, cooking good food, playing sports such as tennis and relaxing with friends and family.

ABSTRACT
Food webs have been used extensively to map exclusive insect-plant interactions in many different habitats. In this study we employed a food web (network) approach to the interactions between floral visitors and plants found in remnant habitats on a 4,000 acre farm in NSW. This is a novel study, as to our knowledge nobody has looked at these interactions within every part of the native vegetation remnants on a farm. We assessed network metrics such as interaction frequency, connectedness, robustness and specialization in R. We also used linear models to assess relationships between these network metrics and flower visitor (bee) body size. Furthermore, we assessed body size against the size of remnants, and the distance between the remnants.

Give it to me straight: are linear strips appealing for woodland birds in agricultural environments?

Mr Mark Hall1, Dr Dale Nimmo2, Prof. Andrew Bennett1,3
1La Trobe University, Bundoora, Australia, 2Charles Sturt University, Albury, Australia, 3Arthur Rylah Institute, Heidelberg, Australia

SYMPOSIUM: Advances in the ecology and management of production landscapes (2), December 2, 2015, 2:15 PM - 5:30 PM

Biography: Mark Hall is a PhD candidate at La Trobe Uni looking at the role of vegetated linear networks in supporting native pollinators (birds, bees and wasps largely). This usually involves cups of tea with landholders and a chat about the old days...and a bit of birdwatching.

Increasing pressure from human land use has caused loss and degradation of woodland ecosystems around the world, leading to isolation of remaining habitat patches for wildlife. Woodland dependent biodiversity, such as woodland birds, are faced with finding suitable habitat that provides food and shelter resources adequate to sustain their populations. In heavily modified regions, remnant woodlands often take the form of linear roadside and river networks. Despite their ubiquity, these linear networks are poorly understood for their role in landscape-scale conservation. This study aimed to identify the role of linear networks for the conservation of woodland birds in a heavily modified agricultural landscape of southeastern Australia. We used a whole of landscape approach, with 30 large 10x10km landscapes chosen from an existing data source. Within these landscapes, 120 sites were selected along roads and creeklines where birds had previously been surveyed. We specifically examined the effects of the following characteristics of linear vegetation networks on woodland bird communities within 3km of the site; 1) the overall amount of vegetation within the landscape, 2) the width of the linear strip, 3) the connectivity of linear networks, 4) the grain size (how tightly linear networks are configured within a landscape and 5) the density of scattered trees surrounding linear strips/networks, providing stepping stones for movement. We tested these on woodland birds, examining differences between species richness and diversity. Our results are discussed in relation to applied conservation and management of linear vegetation networks around the world.

Optimising prescribed burning for production and biodiversity when cattle graze on regenerating native pastures

Dr Anja Skroblin1, Dr Katherine Tuft1, Dr Sarah Legge2, Dr Greg Bishop-Hurley3, Kira Andrews4
1Australian Wildlife Conservancy, Subiaco, Australia, 2Australian National University, Canberra, Australia, 3CSIRO, St Lucia, Australia, 4Rangelands NRM, Broome, Australia
Biography:

Dr Anja Skroblin is a wildlife ecologist for the Australian Wildlife Conservancy. Her research combines expertise in ecology, evolution and molecular genetics to develop and implement land management strategies for biodiversity conservation. She is passionate about developing cross-tenure approaches to managing threats and enhancing outcomes for threatened species and communities.

Prescribed burning is an important management tool for both conservationists and pastoralists in the extensive rangelands of northern Australia. It can be used to support biodiversity outcomes as well as pastoral production by reducing the risk of wildfire, and improving the nutrient value of pasture. Prescribed burning may however have negative impacts on biodiversity and long-term pastoral sustainability if cattle grazing is concentrated on sensitive regenerating pasture, and cattle grazing has been shown to negate the benefits of prescribed burning on recovery of declining mammal populations. GPS collars with activity sensors were deployed on 48 free-ranging cattle to examine grazing behaviour in response to EcoFire prescribed burning, a regional fire management program in the Kimberley. The impact of grazing on regrowth of pastures was assessed at 16 fire scars that contained paired fenced (no grazing) and unfenced (potential grazing) monitoring plots. The grazing behaviour of individual cows was influenced by the distance to water, and the pastoral quality choices available within the landscape, including regrowth on fire scars. Striking differences in vegetation regrowth were evident between areas that were accessible and fenced-off from cattle. Grazing pressure following prescribed burning acted to intensify the impact of fire by removing regrowth of ground cover habitat for native fauna. Stocking rates as well as pastoral quality influenced this grazing pressure. These outcomes improve our understanding of factors that influence grazing pressure following fire, and help managers to refine their prescribed burning practices to maximise production and biodiversity outcomes.

Bushfire and spatial and temporal diversity of understory plants from two Kangaroo Island mallee communities

Dr David McKenna

1SA Department of Environment, Water and Natural Resources, Adelaide, Australia

Biography:

I have a fire ecology role with the Fire management unit at DEWNR. My particular interests are around how we better incorporate landscape fire regimes and effective risk reduction as part of our ongoing fire management program and developing an adaptive management framework for our fire program.

In this study, plant community composition was surveyed at 16 mallee sites from two vegetation communities across western Kangaroo Island. Surveys were conducted in 2002 and 2004, prior to a large scale bushfire in December 2007 that burnt 96% of the native vegetation in the area, providing an opportunity to measure the post-fire changes in 2010 and 2013. The aim was to examine spatial and temporal changes in plant diversity. Plant species composition was compared using PERMANOVA+ and total beta diversity was partitioned into turnover and nestedness components to better understand the site to site variation. I found a total of 186 species across all sites. Mean site species richness was variable depending on the site, season and vegetation type, but increased significantly for both communities following fire (45% for E. remota sites and a 130% for E. diversifolia sites), although E. remota sites had higher species richness both before and after the fire. For each vegetation type, spatial beta diversity patterns were similar across sample years, although sites were less similar in E. diversifolia than in E. remota sites. Site to site variability was generally high, with differences strongly driven by species turnover rather than subsampling in a nested fashion. Mean temporal beta diversity components of single site analysis before and after fire revealed that 38% and 25% of the species were unique to the pre-fire samples. Temporal changes at a site were less than between sites in any year, with nestedness a stronger component of total beta diversity.

Ecosystem services in a changing climate: dung beetle mediated gas emissions from manure

Dr Jean Drayton1, Associate Professor Nigel Andrew1

1Insect Ecology Lab, University of New England, Armidale, Australia

Biography:

Dr Nigel Andrew is an Insect Ecologist working on responses to micro and macro climatic changes on insect ecology, behaviour and physiology. He is also the current ESA President.

Background/Question/Methods

Dung pats deposited onto pastures are sources of the greenhouse gases (GHGs) methane, nitrous oxide and carbon dioxide. The physical and chemical properties of the soil and manure can influence emission rates; factors such as temperature, moisture content, pH, aeration and the availability of suitable substrates can influence microbial activity and hence the rate at which GHGs are formed and released from manure. The movement and churning of manure by dung beetles can alter the chemical, physical and microbiological properties in dung and soil and therefore affect gas losses. For example, dung beetles aerate dung pats and can slow anaerobic processes such as methane formation. We used a non-steady state chamber design to investigate if dung beetles can modify the GHG emissions from cattle manure. Emissions of methane, nitrous oxide and carbon dioxide were monitored in cattle dung pats that were either colonised by dung beetles, or that contained no dung beetles.
Results/Conclusions
Our initial results reveal a clear signature of the dung beetles on emissions of carbon dioxide and methane from cattle manure. Initially, dung pats that contained beetles showed higher fluxes of carbon dioxide than control pats. Through the course of the experiment however the trend was reversed. Our results indicate that dung beetles can alter the methane and carbon dioxide budgets of pastures that are grazed by cattle. Given that cattle manure is a source of GHGs, our results could have implications for mitigating emissions from livestock production.

Why do ecologists lag behind when it comes to publishing research data?

Dr David Turner1,2, Dr Anita Smyth1, Prof Andy Lowe1
1Adelaide University, Adelaide, Australia, 2TERN Eco-Informatics, Adelaide, Australia

Biography:
Dr David Turner has a broad ecological background involving projects branching across temperate marine environments, terrestrial vegetation modelling and adaptive environmental management. Most recently he has worked as an ecological data subject matter expert focussing on the challenges associated with storing, manipulating and providing access to diverse and complex data.

Scholarly data publishing (DP) is a new scientific practice that is rapidly challenging our science ethos. Many scientists now make their data available online in public repositories and data journals. While initially a requirement of some journals and funding bodies, new opportunities are emerging to directly benefit those that publish their data (e.g. data citation indices). Nevertheless, the uptake of data publishing in ecology is reported to be slower than in other science disciplines (e.g. genetics).

Ecologists cite many barriers to publication, such as insufficient time to prepare data, scarce resources, a lack of clarity about ownership, and poor knowledge about how to store and lodge data. The underlying reasons in many cases stem from the fact that diverse and sometimes conflicting interests often drive the data publication process. Those designing and building systems often have little direct experience with research data reuse or the scientific publication process, meaning that platforms are not necessarily built in a way that fits in with a researchers usual workflow. Not only then, does the whole publication process appear unfamiliar, but also key functionality may be missing entirely.

We argue that it is not that ecologist don’t want to share their data, as this has been common practice for many years, but instead that many struggle to find relevance for, and or incentives to keep up with the technologies and new practices. Here we explain data publication from an ecologists perspective and address some of the challenges they encounter.

Understanding the nuances of data publishing for maximum research impact

Dr Anita K. Smyth1, Mr Craig Walker1, Professor Andrew J. Lowe2
1The University of Adelaide (TERN Eco-Informatics), Adelaide, Australia, 2The University of Adelaide, Adelaide, Australia

Biography:
Publishing data is an essential part of reproducibility in science. As a Data Facilitator, Dr Anita Smyth manages data relations, licensing and user support for publishing ecological data in TERN’s AEKOS. She provides beneficial interactions with the ecosystem science community seeking to use AEKOS by drawing on her research networks and experience.

Data empowers ecologists as it drives scientific discovery - the hallmark of mainstream science. While ecologists have been sharing data for a long time, data publishing is a relatively recent phenomenon. It has a lot in common with journal article publishing. Researchers generally submit datasets and associated metadata using online data submission tools for archiving in data repositories (e.g., Dryad, AEKOS, institutional platforms). They also submit data papers and dataset packages to data journals such as Nature Scientific Data. Either way, both approaches use e-platforms that not only enable researchers to securely archive important data but also allow others to discover, access and reuse the data as prescribed by copyright or bespoke data licences that come with data downloads.

Many of today’s ecologists struggle and even fear publishing their data as the practice is new, lacks consistent standards and has many technical, legal and citation nuances that aren’t well understood nor documented. For example, did you know US Creative Commons Zero licences mean researchers don’t have to cite your data in their derivative works? Another issue is how to cite new datasets derived from multiple datasets (e.g., 20+ data authors) when reference lists in journal articles must be streamlined and yet the licensing conditions of full attribution must be cited. Here, we present the ‘dos and don’ts’ of data publishing to help minimise these issues (and others) to help ecologists manage appropriate reuse of their data, identify suitable licensing conditions and achieving maximum impact.

Open woodlands; making the Native Vegetation Information System (NVIS) Reusable, Accessible and Discoverable (RAD)

Dr Jeremy Groves1, Mr David Osborn1, Ms Natalie Lyons1, Mrs Lalage Cherry1
1The Department of the Environment, GPO Box 787, Australia

Biography:
Dr Jeremy Groves is an ecological data subject matter expert, working to make the Native Vegetation Information System (NVIS) a reusable, accessible and discoverable system.
There is a strong push across the Australian, State and Territory Governments to improve (open) access to public sector information. The open access agenda is focused on making data and information reusable, accessible and discoverable (RAD) by the community, business and government. However, releasing Commonwealth information faces many of the same challenges as that of researchers: data integrity, copyright, licensing, derivatives and acknowledgement.

This presentation discusses the open data agenda and what it means for the National Vegetation Information System (NVIS). The NVIS is an ongoing collaborative initiative between the Australian, state and territory governments to manage national vegetation data to improve vegetation planning and management within Australia.

The Department is collaborating with state and territory’s to update NVIS. It provides a useful opportunity to consider how vegetation data can be made more RAD, consistent with the open data policy agenda. There is already broad agreement across all jurisdictions for NVIS data to be supplied under a creative commons license. An ideal outcome of open licensing would be the ability to have a publicly available NVIS database and the potential to generate new derived products. There is initial work underway, by the Department, to reduce the major challenges of open data by automated data cleaning, review derived products, automated vegetation categorisation and develop open source methods to create new derived products to support this longer term view.

The benefits from more accessible and discoverable vegetation information could inform new management frameworks, models and understanding of vegetation and biodiversity across Australia.

A Scientific Workflow to apply an IUCN Red List Ecosystem Assessment of Mountain Ash Forest

**Dr Siddeswara Guru**, Mr Ivan Hanigan1, Mr John Stein2, Mr Wade Blanchard3, Dr Emma Burns2, Prof. David Lindenmayer2, Prof Tim Clancy1

1University of Queensland, St Lucia, Australia, 2Australian National University, Canberra, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Dr Siddeswara Guru is the TERN Data Integration and Synthesis Coordinator at The University of Queensland. He initiate, co-ordinate and manage ecological data management, e-infrastructure and synthesis projects. He has graduated with PhD from University of Melbourne and MBA from University of Tasmania.

The mountain ash forest of the Central Highlands in Victoria is globally iconic, and characterised by spectacular Mountain ash trees, which are the world’s tallest flowering plant. The forest is highly valued for its contributions to water quality and timber production. Burns et al. (2015) applied the IUCN Red List of Ecosystems criteria to assess the risk of ecosystem collapse in the forest. One of the major challenges with any scenario-based risk assessments is to make the entire analysis repeatable so that others can re-run the assessments, examine assumptions, verify the results and explore sensitivity analyses.

Scientific workflow software is predominantly used to describe, manage and share complex scientific analyses. In the scientific workflow paradigm, complex experiments are divided into a set of smaller inter-related tasks where data or control is passed from one task to another. These tasks are inter-connected and executed to deliver the outcome. The workflow management systems offer flexibility to use different programming languages to implement tasks used to compose a workflow.

We have re-created the assessment performed by Burns et al. (2015) as a Kepler scientific workflow. The workflow is shared in the cloud-based Collaborative Environment for Ecosystem Science Research and Analysis (CoESRA) system. Any researcher with AAF authentication can log in to the system, access a virtual desktop and re-run, review and study the assessment experiment. This has significantly enhanced the transparency and credibility of the scientific research so that it will have a long-lasting impact on policies to protect the mountain ash forest.

The challenge of combining 176 x #otherpeoplesdata to create the Biomass And Allometry Database (BAAD)

**Dr Daniel Falster**, Dr Richard FitzJohn1, Dr Remko Duursma2, Dr Diego Barneche1,3

1Macquarie University, Biological Sciences, Australia, 2University of Western Sydney, Richmond, Australia, 3Monash University, , Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Dr Daniel Falster is an ARC postdoctoral research fellow at Macquarie University. He uses a combination of maths, computer models, and large data sets to test fundamental ideas about the processes shaping biological communities. He is passionate about science, open data, reproducible research, and teaching biologists to code.

Despite the hype around "big data", a more immediate problem facing many scientific analyses is that large-scale databases must be assembled from a collection of small independent and heterogeneous fragments -- the outputs of many and isolated scientific studies conducted around the globe. Together with 92 other co-authors, we recently published the Biomass And Allometry Database (BAAD) as a data paper in the journal Ecology, combining data from 176 different scientific studies into a single unified database. BAAD is unique in that the workflow -- from raw
Identifying centres of range-extent endemism using plot-based datasets

**Dr Greg Guerin**, Prof. Andrew Lowe

1The University of Adelaide, Adelaide, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

**Biography:**
Dr Greg Guerin is a postdoctoral researcher at the University of Adelaide affiliated with the Terrestrial Ecosystems Research Network. His areas of interest include community ecology, biodiversity mapping and ecological gradients.

Concentrations of range-restricted biodiversity in a geo-political context are conservation priorities and indicators of biogeographic processes. We aimed to find centres of plant endemism within South Australia, taking advantage of large, systematically collected and standardised species occurrence datasets available through the Aekos portal of the Terrestrial Ecosystem Research Network (TERN). This included 330,000 records of 3,000 species in over 14,000 field plots from the Biological Survey of South Australia, supplemented with records from poorly sampled regions via TERN’s AustPlots program. Aekos has functionality to re-submit modified data used for analysis as a static dataset. We developed a new implementation of ‘range-rarity richness’ in which species richness is weighted by extent of occurrence (rather than frequency or area of occupancy), referred to as ‘georeferenced weighted endemism’. Species weights and endemism scores were poorly correlated between range estimation methods and the highlighted spatial areas of high endemism differed from scores based on categorical endemics. We identified Western Kangaroo Island, the Southern Mount Lofty Ranges, the Anangu Pitjantjatjara Yankunytjatjara lands and lower South East as areas of range-restricted plant diversity in the context of South Australia. This analysis was significantly enhanced by TERN’s data infrastructure through provision of data and resubmission of data for repeatability.

Data publication, data quality, assertions and service

**Mr Lee Belbin**

1Atlas of Living Australia, Carlton, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

**Biography:**
Lee Belbin is a geoscience graduate and IT postgraduate who has evolved from exploration geology, teaching and research, analytical ecology to management and policy development. He now provides project management for, and advice to international and national biodiversity-related projects: He is a surfer with a small work problem.

The Atlas of Living Australia accepts any species observations or specimen records and makes them publicly available. The observer generally believes their data is at least suitable for their work but other potential users of their data may have a different perspective. What do biodiversity aggregators such as the Atlas do to ensure that data publishers and users are both well-supported?

A traumatic process in publishing data may well result in data lost forever. The Atlas provides a simple ‘sandbox’ (http://sandbox.ala.org.au) where you can paste or upload CSV-formatted data. The sandbox searches the data for standard fields such as latitude, longitude, species names etc. This process uses the Darwin Core standard (http://rs.tdwg.org/dwc/index.htm) and standards are the second facilitator of data publishing. Darwin Core has 185 terms that can be used to describe a record, making the data self-describing. Once standardized, the Atlas applies 92 automated tests and attaches any ‘failures’, called assertions to each data record. These assertions are reported to the publisher. These tests cannot detect all issues, so a public annotation service is provided. All submitted data is then made openly available (with citations) through interfaces targeted to different communities. For example, the Spatial Portal (http://spatial.ala.org.au) and the ALaVR library are provided for the research community. The final step is the provision of usage statistics to data publishers.

Data-driven analysis of biological survey gaps supports species discovery through Bush Blitz

**Dr Kristen Williams**, Dr Brian Hawkins, Mr Art Langston, Mr Glenn Manion, Dr Daniel P Faith, Ms Jacqui Meyers, Mr Justin Perry, Dr Tom Harwood, Dr Simon Ferrier, Ms Jo Harding

1Biodiversity, Ecosystem Knowledge and Services (CSIRO Land and Water Flagship), PO Box 1600, Australia, 2Australian Biological Resources Study (Director of National Parks, Department of the Environment), National Botanical Gardens, Canberra, Australia, 3Scientific Services Division (Office of Environment and Heritage), University of New England, Armidale, Australia, 4The Australian Museum, College St, Sydney, Australia, 5Landscape Intensification (CSIRO Land and Water Flagship), Townsville, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

**Biography:**
Dr Kristen Williams is a postdoctoral researcher at CSIRO Land and Water Flagship, leading the development and implementation of Bush Blitz, a data-driven citizen science project to identify, map and monitor species in Australia. Bush Blitz is connected with the Atlas of Living Australia, a biodiversity database held by the University of Adelaide. Dr Williams has a PhD from the University of Sydney, where she researched biodiversity monitoring using remote sensing, and an Honours degree in Environmental Sciences from the University of Queensland. She has worked as a consultant to government, industry and conservation organisations.
Dr Kristen Williams leads a multidisciplinary group of scientists within a program of research focussed on a sustainable Australia where biodiversity prospers and ecosystems meet the needs of all people. She has a background in biodiversity modelling, conservation assessment and systematic conservation planning incorporating process knowledge of ecosystems and whole landscape perspectives.

Bush Blitz (www.bushblitz.org.au) is Australia’s largest nature discovery project – a multi-year, multimillion dollar partnership to document the plants and animals in hundreds of properties across Australia’s diverse landscapes. Since the program began in 2010 Bush Blitz has discovered about 600 new and undescribed species and has added thousands of species to what is already known – providing baseline scientific data informing the protection and management of biodiversity. CSIRO is supporting the program through data-driven analyses of biological survey gaps to enhance local targeting and national coverage of field surveys. Four biological groups are used as indicators of survey completeness – vascular plants, reptiles, amphibians and land snails – informing the selection of new areas where predominantly vascular plants and invertebrate surveys are conducted. The specialised analytical framework, which uses the principle of complementarity, combines the biological survey data with spatial environmental data at 250m resolution to capture heterogeneity across a range of scales. Resulting layers of information support subsequent area identification for further investigation of survey potential taking into account field logistics. This ‘big data’ application has only recently become feasible through data aggregations such as the Atlas of Living Australia (www.ala.org.au) and the Australian Ecological Knowledge and Observation System (www.aekos.org.au). While data for plants and vertebrates are well represented, there is a need to focus more effort on mobilising invertebrate data. We discuss our experience in accessing and using such aggregated biological data and outline where further integration of ecological data would enhance their effectiveness for such meta-applications.

The challenge of reusing data and aggregating different datasets for assessment and reporting.

Mr Glen Scholz
1DEWNR, Plant Biodiversity Center Lot 1 Hackney Rd, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Glen Scholz is currently the Principal Aquatic Ecologist in the Evaluation and Reporting Group in DEWNR and advises on evaluation and reporting aspects of State monitoring programs including Marine Parks, Lake Eyre Basin Rivers Assessment, and NRM programs and SOE reporting.

The Evaluation and Reporting Group in the Department for Environment Water and Natural Resources (DEWNR) are tasked with reporting on a range of Natural Resource issues across South Australia. Invariably this involves reviewing a range of data sets that were collected for a range of purposes using various methodologies. The challenge is to determine what data can be aggregated in a fit for purpose way to report and inform on natural resource issues.

In assessing the application of datasets the biggest problem is that metadata records describing the context for the data are inadequate. This includes clarity around the purpose, the questions the data was designed to answer and the scale at which the data informs. In some instances data has been disaggregated from other lines of evidence as a single theme thereby losing the associated context i.e fish data separated from water quality and flow data.

Before assessing the application different data sets it is essential to have set clear questions so the process is not driven by the method or the data available. Setting the scale at which the data can report is also a key consideration in integrating datasets. This presentation will discuss a number of key solutions for aggregating different data sets using case studies.

Open access data: facilitating links between science and policy

Dr Trish Lavery
1Department of the Environment, Canberra, Australia

SYMPOSIUM: Modern ecology; challenges and opportunities, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Dr Trish Lavery is a senior project officer in the Department of the Environment. Her current work is focused on managing data and information accessibility of the National Environmental Science Programme. Trish has a PhD, has co-authored twelve scientific publications and has been awarded the coveted F. G. Woods Memorial Scholarship (2015).

The Australian Government is committed to supporting the open access agenda and considers that information funded by the Government is a national resource that should be managed for public purposes.

The Department of the Environment’s ‘National Environmental Science Programme’ (NESP) is a $145 million programme designed to fund world-class biodiversity and climate science to guide and assist decision-makers to understand, manage and conserve Australia’s environment. The NESP researchers have committed to ensuring that all research outputs arising from NESP research are made publicly and freely available including all datasets, secondary data products, publications, images, models and other outputs produced during the programme.

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Timely access to robust environmental information underpins successful policy and is crucial to effective decision making within the Department of the Environment. This presentation provides case study examples designed to illustrate the synergies that occur when research data is made reusable, accessible and discoverable by the community, business and government and will reflect on lessons learned from both policy and research perspectives.

Maximising the value of environmental information – a national perspective

Ms Dayani Gunawardana¹, Lalage Cherry¹, Dave Osborn¹
¹Australian Government Department of the Environment, Canberra, Australia

Biography:
Dayani Gunawardana is a senior policy officer, Australian Government Department of the Environment. Her current work is focused on establishing the Essential Environmental Measures for Australia programme and delivering strategic policy advice to improve the quality and availability of environmental information to support decision makers and the broader community.

Public sector information is a valuable resource, but this value can only be fully realised when the community (including government, the research sector and industry) can discover, access and reuse it.

In line with movements across the globe, the Australian Government has committed to open access of public sector information. This presentation explores some of the challenges the Department of the Environment faces in implementing an open data agenda. It provides an overview of steps the Department is taking to improve access to environmental information.

Working with state and territory governments, the Department is improving access to the environmental information it holds. This includes information on threatened species and ecological communities, national heritage, protected areas and Ramsar wetlands. Licensing barriers have been addressed and many of these datasets are now open access through internet download and increasingly, through web services.

The newly established Essential Environmental Measures for Australia programme will provide broader momentum across the environmental information community for the open data agenda. The programme takes a strategic and collaborative approach to improve our capacity to track trends in the state of the environment. It aims to identify essential environmental measures and work with data custodians, domain experts and data users across Australia to make data on these measures discoverable, accessible and re-usable.

In addition to these two initiatives, the Department is also supporting the open data agenda through the National Environmental Science Programme and the National Vegetation Information System.


Mrs Valerie Hagger¹, Dr Kerrie Wilson¹, Dr John Dwyer¹ ²
¹The University of Queensland, Brisbane, Australia, ²CSIRO, Brisbane, Australia

Biography:
Valerie Hagger is a Senior Ecologist with 12 years professional ecological and environmental consulting experience. Currently she is undertaking a PhD at The University of Queensland. Her research project investigates the costs and success of revegetation in Australia and the potential for achieving multiple outcomes for biodiversity conservation and carbon sequestration.

Investment in revegetation is critical to conserve biodiversity, reverse environmental damage, sequester atmospheric carbon and provide ecosystem services. Revegetation is characteristically time and resource-intensive, and often has a low likelihood of success. There are however few national-level data in Australia on either costs or success. Accounting for the possibility of failure will likely influence planning for revegetation and help predict what can be achieved in the long term.

We surveyed restoration ecologists, practitioners and researchers across Australia involved in revegetation of terrestrial native vegetation on cleared lands. The purpose was to elicit information on the motivations for undertaking revegetation and the factors that influence the costs and success of revegetation.

Methods involved a quantitative online survey, informed by semi-structured interviews and focus groups.

In this talk we will explore:
1) the motivations for undertaking revegetation
2) the extent planning and monitoring and/or evaluation of revegetation is being undertaken by restoration practitioners from different organisations
3) the factors influencing costs and success.

We show that revegetation is undertaken for a range of purposes. The predominant primary purpose is biodiversity enhancement, however most projects also incorporate additional benefits (such as water quality improvements, social reasons or biodiversity offset).

Two thirds of the respondents identified revegetation projects that failed to deliver the expected outcomes. A mixture of factors was identified as significant constraints to revegetation success, ranging from funding shortfalls to unexpected natural events. We show that although monitoring of revegetation is common, long-term monitoring and the collection of quantitative data is rare.
This establishment occurred regardless of whether soil species successfully established in newly burnt Austrostipa grasslands although it was not clear that all species would form differentiated largely by their lower phosphorus concentrations, higher pH, and lower aluminum chemistry across the different vegetation states in the reserve and then explored biotic controls on native forb establishment. We first assessed soil soil interactions and

Private land conservation in a variety of human-modified landscapes is a growing area of interest and investment. Our presentation explores the challenges and responses of private landholders as they balance lifestyle and livelihood with restoration and stewardship activities. Data was obtained from narrative interviews and property walks with participants in voluntary private land conservation programs in three case study landscapes: agricultural, rural-amenity, and urban residential. A common tension for informants is how they go about creating space and practices for conservation on their properties amid a host of other aspirations. Critical motivators across the case studies are belief and acknowledgement of 1) the conservation value of inhabited land and 2) the landholder’s contribution to the quality of the wider landscape. We stress the importance of thinking about ecosystems on private land as “inhabited” and highlight findings that could be useful for agencies seeking to support private land conservation in a diversity of inhabited landscapes.

Making restoration decisions: Accounting for stakeholder values, time preferences and attitudes towards risk

Biography:
Dr Angela Guerrero is an interdisciplinary scientist with an interest in social-ecological aspects of environmental management. Angela has a background in business management, environmental management, and social science. Angela utilises her broad set of skills to develop and apply approaches that integrate social and ecological knowledge for better environmental decision-making.

Restoration is an important approach to retaining Earth’s biodiversity and the health of its ecosystems. But making restoration decisions is a challenging task in the face of multiple underlying values, and the long timeframes and uncertainty surrounding restoration outcomes. Restoration goals and decisions are influenced by the different values held by those in charge of making decisions. In addition, decision makers hold different attitudes towards risk and have different time preferences. This multiplicity of values, risk attitudes and time preferences means that trade-offs between competing objectives and alternatives are often necessary. We reviewed the restoration literature to identify the extent to which these aspects are captured by current approaches to restoration decision making. We found that values are rarely considered from the outset in an explicit way, and that consideration of attitudes towards risk and time preferences is rare. We present an approach for restoration decision making that fills these gaps, and illustrate its application through a case study of restoration decision making in South East Queensland.

Restoration barriers of novel temperate grassland communities in the Victorian Volcanic Plains

Biography:
Dr Tara Zamin is plant community and ecosystem ecologist with previous experience in Arctic tundra ecology and Canadian federal science policy. Following a transition from one treeless ecosystem to another, her current work focuses on improving grassland restoration outcomes via integration of plant-soil interactions and community assembly theory.

Restoring ecological integrity to native grasslands following years of intensive agricultural use is integral to achieving scientific and social goals from maintaining biodiversity to creating natural spaces for recreation. A large grassland reserve has recently been created from retired pasture on the outskirts of Melbourne. With over 13,000 hectares to be restored, it is essential to determine the most efficient pathway to restoration. The objective of this study was to identify the biotic and abiotic controls on community assembly with a focus on native forb establishment. We first assessed soil chemistry across the different vegetation states in the reserve and then explored biotic controls on native forb establishment via a seeding experiment following a natural fire.

The relatively unmodified Themeda-dominated grasslands had entirely different soil chemistry from the retired pasture sites, with Themeda sites differentiated largely by their lower phosphorus concentrations, higher pH, and lower aluminum concentration. Eight of the ten planted native forb species successfully established in newly burnt Austrostipa grasslands although it was not clear that all species would form persistent populations. This establishment occurred regardless of whether soils were additionally disturbed by raking when seeds were sown, although disturbance did improve establishment by 50% overall. Meanwhile, exotic dominance reduced native forb establishment by 24%.
Offset or off-the-mark? Seedling emergence and survival following topsoil transfer in Banksia woodland.

Mr Pawel Waryszak1, Dr Joe Fontaine1, Dr Rachel Standish1, Dr Phil Ladd1, Prof. Neal Enright1
1Murdoch University, Perth, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 2), Ballroom C, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Pawel Waryszak is in the final year of his PhD Banksia Woodland restoration project at Murdoch University, WA. Prior to study in Perth, he spent three years assisting in plant-related research run by Macquarie University, Sydney. Originally, he is from Poland where he graduated in Environmental Science.

Floristically rich and ecologically complex, Mediterranean-type ecosystems are rapidly being cleared for urban, horticultural and industrial development. A prime example is Banksia woodland, an ecosystem restricted to the Swan Coastal Plain in Western Australia. In order to compensate for the clearing of Banksia woodland due to urbanization, land developers are required to attempt biodiversity offsets whereby topsoil from newly cleared landscapes can be moved to degraded land with the aim of restoring Banksia woodland. Yet the science and practice of restoration ecology is not sufficiently advanced to know for certain that this aim can be achieved. Assessing the efficacy of a spectrum of restoration techniques will provide new insights for the restoration of endangered plant communities, and critically, a test of the feasibility of biodiversity offsetting.

The topsoil was subjected to three site-scale treatments: altering topsoil depth, ripping & herbivore exclosures. Additionally, six plot-scale treatments were applied to explore germination effect (three smoke water-related, topsoil heating) and competition effect (herbicide & artificial shade installation) on native seedlings’ emergence and survival.

Significantly fewer seedlings emerged from ripped (17.01 ±1.03 SE) than unripped plots (37.99 ±2.05 SE). Species richness was similar across all treatments with a total number of native plant species emerging from the transferred topsoil of 129 in the first year and 115 in the second year. Mean survival rates of native perennial seedlings were very low (year I = 11.1% & year II = 1.2%). The maximum average survival was recorded under artificial shade (41% ±12.2 SE).

Soil seed banks and the restoration of plant biodiversity in an arid zone habitat.

Dr Duncan Mackay1, Dr. Molly Whalen1, Dr. Kieren Beaumont1, Dr. Richard Davies1
1Flinders University, Bedford Park, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 2), Ballroom C, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Dr Duncan Mackay is interested in the behavioural ecology and conservation of plant-insect interactions. He is currently working on the conservation of plant-animal interactions in fire-affected communities as well as on the conservation of plant communities in arid South Australia.

Predicting the response of native vegetation in Australia’s arid rangelands to management actions such as changing grazing regimes is often hampered by a lack of knowledge regarding the nature of native plant biodiversity at a local scale. Simply measuring above-ground plant species richness can be quite misleading because in arid habitats much of a site’s plant diversity, particularly that of short-lived species, may be present as dormant seeds in the soil seed bank. We are investigating factors influencing variation in both above- and below-ground plant diversity in a large (ca. 420,000 km²) conservation reserve in arid South Australia. This reserve, “Witchelina”, has a long history (ca. 140 years) of pastoral use but was destocked in 2010 when it was purchased by the Nature Foundation of South Australia. Particular factors being investigated include variation among different habitats and effects of past grazing intensities. For example, we are comparing the diversity and composition of the seed banks and above-ground vegetation in areas close to watering points with a history of heavy grazing with those of areas more distant from watering points that have been less heavily grazed. In degraded sites close to watering points, native perennial grasses were uncommon in the above-ground vegetation, despite being frequent in the less degraded sites further from watering points.

Galadriel’s Gift: soil legacies in grassland restoration

Ms Monique Smith1, A/Prof Jose M. Facelli1, Dr. Leanne Rosser2
1The University of Adelaide, Adelaide, Australia, 2Department of Environment, Water and Natural Resources, Adelaide, Australia

SYMPOSIUM: Synthesising restoration outcomes in agricultural and mined landscapes (part 2), Ballroom C, December 2, 2015, 2:15 PM - 5:30 PM

Biography:
Monique Smith holds a Bachelor of Science in Biodiversity and Conservation with first class honours, and is currently a PhD candidate at The University of Adelaide.
Interactions between plants and their soil community are often overlooked in restoration projects. Farming practices and subsequent exotic plant invasion can result in changes in the soil microbial community in abandoned farmland (oldfields). These biological legacies can hinder native plant establishment or encourage invasion of other exotic plants (meltdown phenomenon). To test these hypotheses two native grasses, Rytidosperma auriculatum and Austrostipa nodosa and an invasive grass, Lollum rigidum were grown in four soil treatments, each containing sterile soil inoculated with soil from either 1) an orchard containing a monoculture of A. nodosa, 2) an oldfield dominated by an invasive, Avena barbata, 3) a remnant area containing mainly native grasses, or 4) no inoculum (control). Ten replicates of each species were grown in the different soil treatments. Addition of inoculum increased mortality of A. nodosa four-fold, but did not affect biomass of surviving plants. R. auriculatum performed better when inoculated with grassland remnant soil, producing the highest biomass and suffering no mortality, whereas in the oldfield treatment it had the highest mortality and lower biomass. There was no evidence to support the meltdown hypothesis: all inoculant types increased the biomass of L. rigidum equally contrary to the predicted advantage in soil inoculated with oldfield soil. Future restoration of R. auriculatum could benefit from incorporating soil microbes from remnant areas, however high mortality in A. nodosa under all treatments may indicate a high sensitivity to soil microbes in this species. Further, specificity of responses adds more complexity to the issue.

From Little Things Big Things Grow - How do savanna trees succeed with frequent fire?

Ms Michelle Freeman

1The University of Melbourne, Melbourne/Parkville, Australia

Biography:
Michelle Freeman is a PhD student in the School of BioSciences at the University of Melbourne. Her passion is for smart forest management to achieve environmental, social and economic outcomes. In particular she is interested in opportunities for engaging Indigenous people in land management.

In Australian savanna ecosystems, accession of sub-adult trees to the overstorey is thought to be limited by a major demographic bottleneck caused by frequent fire. Despite this contention, juvenile eucalypts appear to be highly successful at recruiting into adult size classes even if subjected to repeated topkill by fire, in contrast with observed responses for resprouting pantropical non-eucalypts. Resource competition, tree architecture and other trait characteristics are likely critical mechanistic drivers that interplay with fire to determine overall species success in these ecosystems. My research addresses the comparative role of such drivers in sub-adult tree dynamics and potential changes to savanna tree biomass, structure and composition. In this speed talk I will introduce preliminary results from my analysis of data collected by CSIRO in the early 1990’s at Kapalga research station in the Northern Territory and current fieldwork being undertaken on the Tiwi Islands as part of the Tiwi Carbon Study. Developed in response to recent attention on fire management to achieve ecological outcomes and livelihood opportunities for Indigenous Australians through participation in carbon markets, this research will contribute to strengthening carbon accounting methodologies and help to cement our understanding of savanna tree ecology in relation to fire management.

Woody weed seed predation by small mammals has the potential to limit shrub encroachment

Ms Charlotte Mills

1UNSW, Sydney, Australia

Biography:
Charlotte is a first-year PhD candidate at the Centre for Ecosystem Science UNSW, supervised by Associate Professor Mike Letnic. Her research explores the relationship between woody weed shrub species and Australia’s declining mammal species, with study sites including Strzelecki Regional Reserve, Scotia Wildlife Sanctuary (AWC) and Arid Recovery Reserve.

Native mammal population declines in arid Australia preceded any understanding of their inter-specific interactions, and may have played an important role in shaping Australian vegetation communities. Shrub cover in arid and semi-arid Australia has increased dramatically over the past century coincident with declines of native mammal species in the critical weight range. Hypotheses to explain the increase in shrub cover and associated land degradation range from increased CO2 emissions to overgrazing, but none adequately explains all elements of woody weed encroachment. Research has not previously considered the role of declining native mammals in shrub encroachment, despite knowledge that native mammals predate on shrubs. If native mammals such as hopping mice (Notomys spp.) and the burrowing bettong (Beltonia lesueurii) were once important predators of shrub seeds in Australian arid environments, it is conceivable that their decline may have precipitated increases in shrub abundance. This talk will explore the relationship between woody weed shrub species and Australia’s declining mammal species, with particular focus on their role as seed predators.

Woodland birds: what are they and why should we care?

Ms Hannah Fraser

1University of Melbourne, Parkville, Australia, 2RMIT University, Melbourne, Australia

Biography:
Australia’s woodlands have been decimated, largely to make way for agriculture and urban development. Unsurprisingly, many birds that rely on these areas are threatened or declining. As a result many researchers investigate the decline of woodland birds, but there is no shared understanding of what constitutes a ‘woodland bird’. Each researcher uses their own list of woodland birds, such that results are difficult to compare across studies, which may inhibit our ability to conserve the woodland bird community. Unfortunately, classifying woodland birds is complicated by questions such as: what vegetation qualifies as woodland?; are we interested in all birds in woodlands or just the ones that spend the majority of their time there?; and do we only include species that nest in woodlands or also those that forage there?

We have quantified differences in the way woodland birds are classified, investigated why these differences occur, and demonstrated that different classifications of woodland birds influence research conclusions. In this study, we attempt to answer the tricky question – what constitutes a woodland bird? By examining the relationships between species occurrence data, functional traits, and the extent of different vegetation communities we were able identify the species that depend on woodlands. We suggest that focusing on these woodland dependent species will help advance our understanding of the ecology and prevalence of woodland birds.

Environmental drivers of species distribution on a granite outcrop

Mr Gunnar Keppel1, Dr Grant Wardell-Johnson2, Dr Colin Yates3
1University of South Australia, 2Curtin University, 3Department of Parks and Wildlife, Western Australia

Community Ecology (3), December 3, 2015, 10:15 AM - 12:15 PM

Biography:

Gunnar Keppel is interested in biodiversity conservation, climate change refugia, island biology and plant community assembly. He strives to better understand natural environments and our impact on them, focusing on the integration of biogeography, ecology, genetics and remote sensing.

Granite outcrops provide important topographic complexity to the otherwise mostly subdued landscapes of south-west Western Australia, creating numerous microhabitats. One of the major habitats are ephemeral herbfields, which lack photosynthesizing tissue during the dry and warm summers but come to live during the the wetter and cooler winter/spring months. These herbfields are known to have considerable species diversity and are likely to differ in species composition depending on the prevalent microclimate. We investigate what environmental variables drive the species composition of herbfields and whether species in the same genus maximize available resources through temporal separation in flowering times. We established permanent 1 x 1m vegetation plots, measuring soil depth, recording cover abundance of every species fortnightly and microclimatic (temperature and humidity) at hourly intervals for an entire growing season (April - November) on Boyagin Rock (c. 100km SE of Perth). We recorded almost 100 species in 50 plots. Temperature, humidity and soil depth were important predictors of species composition and hence species distributions. Congeneric species displayed stacked flowering, avoiding competition for pollinators and reducing the chances of hybridization. Microclimatic (spatial) differentiation and temporal partitioning of available resources are therefore two important factors facilitating a high species diversity on this granite outcrop.

Multi-scale effects of nutrient enrichment and weeds in box-gum woodland

Prof Don Driscoll1
1Deakin University, Burwood, Australia

Community Ecology (3), December 3, 2015, 10:15 AM - 12:15 PM

Biography:

Professor Don Driscoll is Professor of Terrestrial Ecology at Deakin University in Burwood, Melbourne. Don mostly studies the landscape ecology of reptiles and invertebrates in agricultural landscapes, but in this study has strayed into traditional restoration.

Nutrient enrichment is often associated with invasion by exotic plants, and high impacts on native plants. In grassy box woodlands in the ACT we used a combination of a natural and manipulative experiment to examine the relative influence of nitrogen and phosphorus enrichment on occurrence of native and exotic plant species. We also tested factors that might be used by managers to modify the effects of nutrient enrichment, including grazing by kangaroos, carbon addition, biomass removal and fire. We found that two exotic species dominated high P sites, driving down exotic and phosphorus enriched sites to prevent exotic weeds from dominating and reducing native plant richness.

The roles of amphibian larvae in affecting mosquito populations

Prof Leon Blaustein1, Dr Gail M Moraru1, Ms Anna Gershberg1, Ms Meital Stein1, Mr Jonathan Blaustein1, Prof Burt P Kotler2, Dr. Claire Duchet1
1Institute of Evolution and Department of Evolutionary and Environmental Biology, University of Haifa, Haifa, Israel. 2Blaustein Institutes for Desert Research, Ben Gurion University, Sede Boker, Israel

Community Ecology (3), December 3, 2015, 10:15 AM - 12:15 PM
The decline of amphibians worldwide may have large consequences for mosquito populations. Amphibian larvae may have agonistic interactions with mosquito larvae via competition, intraguild predation and predation. Amphibians may not only affect immature mosquito stages by these mechanisms but may influence oviposition decisions by gravid mosquitoes and indirect effects through community structure alteration. Here, we feature some interactions we have explored using mostly outdoor mesocosm experiments, assessing the importance of larval stages of three amphibian species - Bufo viridis, Hyla savignyi, and Salamandra infraimmaculata - in affecting mosquitoes. All three species are of conservation concern in Israel. We found B. viridis tadpoles to be strong competitors and intraguild predators of mosquito larvae, Culiseta longiareolata. Culiseta longiareolata also avoided ovipositing in pools containing B. viridis tadpoles. Increasing food resources eliminated effects of Bufo tadpoles on C. longiareolata, indicating that competition is likely exploitative rather than interference. The predator, Notonecta maculata, indirectly positively affected B. viridis tadpoles by eliminating its inter-specific competitor, C. longiareolata larvae. Hyla savignyi tadpoles caused strong negative density-dependent effects on oviposition by C. longiareolata and Culiseta laticinctus adults and negative effects on larval development of these two mosquito species. Salamandra infraimmaculata larvae do not appear to reduce oviposition by C. longiareolata but consume the larvae and egg rafts. Salamandra larvae, upon metamorphosing and exiting pools, have residual effects including increased mosquito oviposition but decreased survival. These results indicate the importance of amphibians for natural mosquito control and that conservation management is needed in concert with mosquito control management.

Precision of systematic and random sampling in clustered populations: habitat patches and aggregating organisms

Dr Richard McGarvey1, Dr Paul Burch2, Janet Matthews1
1South Australian Research and Development Institute (SARDI), Aquatic Sciences, Adelaide, Australia, 2Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Kingston, Australia

Biography:
Dr Richard McGarvey is a fishery population biologist, with a research focus on statistical population modelling using maximum likelihood, field survey design, bioeconomics, and trophic energetics. The work to be presented was developed for application to abalone and lobster field surveys.

Natural populations of plants and animals cluster spatially because (1) suitable habitat is patchy, and (2) within suitable habitat, individuals aggregate. We compare the precision of random and systematic field sampling survey designs under these two processes of species clustering. Second, we evaluate the performance of 13 estimators for the confidence interval from a systematic survey. The standard systematic survey design, a uniform 10 x 10 grid of transects, was much more precise than random sampling. Variances of 10,000 replicated systematic survey mean density estimates were 1/3rd to 1/5th smaller than those from randomly allocated transects, implying 3-5 times more random transects would be needed to give equivalent precision by a random survey. Patches of habitat were alone sufficient to yield this much higher precision for the systematic design. But standard \( \left[ \frac{\sigma^2}{n} \right] \) methods to compute confidence intervals underestimate this higher precision of systematic surveys. Testing 10 published and 3 newly proposed systematic survey variance estimators, the two that corrected for inter-transect correlation were both more accurate and more precise in clustered populations. These greatly outperformed the more commonly recommended ‘poststratification’ variance estimators. However, no systematic variance estimators tested were free from bias. On balance, systematic designs are more precise in clustered populations, while random designs, using \( \frac{\sigma^2}{n} \), permit unbiased estimates of confidence interval. The search continues for better estimators of sampling variance for the systematic survey mean.


Trading biodiversity: vegetation surrogates used in offset schemes do not predict total biodiversity value

Ms Jayne Hanford1, Dr Matthew Crowther1, Associate Professor Dieter Hochuli1
1The University of Sydney, Sydney, Australia

Biography:
Jayne Hanford is currently a PhD student in the Integrative Ecology Lab at The University of Sydney, looking at the biodiversity value and mosquito risks associated with urban wetlands. This presentation is based on her Honours work investigating the efficacy of vegetation as surrogates for total biodiversity value.
Biodiversity offset schemes are globally popular as policy tools for balancing the competing demands of conservation and development. Offset schemes frequently derive biodiversity trading currencies from vegetation surrogates that are combined to give a single score (multi-metric) representing a site’s total biodiversity value. Unfortunately, these simplified metrics are rarely validated, resulting in biodiversity trades that may not be ‘like for like’ and may instead be insidiously accelerating loss of biodiversity values. The aim of our study was to evaluate the use of vegetation multi-metrics as a surrogate for total biodiversity value in a model biodiversity offset scheme, using ants as measurable compositional and functional components of total biodiversity value. We sampled ant community composition and seed removal in remnant Cumberland Plain Woodland and assessed the use of vegetation attributes, individually and as a multi-metric, in predicting differences between sites. Our model vegetation multi-metric did not represent ant community composition or seed removal. Only one of the ten sampled vegetation attributes, native plant species richness, showed a significant (positive) correlation with ant morphospecies richness and functional group richness. Our results suggest that assumptions of surrogacy underpinning the use of vegetation multi-metrics in biodiversity offset schemes are incorrect for total biodiversity value. These findings highlight the urgent need to validate multi-metrics as surrogates prior to their implementation, especially for biodiversity trading currencies. Despite admirable intentions, offset schemes will never achieve their goal of ‘no net loss’ of biodiversity values if trades are based on metrics unrepresentative of total biodiversity.

Compounding effects of habitat fragmentation and predation on bird nests in Samoa

Ms Rebecca Stirnemann1, Murray A. Potter1, David Butler2, Edward O. Minot1
1Ecology Group, Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand, 2David Butler Associates Ltd, 588 Brook Street, Nelson, New Zealand

Habitat fragmentation and invasive species are two of the greatest threats to species diversity worldwide. This is particularly relevant for oceanic islands with vulnerable endemics. We examine how habitat fragmentation influences nest predation by Rattus spp. on cup nestling birds in Samoan forests. We determined models for predicting predation rates by Rattus on artificial nests at two scales: (1) the position of the bird’s nest within the landscape (e.g. proximity to mixed crop plantations, distance to forest edge); and (2) the microhabitat in the immediate vicinity of the nest (e.g. nest height, ground cover, slope). Nest cameras showed only one mammal predator, the black rat (Rattus rattus), predating artificial nests. The optimal model predicting nest predation rates by black rats included a landscape variable and a local nest site variable. Predation rates were significantly higher for nests in forest edges near mixed crop plantations than in edges without plantations. In contrast, predation rates did not vary significantly between edge habitat where the matrix did not contain plantations, and interior forest sites (>1 km from the edge). As groundcover reduced, nest predation rates increased. Waxtags containing either coconut or peanut butter were assessed as a second method for determining rat abundance. Rural development in Samoa will increase the proportion of forest edge near plantations. Our results suggest that this will increase the proportion of forest birds that experience nest predation from black rats. Retaining large forest patches free of plantations will reduce nest predation by rats, but it is may not be sufficient for maintaining populations of predator-sensitive bird species on South Pacific islands.

Matching quadrats to defined vegetation communities

Dr Margaret Donald1,2, Dr Anne Marie Clemente2
1UNSW, Kensington, Australia, 2Anne Clements & Associates, North Sydney, Australia

We illustrate the shortcomings of plant community descriptions which list species only, without indicating expected cover or expected frequency of observing the species in a standard quadrat. A list is equivalent to summarising floristic data as presence/absence data.) We consider thirteen quadrats from a site in Belmont (on Lake Macquarie, NSW), where the development application required that the quadrats be allocated to predetermined communities. We show, that despite the number of native species per 0.04 ha quadrat ranging from 42 to 64 (in all 189 native species), no quadrat could be allocated with certainty to any of the five local vegetation communities (nor to any one of the 362 Hunter Catchment vegetation communities). We illustrate the problem in two ways: firstly, by calculating confidence bounds for the number of native species within a quadrat which match the listed species for a community divided by the number of listed species for that community, secondly, by finding both weighted and unweighted odds ratios (and confidence bounds) for the odds ratio of belonging to one community versus another where these are the two best matches. The weighted analyses were used to overcome the problem that within a set of listed species, some species might be expected to be almost always seen in the community. The confidence bounds on the proportions of matching species, and the confidence bounds on the odds ratios illustrate that lists of species (or presence/absence data) are an inadequate basis for determining the vegetation community to which a quadrat belongs.

Combining presence-only and presence-absence data for species distribution modelling

Dr Jane Elith1, Dr Will Fithian2, Prof Trevor Hastie1, Prof David Keith2
1University of Melbourne, Australia, 2UC Berkeley, USA, 3Stanford University, USA, 4University of New South Wales, Australia

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Biography:
Dr Jane Elith's research focuses on species distribution models (SDMs, aka ecological niche models) which model the relationship between a species and the environments in which it occurs. She is particularly interested in technical aspects of the models, but also in their use for practical applications.

Presence-only records may provide data on the distributions of rare species, but commonly suffer from large, unknown biases due to their typically haphazard collection schemes. Presence-absence or count data collected in systematic, planned surveys are more reliable but typically less abundant. In this study led by statistician Will Fithian, we propose a probabilistic model that allows joint analysis of presence-only and survey data, exploiting their complementary strengths. Our method pools presence-only and presence-absence data for many species and maximises a joint likelihood, simultaneously estimating and adjusting for the sampling bias affecting the presence-only data. By assuming that the sampling bias is the same for all species, we can borrow strength across species to efficiently estimate the bias and improve our inference from presence-only data. We evaluate our model's performance on data for 36 eucalypt species in south-eastern Australia. We find that presence-only records exhibit a strong sampling bias towards the coast and towards Sydney. Our data-pooling technique substantially improves the out-of-sample predictive performance of our model when the amount of available presence-absence data for a given species is scarce. If we have only presence-only data and no presence-absence data for a given species, but both types of data for several other species suffering from the same spatial sampling bias, then our method can obtain an unbiased estimate of the first species' geographic range. I am presenting this recently published work because it is a useful new development for the difficult task of modelling with presence-only data.

Analysis of environmental matching for the prediction of invasion risk

Dr Robert Cope1, A/Prof Joshua Ross1, Talia Wittmann1, A/Prof Phillip Cassey1
1The University of Adelaide, Adelaide, Australia

Biography:
Dr Robert Cope is a postdoctoral research associate working in the Invasion Ecology group within the School of Biological Sciences at the University of Adelaide.

Biological invasions present significant environmental and economic costs when alien species become established. One key contributing factor in determining invasion risk is whether environmental conditions are suitable in a new location for an alien species to survive and breed. For a particular species, environmental niche models can be used to predict the suitability of a new habitat based on environmental conditions in the species historic range. For biosecurity risk assessment, however, it is often necessary to determine establishment risk between two regions across a broad range of different exotic taxa. In this study, we developed a method to quantify environmental similarity between geographic regions by comparing a broad range of environmental variables. We validated this environmental matching method through both cross-validation on the native ranges of a collection of mammalian, reptilian, and avian species, and analysis of observed ranges for a variety of alien species that have become established in Australia. We determined globally the regions from which species are most likely to survive if they arrived in each state of Australia. Environmental matching techniques, such as the one developed here, are critical for the effective construction of integrated invasion risk models, and the subsequent application of ecological knowledge to biosecurity policy decisions.

Trait-environment relationships change with spatial scale, sampling strategy and growth form: Eucalypts in the Mallee

Dr Peter Vesk1, Dr Laura Pollock2, Dr Luke Kelly2, Mr Paing Soe1, Ms Freya Thomas2, Mr Will Morris1, Mr Matt White3
1University of Melbourne, Melbourne, Australia, 2Universite Grenoble, Grenoble, France, 3Dept. Env. Land Water & Planning. Melbourne, Australia

Biography:
Dr Peter Vesk is an ecologist who divides his efforts between generalisation in ecological science and quantitative ecological management.

New trait-based multi-species distribution models allow us to quantify trait-environment relationships. However, the generality of those relationships is uncertain because most studies have been done at a single spatial scale on steep or long environmental gradients (such as mountain ranges). Here, we test how trait-environment relationships change with spatial extent, growth form, sampling design and environmental variables for 11 Eucalyptus species in ‘mallee’ vegetation in semi-arid southeastern Australia. Hierarchical regression modelling showed that three functional traits (specific leaf area, maximum height, and seed mass) helped to explain the occurrence of species along soil and water gradients. For example, larger seeded species were more likely to be found on sandy soils. However, predictions changed depending on sampling design. Remotely-sensed variables were not always good surrogates for field-based measures of soil properties. Effects tended to shift when multiple growth forms were included (both single-stemmed trees and multi-stemmed mallee species). Some strong effects at a fine spatial grain were weaker at a coarser spatial grain, suggesting important local effects may be diluted or missed entirely in broadscale trait-environment studies. This work points to the need for close attention to scale, sampling and species set in further study but paves the way for more refined understanding of trait-environment relations.

Developing a Workflow for the Artificial Neural Network Modeling of High Dimensional Data
Human judgment vs. theoretical models for the management of ecological resources

Dr Matthew Holden1, Professor Stephen Ellner2

1Centre of Excellence for Environmental Decisions, University of Queensland, St Lucia, Australia, 2Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, USA

A workflow for modeling high dimensional data is proposed and discussed. Artificial neural networks (ANNs) are flexible but complex constructs that approximate mathematical functions. ANN paradigms are tested with synthetic, low dimensional data and the solutions obtained are explained. Reduction and mining of a large public domain, entomology dataset is accomplished. Low dimensional problems from the mined data are formulated, solved with the explained network paradigms and the solutions evaluated. Extending this workflow to modeling empirical, field data and how this will help the management of insect populations is considered.
Despite major advances in computation, optimization, and modeling, there has been resistance to using these tools in the actual practice of environmental management. Given a management problem and a set of ecological and economic assumptions, translated into a model, optimization methods can be used to solve for the most cost effective management actions. However, when the underlying assumptions are wrong, such methods can potentially lead to management actions that harm the environment and economy. While managers using experience and judgment develop more subjective decisions, their process is not necessarily constrained by the same rigid assumptions and therefore may sometimes outperform model-based policies. In this talk, we explore how well humans, using their experience and judgment, manage simulated populations in an online computer game and compare their management outcomes to the performance of a variety of mathematical models that passively manage the simulated population based on the data resulting from the model’s decisions. We consider models that (1) perfectly represent the system (2) specify the system correctly but with no a priori knowledge of the parameter values (3) mis-specify the dynamic equations and (4) ignore age structure. Humans on average perform much worse than the models in cases 1 - 3, but in some scenarios models produce worse outcomes than those resulting from human management. When the models ignore age structure, they generated poorly performing management decisions, but still outperformed humans using experience and judgment 66 percent of the time.

**Landscape-scale restoration: selecting optimal networks across space and time**

**Biography:**

Dr Karen Ikin is a postdoctoral fellow with the ARC Centre of Excellence for Environmental Decisions, based at the Fenner School of Environment and Society, Australian National University, Canberra, Australia. Her research focuses on wildlife and habitat conservation in human-modified environments, such as those that occur in urban and agricultural landscapes.

The restoration of degraded lands is an international conservation goal, with multi-billion dollar annual investment. The goals of restoration initiatives usually align with traditional measures of conservation value, such as maximising site-level biodiversity outcomes. Analogous to selecting protected areas, systematic conservation planning approaches can be used to optimally locate new networks of restoration plantings to achieve cost-effective landscape-scale biodiversity outcomes. Our study shows that it is also possible to apply a landscape-scale, complementarity-based optimisation approach to evaluate how well an existing network of restoration plantings meets conservation targets for woodland birds of conservation concern.

We found that incorporating dynamics in species occurrences across a five-year period gave better outcomes compared with using a static optimisation approach. Importantly, we found that for equivalent cost, number of plantings, and combined restored area, a temporally-dynamic optimised approach gave consistently better outcomes compared with ranking plantings by the richness of conservation concern. This was true both for average minimum percent occurrence of species maintained through time and the proportion of the bird community meeting conservation targets. We also found that plantings selected under the optimised approach represented the range of planting attributes, whilst those selected under the ranked approach were larger in size, as were individual plantings with high species richness. Adopting a landscape-scale, temporally-dynamic approach leads to considerably better outcomes than applying conventional site-scale metrics, and is crucial for the wise allocation of restoration investment to reach desired conservation goals.

**Reductions in egg size at an active invasion front increase costs of plasticity in offspring**

**Biography:**

Dr Jayna DeVore generally focuses on invasion biology. Her PhD at the University of Georgia demonstrated how grass invasion alters forest floor food-webs, after which she studied the influences of an invasive algae on mudflat communities. She is currently working with Rick Shine, researching the roles of evolution and plasticity in load invasion.

During biological invasions, low densities of conspecifics at the advancing front result in reduced pressure from intraspecific competition. Frontal populations are therefore expected to shift towards an r-selected strategy, in which parents produce large numbers of low-quality offspring (thereby maximising population growth in low-competition environments). However, associated decreases in per capita investment may also reduce offspring performance. We collected cane toads from frontal and core populations within Australia and bred them in a common garden. In accordance with our expectations, frontal toads produced significantly smaller embryos than toads from long-established populations. Tadpoles from these clutches were then raised in aquaria where we manipulated food availability and the presence of predator cues from nonlethal (caged) dragonfly larvae. Regardless of origin all tadpoles displayed similar plastic responses to predator cues, increasing chemical production in predator exposed...
treatments, but in the presence of these cues tadpoles hatched from larger embryos (i.e., those from core populations) were far more likely to survive to metamorphosis. In the absence of predator cues, however, embryo size did not affect survival. Our data demonstrate that, although invading and established populations display similar levels of plasticity, reduced parental investment at the front renders these plastic responses more costly in invasion-front tadpoles.

Disentangling the multiple dimensions of invasiveness

Jane Catford1,2, John Baumgartner1,2, Peter Vesk1, Yvonne Buckley1, Michael McCarthy1
1University of Melbourne, University of Melbourne, Australia, 2Australian National University, Canberra, Australia, 3University of Minnesota, Saint Paul, USA, 4Macquarie University, Sydney, Australia, 5Trinity College Dublin, Dublin, Ireland

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Jane Catford is a plant ecologist with an interest in community assembly and invasion ecology. She is a Research Fellow in the School of Biosciences at the University of Melbourne, and a Visiting Fellow at the Australian National University and University of Minnesota.

Considerable effort has gone into identifying characteristics of invasive species, yet a definitive list of traits remains elusive. Using evidence from ecological theory, literature reviews and quantitative modelling of alien plants’ population characteristics, we contend that failure to distinguish among the 15 forms of invasiveness may obscure invasive species traits. A review of 24 academic and policy documents reveals that most invasive species classifications rely on combinations of four population characteristics (local abundance, geographic range size, environmental range size, spread rate), plus impact. Supporting our assertion that species may therefore be invasive in 15 ways, all combinations of these criteria were used by at least one of the 112 studies that underlie a highly influential meta-analysis of invasive plant traits. Notably, 14% of these studies defined invasiveness solely on high abundance while 44% did not include abundance as a criterion at all. The maximum relative cover, range sizes and spread rates of 444 alien herbs in Victoria, Australia varied, with invasive and non-invasive species featuring at the both ends of each gradient representing population characteristics. Only their environmental and geographic range sizes were correlated. Although probability of being classified as invasive increased with species cover, these data illustrate that invasive species can possess distinct population characteristics. Given that traits associated with high abundance are likely to differ from those associated with fast spread and broad ranges, confining the 15 forms of invasiveness may obscure traits that are routinely possessed by subsets of invasive species hindering weed risk assessment.

Sucking the lifeblood out of major invasive weeds of Australia

Mr Robert Cirocco1, A/Professor Jose Facelli2, Professor Jennifer Watling2
1The University of Adelaide, Adelaide, Australia, 2Northumbria University, Newcastle, United Kingdom

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Robert Cirocco’s interests lay in the fields of terrestrial plant eco-physiology and ecology. His specialties include parasitic plants, chlorophyll fluorescence and photoprotection of plants. Robert is currently working on the differential impact of a native parasitic plant on introduced versus native hosts.

Major invasive weeds cost Australians around 77 million dollars annually in addition to incalculable costs to biodiversity. Native parasitic plants may have detrimental effects on performance of invasive hosts by removing resources via suckers and thus contribute to their demise. Glasshouse studies have documented severe effects of parasites on invasive species, but the effects of parasites may be highly variable depending on environmental conditions. We conducted physiological measurements to investigate the effects of the native parasitic vine Cassytha pubescens on the major invasive weed gorse (Ulex europaeus) across three field sites in the Mt. Lofty Ranges of South Australia. Photosynthetic performance and nitrogen concentration of gorse were strongly decreased by C. pubescens consistently across sites, but photodamage (light-induced break down of the photosynthetic apparatus) in response to infection was only evident at two of the sites. Carbon isotopes of the parasite were much higher than those of the host at the same two sites indicating its main mode of resource removal may be via osmotic loading rather than by maintaining higher transpiration rates than its host. Correspondingly, sodium concentration of C. pubescens was strongly elevated at one of these two sites. The data indicate that C. pubescens negatively affects photosynthesis by removing large amounts of nitrogen from the host. Thus, this parasite shows promise as an effective native bio-control against major invasive weeds of Australia and if successful, may be used to help restore our native biodiversity.

Biodiversity impacts of an invasive grass: ant community responses to Cenchrus ciliaris in central Australia

Ms Sarah Bonney1,2, Professor Alan Andersen1,2, Dr Christine Schlesinger2
1CSIRO, Darwin, Australia, 2Charles Darwin University, Darwin, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Sarah Bonney is a PhD student at CSIRO and Charles Darwin University, studying the effects of ants on ecological processes. Her research interests centre on ant ecology.
Exotic plant invasions are among the most serious threats to biodiversity and ecosystem functioning. Buffel grass is an invasive perennial grass, negatively impacting ecosystems in arid Australia and internationally. Buffel grass is known to reduce plant diversity and abundance as well as increase the severity of fire. An increase in buffel grass biomass and reduction in native plant species is believed to affect native fauna, but there is limited direct evidence of this. Moreover, most studies of buffel grass impact involve comparing invaded and uninvaded sites, without information on any pre-existing site differences. This study used plots where buffel grass had been experimentally removed and native vegetation allowed to regenerate (B-), matched with controls where buffel grass remained (B+), to investigate the impact of buffel grass on ant diversity and composition, and rates of seed dispersal. Differences in ant diversity and composition were also compared between two microhabitat types: bare ground and under cover, to investigate the mechanism behind any differences between B- and B+ plots. Ant abundance and richness was much higher in B- plots, and there were marked differences in species composition. There was a particularly pronounced difference for Hot-Climate Specialists, which were far more abundant in B- plots. Differences between plot types occurred for both microhabitats, and so were not a simple function of differences in microhabitat cover. Seed removal rate was higher in B- plots. This study has shown the invasion of buffel grass has had a major impact on an ecologically dominant faunal group.

Multiple threats, or multiplying the threats? Interactions between invasive predators and other ecological disturbances.

**Dr Tim Doherty**1,2, Professor Chris Dickman2, Dr Dale Nimmo3,4, Dr Euan Ritchie2

1Centre for Ecosystem Management, School of Natural Sciences, Edith Cowan University, Joondalup, Australia, 2Desert Ecology Research Group, School of Biological Sciences, University of Sydney, Sydney, Australia, 3Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Burwood, Australia, 4Institute for Land, Water and Society, School of Environmental Science, Charles Sturt University, Albury, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Dr Tim Doherty is a wildlife ecologist interested in fire ecology, invasive species, trophic cascades, and arid and Mediterranean systems. He recently completed his PhD.

Invasive mammalian predators have caused numerous extinctions across the globe, and considerable cost is now associated with minimising their impacts. Here, we synthesise evidence of interactions between invasive predators and six key threats that together have strong potential to influence both the impacts of the predators, and their management. Using a series of case studies, we show that impacts of invasive predators can be classified as either functional or numerical, and that they interact with other threats through both habitat- and community-mediated pathways. Greater recognition of the ecological complexities between major processes that threaten biodiversity is required to both advance ecological theory and improve conservation actions and outcomes. We discuss how novel approaches to conservation management can be used to address interactions between threatening processes and ameliorate invasive predator impacts.

**Going feral: Establishment and expansion of a human-associated gecko in natural environments**

**Ms Louise Barnett**1, Dr Ben Phillips2, Dr Conrad Hoskin1

1James Cook University, Townsville, Australia, 2The University of Melbourne, Parkville, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Louise Barnett is a PhD candidate at James Cook University, investigating the invasion of natural environments by the Asian house gecko, Hemidactylus frenatus.

Many species have developed close associations with humans, which have facilitated their introduction and establishment in cities and towns around the world. Currently, habitat fragmentation and urbanisation are increasing, bringing more natural areas in contact with human settlements and infrastructure. It is, therefore, increasingly important to investigate the potential for human-associated species to establish in natural environments. These species also provide unique systems to assess range expansion due to the stark contrast between urban and natural environments. Isolated urban areas in a matrix of natural habitat provide multiple semi-independent invasion fronts at which range expansion can be assessed. In the present study we use the Asian house gecko, Hemidactylus frenatus, as a model system to investigate the colonisation of human-associated species in natural environments. We conducted surveys every month for a year at ten transects leading from urban areas up to 2 km into the bush. There were large, breeding populations of H. frenatus found in natural habitats up to 2 km from the urban edge; however, population size in woodland habitats was variable. Expansion of H. frenatus into natural habitats was facilitated by propague pressure (the size of H. frenatus population in the urban area), and the amount of time H. frenatus had been established in the urban area. In areas with older urban settlements large populations of H. frenatus are more likely to be found further into the woodland.

**Diet of feral cats during boom and bust cycles of their principal prey**

**Miss Stephanie Yip**1

1The University of Sydney, Sydney, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM
The impact of feral cats (Felis catus) on native wildlife is considered to be one of the most significant conservation issues in Australia, with predation by feral cats listed as a Key Threatening Process under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999. To increase understanding of how cats forage when their principal prey vary, we analysed the diets of feral cats that were culled during periods of scarcity and abundance of the native long-haired rat Rattus villosissimus. Feral cats were shot during culling operations in semi-arid grassland habitats in central Queensland, Australia and the stomach contents later identified. The results were used to test some predictions of foraging theory: animals should forage so as to maximize their net rate of energy gain or to minimize their risk of starvation and, in situations where prey numbers fluctuate dramatically, will eat ‘optimal’ prey when it is abundant, but expand their diet to include other prey types when it is scarce. The results largely accorded with expectations, with cats focusing primarily on rats when they were at the peak of their boom cycle, and expanding their diet to encompass a much broader range of prey when rat numbers crashed during their bust phase. While feral cats are often thought to be specialist predators, they may be better considered as facultative specialists that will shift their diet in predictable ways in response to changes in the abundance of primary prey.

**Using Prescribed Burns to Achieve Weed Management Objectives**

**Ms Kirstin Abley**¹, Mr Randall Johnson¹, Mr Andrew Sheath¹

¹Department of Environment, Water and Natural Resources, Athelstone, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Kirstin works as a Fire Ecologist in the Adelaide and Mount Lofty Ranges region of South Australia. She has a particular interest in threatened species management, in ensuring prescribed burns are planned and conducted to achieve positive biodiversity outcomes and in environmentally-sensitive bushfire management.

While the primary purpose of prescribed burning is to minimise the risks that bushfires pose to human life and property, there are often opportunities to achieve ecological benefits from prescribed burn programs. In the Mount Lofty Ranges, areas that are subject to prescribed burning are also often those that are degraded by weeds due to their proximity to urban areas. Tackling fire-responsive weeds is a significant challenge in these areas but, where possible, the Region’s Fire Ecology team are using prescribed burns to their advantage to manage weed infestations. Preliminary results from a recent trial have found that the effectiveness and efficiency of Erica arborea control can be increased when combined with prescribed burning. The results from this trial will be presented and discussed in terms of the potential benefits of using pre-fire weed control instead of just the more traditional, post-fire follow-up.

**Impacts of Myrtle rust on three Australian Myrtaceae species of coastal swamp woodland**

**Mrs Laura Martina Fernandez**², Professor Michelle Leishman³

²Macquarie University, Umina Beach, Australia, ³Plant Biosecurity, Canberra, Australia

Invasive Species (2), December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Laura Fernandez obtained her Bachelor degree in Biological Sciences studying the reproductive ecology of pines that invade native grasslands. She did a Master in Ecology assessing if invasion of exotic Fabaceae was facilitated by native trees in Brazilian semideciduous systems. Currently she is a PhD student at Macquarie University.

Exotic fungal pathogens can have substantial ecological impacts, modifying vegetation community structure, composition and ecosystem processes as well as threatening endangered species and communities. Myrtle rust (Puccinia psidii) is a pathogenic fungus native to South America that affects Myrtaceae species. It was accidentally introduced to Australia and first detected in 2010 in NSW. We conducted two experiments to assess impact of myrtle rust infection on three co-occurring coastal swamp woodland species known to be susceptible: Melaleuca quinquenervia, Leptospermum laevigatum and Baeckea linifolia. Plants of each species were grown individually (Expt. 1) and in mixed species assemblages (Expt. 2), with half inoculated with myrtle rust and the other half remaining as control. Infection level was assessed and its impact on seedling survival and growth recorded. In both experiments L. laevigatum and M. quinquenervia seedlings were heavily infected and showed high degrees of susceptibility with impacts on growth (height, biomass, number of leaves). In contrast no B. linifolia seedling presented visible symptoms of disease. Melaleuca quinquenervia seedlings had greater infection levels and suffered greater growth reductions than L. laevigatum in both experiments. Biomass allocation was largely unaffected, except for increased stem mass fraction. Differential levels of infection did not result in relative abundance changes. As M. quinquenervia is dominant in coastal swamp communities and highly susceptible to myrtle rust, changes in community structure are likely. This study is a first step towards better understanding of the ecological impacts of myrtle rust aimed at improving the conservation of Australian Myrtaceae-dominated plant communities.

**Restoring a Threatened Ecological Community following iron-ore mining**

**Dr Lucy Commander**², Dr Peter Golos¹, Dr Luis Merino Martin¹, Dr Jason Stevens¹, Dr Ben Miller¹

¹Botanic Gardens and Parks Authority, Kings Park, Australia, ²The University of Western Australia, Crawley, Australia, ³French National Institute for Agricultural Research (INRA), Montpellier, France, ⁴Centre for Ecology and Hydrology (CEH), Wallingford, UK

Restoring a Threatened Ecological Community following iron-ore mining
Biography:
Dr Lucy Commander is a Restoration Seed Ecologist who undertakes research for the mining industry to improve seed use in restoration. She has worked in a variety of ecosystems from grasslands to shrublands and woodlands in the tropics, desert, Mediterranean and coastal regions of Western Australia.

Ecological restoration of areas that have been degraded or destroyed is increasing in prominence in Australia. While challenging in every ecosystem, and after any type of damage, restoration is particularly difficult following surface mining, where the entire ecosystem is removed and landforms may be altered. This study investigated restoration at an iron-ore mine on a Banded Ironstone Formation (BIF), for which one of the conditions for restoration was to restore 70% of the original vegetation, a Threatened Ecological Community. Field, glasshouse and laboratory experiments were conducted over four years to determine the effects of abiotic filters (rainfall and soil properties) and landscape position on seedling emergence, demographic processes (germination, emergence, survival) limiting seedling recruitment, seed addition and seed pre-treatment experiments to determine microsite vs seed limitation, the use of novel seed technologies such as seed ‘pellets’, the effect of topsoil source on seedling emergence, and whether seed germination traits explain seedling emergence and the seedling community resulting from a biodiverse broadcast seed mix. Results show that while restoration is indeed challenging, research can result in improvements to restoration practices, and can also experimentally test ecological theories about community assembly.

Biodiversity recovery in restored rainforest: faith and fact

Prof Carla Catterall1, Ms Kylie Freebody1, Dr Amanda Freeman2, Dr John Kanowski1,2, Dr Luke Shoo1
1Griffith University, Nathan, Australia, 2School for Field Studies, Yungaburra, Australia, 3Australian Wildlife Conservancy, Malanda, Australia, 4The University of Queensland, Brisbane, Australia

Proponents of forest restoration as a tool for biodiversity recovery often hope or believe that diverse species will colonise once a basic vegetation framework has been reinstated. We evaluate the evidence for this assumption in the globally-significant Australian Wet Tropics. Across a landscape of about 800 km2 we surveyed woody plants and birds in intensively restored “biodiverse plantings” aged 1-25 years, located on former pasture land, compared with reference sites in intact rainforest and grazed pasture. Abundance and total species richness in the older replanted sites approached rainforest values, but the species composition of both birds and woody seedlings remained distinctly different. For both groups, species whose attributes suggest low colonisation potential (plants with large propagules, sedentary birds) were slower to build over time towards a forest-like richness than was the case for more mobile species. Development was particularly slow for plants from near-basal evolutionary lineages and regionally endemic rainforest bird species - both of high conservation significance. Thus, although intensively replanted sites rapidly developed a forest-like structure and high diversity of regionally-indigenous flora and fauna, the considerable financial investment in restoration action had least benefit for the species which are arguably most in need of it. The rate of recovery of birds, but not plants, was faster in sites which had most nearby remnant rainforest. These findings highlight the need for realistic restoration planning, the imperative to protect old growth remnant forest and the limitations of restoration offsets.

Friend and foe: wetland communities and conservation through the lens of common reed (Phragmites australis)

Dr. Jasmin G. Packer1,2, Professor Christoph Kueffer1, Dr. Hana Skálová3, Professor Laura A. Meyerson4, Dr. Petr Pyšek3,5, Associate Professor José M. Facelli4
1The University of Adelaide, Adelaide, Australia, 2Swiss Federal Institute of Technology (ETH Zürich), Zürich, Switzerland, 3Institute of Botany, The Czech Academy of Sciences, Praha, Czech Republic, 4Natural Resources Science, University of Rhode Island, Kingston, USA, 5Department of Ecology, Faculty of Science, Charles University in Prague, Prague, Czech Republic

Biography:
Dr Jasmin Packer is a conservation biologist connecting global expertise with local action. Her collaborative research focuses on understanding interactions between native and non-native biota to develop solutions that improve hands-on nature conservation. As an affiliate of The University of Adelaide and ETH in Switzerland, Jasmin synthesises Australian fieldwork with multi-continent experiments.

Wetlands are important biodiversity hotspots worldwide and are predicted to be increasingly vulnerable to climate change and other disturbances. Temperature extremes, hydrology modification and human-influences all alter wetland capacity to support native biota like the nationally endangered southern emu-wren (Stipiturus malachurus). Adding to the challenge is Phragmites australis (common reed), arguably the world’s most widespread flowering plant. It is highly adaptable (in terms of phenotype, genotype and karyotype), long-lived (clones may live up to 1000 years), responds rapidly (one plant can cover 1250 m2 in 2 years) and occurs within species-rich communities or dominant stands. These characters, and invasiveness in North America and some islands, make it a useful model to understand environmental conditions, and predict community responses under future scenarios.
We present our recent Phragmites australis monograph, identify knowledge gaps, and outline multi-continental projects to address three challenges. (1) Although managed as a native cosmopolitan species in Australia, the genetic structure at local and continental scales is virtually unknown. (2) With invasive non-native haplotypes out-competing natives in North America (e.g. genome and ploidy-related productivity and environmental tolerance), and similar emerging in China, there is growing international concern that expanding, monospecific stands in Australia could be cryptic non-natives. (3) Australia’s strong sunlight allows for higher weed productivity than reported elsewhere, and can contribute critical data to global predictions on wetland communities. Together these initiatives will identify strategies to improve conservation and restoration (inc. ecosystem function and diversity for emu-wrens) where weed is likely to occur now and in the future.

Assessing adaptive potential of revegetation: Comparing genomics of natural and revegetated stands of Eucalyptus microcarpa

Ms Rebecca Jordan1, Prof Ary Hoffmann1, Dr Suzanne Prober2, Dr Shannon Dillon2
1University of Melbourne, School of BioSciences, Parkville, Australia, 2CSIRO, Land and Water Flagship, Floreat, Australia, 3CSIRO, Agriculture Flagship, Black Mountain, Australia

Restoration Ecology, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Rebecca Jordan is a PhD candidate investigating climate adaptation in the Grey Box Eucalypt (Eucalyptus microcarpa). Her project aims to improve conservation and revegetation efforts by increasing understanding of climate adaptation at both genomic and quantitative trait levels, as well as comparing genomic diversity within natural and revegetated sites.

To ensure evolutionary resilience under climate change, successful revegetation relies on capturing high levels of genetic diversity and thus adaptive potential. As the traditional use of exclusively local material is challenged, understanding species’ adaptation to climate will be critical for determining seed sources for robust revegetation into the future. In Australia, Eucalypts are a dominant species across many landscapes and are extensively used in revegetation. However, knowledge of genomics underlying adaptation is limited, with current genomic climate adaptation research in trees focusing predominantly on northern hemisphere species. Utilising the power of genomics, we employ DArTseq, a reduced-representation genomics approach, to investigate genomic diversity and adaptation in Eucalyptus microcarpa, an important revegetation species used extensively across agricultural south-eastern Australia. In particular we compare the genomics of natural stands to revegetated sites and fragmented sites – common seed sources in modified landscapes. This works aims to assess how well current revegetation strategies have captured both neutral and adaptive genomic diversity, and thus adaptive potential. Differing results between diversity within and differentiation between sites suggests that, at the landscape level, not all variation is being captured or maintained in fragmented and revegetated sites. Through this case-study, we demonstrate how genomics can provide deeper insight into the genomics of revegetation - beyond general genetic diversity, and towards comparisons of neutral versus adaptive genomic diversity and thus adaptive potential; knowledge that will assist in improving seed sourcing strategies and evolutionary-resilience of future revegetation efforts.

Post-pine forest restoration

Dr Alison Ritchie1,2, Ms Kate Stanbury3, Dr Jason Stevens2,3, Professor Kingsley Dixon1,3
1Curtin University, Perth, Australia, 2Kings Park and Botanic Garden, Perth, Australia, 3University of Western Australia, Perth, Australia, 4Rocla Quarry Products, Perth, Australia

Restoration Ecology, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Alison Ritchie is a post-doc restoration ecologist and conservation biologist, working in a collaborative program between Curtin University and Kings Park and Botanic Gardens, and is a board member for the Society for Ecological Restoration Australasia.

The State Government of Western Australia is removing >15,000Ha of forestry plantations on the Gnangara Groundwater Mound (located approximately 50km north of Perth) to decrease the drawdown on the Gnangara Groundwater system. This provides an opportunity to restore strategic ecological links with remnant intact native Banksia woodlands however the science underpinning Banksia woodland restoration after pines is absent. This research project provides fundamental understanding of how to restore biotic systems and overcome abiotic limitations to ensure Banksia woodland systems can be restored to the highest achievable standard. We show that correct handling of the native topsoil seedbank, scalping of topsoil weed seed banks can substantially improve native seedling recruitment and establishment. Key factors to consider are depth of topsoil spreading, spreading and site manipulation operations. High densities (up to 180 plants/m2) and diversity (up to 39 species/m2) of native species can be restored in post-pine environments if appropriate restoration is undertaken (compared to an almost complete absence of native species in non restored systems). Increasing topsoil depth can decrease weed densities (up to 40%) and diversity (up to 50-75%). This research will be of regional and global significance, as worldwide, up to 39% of plantations are composed of coniferous species that are often non-native. With worldwide declines of biodiversity, this project will be of significance to land managers and conservation agencies that have an interest in the restoration of forestry plantations to native woodlands.

Effect of land management on structure of semi-arid Eucalyptus woodlands

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Essential to effective vegetation conservation and restoration is an understanding of the structure of individual trees and tree stands. However, such data for Australian Eucalyptus woodlands come mostly from forestry research and tend to be restricted to production forest types, and merchantable stems and species. We aimed to improve understanding of tree and stand structure for naturally-occurring Eucalyptus from temperate woodlands in NSW. Agricultural development of these landscapes has altered vegetation structure and river flows. We explored relationships among tree dimensions, crown senescence, vegetation density, number of hollows and growth for >2000 naturally-occurring trees on 105 1-ha sites in remnant vegetation. Four species accounted for 94% of trees measured: Eucalyptus camaldulensis, E. melliodora, E. microcarpa and E. populnea. Impacts of human manipulation of the landscape were apparent in shape, growth of trees and number of hollows. Trees showed large and increasing variation in shape with increasing diameter, and relative tree dimensions varied among species. Past attempts by people to kill trees has resulted in frequent coppicing with up to 50% of trees of each species having multiple stems. Multi-stemmed trees had relatively broader crowns and fewer hollows than single-stemmed trees of a similar diameter. Decreasing vegetation density due to tree removal resulted in shorter trees with wider canopies, and increased growth. Progression through crown development and senescence was similar among species but occurred at different trunk sizes for different species. These results highlight the complexity of predicting outcomes of current land management structure and habitat attributes.

Linear clearings lead to a shift in the factors determining distribution and abundance of fauna

Ms Joanne Lee1,2, Professor Sue Carthew2, Associate Professor Jose Facelli1

1University of Adelaide, Adelaide, Australia, 2Charles Darwin University, Darwin, AUSTRALIA

Biography:

Joanne Lee’s research investigated the impacts of mineral exploration on small fauna in semi-arid systems. Joanne research focused on changes to community composition, abundances and behavior in disturbed locations. Joanne’s current interests include restoration ecology and she currently works as a mining rehabilitation specialist in the arid lands of South Australia.

There is a great deal of discussion around how the effects of fragmentation influence species and communities. Here we investigated fragmentation created by track formation during mineral exploration activities in a semi-arid mallee region on northern Eyre Peninsula, South Australia. This type of fragmentation results in high edge to area ratios with minimal vegetation clearance. We trapped small fauna at sites where there has been intensive exploration activity (disturbed sites), and at sites without exploration (undisturbed sites). Vertebrate diversity and species richness at disturbed sites was higher close to track edges compared to the interior and on tracks. Both measures were significantly lower at disturbed sites than undisturbed sites. Individual species varied in response to disturbance, with responses of three types; no response, localised response (abundance varied within the disturbed sites but did not vary between the interior of disturbed sites and undisturbed sites) or generalised response (abundances consistently lower at disturbed sites compared to undisturbed sites). Investigation of habitat and invertebrate availability indicated that factors affecting the distribution of species were distinct for disturbed and undisturbed sites. Vegetation structure was an important determinant for the presence and abundance of species in disturbed sites. The abundance of potential food resources in the form of arthropods was more important in undisturbed sites. We confirm that disturbance created by mineral exploration tracks does induce edge effects even in this naturally patchy semi-arid environment. We suggest these changes are likely brought about by the arrangement of habitat across the landscape.

How well does ecological restoration recover rainforest biodiversity and ecosystem function?

Ms Mia Derhè1,2, Dr Helen Murphy2, Dr Rosa Menéndez3

1Lancaster Environment Centre, Lancaster University, Lancaster, UK, 2CSIRO Ecosystem Sciences, Atherton, Australia

Biography:

Mia Derhè is a PhD candidate investigating the effectiveness of reforestation approaches in restoring biodiversity and ecosystem functioning in the Wet Tropics. Her work focusses on the responses of dung beetle, soil invertebrate and mammal communities and the important ecological functions that they provide.
Tropical forest restoration is an important strategy for increasing provision of ecosystem services and reversing or mitigating biodiversity losses. Such programs require an understanding of how both biodiversity and ecosystem processes respond to restoration efforts. We focus on terrestrial mammals and dung beetles, which play a key role in ecosystem processes such as nutrient recycling and seed dispersal. We assess the response of mammal communities and dung beetle diversity-ecosystem functioning (BEF) relationships to ecological restoration in situ. We use a chronosequence of ecologically restored, previously cleared rainforest sites in the Wet Tropics of Australia to look at how these diversity-functioning relationships respond to ecological reforestation over time. Mammal and dung beetle community attributes and dung beetle-mediated functions were simultaneously sampled at 20 sites across the Atherton Tablelands. Relationships between faunal diversity and ecological function were examined using species and functional diversity indices and functioning was measured as the amount of dung removed, amount of seeds dispersed, and amount of soil displaced during dung burial. The results show that with increasing restoration age, dung beetle species richness, abundance, biomass and functional richness increase, mammal biomass and functional richness increase, and reassembly trajectories move towards a mature forest state in terms of community composition. Functional efficiency also increased with restoration age, and functional diversity indices were better at predicting functioning that species-based metrics. We therefore highlight the importance of using more than one metric to characterise assemblages and BEF relationships in restored areas, to better assess the efficacy of ecological restoration.

Micro-organism triggers widespread small mammal recovery; Rabbit Haemorrhagic Disease Virus maximises bang for conservation buck

**Mr Reece Pedler**1, Mr Robert Brandle1, Dr John Read2,3, Dr Rick Southgate1, Mr Peter Bird1, Dr Katherine Moseby2,3
1Department for Environment Water and Natural Resources, SA Arid Lands Region, Port Augusta, Australia, 2University of Adelaide, Adelaide, Australia, 3Ecological Horizons, Kimba, Australia, 4Ensign Environmental Services, Kingscote, Australia, 5Primary Industries and Regions South Australia, Adelaide, Australia

Restoration Ecology, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Reece Pedler is a threatened species project officer for the Department for Environment, Water and Natural Resources, based in the north of SA. In addition to work on threatened mammal fauna, he is completing a PhD on the movement and breeding ecology of nomadic shorebirds (Banded Stilts) through Deakin University.

Funding for species conservation is insufficient to meet the growing challenges facing global biodiversity, yet we often focus on expensive single-species recovery actions with limited gains, while neglecting broader management that addresses threatening processes. In arid inland Australia the small mammal fauna has suffered the world’s worst extinction rate, attributable largely to competition from introduced rabbits and predation by feral cats and foxes. The biological control agent Rabbit Haemorrhagic Disease Virus (RHDV) was introduced into Australia in 1995; dramatically suppressing rabbit populations, with linked reductions in populations of their main predators, cats and foxes. We examined the effect of this cheap and wide-reaching ecosystem management tool on threatened small mammals. Despite low rainfall conditions over the first 14 years following the spread of RHDV, two IUCN-listed native rodents (the Dusky Hopping-mouse and Plains Mouse) increased their extent of occurrence by 241-365%. The Crest-tailed Mulgara, a threatened marsupial micro-predator, underwent a seventy-fold increase in extent of occurrence and a 12-fold increase in area of occupancy. These recoveries are indirectly attributed to RHDV via decreased competition for food resources and the linked decline of rabbit-dependent introduced predators. These three previously threatened species now qualify for downgrading from the IUCN Red-List; recovery on a scale rarely seen in any mammal. The use of rabbit bio-control as a tool for reducing cat and fox predation on threatened small mammals is a demonstration of the wide-reaching benefits created by conservation programs that take a big picture approach to addressing threatening processes over large spatial scales.

The landscape of turnover: a spatially explicit mapping of species turnover using zeta diversity

**Dr Guillaume Latombe**1, Prof Cang Hui2, Ms Mariona Roigé1, Prof Melodie A. McGeoch1
1Monash University, Melbourne, Australia, 2Stellenbosch University, Matieland, South Africa, 3Lincoln University, Lincoln, New Zealand

Spatial Ecology, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Dr Guillaume Latombe is a Postdoctoral Fellow at Monash University. His research focuses on using complexity-based and mathematical approaches, along with dynamic modelling, to derive informative community patterns and to unveil the process-pattern relationships shaping community structures, with applications to biological invasions.

Zeta diversity measures the spatial turnover in species composition by computing the average number of species shared across multiple assemblages. Unlike other measures of species compositional turnover, such as beta diversity, zeta diversity partitioning quantifies the complete set of diversity components for multiple assemblages. It therefore more comprehensively represents the spatial structure of multispecies distributions. However, current measures of zeta diversity are spatially implicit, and therefore still do not fully take into account the spatial heterogeneity of species assemblages. For example, local communities across a landscape may be assembled by different processes (e.g. neutral or niche), some depending on the species identity and the environmental characteristics. We introduce a spatially explicit representation of species turnover, based on the combinations of local zeta diversity indices computed across the nearest assemblages for each location. The result is a landscape of species turnover that can be visualised as a spatial map. We apply this technique at a continental scale to unveil the spatial structure of bird communities across Australia using occurrence records from the Australian Bird Atlas, and at a local scale for an alien plant community in a National Park in South Africa, using systematic presence-absence records. As a result, regions with different levels of community turnover naturally emerge across Australia using occurrence records from the Australian Bird Atlas, and at a local scale for an alien plant community in a National Park in South Africa, using systematic presence-absence records. As a result, regions with different levels of community turnover naturally emerge across Australia using occurrence records from the Australian Bird Atlas, and at a local scale for an alien plant community in a National Park in South Africa, using systematic presence-absence records.
Spatial dynamics of coastal bird communities in relation to habitat types and connectivity

Ms Christina Buelow¹
¹James Cook University, Townsville, Australia

Biography:
Christina Buelow is a PhD candidate at James Cook University, Australia. Following years of assisting a variety of field-based ecological studies, her research now focuses on the drivers, patterns and consequences of relationships between bird-communities and coastal ecosystem connectivity.

Coastal bird communities have primarily been investigated in isolation, considering only individual coastal habitats and their small-scale vegetation patterns. Given that coastal areas provide a large and, importantly, concentrated diversity of connected habitats; the concerted influence of coastal habitat type, connectivity and spatial scale on bird communities should be examined. Disregarding these combined spatial effects defies understanding the nuanced nature of coastal bird communities, where there may be considerable overlap in communities of adjacent habitat types.

This study determined differences in bird-community composition within coastal habitats, and whether this is influenced by large-scale patterns in habitat connectivity. Bird-community surveys were conducted in multiple coastal habitat types along the northeast coast of Australia. Habitat connectivity patterns were quantified at three, six and twelve kilometre spatial scales surrounding each survey area. Bird-species abundance differed between mangroves and adjacent saltmarsh, Melaleuca and rainforest habitat types, but not between mangroves and adjacent Eucalyptus habitat. Habitat connectivity was found to influence coastal-bird community composition at three, six and twelve kilometre spatial scales, and the most important habitat connectivity patterns contributing to bird-community composition differed depending on spatial scale. These results suggest that there is a structural or resource element linking coastal mangrove and Eucalyptus habitat types from a bird-preference perspective. Additionally, this study clearly indicates that the most important aspects of coastal habitat connectivity influencing bird communities differ depending on spatial scale. This provides the first step into investigating the role that spatial dynamics of habitat type and connectivity play in coastal bird communities.

Horses for courses: monitoring stream bank erosion in the Australian Alps with unmanned aerial vehicles

Dr David Paull¹
¹University of New South Wales, Canberra, Australia

Biography:
DR David Paull is Senior Lecturer and Geography Coordinator in the School of Physical, Environmental and Mathematical Sciences at the University of New South Wales, Canberra. His research interests include Biogeography, Geomorphology and GIScience.

Over 10,000 wild horses inhabit the Australian Alps, with the vast majority being found within the iconic Kosciuszko National Park. Their trampling impacts on sphagnum bogs and other endangered ecological communities have been described as both extensive and horrific. While qualitative assessments of the horse impacts upon stream bank erosion have been conducted at multiple reference sites throughout the park, no previous attempt has been made to geospatially quantify the dimensions of damage. In this study, an approach to model small watercourse morphology is presented. The aim is to establish detailed terrain models and aerial photo mosaics that can be used as a baseline against which the future condition of streams might be assessed. Based on low altitude Unmanned Aerial Vehicle (UAV) surveys of select stream reaches, trials have been undertaken to capture high-resolution digital images, which were then processed using Structure from Motion (SfM) techniques to produce dense point clouds. Ground control points collected using RTK GPS were then identified within the point clouds and used to transform the data coordinates. Interpolation to elevation grids and mosaicking of the aerial photographs has produced promising results; with further refinement of the methods this is expected to offer a low-cost, repeatable approach for monitoring stream bank conditions against the backdrop of wild horse control.

Determining climatic decoupling to predict persistence of arid zone aquatic refugia

Prof Jenny Davis¹, Mr Ian Kidd², Dr Jayne Brim Box³
¹IAE, University of Canberra, College Street, Australia, ²IMAS, University of Tasmania, Launceston, Australia, ³Dept of Land Resource Management, Alice Springs, Australia

Biography:
Professor Jenny Davis is the Chair of Water Science, Institute for Applied Ecology, University of Canberra. She has a PhD & BSc (Hons) from the University of Tasmania, was a Queens Fellow in Marine Science at UWA and has previously held academic positions at Murdoch University (WA) and Monash University (VIC).
Refugia are important habitats that biota retreat to, persist in and potentially expand from, under changing environmental conditions. The presence of stable microrefugia, sites with cooler maximum temperatures that are decoupled from the regional climate, are thought to have been imperative for the persistence of species over many millennia and multiple climate change events. Arid zone waterbodies are considered to represent evolutionary or ecological refugia, based on characteristics of the species they support and the presence of permanent water. This study sought to determine the extent of decoupling of arid zone springs and rockholes from the regional climate (rainfall and temperature) as a means of predicting the importance of these sites as refugia under future drying and warming climate scenarios. To do this we have logged air and water temperatures and water depths at groundwater-dependent and surface water-dominated (rainfall) sites in central Australia, over multiple seasons. We found, perhaps not surprisingly, that groundwater-dominated sites previously identified as evolutionary refugia (on the basis of the presence of relictal and endemic species) displayed the greatest amount of thermal buffering and most stable water levels. These results give us a greater degree of confidence in predicting the importance of groundwater-dominated sites as climate refugia in the future. However, although rainfall-dominated sites displayed much greater variability in water levels, some thermal buffering was also evident. This suggests that other factors, such as shading and stratification, may also act to confer some refugial characteristics with respect to temperature.

**Food webs in space: spatial processes and network assembly**

**Prof Ross Thompson**
1Institute for Applied Ecology, University of Canberra, Canberra, Australia

Spatial Ecology, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Professor Ross Thompson is Director of the Institute for Applied Ecology and an ARC Future Fellow at the University of Canberra. His research is primarily in freshwaters, particularly addressing human impacts on food webs and ecosystem processes.

The role of spatial processes in determining local patterns of diversity is becoming increasingly recognised, and has important implications for conservation and restoration ecology. Using data from three aquatic systems: the Pilbara in Western Australia, central Australian waterholes and central Victoria streams, I will discuss the spatial processes that may act to promote diversity in connected systems. Food webs described from these three regions show that connectivity of habitats is a key driver of local diversity, and that movement of organisms in space is an understudied part of food-web assembly. Climate change, abstraction of water and local habitat degradation all have the potential to disrupt spatial processes, resulting in changes in ecological networks.

**Spatial and temporal structure of zooplankton communities in the Coorong, South Australia.**

**Mr Deevesh Hemraj**
1Md. Afzal Hossain, Prof. Jian Qin, Assoc. Prof. Qifeng Ye, Prof. Jan Jendyk, Dr. Sophie Leterme
1Flinders University, Adelaide, Australia, 2South Australian Research & Development Institute, Adelaide, Australia

Spatial Ecology, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Deevesh Hemraj is from Mauritius. He has travelled to Adelaide, South Australia, in 2009 to undertake a Bachelor of Science in Marine Biology (Hons) at Flinders University. After completion, he got offered a PhD candidature in 2013 in the Leterme lab (School of Biological Sciences, Flinders University).

The Coorong (South Australia) is a wetland of international importance under the Ramsar Convention that supports a variety of ecologically and commercially key plant (Ruppia tuberosa), fish (Black bream, Greenback flounder, Muloway, Small mouthed hardyhead, Yelloweye mullet,) and waterbird (Banded stilt, Curlew sandpiper) species. Extreme salinities due to a period of drought (2004-2009) had an impact on the distribution of these species over the length of the wetland. Increased freshwater input since 2010 allowed for the flushing of much of the accumulated salt; however high salinities are still observed in the southern lagoon. The trophic interactions between species of the Coorong are highly dependent on its salinity levels and various other environmental parameters. In particular, trophic dynamics are highly dependent on the level of interconnectedness between primary and secondary production. Being the major secondary producers, zooplankton are the link between primary production in the Coorong and higher consumer levels, such as small nekton (Small mouthed hardyheads and Sandy sprats). Therefore, spatial and temporal changes in zooplankton communities will affect trophic interaction and interconnection in the Coorong. Here, we present the influence of environmental parameters on the change in distribution and community interactions of phytoplankton and zooplankton along the length of the Coorong from November 2013 to October 2014. Spatial and seasonal changes in plankton community structures are looked at, especially with variation in salinity, as well as eutonics or eoclines in the ecosystem.

**Spatial models of vegetation traits: new products and insights using informatics**

**Dr Graeme Newell**
1Dr Graeme Newell, Dr Canran Liu, Dr Steve Sinclair, Dr Peter Griffioen
1Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Australia, 2Ecoinformatics, Montmorency, Australia

Spatial Ecology, December 3, 2015, 10:15 AM - 12:15 PM
Native vegetation is a critical feature of our environment supporting cultural and societal needs, as well intrinsic environmental values. Agencies use maps (‘spatial models’) of the distribution, composition, and quality of native vegetation as a key resources in conservation planning and management.

Ecology as a discipline incorporates aspects of descriptive natural history through to complex mathematical / statistical analytics. Informatics and machine learning offer new approaches and opportunities for combining information and finding patterns in very large datasets that can be assimilated from various sources. We have collated and developed a library of spatial and aspatial data relevant to the flora and ecosystems of SE Australia, and coupled this with a suite of machine learning tools, some of which are novel to ecological modelling.

These data and systems provide the capacity to produce ‘maps’ of varied ecological phenomena, including the distribution of flora and fauna (both current and pre European settlement); community structure (e.g. vegetation type); community function (e.g. condition, etc.), and expressions of various physiological and ecological traits. These tools allow us to learn, discover and represent ecological patterns, often intuitionally understood by field ecologists, but have thus far been difficult to express and visualise.

Collectively these products display a wide variety of ecological ideas in addition to vegetation type or extent. As data-driven models of ecological phenomena they also provide the basis for generating new ecological insights (i.e. hypotheses), and testing these with new and relevant field data.

**Spatial ecology of a refuge population of the threatened plains mouse**

**Ms Lauren Young**

1University of Sydney, Sydney, Australia, 2CSIRO, Alice Springs, Australia

Spatial Ecology, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Lauren Young is a PhD candidate with the University of Sydney, based in Alice Springs at CSIRO Land and Water Flagship. Her research interests are centred around arid zone ecology and conservation. She is currently studying the spatial ecology of the nationally threatened plains mouse.

The plains mouse (Pseudomys australis) is a threatened, irruptive native rodent, with a distribution spanning the stony deserts of South Australia and the southern Northern Territory. Plains mouse populations increase in abundance across the landscape in response to rare, large magnitude rainfall events and contract back to discrete cracking clay refuges as conditions dry. The small and discrete spatial extent of these refuges makes them ideal management foci; however, the full extent of refuges needs to be determined to develop effective management actions.

Here I describe a study undertaken at study sites in the southern Northern Territory to determine the spatial ecology of the plains mouse within refuges during dry conditions. Live-trapping was undertaken from October 2013 to determine the presence of plains mice at six sites within cracking clay habitat. Camera-trapping began in April 2015 to determine the spatial distribution of the plains mouse beyond the live-trapping sites. Trapping data were used in combination with home-range data, to define the spatial scale of plains mouse refuges. Plains mouse abundance and distribution fluctuated over the study period suggesting that the spatial scale of refuges change over time. This fine scale knowledge of the distribution of plains mice during dry conditions, when they are at their most vulnerable, will allow for the development of more targeted conservation management strategies.

**Indicators of an ecological barrier for two thick-billed grasswren subspecies.**

**Ms Amy L. Slender**, Ms Marina Louter, Dr Michael G. Gardner, Prof Sonia Kleindorfer

Flinders University of South Australia, GPO Box 2100, Adelaide, Australia, *South Australian Museum, Adelaide, Australia

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

**Biography:**

Amy Slender completed her honours in Sydney on the immune system of the Koala. She is now in the third year of a PhD project on population genetics of a threatened Australian bird, the thick-billed grasswren.

Ecological speciation is an important driver of biodiversity and occurs when populations in different habitats evolve and diverge. Little is known about ecological factors that limit gene flow or favor divergence in parapatric populations. Here, we examine the distribution of plant species to test if habitat differs across two parapatric avian subspecies in a xeric environment. The threatened thick-billed grasswren consists of two subspecies, Amytornis modestus raglessi and A. m. indulkanna, that are differentiated at a mitochondrial marker. The two main haplogroups are geographically structured but are not currently isolated from each other. The results of this study found changes in vegetation type across the landscape, which created an ecological cline whereby haplotypes of each subspecies were asymmetrically distributed across the cline. Only the haplotypes of A. m. indulkanna were found in an area dominated by the shrub species Atriplex nummularia omissa, Maireana aphylla and Ptilotus obovatus (referred to as Zone A). Haplotypes of both A. m. raglessi and A. m. indulkanna occurred in habitat dominated by the shrub species Maireana pyramidata.
Habitat restoration from grazing predicts presence and home range size in Thick-billed Grasswrens

Ms Marina Louter1, Ms Amy L. Slender1, Dr Michael Gardner2,3, Prof Sonia Kleindorfer1
1School of Biological Sciences, Flinders University, Adelaide, Australia, 2South Australian Regional Facility for Molecular Evolution and Ecology, South Australian Museum, Adelaide, Australia

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Marina Louter finished a Master in Biology at the University of Groningen in her home country, the Netherlands before coming to Australia to study birds. In 2012 she joined the Birdlab at Flinders University as a PhD candidate studying the behavioral ecology of a vulnerable arid-zone bird: The Thick-billed Grasswren

Key physiological traits explain range structure in central place foragers

Prof Steven Chown1, Dr. Brigitte Braschler2
1Monash University, Melbourne, Australia, 2University of Basel, Basel, Switzerland

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Steven Chown has pioneered the area of macrophysiology - the ecological implications of physiological variation across large spatio-temporal scales. He has a particular interest in biological invasions. His research has a significant influence on science and conservation policy and practice, especially in the Antarctic.

Two key components of geographic range are range position and structure. The latter includes size and internal variation in abundance. Much work has focussed on understanding the way in which physiological traits influence range position. Range structure is less frequently explored from this perspective, yet it plays a large role in geographic range dynamics. Much focus has also been given to the importance of microclimate in the context of understanding range position, resulting in substantial recent scrutiny of key macroecological hypotheses. These include the climatic variability hypothesis, and the proposal that critical thermal limits may explain range position, and risk from anthropogenic climate change along environmental gradients. Here we combine information on body size, water balance, thermal tolerance, temperature limits to foraging activity, and abundance variation over 5 years and >20 sites in c. 65 species of ants to re-examine these ideas. Ants are central place foragers with temperature influencing fitness directly and via transitive hierarchies of dominance. We find that critical thermal limits closely reflect microclimates of the sites, as recorded by >5 years of soil surface temperature measurements. These limits have less of an influence on foraging activity temperatures, which depend also on biotic interactions. Critical and foraging temperature range explain much variation in specialization and range size, with some influence on abundance. Water balance characteristics have an influence on range structure too, and are closely related to precipitation. At this level, the climatic variability hypothesis cannot be rejected, while risks from warming are overestimated using macroclimate information.

What did the wolf eat? Understanding the diet of a globally distributed predator

Dr Thomas Newsome1
1University of Sydney / Oregon State University, .

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Thomas Newsome is a post-doctoral scholar at The University of Sydney and Oregon State University. Thomas’ research focuses on predator ecology and trophic cascades. He is particularly interested in how humans and top predators shape and drive ecosystem processes.

Atriplex vesicaria and Acacia spp (Zone B). Between the zones, the grass species Zygochloa paradoxa may represent resistance to dispersal as no grasswrens occurred in this habitat type (sand dunes). These findings point to ecological patterns for haplotype occurrence in two parapatric subspecies, and also identify a possible barrier to gene flow due to habitat (sand dunes dominated by Z. paradoxa).

Habitat restoration from grazing predicts presence and home range size in Thick-billed Grasswrens

Ms Marina Louter1, Ms Amy L. Slender1, Dr Michael Gardner2,3, Prof Sonia Kleindorfer1
1School of Biological Sciences, Flinders University, Adelaide, Australia, 2South Australian Regional Facility for Molecular Evolution and Ecology, South Australian Museum, Adelaide, Australia

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The movement of organisms through their environment is an intrinsic component of an animal’s ecology and lies at the heart of ecological field research. Home range size and habitat use are essential to determine the appropriate size of a potential conservation area needed to support specific taxa. We conducted the first-ever telemetry study to record the movements of a subspecies of Thick-billed Grasswrens (Amytornis modestus raglesi), a bird of conservation concern, in Witchelina Reserve in the arid zone of South Australia. We used Kernel Density Estimators for each individual grasswren male to estimate home range size and home range overlap. To assess which ecological predictor variables affect A.m. raglesi home range size in grazed and moderately grazed sites, we measured vegetation cover along with invertebrate availability and avian densities. We found that A.m. raglesi adult males had home ranges of 6.6ha ± 4.1 (n=14) and low levels of intraspecific overlap. This home range size is considerably larger than previously described suggesting that the spatial requirements for this species are much greater than expected. There was no difference in home range size in grazed versus moderately grazed sites, but grazing negatively impacted on ecological variables; vegetation cover and insect abundance was higher in areas of moderate grazing. This work provides new biological insights into space use and ecological needs of an arid zone specialist, A.m. raglesi, and offers recommendations for conservation management.

Key physiological traits explain range structure in central place foragers

Prof Steven Chown1, Dr. Brigitte Braschler2
1Monash University, Melbourne, Australia, 2University of Basel, Basel, Switzerland

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

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Two key components of geographic range are range position and structure. The latter includes size and internal variation in abundance. Much work has focussed on understanding the way in which physiological traits influence range position. Range structure is less frequently explored from this perspective, yet it plays a large role in geographic range dynamics. Much focus has also been given to the importance of microclimate in the context of understanding range position, resulting in substantial recent scrutiny of key macroecological hypotheses. These include the climatic variability hypothesis, and the proposal that critical thermal limits may explain range position, and risk from anthropogenic climate change along environmental gradients. Here we combine information on body size, water balance, thermal tolerance, temperature limits to foraging activity, and abundance variation over 5 years and >20 sites in c. 65 species of ants to re-examine these ideas. Ants are central place foragers with temperature influencing fitness directly and via transitive hierarchies of dominance. We find that critical thermal limits closely reflect microclimates of the sites, as recorded by >5 years of soil surface temperature measurements. These limits have less of an influence on foraging activity temperatures, which depend also on biotic interactions. Critical and foraging temperature range explain much variation in specialization and range size, with some influence on abundance. Water balance characteristics have an influence on range structure too, and are closely related to precipitation. At this level, the climatic variability hypothesis cannot be rejected, while risks from warming are overestimated using macroclimate information.

What did the wolf eat? Understanding the diet of a globally distributed predator

Dr Thomas Newsome1
1University of Sydney / Oregon State University, .

Species Distributions, Ballroom B, December 3, 2015, 10:15 AM - 12:15 PM

Biography:
Dr Thomas Newsome is a post-doctoral scholar at The University of Sydney and Oregon State University. Thomas’ research focuses on predator ecology and trophic cascades. He is particularly interested in how humans and top predators shape and drive ecosystem processes.
Grey wolves (Canis lupus) are one of the most extensively studied large carnivores, but there has been no detailed review of the species’ feeding ecology across the globe. This is despite growing debate about how to conserve or restore wolf populations while limiting their impacts on wild or domestic ungulates. Thus, in order to facilitate an informed discussion of grey wolf conservation and management, it is critical to develop a clear understanding of grey wolf dietary ecology across landscapes with varying levels of human influence. In this presentation I will summarise the results of a review that compiled grey wolf dietary data from 167 studies incorporating 89,674 scat and stomach samples. I will outline the extent to which grey wolf diet varies among and within North America, Europe and Asia. Finally, I will highlight the extent to which grey wolves have adapted to human-altered ecosystems and discuss the broader implications of the results for the conservation and management of other canid species throughout the globe.

Continental analysis of Australian rangeland vegetation: floristic, structural and phylogenetic diversity

Dr Zdravko Baruch1, Dr Greg Guerin1, Mr Emrys Leitch1, Dr Andrew Tokmakoff1, Mr Stefan Caddy-Retalić1, Mr Ben Sparrow1, Prof Andrew Lowe1
TERN University of Adelaide, Dernancourt, Australia

Biography:
Dr Zdravko Baruch is currently visiting Associate Professor at the School of Biological Sciences, University of Adelaide. His research specialises in vegetation data analysis and interpretation of AusPlots/TERN Rangelands surveys.

Australian rangeland vegetation thrives under a huge diversity of climate, substrate and disturbance regimes that challenge comprehension and management. The TERN AusPlots Rangelands Survey Protocol collects, stores, and shares biophysical survey data from across the continent that permits direct comparative analyses. Vegetation and soil records from 370 1ha permanent plots across 28 IBRA groupings, containing > 1700 plant species, have been analysed by clustering and ordination of floristic, structural and phylogenetic data to recognize plot relationships. However, large dissimilarities within the data matrix prevented meaningful interpretations. Consequently, sites were clustered into 8-10 ecologically comprehensive groups and pooled into three “superclusters” corresponding to tropical savannas, deserts and temperate and ecoregions. The desert supercluster was the most species rich and with the highest β-diversity, but exhibited only an average growth form diversity. For all superclusters, canonical correspondence analysis showed that aridity and soil N and P content were strongly associated to plot floristic and structural distances whereas soil clay and bulk density had lesser influence. The phylogenetic signature of plots within South Australia was significantly correlated to environmental and geographic distances. This AusPlots approach is the first to be implemented at a continental scale and with such biophysical detail. It provides a vegetation base-line for future rangeland management, conservation and restoration likely to be impacted by climate change.

Reconstructing biome transitions and diversification rate shifts in Hakea

Marcel Cardillo1, Peter Weston, Peter Olde, Zoe Reynolds, Emily Lemmon, Alan Lemmon, Lindell Bromham
1Australian National University, Canberra, Australia

Hakea Schrad. & J.C. Wendl is a large plant genus (149 spp) of the family Proteaceae that occupies a wide range of environments from arid inland deserts to wet coastal forests, making it a good case study to explore the links between biome transitions, niche conservatism, and diversification. Using hybrid enrichment phylogenomics, we have reconstructed a highly-resolved species tree for Hakea, revealing a complex history of biome shifts, geographic spread, and rapid radiations across the Australian continent.

Site fidelity, abundance and distribution of Burrunan dolphins in Adelaide’s coastal waters, South Australia

Ms Nikki Zanardo1, Dr Guido Parra2, A/Prof Luciana Moller1,2
1Centenary Ecology, Behaviour and Evolution Lab, Flinders University, Adelaide, Australia, 2Molecular Ecology Lab, Flinders University, Adelaide, Australia

Biography:
Nikki Zanardo developed a strong passion for marine mammals at a young age, and throughout her university studies, she began to focus her attention on the conservational aspect of research. Currently, her passion for marine mammals is being heartened through research on the Burrunan dolphins inhabiting the Adelaide metropolitan coast.

Little is known about the ecology and behavior of the Burrunan dolphin (Tursiops australis). This hinders assessment of their conservation status and informed decision-making concerning management, which is particularly important considering the increasing anthropogenic threats in coastal waters. We used boat-based surveys and photo-identification data to estimate site fidelity, residency patterns, abundance and habitat usage of Burrunan dolphins in Adelaide’s coastal waters. Sighting rates and site fidelity varied amongst individuals and agglomerative hierarchical cluster analysis led to the categorization of individuals into three groups: transients, seasonal visitors or residents. Analysis of tagged identification rates indicated Burrunan dolphins used the study area regularly from year to year following a model of emigration and re-immigration. Abundance estimates obtained from closed population models ranged from 84 individuals (S.E. ± 31.84) in winter 2013 to 236 (S.E. ± 21.64) in summer 2014.
Variation in number of animals between seasons suggests movement in and out of the area over time. Spatial habitat modelling revealed a change in dolphin distribution across seasons, with an influence of habitat types particularly over the summer months. The varying levels of site fidelity and residency and the relatively high density of dolphins found throughout the study area highlights the Adelaide metropolitan coastline as an important habitat for Burruman dolphins. As these dolphins also appear to spent considerable time outside the study area, conservation and management efforts of this population must take into account anthropogenic activities within Adelaide’s coastal waters and their adjacencies.

Experimental investigations of fire responses in C3/C4 grasses suggest fundamental differences in re-sprouting capacity

Dr John Morgan1, Mr Nick Moore1
1La Trobe University, Bundoora, Australia

Biography:
Dr John Morgan is a plant ecologist interested in the evolution, distribution and ecology of temperate native grasslands.

C4 grasses possess characteristics that potentially advantage growth in fire-prone environments, including high photosynthetic productivity, efficient light and nutrient use, and significant allocation to below-ground reserves and reproduction. Such characteristics allow fast regeneration after fire and may be the consequence of photosynthetic physiology, phylogenetic ancestry or may have been acquired as adaptations to frequently-burnt environments. We aimed to examine the role of photosynthetic pathway on response to fire by comparing regeneration in five closely related C3 and C4 grasses from the Tribe Paniceae (subfamily Panicoideae) to experimental burning. We assessed above-ground regrowth responses to fire, and how allocation from below-ground reserves contributes to this. Two species of C3 grass did not re-sprout after fire, while the third did not recover fully above-ground. There was little evidence of remobilisation of below-ground resources. Regrowth of both C4 species, by comparison, was strong and growth was supported by the re-allocation of below-ground biomass. Differences in response indicate that the C4 grasses are better adapted to fire. Such characteristics may be the direct consequence of photosynthetic pathway or an indirect effect of adaptation in the C3 and C4 species to environments with differing fire regimes.

Abstracts – Poster Presentations

Cascading effects of fossorial mammals on soil processes in arid Australia

Ms Orsi Decker1, Assoc. Prof. Heloise Gibb1, Prof. David Eldridge2
1La Trobe University, Melbourne, Bundoora, Australia, 2University of New South Wales, Sydney, Australia

Biography:
Orsi Decker has recently started her PhD project in Australia investigating the response of soil processes to species extinctions. Her previous work includes habitat conservation of the Spanish moon moth; insect chemical ecology and decomposition studies in savanna grasslands and temporal forests.

European settlement resulted in the extinction of twenty two mammal species and the ecological extinction of many small to medium-sized mammals. Many endangered mammals were once ecologically important ecosystem engineers, causing significant soil disturbance. Digging activity creates fertile patches in arid landscapes through high soil turnover rates mixing soil layers of different depths. Empirical studies show that the foraging pits of native fossorial mammals contain more available nutrients compared with bare soil. We tested whether these microsite effects are meaningful at a larger scale using an exclusion experiment within Scotia Sanctuary, where several species of endangered digging mammals have been reintroduced. Mammals have been fenced out of exclusion plots (20 m x 20 m, n = 10) for 5 years and we predicted that nutrient availability would be lower in exclusion than mammal-accessible control plots. In contrast with previous studies, our exclusions did not have lower nutrient content compared with control plots. These results raise the question: how meaningful is the disturbance impact at larger scales? Foraging pits occupy less than 1% of the whole plot surface area which might explain why effects were not apparent at the landscape scale.

Influence of Various Environmental Factors on Seed Germination of Carpet Weed (Galenia pubescens)

Mr Ako Mahmood1, Dr Singarayer Florentine2, Dr Chauhan Bhagirath3, Dr David McLaren4, Dr Wendy Wright5, Dr Grant Palmer6
1Federation University - Australia, Ballarat, Mt Helen campus, Australia, 2Federation University - Australia, Ballarat, Mt Helen campus, Australia, 3The University of Queensland, Toowoomba, Australia, 4La Trobe University, Melbourne, Australia, 5Federation University - Australia, Gippsland, Australia, 6Federation University - Australia, Ballarat, Mt Helen campus, Australia

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Is the Whole of Paddock Rehabilitation Program putting paddock trees back into agricultural landscapes?

Ms Miriam Adams-Schimminger1, Dr David Freudenberger1, Mr Graham Fifield2
1The Fenner School of Environment and Society, The Australian National University, Canberra, 2Greening Australia, Aranda.

Biography:
Miriam Adams-Schimminger is an Honours student at the Fenner School of Environment and Society. She started there in July after graduating from the ANU with a BSc in 2014. She is interested in woodland restoration and empowerment through education.

The lack and further decline of paddock trees in the agricultural areas of south-eastern Australia impacts negatively on both ecology and agriculture, with 95% of box gum grassy woodlands cleared for production since colonisation. The aim of this study is to investigate whether the whole of paddock rehabilitation program is on track to return paddock trees to these landscapes and how well this is being done. The quality of the program will be assessed through onsite ecology, discussions with landholders, and an assessment in meeting its aims. Preliminary data will be presented on this.

Discovering acoustic feature extraction and selection algorithms for frog vocalization monitoring with machine learning techniques

Mr Jie Xie1, Dr Jinglan Zhang1, Prof Paul Roe1
1Queensland University of Technology, Brisbane, Australia

Biography:
Jie Xie is a PhD student at Queensland University of Technology. His thesis is entitled: Acoustic Monitoring by Frog Call Analysis. Through the study of frog vocalizations, the frog species and frog calling activity are monitored through a large spatial and temporal scale.

Over past few decades, frog species have been experiencing dramatic decline around the world. The reason for this decline includes habitat loss, invasive species, climate change and so on. For achieving the information of frog species, classifying frogs has become increasingly important. In this study, acoustic features are investigated for frog call classification with 16 frog species. For each frog species, six instances are selected from which ten acoustic features are calculated. Then, the multicollinearity between ten features are studied for selecting non-correlated features for subsequent analysis. Finally, a k-nearest classifier, a support vector machines classifier, and a decision tree classifier are used for frog call classification with selected acoustic features reactively. Our experiment results show that acoustic features can successfully classify frog species with machine learning techniques.

Investigating factors affecting restoration of native grassland in ex-cropland

Mr Shakir Bahaddin1, Dr Sinarayer Florentine1, Dr Nicholas Schultz2, Dr David McLaren2, Dr Steve Sinclair2, Mr Keven Banner4
1Federation University Australia, Ballarat, Australia, 2La Trobe University, Bendigo, Australia, 3Arthur Rylah Institute for Environmental Research, Heidelberg, Australia, 4Metropolitan waste management group, South Melbourne, Australia

Biography:
Ako Mahmood is a PhD student by Research at the Centre for Environmental Management, Faculty of Science and Technology, Federation University Australia.

Carpet weed is a South African woody prostrate perennial succulent herb belonging to the Aizoaceae family (ice plants). It was first recorded in Victoria and NSW in the early 1900s and has since become a serious weed threatening temperate Australian indigenous grasslands. Until recently, little was known about its seed ecology, including its germination, seed longevity and seedling emergence under various environmental conditions. Therefore, we investigated the effects of various factors that could affect carpet weed seed banks in both laboratory and field experiments as a means of developing long term management strategies. Results show that carpet weed was able to germinate over a broad range of temperatures but that short bursts (5 minutes) of high temperatures (80 C to 120 C - replicating possible exposure to a fire), significantly reduced seed germination. Seed germination was positively favoured by light, indicating that buried seed will remain in a dormant state until disturbed. Seedling emergence was greatest (53%) for seeds placed on the soil surface and considerably decreased as planting depth increased from 0.5 to 1 cm. Water stress greatly reduced carpet weed seed germination and germination was completely inhibited at water potentials of -0.4 to -1.0 MPa. Further, carpet weed is moderately tolerant to salinity. Carpet weed can germinate in both alkaline and acidic. The results of this study may assist in developing tools and strategies for the long term management of this noxious weed in Victoria and other parts of Australia.

EcoLOGICAL SOCIETY OF AUSTRALIA 2015 ANNUAL CONFERENCE | BOOK OF ABSTRACTS
The ecological barriers to restoring ex-arable land to native grassland include soils that contain high levels of nitrogen and phosphorus, and an extensive seed bank of exotic weeds. These factors give exotic species a competitive advantage over native species, which can prevent the re introduction of native species. We aim to determine the individual effects of high N and P levels, and the role of the exotic soil stored seed bank, as barriers to restoration.

In this poster presentation, we focus on addressing the problem of the exotic seed bank. We trialled the use of large blocks of green waste taken from metropolitan green waste collections, which were predicted to generate enough heat to reduce the viability of the seed bank, allowing reseeding with native species. To test the impact of temperature generated from green waste on seed viability, the seeds of two weed species (Nassella trichotoma and Galenia pubescens) and one native species (Themeda triandra) were placed in nylon mesh bags and buried under the oversize green waste piles at three different depths (0, 5 and 10 cm). The temperatures produced in the soil by the hot green waste were measured by data loggers placed under the piles. The maximum temperature recorded was 63 °C and the viability of the buried seeds was dramatically reduced. This work has shown promising preliminary success as a potential technique for reducing weed seeds stored in the soil.

Short-term change in vegetation quality with stock exclusion fencing is measurable

Ms Claire Moxham1, Ms Sally Kenny1
1Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Australia

Biography:
Claire Moxham is currently leading research in the Vegetation Ecology program at ARI through landscape scale, multi-catchment, partnership projects that foster strategic ecological solutions leading to enhanced biodiversity, production and policy outcomes. Research is focused on various aspects of applied vegetation ecology and ecosystem function in relation to management interventions.

Stock exclusion fencing is a common native vegetation management intervention in agricultural landscapes to facilitate recovery from degradation caused by stock grazing and restore the vegetation to a preferred state, based on conservation objectives. However, the effectiveness of this intervention has rarely been assessed. In addition, the detection of vegetation change in the short-term is important for reporting on investment program outcomes; however, rarely quantified.

Twenty-five sites in the Victorian Mallee that have been monitored twice (2009/10 and 2012) were examined. Sites were stratified on grazing level: grazed, recently ungrazed (< 10 years since grazing) or long ungrazed (> 10 years since grazing), and within three vegetation types: Saltbush Mallee, Dry Woodland, Inland Plains Woodland. Analysis of variance was used to determine if there had been any change between survey periods in species richness and direct percent cover of species and substrate (bare ground, litter and cryptogams).

Vegetation change can be measured in the short-term (< 5 years); however, the level of change varied depending on the attribute measured. Both native species richness and average cover were higher in the second survey period while average exotic species cover was higher in the first survey period. Furthermore, the results suggest that visual estimates of cover abundance in quadrats are good for detecting broad vegetation changes but finer scale measures of abundance are required to detect more subtle vegetation changes. The results of this project will provide evidence-based knowledge that will inform future native vegetation monitoring programs and management interventions.

Win-Win Ecology: getting farmers and conservationists to solve each other’s problems!

Mr Asael Greenfeld1, Dr. Eddie Van Etten1, Dr. Eli Groner2
1School of Natural Sciences, ECU, Joondalup, Australia, 2Dead Sea Arava Science Centre, Mitzpe Ramon, Israel

Biography:
Asael Greenfeld holds a M.Sc. in Dry Land Ecology from BGU Israel and is a teacher of Environmental Science in the township of Mitzpe Ramon in the Negev Desert. He is currently residing in Perth WA working in Jewish Education, has recently begun a PhD course in WA that he intends to continue in Israel.

Worldwide, population growth is intensifying the competition over land use between industries looking after humanities needs, such as farmers, and conservationists caring for nature. The interactions between the natural flora and fauna and farming can be competitive and destructive for both the farmer’s yield and for nature, but responsible management has the potential of not just reducing the damage but even achieving mutual benefits. This general concept, introduced by modern ecologists as win-win (reconciliation) ecology, promotes human development to reconcile natural species into developed landscapes rather than set aside sanctuaries or nature preserves which will never be sufficient to protect the whole world’s
biodiversity. This idea seems utopian and that is also its main fault – it requires both extensive research and uncommon cooperation between opposing forces.

In this conceptual project we created a model where win-win ecology can work, and are planning to practically explore this model using test cases in farms in semi-arid regions of WA, and in the Negev Desert in Israel.

Small communities that live off the land are often open-minded to the importance of sustainable development, and can have close relationships between farmers, rangers, and other interested parties that can make such cooperation possible. Our model suggests that by learning the challenges each party is facing, scientists can collaborate and study relevant interactions of local plants and wildlife with the introduced cultivated species, as well as contribute suggestions of management tools and solutions that will allow reconciliation.

Who needs nature: wellbeing and nature in cities

**Ms Lucy Taylor**, Associate Professor Dieter Hochuli

1University of Sydney, Sydney, Australia, 2University of Sydney, Sydney, Australia

POSTER: Advances in urban ecology and research practice: solutions through communication, collaboration and coordination

Biography:

Lucy Taylor’s research involves investigating the impact that animal and plant life has on urban residents’ wellbeing. This includes the effect of greenspace and biodiversity on health, the impact of policy and urban design on the wellbeing of human and non-human inhabitants, and the values and ethics surrounding human/non-human interaction.

Cities are often considered degraded due to their novel mix of native, introduced, migratory or cultivated plant and animal species. With over half of the world’s population lives in urban areas, interventions concerning human wellbeing are often targeted toward cities. Interaction with nature has been shown to affect the health of inhabitants. We investigate how urban biodiversity affects the wellbeing of residents in multiple cities. Wellbeing is a composite measure of quality of life that is based on health, social engagement, financial wealth, employment, education and environment. We used a survey of urban inhabitants to ask how people interact with and value nature, how much they know about it, and about their wellbeing. The results are considered with demographic and biodiversity indicators using GIS. By incorporating biodiversity into their conceptual frameworks, governments and planners will be able to optimise urban environments for the health of human inhabitants. Outcomes of this project will inform urban policy, design and planning.

Cultivating botanical literacy with campus flora: mobile engagement tool

**Ms Caroline Cheung**, Prof Glenda M Wardle, Dr Rosanne Quinnell

1University of Sydney, Sydney, Australia

POSTER: Advances in urban ecology and research practice: solutions through communication, collaboration and coordination

Biography:

Caroline Cheung is a final year BSc/BComm student at The University of Sydney. Caroline secured a summer scholarship in the School of Biological Sciences to work on the Botanical Explorer project where she developed the ClimateWatch trail and provided invaluable development input on the CampusFlora project. CampusFlora Project site: https://campusflora.wordpress.com/

Urbanised environments reduce the opportunities to connect with nature. In turn, this limited experience of the variety of species, and particularly plants, undermines the educational objective of building an ecologically- and botanically-literate society. What is needed to improve botanical literacy is to overcome the reluctance many people have to learning about plants by making the information accessible and engaging.

With this in mind the CampusFlora project was developed as a partnership between staff and undergraduates at the University of Sydney. It is an App designed to address the issue of ‘plant blindness’ (lack of awareness of plants) by introducing people to plants that they encounter in their daily life. CampusFlora provides educational information, relevant for a novice or expert, and offers botanical narratives via ‘trails’ using the botanical resources within the campus landscape.

CampusFlora builds on this botanical framework to offer broader learning experiences. Firstly, it leverages off the innovative ‘anywhere and anytime’ mobile technology, to pique the interest of technology-savvy students. Secondly, the project also engages with ecology students, or any life-long learners. For example, CampusFlora is used as a complementary tool to improve the plant identification skills needed to record phenological observations for a citizen science program called ClimateWatch. The CampusFlora app offers exciting future prospects; from its inception it has been developed to be an open system, shareable across institutions and platforms. A network of CampusFloras is being planned that through partnerships, will enable students to collaborate on large-scale studies in urban ecology.

Comparing ecological, morphological and physiological traits of endangered Melaleuca irbyana to commonly distributed Melaleuca bracteata

**Ms Thita Soonthornvipat**, Associate Professor Jennifer Firn, Professor Acram Taji, Professor Susanne Schmidt

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Climate change is underway, and one of the strategies we have to mitigate climate change impacts on biodiversity is assisted gene flow. Assisted gene flow makes use of long-standing adaptation to climatic gradients and aims to both increase the recipient populations fitness, and increase its adaptive capacity to climate change. It’s a great idea, but how do we go about identifying appropriate source/recipient populations? Here I outline a strategy for identifying source/recipient populations, and I illustrate the strategy by reference to a newly collected dataset on climatic adaptation in skinks from Australia’s Wet Tropics.

1Queensland University of Technology, Brisbane, Australia, 2Queensland University of Technology, Brisbane, Australia, 3The University of Queensland, Brisbane, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
Dr Ben Phillips1, Mr Stewart Macdonald2, Dr John Llewellyn2, Prof Craig Moritz3
1University of Melbourne, 2James Cook University, 3Australian National University, 

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
The Spatial Ecology and Evolution Lab investigates how spatial processes influence evolution. A current focus is looking at the evolution of climate-relevant traits in isolated populations, to understand the role of isolation and climatic extremity in generating adaptive diversity in the traits that mediate the impact of climate change.

The store and exchange of organic carbon in soils is large and critically important in global carbon cycling and providing invaluable ecosystem services. However, the understanding of soil organic carbon turnover in extensive semiarid regions (including Australia) is inadequate. Long-term drought, occasional episodic rainfall and fires are all likely to constrain biological activity and hence soil carbon dynamics. Soil respiration in semiarid woodlands is likely to be spatially heterogeneous due to the distribution of vegetation patches and areas in between. An in-situ experiment was implemented to better understand soil respiration in semiarid Mallee under different patches (under- and inter-canopy) and the effect of wild fire (unburnt and burnt locations). Five PVC collars were randomly placed, inserted at each location and patch in late March 2014, two months after a wild fire and three months prior to starting measurements, and kept in-situ throughout the experiment. Soil respiration was measured at monthly intervals, by using a manual chamber connected to an infra-red gas analyser. Soil temperature and soil water content of multiple depths were measured concurrently with soil respiration. The results showed that soil respiration was not affected by the wild fire (p = 0.233), but differed between patches (p < 0.001) and varied over time (p < 0.001). Soil CO2 flux was greatest in January 2015 immediately following 80mm of rain, but changed little during most of the year. Soil respiration was most strongly influenced by soil water content with soil temperature acting as a secondary modifier.

Identifying source and recipient populations for use in assisted gene flow.

1Queensland University of Technology, Brisbane, Australia, 2Queensland University of Technology, Brisbane, Australia, 3The University of Queensland, Brisbane, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
Thita Soonthornvipat is a PhD student in her second year under the supervision of Associte Prof. Jennifer Firn at QUT. She has a background in agriculture field and graduate master from faculty of Agriculture in Thailand and works in an academic area at Chiang Mai Rajabhat University.

Melaleuca irbyana R.T. Baker (swamp tea-tree) is a small to medium size tree listed federally as critically endangered under the Environment Protection and Biodiversity Conservation Act 1999. Despite, considerable conservation efforts to protect the integrity of the remaining populations of M. irbyana which are concentrated in the south-west peri-urban fringe of South East Queensland, this species remains under the threat of extinction due to increased land clearing for urban expansion and coal seam gas exploration as well as the common indirect effects of urbanisation such as eutrophication. Prior to European settlement, M. irbyana had a limited distribution when compared to other widespread and commonly co-occurring congeneric species Melaleuca bracteata F. Muell. To better understand the limited distribution of M. irbyana, I compared the germination success rate of M. irbyana to M. bracteata. I also compared how germination success rates were impacted by light, temperature and humidity. I found that M. irbyana had a high germination success rate (>80%) but under limited environmental conditions, while M. bracteata had a high germination success rate under a wide variety of environmental conditions. I am collecting more evidence concerning the ecological, growth and physiological traits of M. irbyana in comparison to M. bracteata, but this first study indicates a narrower suite of environmental conditions may be limiting the distribution of this important endangered Australian tree.

A wild fire does not affect soil respiration in semiarid woodlands

Mr Qiaoqi Sun1, Professor Wayne Meyer1, Dr Georgia Koerber1, Professor Petra Marschner2, Professor David Chittleborough3
1School of Biological Sciences, University of Adelaide, Adelaide, Australia, 2School of Agriculture, Food and Wine, University of Adelaide, Adelaide, Australia, 3School of Physical Sciences, University of Adelaide, Adelaide, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
Qiaoqi Sun is a PhD student at University of Adelaide. His research aims to better understand soil carbon dynamics in semiarid woodlands under a changing climate.

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Can drone imagery be used as an input for vegetation index estimation?

Dr Elena Kondrlova1, Prof Wayne S. Meyer2, Dr Georgia R. Koerber2, Dr Kenneth D. Clarke2, Dr Ramesh Raja Raja Segaran2, Mr. Adam D. Kilpatrick2, Assoc. Prof. Lian Pin Koh3, Dr Bertram Ostendorf
1Department of Biometeorology and Hydrology, Slovak University of Agriculture, Nitra, Slovakia, 2School of Biological Sciences, University of Adelaide, Adelaide, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
Elena Kondrlova received her PhD in Landscape Engineering from Slovak University of Agriculture in 2009. She has obtained research experience during PostDoc research stays at Wageningen University (2010) and the University of Adelaide (2013 and 2015). Her current research focuses on spatial analysis and modelling of the ecosystem processes.

Mallee vegetation has been studied at Calperum Station north of Renmark in South Australia since August 2008 as part of the OzFlux network. A crucial factor needed for the interpretation of measured carbon, water, and heat fluxes is green plant coverage. Ground sampling of leaf material is destructive and excessively time consuming. Furthermore, the sparse and spatially heterogeneous distribution of vegetation in mallee ecosystems makes it difficult to employ traditional methods of leaf area estimates.

Here, we explore the use of ultra high resolution airborne imagery to quantify vegetation cover distribution. Imagery of a 1ha area was obtained at a ground resolution of 1cm, mosaicked and ortho-rectified. It was then processed in Breedpix, a software package previously developed to estimate the plant cover distribution for crops using ground-based RGB photography. The mapped area mainly contained well-developed vegetation cover, except for one patch that had recently been burnt and had recovering plant cover. The Breedpix software estimated that for the unburnt portion of the site vegetation cover was 40% while in the burnt portion it was only 16.5%. The advantage of this method is the rapid processing capability to estimate the vegetation cover distribution for large areas. The relationship between vegetation cover and ground based leaf area index (LAI) estimates will be explored to assess the minimum number of ground-based sampling points for spatial estimates of mean conditions.

Understanding the impact of environmental change on copepod Gladioferens pectinatus reproduction

Ms Laetitia Allais1, Mr Deevesh A. Hemraj2, Mr Jan Jendyk3, Dr Sophie C. Leterme4
1Flinders University, Adelaide, Australia, 2Flinders University, Adelaide, Australia, 3Flinders University, Adelaide, Australia, 4Flinders University, Adelaide, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
Laetitia Allais is a Master degree student in Biology and Environmental Health specialising in Marine Biology at the University of Nice, France. She completed an internship in the Plankton Ecology Lab at Flinders University, supervised by Dr Sophie Leterme. Her research interests include ocean acidification, estuarine environments and zooplankton.

The calanoid copepod Gladioferens pectinatus Brady occurs in the freshwater to brackish regions of the Coorong wetland. It plays an important ecological role in the Coorong as main food source for a range of small nekton species and for other crustacean feeders. During the 2004-2008 prolonged drought, the Coorong wetland became hypersaline and there was a significant risk of acidification in the Lower Lakes (i.e. Lake Alexandrina and Lake Albert). The effect of salinity and pCO2 levels on the life cycle of G. pectinatus was tested and the survival and duration of life stages assessed. While no changes were observed in egg hatching or at the naupliar stage, copepodite and adult stages presented differences between salinity and pCO2 treatments. In particular, no copepods reached adulthood at 2 psu. The optimum conditions to complete G. pectinatus life cycle were attained at 10 psu and 2,000ppm. Our results suggested that a lower salinity combined to a higher pCO2 would modify the geographic distribution and the abundance of G. pectinatus in the Coorong. Those mechanisms would subsequently influence the entire food web with probable mismatches between trophic levels.

An investigation into the function of pilosity and sculpturing in ants

Mr James Buxton1, Dr. Kylie Robert1, Dr. Alan Marshall1, Dr. Travis Dutka1, Assoc. Prof. Heloise Gibb1
1Department of Ecology, Environment and Evolution, La Trobe University, Melbourne, Australia

POSTER: Biological adaptation along environmental and bioclimatic gradients

Biography:
James Buxton completed a honours project from August 2014 to May 2015 at La Trobe University, supervised by Assoc. Prof. Heloise Gibb and Dr. Kylie Robert. This presentation provides a summary of this project.

The trait-based approach to ecology promises greater generality in our understanding of how species assemblages are structured. The value of this approach depends on linking traits with ecological functions but there is limited evidence of the functional value of many commonly-used traits. We investigated the function of two traits, pilosity and sculpturing, in ants. Previous studies have linked these traits with a range of environmental...
variables using a correlative approach, but their functions are poorly understood. We used a cross-species comparative approach to test the function of pilosity and sculpturing, and manipulative laboratory experiments on Calomyrmex purpureus to test the function of pilosity. Cross-species comparisons revealed little evidence that pilosity functions to determine heat- or desiccation tolerance. In C. purpureus, hairs appeared to be primarily mechanoreceptive. The presence of barbs on hairs could suggest a defensive function in this species. The cross-species comparison suggested that there is limited evidence that sculpturing is linked to a tolerance of heat and desiccation stress. Sculpturing was primarily linked to body water content, cuticle thickness and hardness. Experimental or cross-species investigations are critical to determining the function of traits to ensure that the ecological importance of trait-environment relationships is better understood.

The native invader: Pittosporum undulatum and its influences on soil properties and function

**Ben O’Leary**, Marin Burd, Ros Gleadow

*Monash University, University of Massachusetts Boston, USA.*

**POSTER: Biological adaptation along environmental and bioclimatic gradients**

Pittosporum undulatum is a tree native to coastal south-eastern Australia that has become invasive outside of its native range. It is now a major issue across all states and territories of Australia, as well as internationally. At the Dandenong Ranges in Melbourne’s east, an estimated spread of approximately 80m spread per year suggests the area will be entirely enveloped by P. undulatum within 25 years.

Fire has been recognised as a way of controlling P. undulatum. However, given the species prominence along peri-urban fringes, it has not been considered a suitable tool. Understanding the way in which this species interacts with its environment is considered key to controlling it. As Pittosporum undulatum becomes dominant at a site it shades out understory species, reducing plant biodiversity and density. This shift is likely to influence the structure and function of invaded soils. The study presented here investigates the influence of Pittosporum undulatum on invaded soil. Specifically we examine the way P. undulatum affects nutrient concentrations and microbial biomass levels within the soil. This will be contrasted against samples taken from previously invaded soils where P. undulatum has since been removed.

The role of community forestry program on forest cover change in Gorkha, Nepal

**Mrs Sujata Shrestha**, Professor Kamaljit Singh Bawa

*University of Massachusetts Boston, Boston, USA.*

**POSTER: Conservation Ecology**

**Biography:**

Sujata Shrestha is a PhD candidate at University of Massachusetts Boston, USA. She is currently affiliated with University of Southern Queensland in Toowoomba as a Research Associate.

Understanding the impacts of forest management policies and programs on forest conservation and livelihood enhancement is critical in developing countries as in Nepal where larger number of people are conserving forests to safeguard their livelihoods in the form of community forestry. Started in early eighties community forestry program in Nepal has become very popular after 1990 and about 22% of the total forest areas in Nepal is currently managed by local communities. However, there is a lack of quantitative evidence on the impacts of community forest management program on forest cover change that hinders potential improvement in forest management policies in future. This study quantifies the forest cover change induced by the community forestry program. We analyzed the forest cover change in thirty-one community forests from Ludikhola watershed of Gorkha district of Nepal from the year 1989 to 2014 using satellite imagery. Our result shows that the forest areas both inside and outside the community forests were decreased from the year 1989-1999. However, the forest areas inside the community forests were increased while the forest areas outside the community forests decreased thereafter from the year 1999 to 2014. Likewise, a remarkable shift from the bushes to the forest areas was noticed inside the community forests indicating the improvement in forest cover in community forests in recent time suggesting the positive role of community forestry program in increasing the forest cover in the study area.

Beyond advocacy: Making space for conservation scientists in public debate

**Dr Georgia Garrard**, Dr Fiona Fidler, Dr Bonnie Wintle, Dr Yung En Chee, A/Prof Sarah Bekessy

*RMIT University, The University of Melbourne,*

**POSTER: Conservation Ecology**

**Biography:**

Dr Georgia Garrard a post-doctoral research fellow at RMIT University. As a quantitative ecologist, she has worked on projects related to urban biodiversity conservation and imperfect detectability. She is interested in the intersection of science and policy, particularly in the way in which science can inform environmental impact assessment and management.
The topic of advocacy by scientists has been debated for decades, yet there is little agreement about whether scientists can or should be advocates. The fear of crossing a line into advocacy continues to hold many scientists back from contributing to public discourse, impoverishing public debate about important issues, including conservation. We believe that progress in this debate is limited by a misconception about the relationship between scientific integrity and objectivity. We unpack this relationship and debunk three common misconceptions about advocacy by scientists: namely, that advocacy is harmful to scientific credibility, beyond the scope of science, and incompatible with science, which is value-free. We propose new ways of thinking about responsible advocacy by conservation scientists, drawing on practices from the health sciences, where researchers and professional bodies are empowered to act as health advocates. We end by highlighting the unique skills and approaches that conservation scientists and ecologists bring to public discourse, and propose starting points for responsible advocacy. In so doing, we hope to open further space for conservation scientists and ecologists to actively and legitimately engage in public debate about conservation issues.

Understanding Phragmites australis expansion to promote faunal habitat within the Fleurieu Peninsula Swamps, South Australia.

Tessa Roberts1, Dr Jasmin Packer1, Assoc Prof José Facelli1, Rebecca Duffield1,2, Dr Sacha Jellinek3

1School of Biological Sciences, The University of Adelaide, Adelaide, Australia, 2Mt Lofty Ranges Southern Emu-wren and Fleurieu Peninsula Swamps Recovery Program, Conservation Council SA, Adelaide, Australia, 3Department of Environment, Water and Natural Resources, Adelaide, Australia

POSTER: Conservation Ecology

Biography:
Tessa Roberts completed a Bachelor of Environmental Science at The University of South Australia, and began Honours at The University of Adelaide in July 2015. Early curiosity and love for nature was sparked by childhood in semi-rural Victor Harbor, ultimately leading to a career change following 10 years in graphic design.

Phragmites australis is a key functional component of wetlands on every populated continent. It is a vigorous clonal reed of high productivity that acts as an ecosystem engineer; however, its colonising character (e.g. ability to rapidly establish and expand into dense monospecific stands) is of growing international concern. Anthropogenic factors particularly when combined with non-native haplotypes are known to amplify this expansion.

South Australia’s Fleurieu Peninsula Swamps are rare ecosystems, home to the endangered southern emu-wren (Stipiturus malachurus). Much of the recent management is compromised by expansion and increased dominance of P. australis, severely threatening emu-wrens in particular.

We are investigating the influence of disturbance on Phragmites australis, and the effect on habitat quality. Firstly, we present a review on the response of P. australis communities to disturbance regimes within Mediterranean wetlands globally. Secondly, we present our current study which focuses on P. australis stands within close proximity to a core southern emu-wren population within the Black and Tookayerta swamp systems of the Fleurieu Peninsula. Our research will examine a) what subspecies/haplotypes are present?, b) how does P. australis respond to fire and grazing?, c) how does P. australis influence biotic diversity? and d) what is the optimal management to promote habitat for emu-wrens? The project combines field experiments with laboratory analyses (soil and molecular) to examine the response of P. australis (demographics and genotypes) and the community (plant, animal and microflora diversity). The findings will enable partners to better predict Phragmites australis expansion and identify disturbances benefiting emu-wren habitat.

Conservation actions with landholders to protect a critically endangered ecological community the Fleurieu peninsula swamps

Mr Tim Vale1, Ms Julie Schofield1, Mr Andrew West2

1Conservation Council, Adelaide, 2Natural Resources Adelaide and Mt Lofty Ranges, Adelaide

POSTER: Conservation Ecology

Biography:
Julie Schofield has spent many years of her career on research and conservation of threatened species and communities.

Fleurieu Peninsula Swamps are listed as a critically endangered ecological community due to the small patch sizes of remaining Swamps and their vulnerability to ongoing threats. Many landholders value the Swamps on their property for the sense of wellbeing and natural beauty that they create, however they also need to find a productivity/nature balance and may not have larger amounts of time or money to invest in the protection of the Swamps.

In most cases the Fleurieu peninsula swamp are long linear systems and their health is affected by management actions both up and down stream. Restoration based on a whole swamp-system approach could be more relevant with on-going climatic change as the mechanisms that underpin the vigour and longevity of FP swamps.

As many of the Fleurieu peninsula swamps are on private property we have involved landholder from the conception of the project aiming to giving them a forum and support group to undertake management actions that will benefit not only their individual properties but the health of the whole system. We are trialling two project areas where we will undertake planning and management actions at multiply property scale.
The broad purpose of this project, beyond the conservation of the Fleurieu peninsula swamp vegetation communities, is to determine whether planning and implementing a strategic approach across multiple connected swamps (a swamp system) will result in better long-term outcomes than the current approach of targeting work on an individual swamp basis.

Recent Marsupial extinctions: where, which and how many are lost?

**Margarita Medina**, Carlos E. González-Orozco, Matthew Phillips, Andrew Thornhill, Bernd Gruber

1University of Canberra / Institute for Applied Ecology, Canberra, Australia, 2Institute for Applied Ecology and Collaborative Research Network for Murray-Darling Basin Futures, University of Canberra, Canberra, Australia, 3Queensland University of Technology, Science and Engineering Faculty, Earth, Environmental and Biological Sciences, Bioscience, Brisbane, Australia, 4University of California, Berkeley, Berkeley, United States

POSTER: Conservation Ecology

**Biography:**
Margarita Medina is a PhD student at the University of Canberra, currently working in the project of marsupials’ evolution. Interested in phylogenetics, evolution, conservation, macroecology and spatial patterns.

Extinction is a natural process, allowing species to evolve and diversify. Marsupials have been inhabiting the Earth since the Cretaceous and different species have been lost due to different causes. The aim of this study is to give an overview of the species lost worldwide since the 1800’s. Currently, there are around 330 marsupial species in the world today. In the Americas, there are no reports of recent extinctions but one species fell into the critically endangered category. Whereas for Australasia, according to the IUCN, 20 species have been lost to extinction and five are critically endangered. The main circumstances point to climate change and human settlements. After this review, ask yourself how much did you know about the extinct species? And how much do you know about the ones in the critically endangered category?

Trees with benefits - designing and delivering urban reforestation for diversified outcomes

**Ms Anna Markula**, Mr Dan Cole

1Logan City Council, Logan City DC, Australia, 2The Water and Carbon Group, Brisbane, Australia

POSTER: Conservation Ecology

**Biography:**
Anna Markula is a Senior Environment Officer with Logan City Council and her main areas of work are threatened species management, environmental offsets, and environmental restoration. She is currently managing a number of revegetation projects, including the Federally-funded Slacks Creek Restoration Project. Anna has previously worked for Biosecurity Queensland.

Revegetation projects are often focussed on achieving ecological benefits. Social and cultural benefits should also be considered particularly in highly urbanised areas where communities need opportunities to experience nature.

Logan City Council, with a number of project partners, received Australian Government funding for a project to restore a number of locations in the Slacks Creek corridor, a waterway that links to Moreton Bay.

Specific locations within the project area were targeted to provide additional outcomes beyond standard revegetation which is primarily focussed on site capture and habitat improvements. A key outcome will be to engage a highly culturally diverse local community, and community consultation is ongoing.

An eight hectare arborotum has been planted at Griffith University, with a focus on plants with meaning to Indigenous Australians and early European settlers, and local native species that are rare and threatened. Expected benefits include a learning resource for students, staff, and community members on the meaning of the plants; recreational opportunities; cultural spaces; and a seed bank for future propagation of rare species.

A 0.66 hectare bushfood forest has been planted at Riverdale Park, Meadowbrook. Expected benefits include an educational resource for teaching of Indigenous Australian culture; increased knowledge in the broader community about Indigenous Australian culture; providing intangible elements of Indigenous Australian culture. Traditional ethnobotany values will progressively be incorporated to support contemporary Aboriginal culture in the broader Logan region.

Planning for revegetation projects can include social-ecological exchange to create biodiverse forests that provide multiple benefits and meaning to the community.

Informing revegetation through population genetics: heaps Goodenia South Australia

**Dona Kireta**, Martin Breed, Andrew Lowe

1School of Biological Sciences, University of Adelaide

POSTER: Disturbances

Extensive clearance of natural habitat has occurred globally, disproportionately impacting the most productive land, and feeding the current biodiversity crisis. In response to this issue, increasing resources are being fed into revegetation, but are we really using the right germplasm for restoration? Generally, revegetation is prone to poor success owing to a lack of knowledge and species specific research. Yet a good understanding of a species’ genetic structure can increase revegetation success, where seed sourcing is one of the most important influencing factors. Our study
Diversity-biomass relationships in mixed-species forest plantings

**Mr Timothy Staples**
A/Prof Margaret Mayfield, Dr John Dwyer, Dr Jacqui England

1University of Queensland, St Lucia, Australia, 2CSIRO Land and Water Flagship, Dutton Park, Australia, 3CSIRO Land and Water Flagship, Clayton South, Australia

**Biography:**
I am a PhD student interested in using principles of community ecology to answer questions that have tangible benefits for ecosystem management and restoration, as well as advancing ecological theory. In my Honours project I examined the ecological differences between two congeneric forbs that mediate their coexistence.

Reforestion on previously cleared land is an effective way to offset carbon emissions, and the Australian Government’s Emissions Reduction Fund (formerly known as the Carbon Farming Initiative) is increasing interest in these reforestation projects. Program guidelines encourage landholders to plant multiple species, stating that as well as sequestering carbon, mixed-species plantings can provide additional ecosystem services. However, landholders are paid based only on the planting’s carbon storage, which creates incentive to plant productive species to maximise return on sacrificed agricultural land. Fortunately, it may be possible to maximise carbon yield and ecosystem services at the same time, as there is some evidence that species richness and biomass are positively correlated, but this relationship is understudied in Australian tree plantings. Using an Australia-wide dataset of restoration plantings, natural regrowth and remnant forest, I investigated the relationship between biomass and diversity. As well as species richness, I collected four functional traits that correlate with growth rate, lifespan, reproduction and competition (specific leaf area, wood density, seed mass and plant maximum height), to investigate if functional diversity is a better predictor of biomass than a simple species count. Preliminary results suggest that species richness is a poor predictor of planting biomass, and that functional diversity measures prove more informative in some situations.

Over 50 years of European rabbit data: an extensive spatial and temporal database.

**Emilie Roy-Dufresne**
Damien Fordham, Phill Cassey, Barry Brook, Brian Cook, Greg Mutze, David Peacock, Ron Sinclair, Glen Saunders, Susan Campbell, Malcom Kennedy, Peter West, Barry Richardson, Steve McPhee, David Forsyth, Peter Elseworth, Bill Low

**Biography:**
Since its introduction in Australia, the European rabbit Oryctolagus cuniculus has become a widely abundant pest that destroys native vegetation and competes with native animals and livestock for food. A large number of detailed studies of rabbits were conducted between 1960 and 2015. Together these studies provide over 50 years of information on rabbit demographic traits, occurrence, abundance, and biocontrol efforts. We created a relational database to capture and summarise information from 95 of the most ecologically significant rabbit datasets from around Australia. The database includes information from spotlight surveys (> 1500 transects), capture-mark-recapture experiments (> 500 capture events), occurrence surveys (> 140 000 pts; 1780-2014), abundance and fecundity from shooting studies (> 18 001 entries; 1993-2000), warren surveys (> 500 sites), epidemiological analysis (~ 100 sites; 1995-1999), and release sites for biocontrol agents (> 1500 sites; 1993-1996). The data has been spatially and temporally matched at fine scale resolutions to more than 30 climatic and environmental variables. The database has been developed in a user friendly way to facilitate data extraction so as to address a wide range of ecological and management questions. For example it is already providing a clearer picture of how rabbit abundance varies across space and time; and how rabbit fecundity is affected by inter-annual and seasonal rainfall. This database will continue to be important for modelling and managing European rabbit populations in Australia and beyond.

How understanding the decision context liberates the novel ecosystem paradigm

**Ms Anna Backstrom**
A/Professor Sarah Bekessy, Dr Georgia Garrard

RMIT University, West Footscray, Australia

**Biography:**
Anna Backstrom is a PhD student at RMIT University in the Interdisciplinary Conservation Science Research Group. Anna is a landscape ecologist with research interests in urban biodiversity conservation and restoration ecology.

Urban biodiversity conservation and ecological restoration is conducted within highly modified and fragmented environments. These environments are often so altered as to be considered novel ecosystems. At present, decision frameworks applied to modified ecosystems in urban landscapes...
Trade-offs in fire management between people and avian biodiversity

Ms Alina Pung1, Professor Michael McCarthy1, Dr Luke Kelly1, Dr Karen Rowe2
1The University of Melbourne, Parkville, Australia, 2Museum Victoria, Carlton, Australia

POSTER: Fire Regime Management - connecting science & practice

Biography:
I am a Master student with the Quantitative and Applied Ecology Group in the School of Botany, The University of Melbourne. My current research is focused on the trade-offs in fire management between people and avian biodiversity. My research is currently funded by: Stuart Leslie Bird Research Award (BirdLife Australia)

The primary aim of fuel reduction burning is to reduce the risk of future wildfires to human life and assets (Penman et al. 2011). However, short fire intervals and broad-scale burning presents a major threat to biodiversity (Gill and Bradstock 1995). These trade-offs between human and ecological objectives must be considered for effective fire management.

The overall aim of my project is to model and evaluate the trade-offs in fire management between risks to people, and risks to avian biodiversity associated with different prescribed burning regimes. In this project, I will assess the impact of a range of fuel reduction targets on asset protection and avian biodiversity in Victoria.

I have developed species distribution models from existing datasets to evaluate the relationship between key fire response variables (e.g. time since fire) and the occurrence of bird species. I am focusing on 7 key fire response bird species including the flame robin, Petroica phoenicea and eastern yellow robin, Eopsaltria australis. Additionally, I have used automated recording units to detect the presence of these key fire response bird species within the Victorian Central Highlands across a range of post fire age classes. This occurrence data will be used to evaluate the prediction of the species distribution models.

Risks to human life and assets will be measured by property loss after wildfire events by simulation models.

The findings of my study will clarify the effects of prescribed burning in reducing risk to human life and property, and the resulting impact on bird biodiversity.

Invasive grass impacts fire intensity and seed regeneration potential in temperate Australian grasslands

Mr Zachary Walker1, Dr John Morgan1
1Department of Ecology, Environment and Evolution, La Trobe University, Bundoora, Australia

POSTER: Fire Regime Management - connecting science & practice

Biography:
Zachary Walker is a plant ecologist who studied fire and invasion processes in western Victorian grasslands for his honours

Perennial invasive grasses have great potential to impact ecosystems by changing fire regimes. Given that many grasslands in temperate Australia rely on fire for their maintenance and are currently under threat from invasive perennial grasses, we aimed to determine how Phalaris aquatica was impacting native grasslands. We asked: (i) Does Phalaris invasion alter fuel properties (mass)? (ii) Does Phalaris invasion impact fire behaviour? (iii) How is native herbaceous seed impacted by fire in native and exotic grasslands? Phalaris invasion increased fire intensity, likely driven by the large differences in fuel loads between native and invaded grasslands. Seed regeneration was negatively affected by exotic grass invasion. Seed buried in invaded sites was significantly more affected than seed buried in sites dominated by native herbaceous species. Seed germination was also negatively correlated with residence time, suggesting that Phalaris invasion, although variable in observed residence times, has the highest potential to increase residence times and therefore, the most potential to negatively influence seed germination. The results suggest that Phalaris invasion is altering the fire regimes in native grasslands, and negatively impacting the regeneration of capabilities of native herb species. This is consistent with many other grass invasions that can alter fire regimes through altering characteristics of the fuel.

Hell's ecology: Ecological and biological drivers of detritivore recovery from fire

Mr Joshua Grubb1,2, Dr Heloise Gibb1, Dr Nick Murphy1, Dr Richard Marchant2
1La Trobe, Melbourne, Australia, 2Museum Victoria, Melbourne, Australia

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POSTER: Fire Regime Management - connecting science & practice

Biography:
Joshua Grubb is currently a PhD student at La Trobe University, with a passion for invertebrate ecology. His project uses ecological and molecular methods to investigate the recovery process of detritivorous invertebrates after forest fire.

Fire is the hallmark of many Australian ecosystems, but its severity and occurrence depends greatly on fuel load. In turn, fuel build-up is largely determined by detriticore activity, meaning that the recovery of detritivore populations after fire will influence the risk of future fire. Despite this clear link between detritivores, fuel and fire, globally little is known about what biological and ecological adaptations affect recovery after fire. This project aims to help fill this gap, firstly by describing the recovery patterns of species from four important detritivorous taxa (Diplopora, Amphipoda, Isopoda and Lepidoptera) and secondly, identifying what drives such patterns. To address these aims in an ecological framework, we considered the recovery process in three parts: 1) survival during the fire; 2) persistence in the post-fire environment; and 3) recolonisation of burnt areas. The first section focuses on the role of refugia and behaviour in survival during fire; the second will investigate the influence of microclimate, physiology and life history on population growth after fire; and the third will use genetic techniques and morphology to understand how recolonisation occurs. Preliminary results, from sites burnt on Black Saturday (near Kinglake-Marysville), suggest that wingless taxa rely on in-situ survival more than winged taxa, which latter may favour recolonisation. We expect future results will identify ecological factors important to recovery resilience, and that they will have the potential to inform fire management strategies, particularly regarding the likely impact of fire regimes on detritivores.

Bark fates explored: decomposition and flammability of 10 co-occurring species in eastern Australia

Ms Saskia Grootemaat1, Ian Wright1
1Macquarie University, Sydney, Australia

Biography:
Saskia Grootemaat is a PhD candidate at Macquarie University. Her research focuses on plant traits, flammability and decomposability.

Bark is an important component of the litter layer in Australian forests. In spite of the huge quantitative contribution, still little is known about the fates of bark. In this study we investigated the relative decomposability and flammability of bark and leaves from 10 co-occurring tree species in the Sydney region. Also, we determined whether (combinations of) physical and chemical traits could explain the interspecific variation in bark- and leaf decomposability and flammability.

A considerable variation in bark- and leaf decomposability and flammability was found, both within and across species. Overall, bark decomposed slower than leaves, especially in the first year. Species with slow decomposing leaves seemed to have slow decomposing bark, but this trend fanned out over time. Bark took longer to ignite than leaves, and burned more slowly.

While lignin was the dominant driver of decomposition, different traits were associated with bark- and leaf flammability. Therefore, we found no relationships between (a) bark- and leaf flammability, or (b) decomposability and flammability (for bark or leaves). Litter on the forest floor is a mixture of fast and slow decomposing materials and species, with relatively low or high flammability properties. Combined with weather conditions and the actual litterfall, this gives a complex system for estimating litter pools and fluxes. Despite all the work that has been done on leaves, this is the first time that bark decomposability and flammability of a species-set has been quantified.

How should we model reproductive maturity in plants?

Ms Freya Thomas1, Associate Professor Peter Vesk1
1The University of Melbourne, Melbourne, Australia

Biography:
Freya Thomas is a PhD student at The University of Melbourne in the Quantitative and Applied Ecology Group.

Thirty years after Noble and Slatyer’s (1980) use of minimal demographic data to predict species replacement sequences and vegetation response to recurrent disturbances, ecologists are still ignorant of basic knowledge of life history characteristics for many plant species, and managers are still asking for it. While qualitative data are reasonably widely available, quantitative data on species life history characteristics are often lacking despite being fundamentally useful for quantifying growth rates and ‘age to reproductive maturity’ for use in ecological fire management. ‘Reproductive maturity’ is a central concept for predicting species responses to disturbance, yet is linguistically vague with uncertainties surrounding what to measure, when, why and how to quantify it. I present, compare and discuss three approaches to modeling reproductive maturity for multiple plant species, based on multi-species datasets collected in Victoria, Australia. One approach relates the probability of reproduction to plant size through logistic regression, the second aims to characterise reproductive output with a sigmoid curve, and the third is based on a ‘hurdle’ model which combines probabilities of being reproductively mature with sized-based estimates of expected reproductive output.
The different modeling approaches lead to different types of results, which differ in their appropriateness for different data availability and information needs. These results will be discussed in the context of generalising life history characteristics and designating tolerable fire intervals for multiple plant species and how this may change in various fire prone ecosystems.

Orchids, Insects & Fire: Investigating the impacts of prescribed burning on orchid pollinators in South-Australia

Ms Anita Marquart1, Dr Jose M Facelli1, Dr Renate Faast1, Professor Andy Austin1
1University of Adelaide, Adelaide, Australia

POSTER: Fire Regime Management - connecting science & practice

Biography:
Anita Marquart was a post diploma researcher at the Swiss Federal Institute of Technology (ETH), Zurich Switzerland in 2012 - 2013. She completed a German Diploma (equivalent to Master's Degree) in Biology, Diploma in 2011, with a thesis in Entomology, and was a student research assistant at the Max Planck Institute for Chemical Ecology in Jena in 2009 - 2011.

Fire is an important ecological factor in Australian ecosystems. Because many orchids depend on specific pollinators, they may be more susceptible to disturbances that affect pollinator guilds than generalist species. Therefore, declines or changes in pollinator communities due to prescribed burns and bushfires could lead to reduced pollination success and eventual declines in orchid populations.

This project combines traditional plant and insect ecology with advanced molecular techniques to identify orchid pollinators. We assessed the response of pollinators to prescribed burns and recorded habitat characteristics relevant for insects (such as floral abundance, vegetation height, presence of logs, litter and standing litter). Trapping surveys of potential orchid pollinators were conducted in spring, before and after prescribed burns. Potential orchid pollinators are identified using DNA barcoding with the mitochondrial cytochrome oxidase I (COI) gene and sequencing results are compared with existing databases and confirmed using morphological identification. The data accumulates into a reference library of COI barcodes for the species found in the surveys. The expected outcomes of this project are to increase the understanding of the biology of orchid pollinators and their response to prescribed burning. Our research might help to advise the optimal management of orchid species under fire-managed regimes in the Mount Lofty region of South Australia, as well as more generally in south eastern Australia.

Validating expert opinion provides insights about successional preferences of a threatened heathland bird

Dr Josephine MacHunter1, Dr Danny Rogers1, Dr Evelyn Nicholson2
1Arthur Rylah Institute for Environmental Research, Heidelberg, Australia, 2Department of Environment, Land, Water and Planning, Heywood, Australia

POSTER: Fire Regime Management - connecting science & practice

Biography:
Dr Josephine MacHunter's research examines the responses of fauna and their habitats to fire to help inform fuel management options to maintain ecosystem resilience. Josephine manages the delivery of flora research on fire regimes and plant functional traits. Her PhD investigated the longer term effects of fragmentation on birds.

Elements of fire regimes such as severity and time between fires will affect vegetation succession and thereby influence the habitat suitability for various fauna species. Knowledge of how species respond to fire regimes is important in the fire prone vegetation of south eastern Australia to help evaluate the impact of different fuel management strategies. Where field data is lacking, expert opinion has been considered a useful initial step in predicting fauna responses to fire. However such data may lack precision in capturing the true responses of individual species leading to fire management strategies with unintended consequences in terms of species persistence. Chestnut-rumped Heathwren (Hylacola pyrrhopygia) was identified as a priority for field validation of expert predictions due to its threatened status and low detection rates in state-wide bird monitoring programs. Surveys were undertaken in Heathy Woodlands in Victoria using call playback of their territorial song to help in the detection of this cryptic species. Thirty-seven sites were stratified according to four growth stages derived from different ages post fire. Initial results showed that the Chestnut-rumped Heathwren had a clear preference for earlier growth stages, contradicting existing understanding based on expert opinion. This discrepancy may partly stem from the coarseness of vegetation units (a generic heathland) used in expert elicitation compared to the more constrained environmental envelope that occurred in this particular study (Heathy Woodland). This highlights a scale issue when integrating finer scale field based data into state-wide fire planning processes that tend to use coarser scale vegetation units.

How does site preparation affect the survivorship of revegetated native grasses?

Mr Christopher Butcher1
1Department of Environment, Water and Natural Resources, Adelaide, Australia

POSTER: Landscape-scale restoration of a Ramsar wetland

Biography:
Christopher Butcher is driven to find innovative solutions for the sustainable and responsible use of our natural environment. He has worked on several major restoration and infrastructure projects, in both public and private sectors, in South Australia, Italy, and Kazakhstan.
Native grasses are an integral part of the environment in South Australia. They provide many ecosystem services, including habitat for animals, and erosion prevention. Over the past five years grassy woodlands have been restored around Lakes Alexandrina and Albert in South Australia. This project seeks to determine how to maximise grass survival in a large-scale restoration program. Implications of the study may affect the best practice for revegetation site preparation.

Under the Coorong, Lower Lakes and Murray Mouth (CLMM) Recovery Project, two established site preparation techniques were compared in a controlled field experiment. The study compared the survival of native grass tubestock at eighteen paired plots across six sites. Each plot was 9 x 9 metres and contained 550 grasses from ten different species. Site preparation methods were: (i) spray existing vegetation with glyphosate herbicide; and (ii) remove the top 10 centimetres of soil. The latter was done because ex-pastoral topsoil may contain high levels of plant nutrients (e.g. manure), favouring weed growth; this layer also retains most of the viable weed seed bank.

We hypothesised (i) spraying weed species would reduce initial competition, and (ii) topsoil removal would eliminate nutrient-rich, seed-laden soil; thereby allowing native grasses to re-establish.

While initial data is still being collected, we expect our results will have clear benefits to the efficiency and success of revegetation efforts, and set the foundation for more focussed research. Learnings will not be limited to grasses but applicable to other herbaceous and non-herbaceous plants (i.e. trees and shrubs).

This work is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia.

**Buffel grass roadside survey and predictive modelling**

Dr Victoria Marshall, Dr Megan Lewis, Dr Bertram Ostendorf, Dr. Jonothan Tuke

*The University of Adelaide, Glen Osmond*

**POSTER: Linking data to wildlife management through complex ecological models**

**Biography:**

Dr Victoria Marshall is a researcher at The University of Adelaide specializing in GIS and remote sensing, with expertise in invasive species ecology, and species distribution modelling.

Roadside survey is commonly used to rapidly map and monitor regional distribution of invasive species but is not typically applied to predictive modelling. We present the results of an extensive Buffel grass roadside survey and model the environmental conditions associated with roadside occurrence. Over 3100km of South Australian roads were surveyed by highly experienced observers at an ideal survey time (Buffel grass actively growing after rains). Presence, absence and density (categorical: sparse, low, moderate, and high density) were recorded continuously at the roadside (the shoulder of the road) and on adjacent land. The shoulder of the road was defined as the roadside area affected by disturbance activities such as: maintenance activity disturbances, tyre marks, culvers, grader marks, pits, and car park areas. Whilst the adjacent land was considered the land beyond the shoulder of the road, which may not experience as much repeat surface disturbance. Buffel grass was logged along most major highways within our study extent, but mostly at sparse density and typically recorded within the shoulder of the road. Logistic regression analysis was used to model the environmental conditions associated with Buffel grass occurrence at the roadside and on adjacent land. We argue that the model based on adjacent land data is more representative of “at risk” habitats away from the road and that our survey methodology may be applicable to other road-associated invasive species and invite further investigation.

**On-ground climate change adaptation – a practitioner’s view**

Dr Mark Siebentritt, Dr Jenni Garden

*Seed Consulting Services, Adelaide, Australia*

**POSTER: Linking data to wildlife management through complex ecological models**

**Biography:**

Mark’s an experienced environment and sustainability manager and leader in environmental change, with 15+ years in public and private sectors in climate change, water and natural resources management. His current work focuses on climate change adaptation and mitigation planning services, and bringing rigorous science to bear on complex decision-making processes.

Climate change adaptation research has gained substantial momentum over the last few decades, and more recently there has also been a drive to integrate and apply scientific findings to policy and on-ground action. For example, South Australia’s Strategic Plan 2011 has a specific target to: “develop regional climate change adaptation plans in all State Government regions by 2016”. Despite the significant work that’s been done in terms of research and modelling to look at climate adaptation from a conservation perspective, translating these findings into on-ground action is not always straightforward. We will present a series of case studies from SA and ACT where tools have been developed and discuss the challenges of their on-ground application.

**Do boat moorings alter fish community composition in an urban estuary?**

Mr Brendan Lanham, Associate Professor Alistair Poore, Dr Luke Hedge, Dr Adriana Verges, Professor Emma Johnston

*University of New South Wales, Kensington, Australia*

**POSTER: Linking data to wildlife management through complex ecological models**
As the human population continues to grow, so does the reliance on coastal areas. The increase in human activity has led to an increase in the construction of artificial structures in marine habitats. Differing physical properties of artificial structures in contrast to nearby natural habitats often result in a distinct community composition. Common artificial structures in estuarine habitats include those built for boat storage (marinas and moorings). Boat moorings disturb the benthic habitat and while their detrimental effects on seagrass habitats are well established, their effects on other components of the ecosystem, including fish, are less well understood. Given that fish are often attracted to artificial structures, and that environmental managers in the highly urbanised estuary of Sydney Harbour are aiming to reduce the number of moorings in use, we aim to understand how fish communities interact with boat moorings. Utilising underwater video at six sites in Sydney Harbour, we are assessing how fish activity varies at two scales; among sites that contain or lack boat moorings, and variation with distance from existing moorings within mooring sites. We will present the latest data on fish abundance, composition and feeding activity from this ongoing sampling program.

Determinants of spatial patterning in forests: a global synthesis

Ms Jessie Buettel1, Prof. David Bowman, Assoc. Prof. Mark Hovenden, Assoc. Prof. George Perry, Prof. Barry Brook
1University of Tasmania, Hobart, Australia

Plant ecologists have long been interested in describing spatial patterns of trees, with the goal of inferring the underlying eco-evolutionary processes that underpin forest dynamics. Due to scale-dependent heterogeneity and complexity in identifying these processes, large sample sizes covering a broad cross-section of forest types are needed. We synthesised global plot data drawn from 90 papers covering 144 distinct forest communities (over 1,000 plant species occurrences), to test the frequency of aggregated or random patterning of trees and its link to potential driving processes. We found aggregation to be the dominant pattern, in line with expectation, with no strong ecological predictors but a geographic bias. A corrected analysis showed a similar trend but revealed additional effects of shade tolerance and dispersal vector. However, we also discovered two strong methodological biases; aggregation decreased as plot size increased, and random patterns were predominant only when the larger-sized trees were sampled. These results confirm aggregation as the most common pattern in forest plots worldwide, but also highlights the sensitivity of spatial-pattern analysis to predetermined methodological choices by researchers.

Spend or wait? Delaying can be optimal in conservation

Dr Gwenllian Iacona1, Prof Hugh Possingham1, Dr Michael Bode2
1University of Queensland, St. Lucia, , 2University of Melbourne, ,

Biodiversity conservation is a crisis discipline, plagued by increasing threats and chronic funding constraints. We explore the consequences of conservation organizations reacting to this state of crisis by rushing to spend money as soon as possible after they secure it. “Front-loading” of spending on conservation goals is understandably common because agencies want to address imminent threats. Here we develop a theory of conservation investment that outlines the costs and benefits of two manager options: spend now or invest to spend later. Our modelled system includes the ability of manager actions to counteract declining biodiversity decreases with time but also the potential to increase available funds, or the effectiveness of spending, if action is delayed.

We find that waiting to spend can be the optimal strategy if biodiversity decline does not follow instantaneously from local degradation. The optimal timing of spending represents a balance between the rate at which conservation funds appreciate in value (e.g., through interest rates), and the rates of biodiversity decline. We illustrate the theory with two applications where action can counteract an extinction debt in forest dwelling birds: forest restoration in South Australia’s Mount Lofty Ranges, and Paraguay’s Atlantic Forest. We show that with feasible interest rates, greater conservation outcome can be achieved by front-loading only a small proportion of available funds. This suggests that such benefits can justify conservation inaction under the right conditions, if delays allow managers to build capacity or leverage additional money.

Diamonds Aren’t Forever: The ecology of the Diamond Firetail in the Mount Lofty Ranges

Ms Grace Hodder1
1The University of Adelaide, Adelaide, Australia, 1Department of Environment, Water and Natural Resources, Adelaide, Australia

Biography:
Brendan Lanham is PhD student from The University of New South Wales investigating ecological interactions between fish and structures; natural and artificial. The main focus of his research is endeavouring to understand what ecological processes drive fish abundance and behaviour in relation to structure
The Diamond Firetail (DFT) is a spectacular finch, popular amongst naturalists and the general community due to its brilliant plumage and social demeanour. It is one of a suite of ground-foraging birds with rapidly declining population abundance in the Mount Lofty Ranges (MLR) region, where it is now considered vulnerable. The complete disappearance of this charismatic bird from the MLR is inevitable, should imminent remedial action not be taken. Whilst DFTs are known to be adversely affected by clearing for agriculture and urban development on a broad-scale, it is not known exactly which ecological processes directly affect the MLR population. One hypothesis is that a shortage of food, particularly during winter, when breaking rains cause seeds to germinate and become unavailable to foraging birds, is limiting juvenile recruitment into the adult population.

This study aims to test the hypothesis that a food shortage at critical periods is affecting DFT survival. The project initially examined aspects of the DFT diet, in conjunction with ongoing temporal measurements of food resource availability and patterns of seed production. The survival of DFTs at sites supplemented with additional feed, and at control sites (no supplementary feeding) is being monitored, along with sub-population abundances and demographics. The study will provide an ecological basis for an effective management plan targeting the MLR DFTs by providing in-depth, species-specific ecological knowledge; information that is largely lacking for the Diamond Firetail.

Living heritage in decline: a biophysical survey of old blaze trees in NSW

Dr Peter Spooner1, Mr Jake Shoard1
1Charles Sturt University, Albury, Australia

I have a background researching forest health in NZ. Following a stint as a consultant, I am now completing a PhD at UQ and CSIRO. My project involves using macroecological models to predict the ‘insurance value’ of beta diversity in woody plant communities for maintaining ecosystem function under climate change.

Incorporating species’ abundances in models to predict plant community responses to climate change

Mr James McCarthy1,2, Dr John Dwyer1,2, Dr Simon Ferrier2, Dr Karel Mokany2
1The University of Queensland, School of Biological Sciences, Brisbane, Australia, 2CSIRO, Land and Water Flagship, Canberra, Australia

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that estimates relationships between CORVEG cover estimates and actual counts (for individual species in each stratum), as well as an overview of how the model will be applied to predict rank abundance distributions of SEQ woody plant communities under future climates.

Innovative approaches to controlling a threat to honeybees in the sub-tropics

Dr R. Andrew Hayes1, Ms Brogan Amos2,3, Mr Steven Rice1, Dr Diana Leemon3
1Forest Industries Research Centre, University of the Sunshine Coast, Brisbane, Australia, 2School of Biological Sciences, The University of Queensland, St Lucia, Australia, 3Animal Science, Queensland Department of Agriculture & Fisheries, Brisbane, Australia

POSTER: Open forum

Biography:
Andrew Hayes is a chemical ecologist with 20 years experience studying inter and intra-specific chemical communication between animals and their hosts. He currently specialises in the monitoring and control of insect pests in horticultural and forestry landscapes.

Honeybees (Apis mellifera) and native stingless bees (Tetragonula spp.) are critical pollinators for crops throughout Australia. These bees are now under threat from the exotic small hive beetle (Aethina tumida). This beetle is a scavenger and minor pest of weakened and stressed honeybees in its native sub-Saharan range. The larval beetles feed on hive products which they contaminate with a yeast, Kodamaea ohmeri, which is responsible for the fermentation and destruction of these products. Under the warm, moist conditions in Queensland, the small hive beetle has become a serious apiary pest responsible for losses in excess of $8 million over three seasons. Current control options are only appropriate for some managed honeybee colonies. There is a critical need for a trap that can be deployed for beetle monitoring and control in both managed and unmanaged honeybee and native bee colonies. We are developing an external trap to attract and kill the small hive beetle. The beetles are attracted to a range of hive odours, especially the odours of fermenting hive products. We are investigating the use of these fermentation odours along with beetle pheromones to develop an economical synthetic lure for use in a small hive beetle specific trap. Preliminary field trials using a crude fermentation product trapped beetles both near apiaries and away from apiaries. Using gas chromatography-mass spectrometry and choice-test behavioural assays key attractive volatiles have been identified. Combinations of these key volatiles have been tested in the laboratory and field, results will be discussed.

How does paint colour influence temperature profiles and thermal suitability of roost boxes?

Mr Stephen Griffiths1, Dr Natalie Briscoe2, Dr Pia Lentini2, Ms Jessica Rowland2, Dr Indy Lumsdon2, Dr Kathy Handasyde2, Dr Kylie Robert1
1Department of Ecology, Environment and Evolution, La Trobe University, Bundoora, Australia, 2School of BioSciences, University of Melbourne, Parkville, Australia
3Arthur Rylah Institute, Department of Environment, Land, Water and Planning, Heidelberg, Australia

POSTER: Open forum

Biography:
Stephen Griffiths (MPHil) is a PhD candidate at La Trobe University. His research interests include: the efficacy of roost boxes as a conservation tool to provide supplementary roost sites for hollow-dependent fauna; microbat ecology and sociobiology; risks associated with wildlife interacting with polluted anthropogenic water bodies.

Naturally occurring tree hollows (or cavities) provide protection from adverse weather conditions, leading to their use by many vertebrate species as sites for roosting, breeding and rearing young. Artificial hollows (roost boxes) are increasingly being used as a management tool in areas where natural hollow resources have been depleted. Ideally, roost boxes should provide the same (or better) protection from environmental extremes as tree hollows. The few studies that have examined this have shown tree hollows and roost boxes vary significantly in their physical and thermal properties, with greater thermal fluctuations occurring in roost boxes compared to natural hollows. Understanding the influence of thermal properties of a roost box on an endotherm are complex, because these are often dependent on interactions between the properties of the environment, the roost box and the endotherm itself (including body size and behaviour). In this study we measured how the colour roost boxes are painted affects their thermal suitability to native mammals spanning the full size range of hollow-dependent fauna: microbats (4–40g), sugar gliders (Petaurus breviceps) (up to 140g) and brushtail possums (Trichosurus spp.) (up to 4.5kg). This study aims to answer the following questions: 1) To what extent does paint colour influence thermal properties of roost boxes? 2) How does box colour interact with a range of factors (e.g. aspect, shade cover, solar radiation) to drive daily patterns in internal temperature? 3) What are the eco-physiological consequences for animals day-roosting in boxes painted different colours?

Can we have too much of a good thing? Reinvented engineers (Bettongia lesueur) compromise ecosystem restoration

Mr Matthew J Bowie1, Lian Pin Koh, Adam Dale Kilpatrick
1School of BioSciences, University of Melbourne, Parkville, Australia

POSTER: Open forum

Conservation and restoration efforts may attempt to right the wrongs of past generations, but can this result in too much of a good thing? The creation of fenced feral-free reserves has successfully seen the reintroduction of several locally extinct and endangered animals. Yet, we poorly understand the consequences of faunal repatriation for enclosed ecosystems. Current ground-based surveys are expensive, time consuming and labour intensive. Arid Recovery is one such reserve located within the vast arid lands of northern South Australia. There are concerns surrounding
overpopulation of the reintroduced burrowing bettong (Bettongia lesuere) and sustainability of this enclosed ecosystem. The inherent heterogeneity of these landscapes further complicates studies that struggle to obtain significant sample sizes. Cheap, practical, and repeatable monitoring methods therefore need to be developed. My project aims to assess the ability of unmanned aircraft (drones) to monitor both vegetation and fauna within and among the three sites. I will be presenting findings from my research, along with an assessment of drone use for monitoring vegetation and B. lesuere populations within this important and lands reserve.

The abundance and distribution of Ruppia tuberosa in the Coorong

Ms Kate Frahn1, Dr Susan Gehrig1, Dr Jason Nicol1
1South Australian Research and Development Institute (SARDI), Adelaide, Australia

Biography:
Kate Frahn is a Research Officer at SARDI Aquatic Sciences working in the Plant Ecology sub-program within Inland Waters and Catchment Ecology program.

Ruppia tuberosa is an extremely salt-tolerant, submergent macrophyte, which historically formed extensive beds in the South Lagoon of the Coorong, South Australia. Since 2000, its abundance in the South Lagoon declined to the point where it was not observed in 2009. This decrease in abundance was related to decreased water levels and increased salinity. Floods in 2010/11 resulted in limited re-colonisation of R. tuberosa in the South Lagoon and southern end of the North Lagoon. In December 2011 and 2014, 14 sites were sampled to a maximum depth of 1 m, at 20 cm intervals. Samples were sieved and R. tuberosa shoots were counted and dried to determine biomass. If present, filamentous algae was also collected from the samples and dried to determine biomass. The 2014 survey indicated that R. tuberosa was present in the South Lagoon with a wider distribution and slightly greater abundance than the more dispersed patches found in 2011. Biomass and shoot numbers were highest at sites on the western shoreline of the South Lagoon, suggesting a more persistent population in this area. Results also suggest a reduction of R. tuberosa in areas with higher salinities (>60% TDS), which may also impact reproduction as lower salinities are required for the production of seed and replenishment of the propagule bank.

While the differences in R. tuberosa abundance were significant between survey years, the low shoot numbers and abundances compared to those reported prior to the drought suggest recovery is not, as yet, biologically significant.

Drone use to estimate orangutan density in South East Asia

Ms Molly Hennekam1, A/Prof Lian Pin Koh1
1University of Adelaide, Adelaide, Australia

Biography:
Molly Hennekam is completing her Honours at The University of Adelaide under the supervision of A/Prof. Lian Pin Koh. She has field experience from primate behaviour studies in North Sumatra, to native flora surveys in South Australian arid lands.

The forests of South East Asia are rich with biodiversity, supporting a vast array of threatened and endemic species. However, human induced forest conversion and destruction pose a major threat to the survival of many native species, including orangutans (Pongo pygmaeus and P. abelii). Current methodologies for estimating orangutan populations provide reasonably accurate estimates, but are expensive, time consuming and labor intensive. Consequently, surveys are not being conducted at the frequency required for proper analysis and monitoring of population trends.

Ecologists have recently begun exploring the use of unmanned aircraft (drones) as a relatively inexpensive and time efficient method of estimating orangutan density, which requires a minimal labor input. My project aims to develop and validate a drone-based method for the monitoring of orangutan populations. Empirical nest count data collected by both ground and drone surveys will be used to develop and validate a regression model for estimating the abundance of orangutan nests. This model will then be applied to estimate orangutan density and population within a North Sumatran study site. I will be presenting the findings from my research, including an assessment of drone use as a simple and effective tool in estimating orangutan population size.

A story of a hitchhiker crow. Genetic diversity of native and introduced populations of the invasive house crow (Corvus splendens) in Asia and Africa

Urszula Krzeminska1,2, Robyn Wilson1,2, Beng Kah Song1,2, Sampath Seneviratne1, Sharif Akhteruzzaman1, Joanna Gruszczynska2, Wieslaw Swiderski1, Teh Say Hui1, Christopher M. Austin1,2, Sadequr Rahman1,2
1Monash University Malaysia, School of Science, Jalan Lagoon Selatan, Bandar Sunway, 47500 Subang Jaya, Selangor, Malaysia, 2Monash University Malaysia Genomics Facility, Jalan Lagoon Selatan, Bandar Sunway, 47500 Subang Jaya, Selangor, Malaysia, 3Avian Evolution Node, Department of Zoology, University of Colombo, Colombo, Sri Lanka, 4Department of Biotechnology and Genetic Engineering, University of Dhaka, Dhaka, Bangladesh, 5Faculty of Animal Sciences,
The common house crow (Corvus splendens) is amongst the most wide-spread species of bird with many adverse effects on native fauna and flora, including predation, competitive displacement and disease. It attains high population densities and is considered a pest in many locations with breeding colonies in more than 20 countries outside its native range, where it usually gets by riding aboard ocean ships. Little genetic research on the house crow has been undertaken so we have only a limited understanding of its natural genetic population structure and invasion history. In this study, we employ microsatellite and mitochondrial DNA markers to assess genetic diversity, phylogeography and population structure of C. splendens within its native range represented by Sri Lanka and Bangladesh and introduced range represented by Malaysia, Singapore, Kenya and South Africa. We found high levels of genetic diversity in some of the invasive populations for which multiple invasions are proposed. The lowest genetic diversity was found for the intentionally introduced population in Selangor, Malaysia. Sri Lanka is a possible source population for Malaysia Selangor consistent with a documented introduction over 100 years ago, with port cities within the introduced range revealing possible presence of migrants from other unsampled locations. We demonstrate the power of the approach of using multiple molecular markers to untangle patterns of invasion, provide insights into population structure and phylogeographic relationships and illustrate how historical processes may have contributed to making this species such a successful invader.

The ecology of human online interactions: What video games can tell us about humans

Dr Michael Kasumovic1
1UNSW, Kensington, Australia

POSTER: Open forum

Biography:
I am an evolutionary biologist interested in improving our understanding of how social interactions moderate various strategies associated with fitness.

Humans are social animals. The way we interact, however, has changed dramatically over the last decade. Rather than face to face interactions, individuals are more likely to interact anonymously and online. This has not only changed the structure of populations but has led to changes in behaviour. At the same time, the ubiquity of online interactions in both a social and non-social setting has allowed the exploration of human behaviours in a unique way. I will discuss some recent experiments that I have used to explore individual preferences and the evolutionary and ecological underpinnings that can explain these preferences. I will also discuss how combining different types of technology with ecological and evolutionary theory surrounding social interactions at various levels can help us understand factors such as sexism. I will end by encouraging ecological researchers to use online environments to better understand human populations and their tendencies.

When a problem comes along, you must drip it: Drip irrigation of Eucalyptus largiflorens woodlands

Dr Susan Gehrig1
1South Australian Research and Development Institute, Aquatic Sciences, Adelaide, Australia

POSTER: Open forum

Biography:
Dr Susan Gehrig is a Senior Research Officer within the Plant Ecology sub-program at SARDI, Aquatic Sciences and undertakes research in the ecology of riparian, floodplain and aquatic vegetation. Her areas of interest include the eco-physiology and water requirements of vegetation communities.

Floodplain woodland degradation of the southern Murray-Darling Basin (MDB) increased in severity and magnitude from 2001–09, during severe drought conditions. In 2010–11, inflows to the River Murray system increased for the first time in ten years, resulting in widespread flooding to some low-lying floodplain woodlands; however, many high-elevation black box (Eucalyptus largiflorens) woodlands remained unflooded. In order to alleviate further declines in woodland condition, an alternative direct watering technique was trialed to target stressed black box. An experimental area of irrigated and non-irrigated, 55 × 55 m, plots was established within the high-elevation black box woodland area of the Markaranka Floodplain (South Australia). Over three growing seasons (spring–autumn), three plots were irrigated every week for 16 hours (equivalent rainfall ~20 mm week−1). The effectiveness and feasibility of using drip irrigation was assessed by comparing the tree condition scores, tree water status and understorey plant communities amongst irrigated and non-irrigated plots. The third watering year reiterated that watering via drip irrigation can improve black box and woodland condition. Irrigated black box trees have maintained improved crown condition and water status and the understorey vegetation has remained more abundant and diverse whereas tree and understorey condition in non-irrigated plots has continued to decline across the three years of the trial. Watering applied via drip irrigation appears to arrest the deterioration in condition and promote significant growth flushes, especially during the drier months.

School of Ants Australia – a national citizen science project

Dr Sarah J Hill1, Dr Kirsti Abbott1, Prof. Mark Elgar2, Mr Steve Tremont1, Dr Elizabeth Breese1, Assoc. Prof. Nigel R Andrew1

POSTER: Open forum
School of Ants is a national citizen science project connecting citizens to their local ecology and generating new information on the diversity, distribution and diet of ants in Australian towns and cities. Ants are everywhere. Every Australian interacts with ants on a daily basis, which makes them a perfect candidate for citizen science. We lament the "little black ants" in the garden, but those who most need to understand these ants cannot reliably pin an identity or ecological role on these ants across Australia; we rid our houses of what we perceive as pest ants, but what services are they really providing us, and which ants should we really be killing? School of Ants aims to embed into our idea of an education, academic scientific research and information about ants and their role in our urban ecosystems while citizens collaborate on the research themselves. To this end, we have an ongoing opportunity for collection of ants from food baits – anytime, anywhere across Australia. But we have also smaller, discrete projects, engaging with schools, individuals and organisations to help collect and analyse ecological information about ants in their backyards, school grounds and public spaces. In 2015 the School of Ants project is on tour. Schools and individuals conduct monthly synchronous collections and we deliver educational days to 10 schools across Australia. We've engaged directly with more than 60 students so far, received more than 200 samples and have registered collectors in all states of Australia. Join us at http://schoolofants.net/

**Seasonal and daily dynamics of water storage and mobilization in the mangrove Avicennia marina subsp. australisica**

**Miss Alicia Donnellan Baraclough**, Jarrod Cusens, Sebastian Leuzinger

Plant communities are an elemental part of the Earth's water cycle, and are also sensitive to ongoing global climate change. However, there are still many unknowns regarding how and when plants store and mobilize water within their tissues. In this study New Zealand mangrove forests are used as a model system for understanding tree ecophysiological responses to changing water availability. We used stem diameter variations and leaf turgor changes to study how water storage and mobilization occurs within the plant. These were correlated to environmental conditions in order to understand the effect of microclimate both intra-daily and seasonally. Vapour pressure deficit (VPD) and irradiance were found to be important in explaining diameter changes in the whole stem at a daily scale, whilst rainfall and humidity were more important at a seasonal scale. Irradiance, temperature and VPD explained most turgor changes in the leaf. Surprisingly, intra-day stem diameter variations showed an uncommon pattern compared to terrestrial trees, with stem diameters reaching peak values at midday. These peaks in stem diameter coincided with minimum leaf turgor. To investigate these unusual patterns further, we tried to pinpoint the tissue largely responsible for stem diameter changes by peeling away the bark and placing measuring devices directly on xylem tissue. Daily trends seem to indicate the importance of phloem tissue osmotic changes in drawing water from the xylem in times of high water demand.

**Restoration strategies developed in New Caledonia and the role of research**

**Bruno Fogliani**

School of BioScience, University of Melbourne, Parkville, Australia.

**POSTER: Open forum**

**Biography:**

Bruno Fogliani is actually the Assistant Director of the New Caledonian Agronomic Institute. He is involved in the coordination of several research contracts engaged with New Caledonian Institutions and Mining Industries dedicated to restoration ecology. He organized in 2014 the 2nd Conference of the SER Australasia which it is a board member at large.

In many islands Men depend on nature for their survival, often exposing their environments with strong competition use. In addition, island ecosystems are usually characterized by a high susceptibility to anthropogenic pressures, the impact of invasive species, habitat degradation, pollution and climate change being particularly exacerbated. In this context New Caledonia appears to be a particularly interesting model. The country is one of 34 hotspots for the preservation of the planet's terrestrial biodiversity, taking into account its exceptional biodiversity, ranking the country as one of the three main centers of island endemism in the world. Awareness of extensive environmental damage in the 1970s caused by mining has generated the development of the first research programs to limit soil erosion and loss of biodiversity in ultramafic environments. Programs were then extended to other environments, including dry forests from 2000. The first revegetation experiments have been made in 1971 with exotic species. The study of endemic species has intensified from 1988, the main objective was to inventory the potential species, to test germination and behavior after planting, and the promising results have allowed the use of these species at a larger scale. Since about 10 years, research and experiments grow strongly to further integrate the various components of the environment at different levels, in particular for a higher domestication of the native plant species used for restoration (seed ecology, dispersal, dormancy, germination and conservation), for a better understanding of topsoils, symbionts, the genetic diversity of species, habitat diversity and ecological succession.
Movement restrictions induced by habitat fragmentation disrupt three key proximate processes

Mrs Anita Cosgrove1, Dr Todd McWhorter2, Dr Martine Maron3
1The University of Queensland, St Lucia, Australia, 2The University of Adelaide, Roseworthy, Australia

Biography:
Anita Cosgrove is a PhD Candidate at the School of Geography, Planning and Environmental Management at The University of Queensland. Her research focuses on identifying whether habitat fragmentation impacts sedentary bird species through reduced resource availability.

The ability to successfully move around a landscape is crucial for the persistence of animal populations. Habitat fragmentation reduces the structural connectivity of landscapes which in turn can translate into reduced functional connectivity, thereby impeding movements by fauna among landscape elements. Substantial work has been devoted to understanding the proximate mechanisms that are disrupted by movement restrictions in fragmented landscapes. However, there is no unifying framework explicitly identifying how these processes relate to one another, and the temporal and spatial scales that characterise each. First, we present a conceptual framework outlining the relationship in respect to spatial and temporal scale between three processes: limited resource access, restricted demographic exchange and impeded gene flow. Second, we review the landscape ecology literature to explore the frequency of studies conducted on each of the three processes and whether biases exist in which of the three mechanisms are most studied amongst geographic regions or taxa. Our framework helps focus attention on the process or processes most likely to be impeded given the taxon under consideration and the extent of fragmentation. It is critical to distinguish which processes are disrupted in a particular system because each requires its own distinct management strategy.

Weed control for direct seeded sites: Herbicide tolerance of 12 native species

Mrs Sharon Brown1, Prof Nick Reid1, Dr Rhiannon Smith1, Mrs Jackie Reid1, Mr Dave Carr1
1University of New England, Armidale, Australia

Biography:
Sharon Brown is currently enrolled in the third year of post graduate study (Doctor of Philosophy) at the University of New England. Her research is aimed at improving the success of direct seeding and tree planting techniques in Northern New South Wales.

Direct seeding is a cost-effective way of re-establishing native trees and shrubs in rural landscapes. Although this technique has yielded some positive results in South Australia and Victoria, the success of direct seeding in central and northern NSW has been highly variable. Failures are primarily attributed to heavy weed infestations following spring rains, which coincide with the germination and establishment of native seedlings. Long term weed control using knockdown and residual herbicides prior to sowing is commonly recognised as best practice, although this is not always effective. This raises the question as to whether herbicide oversprays could be used as an effective method of weed control if some native species exhibit tolerance to them. We investigated the tolerance of twelve native tree and shrub species to nine pre-emergent (broadleaf and grasses) herbicides. These trails took place in a temperature controlled glasshouse at the University of New England between December 2014 and February 2015. The results were variable in that different species exhibited tolerances to different herbicides. Survival rate for seedlings treated with Jaguar (Difluffienican) was zero for all species. Eucalyptus, Acacia and Dodonaea species exhibited tolerance to Goal (Oxyfluorfen), Casurina, Senna and Acacia species exhibited tolerance to Spinnaker (Imazethapyr), while all species exhibited tolerance to Amitrole T (Amitrole) and Balance (Isoxaflutole). We are currently investigating the effectiveness of these herbicides against weeds and testing the tolerance of the same suite of species in situ. Clearly, there is scope for continued research on herbicide tolerance of a broad range of species.

Does release method matter when reintroducing brushtail possums to the semi-arid zone?

Ms Hannah Bannister1, Mr Robert Brandle2, Associate Professor David Paton1, Dr Katherine Moseby1
1The University of Adelaide, Adelaide, Australia, 2Department of Environment, Water and Natural Resources, Port Augusta, Australia

Biography:
Hannah is currently studying a reintroduced population of brushtail possums in the Flinders Ranges National Park in South Australia as part of her PhD research, focusing on how release methods and previous experience with predators influence reintroduction success, and determining which resources are vital for population persistence in the area.

Reintroductions are an increasingly common conservation tool used to reverse the decline of threatened species. To be successful, reintroduction techniques need to consider the biology and ecological requirements of the target species - extrapolation of results from studies on other non-related species are often misleading. We tested three release methods on brushtail possums (Trichosurus vulpecula) during a reintroduction to the semi-arid Flinders Ranges National Park: soft-release, hard-release and nest box release. Brushtail possums were historically distributed across most of Australia including arid and semi-arid regions, but have declined from more than 50% of their historical range over the past 200 years. Previous brushtail possum releases have encountered poor post-release survival and hyperdispersal away from release sites, while others have failed to undertake adequate post-release monitoring, with the fate of released possums remaining largely unknown. We aimed to test whether
alternative release methods combined with intensive post-release monitoring could alter these trends. Forty-eight possums were radio-collared as part of a larger release group of 79 possums, with eight males and eight females radio-collared in each treatment group. We monitored the survival, weight, dispersal distance and retention of pouch young (females only) for possums in all treatment groups. As reintroductions are financially and logistically expensive, determining cost-effective, successful release methods will inform future reintroductions for this and other arboreal mammal species.

Can spectral measurements be used as an indicator of stress caused by Phytophthora species in Corymbia calophylla (Marri)?

Mrs Louise Croeser1,2, Trudy Paap1, Giles Hardy1,2, Margaret Andrew3
1Centre for Phytophthora Science and Management, Murdoch University, Perth, Australia, 2Centre of Excellence for Climate Change, Woodland and Forest Health, Murdoch University, Perth, Australia, 3School of Veterinary and Life Sciences, Murdoch University, Perth, Australia

Mycorrhizal inoculation: Putting the fun(gus) back in restoration ecology

Ms Eilysh Thompson1, Ms Aimee Beardsmore2, Mrs Kristine French1, Mr Ben Gooden1
1University of Wollongong, Wollongong, Australia, 2Wollongong City Council, Wollongong, 2500

Eucalypt woodland restoration

Mr Peter Yeeles1, Dr Lori Lach1, Professor Richard Hobbs1, Professor Raphael Didham1,2
1School of Animal Biology, University of Western Australia, Crawley, Australia, 2CSIRO Land & Water Flagship, Centre for Environment and Life Sciences, Floreat, Australia, 3Centre for Tropical Biology and Climate Change, James Cook University, Cairns, Australia, 4School of Plant Biology, University of Western Australia, Crawley, Australia

Biography:
Eilysh Thompson completed a Bachelor of Environmental Science (Advanced) student majoring in life sciences, minoring in international studies and is currently finishing her honours.

It is well established that mycorrhizal fungi play an important role in many ecological processes. Mycorrhizae may, therefore play an important role in restoration of habitat and could be an important tool for use. We addressed whether mycorrhizal inoculate improved the success of restoration of coastal dune systems on the south coast of New South Wales. The levels of plant-AMF infection were determined and compared between reconstructed and remnant coastal dune complexes. Then, using a field experiment we investigated whether the application of a mycorrhizal inoculate to plants prior to dune revegetation facilitated their establishment. We determined a difference in plant-AMF infection between remnant and reconstructed dune systems, suggesting that reconstruction of plant-AMF symbioses are important in tackling restoration. We also established that there is also a difference in survival rate, AMF infection and root and shoot biomass between inoculated and non-inoculated plants. This suggests that pre-inoculation of plants with mycorrhizae could be a valuable management strategy when reconstructing ecosystems. Invertebrate community reassembly over five years of experimental
Faunal community reassembly has long been a key field of research for ecologists interested in rehabilitating degraded ecosystems. Many studies track rehabilitation trajectories across differing planting regimes, restoration techniques and spatial scales, but it can be difficult to disentangle the relative drivers of faunal response without experimental manipulation. Here, we use an experimental woodland restoration project in southwest Australia to investigate invertebrate order and ant species community reassembly responses to varying wood plant diversity treatments. The Ridgefield tree diversity experiment consists of 10 replicate plots of 10 revegetation treatments, varying in tree species and functional group richness, with a sub-plot treatment of herbicide application. fenced paddock and woodland areas adjacent to the restoration plots were used as references. We sampled the invertebrate fauna at the site using 440 pitfall traps per year, from planting in 2010 until 2014. We tested the hypothesis that an increased diversity of woody plants would increase reassembly rates of invertebrate communities towards neighbouring woodlands. Over five years, we sampled a total of 99,671 ants (77 species) and 111,564 other invertebrates. Our results show a significant effect of replanting woody species, however, differences in faunal responses to woody species treatments were idiosyncratic and not clearly related to increased woody species diversity. Herbicide application had a positive effect on multiple measures of ant diversity, with the herbicide effect increased in magnitude over time. These findings suggest that even simple, low-diversity planting treatments, can achieve comparable faunal diversity outcomes, especially when combined with understory weed control.

Competitive interactions between native and exotic invasive species under varying soil nutrient availability

Ms Samiya Tabassum1, Prof Michelle Leishman1
1Macquarie University, Sydney, Australia

Biography:
Samiya Tabassum has graduated with a first class Honours from UNSW under the guidance of Assoc. Prof. Stephen Bonser. She has recently commenced a PhD with Prof. Michelle Leishman looking at mechanisms of range expansion in exotic species. Her presentation focuses on her Master of Research work at Macquarie University.

Exotic species invasion presents a major threat to global biodiversity and is often associated with nutrient enrichment of soils, particularly on soils of naturally low fertility. It is likely that the outcome of competitive interactions between native and invasive plants may be mediated by soil nutrient availability. We independently investigated competitive effect and response in a glasshouse experiment where seedlings of eight functionally similar pairs of exotic invasive and native species from low fertility Hawkesbury Sandstone derived soil were grown under low and high nutrient availability. We tested the hypotheses that native species would be competitively superior at low nutrient availability because they employ a resource conservation strategy and invasive species would be competitively superior at high nutrient availability because they employ a resource acquisition strategy. We also hypothesised that invasive species would be more plastic in their response to increased nutrient availability. We found that nutrient availability did not mediate competitive interactions between invasive and native species. Instead, two invasive and one native species were competitively superior irrespective of nutrient availability. Competitively superior species displayed a mixture of both resource conservation and acquisition strategies in the low and high nutrient treatments. Invasive species were also not found to have higher degrees of trait plasticity compared with native species. This study provides evidence that the a priori classification of invasive and native species does not predict competitive superiority at varying nutrient levels but rather species specific differences in trait values provide a competitive advantage in response to nutrient availability.

Globally managed harvests of mammals in relation to their population persistence

Ms Leah Collett1, Dr Damien Fordham1, Prof Corey Bradshaw1
1University of Adelaide, North Terrace, University of Adelaide, Australia

Biography:
Leah Collett is a second-year PhD student in the Global Ecology Laboratory within the Environment Institute at the University of Adelaide. Her research is looking at the South Australian macropod harvest, identifying possible environmental and climatic drivers of kangaroo abundance and distribution, and developing optimal survey and harvest models.

Wildlife has many uses to humans including meat, skins for clothing and as pets; they can be taken through a managed system or illegally hunted. It is imperative that the exploitation of harvested wild species is undertaken using programs that maintain population stability and viability. We used the IUCN Red List to identify those species that are collected for human use, categorised them by legal or illegal offtake and Red List status. An exhaustive literature review identified when a legal, managed removal including an estimation of population size, quota proposition and legislated harvesting, was introduced to wild mammals to understand if the timing of legal managed harvests reflected in improvements to a species assessment and population trend. One thousand and sixty nine mammal species are collected from the wild for use by humans; that is 20% of all
mammal species assessed by the IUCN Red List of Threatened Species. However, 43% of those species experienced varying levels of illegal harvesting. Further analysis will reveal the extent of illegal removal to species population stability, especially when legal removal also occurs at the same time. Spatial patterns will be identified which will potentially serve as a baseline for those species most at risk from harvesting.

Survey design for detecting declines in the threatened brush-tailed rabbit-rat on the Tiwi Islands.

Ms Hayley Geylo1, Dr Emily Nicholson1, Dr Gurutzeta Guillera-Arroita2, Dr Brett Murphy3, Dr Euan Ritchie1, Dr Dale Nimmo4
1Deakin University, Burwood East, 2University of Melbourne, Melbourne, 3Charles Darwin University, Darwin, 4Charles Sturt University, Albury, Lecturer

Biography:
Hayley Geylo is an honours student in the school of life and environmental sciences at Deakin University (Burwood). She has a keen interest in threatened species conservation, and in particular, the issues surrounding imperfect detection and optimal monitoring.

Population monitoring is an essential component of threatened species conservation. However, monitoring programs are often poorly designed, leading to results that are difficult to interpret or that do not achieve the desired aims of a study. Power analysis is a useful tool to determine survey effort requirements matched to given monitoring objectives. However, this approach requires a priori knowledge about the species under study. We utilized a historical dataset to obtain key information about the distribution of the threatened brush-tailed rabbit-rat (Conilurus penicillatus) on the Tiwi Islands of the Northern Territory, one of the species’ last strongholds. We used a single-season, single-species occupancy modelling approach that explicitly accounts for imperfect detection. We used this analysis to explore the trade-off between the number of sites and replicate visits required to detect meaningful changes in site occupancy. Detectability estimates of the brush-tailed rabbit-rat results in high confidence of detecting the species at each site after relatively few samples (3 trap nights), dependent upon the season in which the survey took place. This suggests that further sampling intensity at each site may be wasted effort. Additional sites must be surveyed in order to improve the statistical power to detect smaller declines. We propose a cost-effective and flexible framework for detecting and assessing declines that is transferable to other species, and provide insight into the potential utility of existing databases.

Seed availability and habitat suitability of the invasive Grey Sallow willow (Salix cinerea) across elevation

Ms Emily De Stigter1, Dr. Joslin Moore1
1Monash University, Clayton, Australia

Biography:
Emily De Stigter has recently started her PhD at Monash University in the school of Biological Sciences. She came from a background in botany and statistics at Humboldt State University in Northern California.

In natural habitats, the replacement of native vegetation by invasive species can cause transformative effects to ecosystems. An invasive species’ ability to successfully establish in a new location directly influences how widespread the species can become. This study aims to define the relative importance of propagule pressure and habitat suitability on establishment across an elevation gradient for invasive species. Elevation has major implications for spread due to its influence on growth rates, phenology, fecundity, and directionality of dispersed seeds. This study will investigate how these factors influence the spread of the willow Salix cinerea, which is invasive in riparian zones and alpine peatlands in south eastern Australia and New Zealand.

A key component of understanding propagule pressure is to understand how fecundity and flowering phenology change with elevation, as this determines the amount and timing of seed available to disperse. We will report the results of the first field season undertaken in the High Country of eastern Victoria that will quantify the effect of elevation on fecundity and flowering phenology across a 1500m elevation gradient.

DNA Barcoding South-east Queensland Rainforest Plants: Identifying potential Subtropical Rainforest Refugia using Phylogenetic Diversity Measures

Ms Marion Howard1
1University of the Sunshine Coast, Sippy Downs, Australia

Biography:
Marion Howard is an Honours Student at the University of the Sunshine Coast, Queensland where she obtained her Bachelor of Environmental Science and was recognised for Academic Excellence. Her Supervisor is Associate Professor Dr. Alison Shapcott.

Biodiversity conservation is important for species and ecosystem adaptive capacity to change. Australian rainforests contain a high proportion of the continents terrestrial biodiversity. Traditionally, studies have focused on the Wet Tropical rainforests of Northern Queensland. The biodiversity and
community assemblages of the highly fragmented subtropical rainforests of South East Queensland are less well known, but recent studies have indicated that these rainforests contain areas of high endemism which may indicate climatic refugia. Refugia are vital for the recolonization of the surrounding areas following disturbance, especially in relation to climate change. One area that has been found to contain significant levels of endemism is The Great Sandy Region. This study has expanded and updated the DNA barcoded library of South East Queensland Rainforest plants and used this to calculate phylogenetic diversity (PD). Phylogenetic diversity measures, species richness (SR), regional ecosystem (RE) type and geology were used to evaluate the patterns and relatedness within and between the Great Sandy Region and neighbouring subregions to identify phylogenetic relationships that may indicate refugia. Results revealed sites of high phylogenetic diversity (PD) and high species richness (SR) were not found to be significant in terms of diversity. Conversely, the rainforest taxa of Fraser Island and Cooloola National Park, within the Great Sandy Region, had lower phylogenetic diversity (PD) and species richness (SR) and were significantly less related than random (phylogenetically even), indicative of refugia. Patterns of diversity in the northern section of the study area were consistent with historic range expansions from refugial communities.

Seasonal diversity of spiders and beetles on a saltmarsh to woodland gradient

Mr John Aalders¹, Dr Peter McQuillan¹
¹University of Tasmania, Hobart, Australia

Biography:
John Aalders completed his BSc in 2012 at the University of Tasmania, and BSc (Honours) in 2014, University of Tasmania. He is a PhD Candidate at the University of Tasmania, researching "island area effect concept a useful tool in understanding the biogeography of plants and terrestrial invertebrates of coastal saltmarshes in Tasmania".

There is no information on terrestrial invertebrates (spiders and beetles) which inhabit Tasmanian saltmarshes. Saltmarshes represent an extreme environment which is likely to impose harsh selection pressures on particular invertebrates. Pitfall trapping was conducted at Long Point on Tasmania’s East Coast, the location recognised as the State’s largest contiguous coastal salt marsh. The saltmarsh zone, vegetated by saline succulents (eg Sarcocornia spp, Tecticornia arbuscula) and saline graminoids (eg Juncus kraussii, Austrostipa stipoides), is bisected by a centrally aligned sand dune that is vegetated by coastal woodland plants such as Acacia mearnsii, Bursaria spinosa, Lomandra longifolia, tussock Poa spp and prostrate herbs. Over 12 months 5,606 spiders (37 taxa) and 1,165 beetles (84 taxa) were caught in 141 pitfall traps set twice each season. Both spider and beetle diversity was greatest in summer, followed by spring and autumn. Of the spider taxa, the genera Venatrix and Artoria (family Lycosidae) were the most widely distributed across the site, with the family Graphosidae and the genus Nicodamus avoiding wetter more saline vegetation. The families Zoridae and Zodariidae preferred the dryer saline grasses and woodland areas. Of the beetle taxa, the genera Venatrix and Artoria (family Carabidae) is restricted to the dryer woodland zone, whereas the genus Steriphus (family Curculionidae) is secure in the wetter saline zone.

Priority threat management in a highly modified landscape: the Brigalow Belt, Australia

Dr Rocio Ponce-Reyes¹, Dr Jennifer Finn², Dr Sam Nicol¹, Dr Iadine Chades¹, Dr Danial Straford², Dr Tara Martin¹, Dr Stuart Whitten³, Dr Josie Canwaridine¹
¹CSIRO Land and Water Dutton Park, Dutton Park, Australia, ²Queensland University of Technology, Garden Point, Australia, ³CSIRO Land and Water Black Mountain, Black Mountain, , ⁴CSIRO Land and Water Bellenden Street, Crace, Australia

Biography:
Dr Rocio Ponce-Reyes is a Postdoctoral Research Fellow at CSIRO. She is currently working on a project about Priority Threat Management in the Brigalow Belt, one of the most fragmented areas in Australia. Rocio finished her PhD at the University of Queensland working on different aspects of conservation of fragmented landscapes.

The Queensland Brigalow Belt is one of the most highly modified bioregions in Australia. Since the mid 1800’s it has been subjected to broad scale clearing. At the same time, this bioregion is recognised as a National Biodiversity Hotspot. We undertook a priority threat management assessment to determine the most cost-effective management actions to protect biodiversity of the Brigalow Belt bioregion over the next 50 years. Data was collected from biodiversity and land management experts and stakeholders of the bioregion through a structured elicitation workshop. Twelve strategies to improve the persistence of threatened species were proposed and prioritised according to their ecological cost-effectiveness. The optimal strategies’ combination under limited budgets was also assessed. If no management strategies are implemented, 21 species are at risk of becoming functionally lost from the bioregion. Implementing all the 12 strategies effectively (average annualised cost of $57$m/year) could avert the loss of 12 of these species. The individually most cost-effective strategies were management of fire and invasive plants, at an average annual cost of $0.55m and $1.53m respectively. Participants suggested a critically important strategy, the building of a common vision for the bioregion to ensure that the proposed management strategies are implemented in a framework that values regional biodiversity and environmental resources with the same value as the current emphasis on production and economics. If a strategy was implemented under a common vision, it increased cost-effectiveness. Without a common vision, losses of two of the 12 regional threatened species cannot be avoided through threat management.

Clonal reproduction and population connectivity in snotty-gobble
Snotty-gobble (Cassyphus pubescens) is a rootless parasitic vine that is native to south-eastern Australia. It has a scrambling growth habit, and a single individual can parasitise multiple hosts. Being a parasite, the populations re-establishment after fire is controlled by complex processes, starting with fire stimulation of germination. It is also known to spread clonally, but the patterns of spread, in particular the balance between reproduction by sexual (i.e. via seed) and asexual (i.e. clonal spread between hosts) is unknown. This becomes particularly interesting given that the species has an extensive range and common status, and there is large fragmentation of the landscapes where the species is found.

This study used molecular markers (Single Nucleotide Polymorphisms by using a Genotyping by Sequencing approach) to determine the prevalence of clonal reproduction in the field. Population connectivity was also estimated using these sequences. A total of 96 individuals were sampled in 5 sites across two national parks (approximately 10 kilometers distant) in South Australia. The data indicated that clonal reproduction was important within all sites. Of 96 samples, 51 were found to be clones, with the highest density occurring in the largest sampled site. Importantly, both parks showed substantial genetic isolation of populations. These results have significant implications for the management of this species, especially considering its extensive range.

Incidence and abundance of mistletoe in western Saudi Arabia.

Dhafer Albakre1, Dr José Facelli1, Dr Magdy El-Bana2
1Faculty of Science, Tabuk University, Tabuk city, SAUDI ARABIA, 2School of Biological Sciences, the University of Adelaide, Adelaide, Australia

While mistletoes are ecologically important as they provide food and shelter for birds and insects, and affect ecosystem nutrient dynamics, when in high abundance they can have negative effects. Recent increase of mistletoe abundances in Saudi Arabia seemingly causes stress and even mortality of their host plants. We determined how altitude and host characteristics affect the distribution of mistletoes in two sites in western Saudi Arabia. In Taif National Park four hosts (Acacia tortilis, Acacia ehrenbergiana, Acacia asak, and Acacia gerrardii) supported the mistletoe Plicosepalus curviflorus. There was no relationship between altitude and the incidence of mistletoe, probably because the potential hosts were present in a small range of altitudes. In addition, there was no strong relationship between host size and the incidence of the mistletoe. In the second site, Alshafa Wadi, we investigated the incidence of three species of mistletoe (Phragmanthera austroarabica, Plicosepalus curviflorus and Viscum schimperi) on a single host species (Acacia gerrardii). Large trees were more likely to have higher numbers of mistletoe than smaller hosts which typically have low mistletoes loading or were uninfected. The incidence of P. curviflorus decreased with altitude while that of V. schimperi increased with it. The distribution of P. austroarabica was independent of altitude. The most likely cause for these patterns is different physiological responses of the three species of mistletoe to differences in temperature and water balances along the altitude gradient.

Hydraulic redistribution in Acacia papyrocarpa (Western Myall) - implications for mine rehabilitation

Dr Emma Steggles1, 2
1University of Adelaide, Adelaide, Australia, 2CSIRO Land and Water, Glen Osmond, Australia

Hydraulic redistribution refers to the process by which some plants distribute soil water via their root systems. Water movement occurs in both vertical and lateral directions according to gradients in plant-soil-water potentials. The downward (negative) movement of water generally occurs during seasons of high rainfall or during large rainfall events. During dry seasons or droughts, this deep soil water is transported via hydraulic lift to sustain surface roots and for transpiration. A series of sap flow meters were installed in multiple root and trunk positions to explore this process in Acacia papyrocarpa (Western Myall). Soils were extremely dry at the site prior to commencing as very little rain had fallen in the preceding year. Immediate changes in sap flow velocity and direction were observed at various root positions in response to heavy winter rains. An extended two week period of sustained negative flow was recorded in tap roots and primary vertical roots. Similar responses were observed again during a large summer rainfall event in the following year. These findings have implications for re-establishing sustainable populations of A. papyrocarpa in post-mine rehabilitated sites. Soil properties of modified overburden soils and tailings differ to undisturbed soils and this may impact soil hydrologic functions. Changes to hydraulic redistribution processes may cause reduced rooting depths and restrict plant access to deeper water sources, making them vulnerable to extended dry periods and droughts.
Seed germination and restoration of keystone arid plant species under water stress thresholds

Ms Corrine Duncan
*Federation University, Ballarat, Australia

Biography:
Corrine Duncan is a PhD candidate at Federation University investigating the revegetation of difficult to establish arid species at Murray Basin mine sites. She is assessing whether ecological processes and conditions, particularly soil water potential, inhibit transition probability between plant life stages.

Restoration following any severe disturbance presents obstacles, though the trajectory in restoration ecology within water limited ecosystems is further complicated by extremely variable climate and slow growth rates of keystone species. Extensive areas of arid and semi-arid ecosystems across the globe are effected by open cut mineral mining, which presents a need for complete reconstitution of the biological community once completed. We are investigating the effectiveness of vegetation rehabilitation efforts on open cut sand mines in the Murray-Darling Basin in south-west NSW. Such efforts have resulted in regeneration of important native shrubs across two sites, however tree species have proven very difficult to establish.

The key objective of this project is to increase the overall restoration success rate of local casuarina woodland with chenopod understory following severe disturbance. The projects focus is on seven important species; Casuarina pauper, Myoporum platycarpum, Geijera parviflora, Alectryon oleifolius, Hakea tephrosperma, and understory shrubs Maireana sedifolia and Maireana pyramidata. Through replicated field experiments and greenhouse trials, the research will develop an understanding of germination, emergence and plant growth relative to the environment, and link seed physiology with water stress thresholds in arid species. We predict that species have specific and critical water potential requirements for each life stage which currently inhibit recruitment, and that current soil stockpiling practices significantly reduces biological activity. The project will define the limiting factors for recruitment at each functional life stage and relate these to the environment, thereby improving the chances of establishing self-sustaining landscapes similar to those previously present.