

LIFE, EARTH & ENVIRONMENT

Annual Report 2015

School of Environmental and Rural Science
University of New England

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University of
New England



Acknowledgements

Many thanks to Adrienne Burns for collating some of the data contained in this report, and for assisting in many ways throughout 2015 in her role as LEE Theme Coordinator. I also thank the past Theme Leader, Professor Caroline Gross, for permission to use some of the information contained in the 2014 Annual Report. Kath McDougall (Research Services) compiled the list of grants, and Chris Cooper (School of ERS) compiled a list of research students. I gratefully acknowledge the various LEE members for supplying photographs from their field research. Finally, Thanks to my colleagues in the LEE Theme for responding to my requests and providing information about their publications and research projects that form the bulk of this report.

Report Prepared by Associate Professor Karl Vernes (LEE Theme Leader) kvernes@une.edu.au

INTRODUCTION

Our purpose is to undertake high quality research that improves our understanding of ecosystems, earth systems and species diversity, as the means to advance ecosystem resilience, and inform management practices to ensure ongoing sustainable landscape use and restoration.

The Life, Earth and Environment (LEE) research theme was established in 2014 as a highly active community of academics engaged in discipline-based and interdisciplinary research that spans natural, rural and constructed landscapes.

The LEE theme sits within the research portfolio of the School of Environmental and Rural Science at the University of New England and brings together the research disciplines of Botany, Earth Sciences, Environmental Management, Earth Sciences, Engineering and Zoology.

Our research theme is underpinned by internationally recognised researchers with strong track records of industry collaboration and competitively funded research projects. These support our large cohort of postgraduate students.

Our theme undertakes broadly based Life, Earth and Environmental sciences focused across five Excellence in Research for Australia (ERA) areas undertaken in higher education institutions across the country, and in an international context.

These areas are:

- Ecology
- Environmental Science & Management
- Evolutionary Biology
- Geology and Earth Sciences
- Zoology

Each area supports a portfolio of research activity that builds on an understanding of fundamental processes to make strategic information available for sustainable management.

The LEE Theme is comprised of 32 academic staff, 5 adjunct and emeritus members, and 21 postdoctoral fellows. Together these researchers supported 82 Higher Degree Research (HDR) candidates in 2015, across all of the LEE research areas.



THEME LEADER'S REVIEW

The Life, Earth and Environment (LEE) Research Theme is a dynamic group comprising nearly 50 researchers and 78 Higher Degree Research (HDR) students who together published more than 100 peer-reviewed papers and in 2015. LEE Theme researchers also secured about \$4.3M of external research funding in 2015, making our theme one of the most active and productive research groups at UNE. Another highlight of 2015 was our very popular LEE Seminar Series. Strongly supported by academics and students alike, the series attracted some of the top researchers in their field from around the world. In 2015, LEE also became active on social media (@UNE_LEE), tweeting publications, research activity and important achievements by LEE members.



2015 was a year of growth for LEE; research funding was up more than 40% from 2014, and UNE achieved stunning results in the 2015 Excellence in Research Australia (ERA) assessments. Three fields in which LEE Theme members publish research (Ecology, Geology, Zoology) achieved the top rating of 5 (“well above world standard”), while four others (Earth Sciences, Environmental Sciences, Environmental Science and Management, and Biological Sciences) were rated as 4 (“above world standard”). The results reflect a strengthening of research outputs in all LEE-related fields compared with the last ERA Assessment in 2012. While 2015 publications didn’t count towards ERA 2015 (which was based on outputs from 2008 - 2013), our strong outputs in 2015 will assist UNE to retain these high research rankings into the future. In 2015 we also welcomed some new staff to the theme, including several new postdoctoral research fellows, strengthening several research areas.



LEE RESEARCH STAFF

PROFESSORS

Professor Fritz Geiser
Professor Caroline Gross
Professor Jeremy Bruhl
Professor Nick Reid

Dr Saeed Mahini
Dr Luke Milan
Dr Romina Rader
Dr Emma Sherratt
Dr Chris Wacker

ASSOCIATE PROFESSORS

A/Prof Nigel Andrew
A/Prof Lalit Kumar
A/Prof John Paterson
A/Prof Darren Ryder
A/Prof Karl Vernes
A/Prof Brian Wilson
A/Prof Stephen Wroe

ASSOCIATE LECTURERS

Dr Kirsti Abbott

SENIOR LECTURERS

Mr Rex Glencross-Grant
Dr Paul McDonald
Dr Julian Prior
Dr Nancy Vickery
Dr Janelle Wilkes

ADJUNCTS & EMERITUS

Dr Guy Ballard
Professor Andrew Boulton
Dr Peter Fleming
Dr Graham Hall
Emeritus Professor Peter Jarman

LECTURERS

Dr Rose Andrew
Dr Alan Baxter
Dr Phil Bell
Dr Stuart Cairns
Dr Hamish Campbell
Dr Luke Milan
Dr Luca Fiorenza
Dr Richard Koech
Dr Rudy Lerosey-Aubril
Dr Tommy Leung

POSTDOCTORAL & RESEARCH FELLOWS

| | |
|----------------------|---------------------|
| Dr Marie Attard | Dr Sarah Mika |
| Dr Adrienne Burns | Dr James Neenan |
| Dr Michelle Carnegie | Dr Julia Nowak |
| Dr Kerri Clark | Dr Clare Nowack |
| Dr Jean Drayton | Dr William Parr |
| Dr Farzin Shabani | Dr Rhiannon Smith |
| Dr Jamie Gorrell | Dr Clare Stawski |
| Dr Jasmine Janes | Dr Subhashni Taylor |
| Dr Gerhard Koertner | Dr Iris Tsoi |
| Dr Justin Ledogar | Dr Laura Wilson |
| Dr John McEvoy | |

A photograph of a rural landscape. In the foreground, a weathered wooden fence runs diagonally across the frame. The ground is covered in dry, yellowish-brown grass. In the background, a dense forest of tall, thin trees stretches to the horizon. The sky is bright, and there is a lens flare effect in the upper right corner.

**LIFE, EARTH AND
ENVIRONMENT
RESEARCH AREAS**

ECOLOGY

UNE is the perfect location to study ecology. The University is close to an exceptional range of natural and modified ecosystems, from rainforests through to semi-arid woodlands and grasslands, as well as freshwater and marine ecosystems. Within two hours drive of Armidale a research can travel between sub-alpine and sub-tropical climates, or semi-arid savannah and lush rainforest. The region is centred on the Great Eastern Ranges biodiversity hotspots and contains world heritage national parks, encompasses most major soil types, and has river drainage systems that flow both east and west, as well as estuarine and marine environments.

The LEE Theme has strong representation in the field of ecology and related disciplines, spanning aquatic through to terrestrial ecosystems, and from genes to landscapes. While much of our work is done locally, and regionally throughout northeast New South Wales, we have many projects throughout Australia, as well as internationally. We have four major research areas: Aquatic Ecology and Restoration, Mammal Ecology and Conservation, Plant Reproduction Ecology, and Movement and Landscape Ecology



Research Faculty

Prof Caroline Gross
Assoc Prof Darren Ryder
Assoc Prof Karl Vernes
Dr Hamish Campbell

Research Fellows

Dr Adrienne Burns
Dr Sarah Mika

Adjuncts & Honorary

Emeritus Prof Andrew Boulton
Dr Guy Ballard
Dr Gerhard Koertner

PhD Students

Robert Baker
Matthew Birch
Solomon Birhanie
Sangay Dorji
Trent Forge
Catie Gowen
David Mackay
Steve McAlpin
Karlie McDonald
Paul Meek
Aaron Mulcahy
Tiger Sangay
Michal Smielak
Rokeya Sultana

Lisa Thurtell
Dana Vickers
Frances Zewe

Masters Students

Marilyn Connell
Tom Lawton
Jon Schlenert
Joshua Whitehead

AQUATIC ECOLOGY & RESTORATION GROUP

The Aquatic Ecology and Restoration Research Group has a focus on applying rigorous science to inform management of a range of freshwater and estuarine ecosystems. Our interests range from innovative fundamental research into how habitat structure affects distribution of freshwater taxa, applied research to monitor human impacts on ecological condition and functioning of catchments, through to understanding the ecosystem services provided by aquatic ecosystems. Much of our research is based in the floodplain rivers of the northern Murray-Darling Basin (MDB) and in the unregulated coastal rivers and estuaries of eastern Australia.



A/Prof Darren Ryder
dryder2@une.edu.au

2015 RESEARCH HIGHLIGHTS

Ecohealth

The Ecohealth program is a comprehensive freshwater and estuarine monitoring program that reports on the health of waterways based on a combination of indicators that identify short-term (water chemistry), intermediate-term (zooplankton, macroinvertebrates), and long-term responses (fish, geomorphology and riparian vegetation) for quantifying, reporting and communicating waterway health, and prioritising management actions. Over 400 sites have been established throughout the Northern Rivers Bioregion that allow us to explore questions such as the physical and chemical drivers of patterns in aquatic and riparian biodiversity and how biogeochemistry regulates aquatic productivity and food webs. (**Research Team:** A/Prof Darren Ryder, Dr Sarah Mika, Dr Adrienne Burns, Mr Ben Vincent).



Environmental Flows in the Murray Darling Basin

The Long Term Intervention Monitoring (LTIM) program of the Commonwealth Environmental Water Office (CEWO) aims to support efficient and effective use of Commonwealth environmental water and demonstrate achievement of environmental objectives. In collaboration with EcoLogical Australia we are quantifying ecological outcomes (water quality, aquatic foodwebs, fish, waterbirds, vegetation) of environmental water in the Gwydir and Warrego-Darling River Systems in the northern MDB. Ryder is also Theme Leader for the Environmental Water Knowledge Requirements (EWKR) program (2015-19) that aims to develop innovative field and laboratory techniques, and quantify and model foodweb responses to environmental watering throughout the MDB. (**Research Team:** A/Prof Darren Ryder, Dr Iris Tsoi, Mr Ben Vincent).



Smart Rocks and Sediment Modelling

Quantifying sediment dynamics in rivers is important for protecting infrastructure and understanding patterns of riverine biodiversity. Existing sediment tracking methods do not provide the spatial resolution to quantify river-scale sediment budgets. Our current research focuses on developing geochemical fingerprinting techniques to quantify the sources of fine sediment that can block entire river channels, and developing 'Smart Rocks' with GPS and tri-axial accelerometers embedded in river stones that allow modelling of precise rock movements as they are mobilised by flood flows. These innovative techniques represent significant methodological and conceptual advancements in river sediment modelling. (**Research Team:** A/Prof Darren Ryder, Dr Sarah Mika).



MAMMAL ECOLOGY AND CONSERVATION

Northeastern NSW has an impressive, and largely intact mammal fauna, and my research aims to better understand the ecology of these mammals so we can better conserve them. Much of this work also focuses on introduced mammals so we can understand the relationship between native and introduced species, and contribute to solutions to their effective management. Some of the research done in the mammal ecology lab also extends further afield, including projects that aim to better manage and conserve mammals in Bhutan and Mexico.



A/Prof Karl Vernes
kvernes@une.edu.au

2015 RESEARCH HIGHLIGHTS

The use of cenotes by mammals of the Yucatan Peninsula

Vast underground rivers flow through Mexico's Yucatan Peninsula. Mostly unseen, these rivers are accessible at cave entrances or 'cenotes' wherever the limestone cavern has collapsed. Cenotes are vitally important to the mammals of the Yucatan, providing the only reliable source of freshwater. Development in the form of resorts, hotels, golf-courses, and other tourism infrastructure threatens this water supply. This project aims to document the use of cenotes by mammals of the Yucatan Peninsula, and in so doing, highlight the importance of maintaining water quality in the aquifer. The work is being done in collaboration with Fred Devos from CINDAQ (Centro Investigador Del Sistema Acuifera de Quintana Roo) in Mexico, and Jim Sanderson from the Small Cat Conservation Alliance (USA).



Predator-Prey dynamics in the Great Eastern Escarpment Forests

Increased numbers of wild dogs are having a significant impact on primary producers and local communities. Cooperative effort is essential for effective management of wild dogs in the complex environmental, social and economic contexts in which they occur. Pressure is brought to bear on livestock producers by the wider community to reduce lethal control of wild dogs and dingoes in particular because of their iconic status and perceived environmental benefit. The trophic interactions between predators, prey and plants and the likely effects of lethal control of wild canids are speculated but, although untested, are affecting management decisions among conservation workers. This project will experimentally determine ecological responses to lethal control in a mesic environment where wild dogs, feral cats, and foxes co-occur with a suite of iconic and threatened mammals such as quolls and brush-tailed rock-wallabies. One of the key aims is to determine whether current wild dog control practices increase, decrease or have no impact upon populations of native and introduced mesopredators, and threatened and non-threatened prey species and vegetation. A number of PhD students are involved in this project, including Fran Zewe (cat ecology), Trent Forge (quoll ecology), Michal Smielak (prey dynamics), Helen Morgan (trophic cascades), Catie Gowen (rock-wallabies), and Paul Meek (camera-trap technology). The project is headed-up by LEE adjuncts Dr Guy Ballard and Dr Peter Fleming.

Dr Peter Fleming (left) and
Dr Guy Ballard (right)



PLANT REPRODUCTION ECOLOGY

Our group works on questions that shed information on how plants reproduce in the environment – especially where there are ecosystem disturbances. We are interested in threatened plant species, invasive species, the impact of fragmentation on plant populations and their pollinators and the impacts of introduced bees on native pollinator networks. As field ecologists we study plant populations in situ and use molecular techniques and glasshouse studies to complement our work. In 2015, Caroline and students Josh Whitehead, Elizabeth Pleskun and research associate David Mackay continued their work on plant-pollinator systems, joined by technician Ian Simpson and research assistant Ellis Mackay.



Prof Caroline Gross
cgross@une.edu.au

2015 RESEARCH HIGHLIGHTS

Impacts of the Asian honeybee (*Apis cerana*) on native and alien plants and pollinators

In March, Caroline and David travelled to Borneo to follow up earlier observations that Asian honeybees forage at night. In steamy lowland forests of Danum Valley they gathered infrared footage of bees foraging in the dark, thus providing a mechanism for this highly mobile species to get the jump over diurnally foraging insects and birds. In November the work was repeated in north Queensland Here, Caroline, Ellis and Josh gathered more infrared footage on the floral preferences and foraging times of the Asian honeybee, proving that it forages well before dawn, and that it also clashes with another introduced species, the introduced honeybee (*Apis mellifera*). Caroline is collaborating with Dr Paulo de Souza (CSIRO, Micro-sensing technology & systems) and his student Setia Budi, to use microtrackers on bees. In this way, temporal and spatial overlap between bees can be accurately investigated.



What pollinates bitou bush?

Elizabeth Pleskun is tracking down the culprits that effect seed-set in the invasive coastal plant, Bitou Bush. Elizabeth is working out the breeding system and the floral visitors at several sites on the North Coast of NSW. While there has been much work on seed dispersal and the biological control agents of Bitou, surprisingly how the plant breeds and how dependent it is on floral visitors for seed production is unknown.



How dependent is an endangered ecological community on introduced honeybees?

Josh Whitehead knows a thing or two about floral visitor behaviour, having watched hundreds of hours of videos dating back to 2007 to capture the identity and behaviour of visitors to hundreds of native plant species. Honeybees are likely to decrease in the wild if the varoa mite invades Australia (which is highly likely). Josh is working out the irreplaceability value of the introduced honeybee in native plant and pollinator networks.

The impacts of habitat fragmentation on the fig fig-wasp mutualism.

David Mackay is in the final year of his PhD fieldwork and in 2015 he travelled from Cape York to Eden in southern NSW to collect leaf samples of the rusty fig, *Ficus rubiginosa*, for use in DNA extractions. David is testing the idea that figs are hypermobile and as such they are resilient to changing climates.

MOVEMENT AND LANDSCAPE ECOLOGY

Research in the Movement and Landscape Ecology Lab is concerned with the study of animal movement, how they interact with the landscape, and respond to environmental heterogeneity. We experiment with a range of telemetry technologies, including GPS, Argos, VHF, acoustic telemetry, and tri-axial accelerometers. We are also involved in the construction of eScience infrastructure to advance the application of animal movement data into ecosystem science and management. In 2016, Hamish will leave UNE to take up a position in the School of Environment at Charles Darwin University.



Dr Hamish Campbell
hamish.Campbell@une.edu.au
Twitter: @Hamish_Dr

2015 RESEARCH HIGHLIGHTS

The behavioural strategies of estuarine crocodiles

The estuarine crocodile is the world's largest reptile and Australia's most formidable predator. The Australian population has increased substantially in recent decades, and although an iconic species, a firm tourist attraction, and undoubtedly important to the freshwater and estuarine ecosystems the species poses a potential risk to the general public. This study examines the long-term behavioural strategies of adult crocodiles utilising satellite tags and underwater acoustic telemetry. Currently we are following the movements of over 80 adult crocodiles on the Wenlock River in Cape York, and have followed the lives of some individuals for over 4 years. Specific projects include; the behaviour of estuarine crocodiles around sites of human visitation, population dynamics and social behaviour, homing and navigation, trophic interactions and habitat linkages.



Prioritising habitat for the southern cassowary

The rainforest habitat of the southern cassowary has been extensively cleared by humans, and the population primarily exists as a metapopulation within discrete protected areas of remnant rainforest. We use satellite telemetry to define the relationship between cassowary home range, movement, site selection and the local landscape. This information is being used to optimise the limited funds available for the protection of land with a high conservation value for cassowaries. We are also examining the critical role cassowaries play as a disperser of native and exotic rainforest plants; and tracking juvenile cassowaries to better understand population connectivity between segregated sub-populations.



Defining critical habitat for riverine animals

Riverine systems are one of the most modified environments on the planet. This broad research program is developing a technique whereby acoustic transmitters and static underwater listening stations are used to provide the necessary data to populate species-predictive-models for aquatic animals. The research is identifying critical habitat and habitat connectivity for a range of threatened species inhabiting tropical waterways.



ENVIRONMENTAL MANAGEMENT

UNE has a long history in environmental science with the Bachelor of Natural Resources degree being the first of its kind in Australia, giving the school more than thirty years of research and teaching experience. Our location in the North Coast region of NSW means we have a wide diversity of ecosystems at our doorstep. To the east we have upland plains, temperate and rainforests, and an array of swamps and streams in pristine National Parks leading to populated urban centres in one of Australia's fastest developing regions. Heading west we find the expanse of the Murray-Darling Basin, with rangelands, irrigated cropping and regulated lowland rivers in a semi-arid climate.



Research Faculty

Prof Nick Reid
A/Prof Lalit Kumar
Dr Saeed Mahini
Dr Julian Prior
Dr Romina Rader
Dr Janelle Wilkes
Mr Rex Glencross-Grant

Adjuncts & Honorary

Assoc Prof Richard Faulkner

PhD Students

Isabelle Balzer
Sharon Brown
Heidi Kolkert
Kathryn Lambert
Rachel Lawrence
Michelle McKemey
Justine Philip
Lorena Ruiz Taloniat
Abbas Vahedian
Robert Baker
Hanieh Saremi
Abdullah Alqurashi
Chidumeje Okonkwo
Farzin Shabani
Amal Allbed
Dymphna Javie

Rasha Al-Jaryian
Mark Cameron
Nadiezhdha Cabral
Mofza Algahtany

Research Masters

Sue Jaggar
Yasser Maklad

BIODIVERSITY, LANDSCAPES AND ECOSYSTEM STEWARDSHIP

I am interested in how governments, industry, public and private organisations and the community can work together to pursue sustainable development, ecosystem stewardship and resilience-based, natural resource management and planning at local and regional scales. My current research interests include landscape revegetation and ecosystem restoration; the environmental impact of wild dog control in temperate wilderness and agricultural landscapes; the nature, value and assessment of ecosystem services; invasive native scrub: soil function, erosion, management and biodiversity correlates; sustainable farming and grazing systems; the role and management of biodiversity in production landscapes; tree–grass interactions; fire and protected area management; ecology and management of plant and animal communities; and environmental dispute resolution. Most of my time is committed to Academic Board presently, as well as the Invasive Animals CRC and the CRC for Spatial Information.



Prof Nick Reid
nrei3@une.edu.au

ECOSYSTEM SERVICES IN AGRICULTURAL LANDSCAPES

I am interested in the role of biodiversity in providing ecosystem processes/ services and how communities respond to drivers of global change (i.e. climate change, land use change). I am particularly interested in understanding how communities assemble and disassemble, change in functioning and how different forms of diversity are impacted at local and landscape scales, and environmental degradation.



Dr Romina Rader
rrader@une.edu.au
Twitter: @rominatwi

ENVIRONMENTAL POLICY

My research interests lie in the areas of natural resource policy, institutional analysis and capacity development, agricultural and natural resource extension, social capital-building for sustainable natural resource management, community-based natural resource management (including community adaptation to climate change), environmental dispute resolution, and natural resource and environmental management in developing countries.



Dr Julian Prior
jprior2@une.edu.au

REMOTE SENSING AND ENVIRONMENTAL MODELLING

My main research interests are in the fields of environmental modelling and Hyperspectral Remote Sensing. Currently I am involved in projects dealing with monitoring health and condition of wetland vegetation, developing indices based on Hyperion data for mapping tannin and nitrogen concentrations in forests, and modelling species distribution based on the tannin and nitrogen maps. In the past I have been involved in using GIS/RS technology for rangeland degradation, habitat mapping, biodiversity & conservation, salt-marsh vegetation mapping, and mapping the distribution of eucalyptus species based on potential solar radiation modelled in a GIS.



Assoc Prof Lalit Kumar
lkumar@une.edu.au

SUSTAINABLE ENGINEERING

We are at the forefront of the transition to a carbon-constrained world. Sustainable technologies are required to allow the world to adapt whilst ensuring a good quality of life for all its residents. Engineers can provide these technologies only through innovation and entrepreneurship. However it must be recognised that a vital link is required to facilitate the work of engineers.

Our purpose is to promote the use of sustainable technologies to protect the environment and to develop and offer sustainable and energy-saving solutions with low greenhouse gas emissions.



Rex Glencross-Grant
rglencro@une.edu.au



Dr Richard Koech
rkoech@une.edu.au



Dr Saeed Mahini
smahini@une.edu.au



Dr Janelle Wilkes
jwilkes2@une.edu.au

EVOLUTIONARY BIOLOGY

Research Faculty

Prof Jeremy Bruhl
Dr Rose Andrew
Dr Emma Sherratt

Postdoctoral Fellows

Dr Jamie Gorrell
Dr Jasmine Janes

Research Fellows

Dr Kerri Clarke

Adjuncts & Honorary

A/Prof Ralph Whalley

Masters Students

Iain Moore

PhD Students

Virgilio Linis
George Plunkett
Christina Prychid
Margaret Stimpson
Ian Telford
Nannette Thomas

BIOGEOGRAPHY & TAXONOMY OF AUSTRALIAN PLANTS

My main research interests are in the biology, ecology and systematics of Cyperaceae. I am part of the international network of researchers working on the Cyperaceae. My contributions to the Flora of North America were published in Volume 23 (2002). I also have been and am involved in studies on a wide range of Australian plant groups (including ferns, wattles, Myrtaceae, Euphorbiaceae, Phyllanthaceae, and Juncaceae).



Professor Jeremy Bruhl
jbruhl@une.edu.au

MORPHOLOGICAL EVOLUTION

I am an evolutionary biologist, focused on developing and applying comparative methods and morphometric tools to studying phenotypic evolution. I research macroevolutionary trends in the morphological evolution of vertebrates to understand the factors responsible for biodiversity. My empirical research has covered reptiles and amphibians, mammals and recently, molluscs. I apply my expertise in 3D digital imaging (micro-CT, surface scanning and microscopy) to characterising morphological variation. I use these data to contribute to systematics (taxonomy) and phylogenetics. And I also use these data with phylogenetic comparative methods to study macroevolution.

I am also interested in theoretical evolutionary biology: I develop morphometric and comparative tools to quantitatively assess phenotypic variation in a macroevolutionary context. In particular, I am working to better integrate 3D digital reconstructions of anatomy with morphometrics and functional biology and phylogenetic comparative methods.



Dr Emma Sherratt
emma.sherratt@une.edu.au
@DrEmSherratt

MOLECULAR ECOLOGY, LANDSCAPE GENETICS AND GENOMICS

I have a diverse background in the ecology, genetics and evolution of wild and domesticated organisms. My recent research involved ecological experiments, landscape genetics and population genomics in a recently-diverged sunflower (*Helianthus*) ecotype growing in extreme conditions in active sand dunes. My current focus is on the genomics of adaptation and speciation, with particular emphasis on their relationship to the landscape. Along the way, I have collaborated on corals, diatoms, birds and crops.

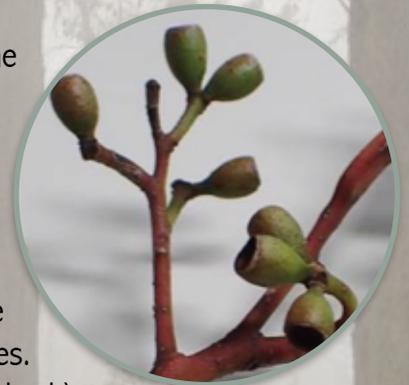


Dr Rose Andrew
randre20@une.edu.au

2015 RESEARCH HIGHLIGHTS

***Eucalyptus* speciation and adaptation**

In 2015 I was joined by Dr Jasmine Janes and Dr Jamie Gorrell from the University of Alberta to work on an ARC Discovery project, 'Genomic signatures of adaptive diversification in woodland *Eucalyptus*' with collaborators from The Australian National University and the University of Melbourne. They will be untangling the complex evolutionary history of the Adnataria (Box-Ironbark) group of species, with the goal of understanding the role that hybridisation has played. They have been working hard in the field to collect representative samples of 10 species from across their ranges. These include *Eucalyptus melliodora* (yellow box), *E. sideroxylon* (mugga ironbark) and *E. conica* (grey box). Strong synergies are developing between this project and that of Tim Collins, an Honours student (cosupervised with Jeremy Bruhl), who is studying the species boundaries between *E. conica* and its narrow endemic relative, *E. magnificata*, which occurs in gorge-rim habitat in the New England area. In another linked project, I have been seeking hybrid populations for mapping speciation genes in this group of species.



Feral cat research

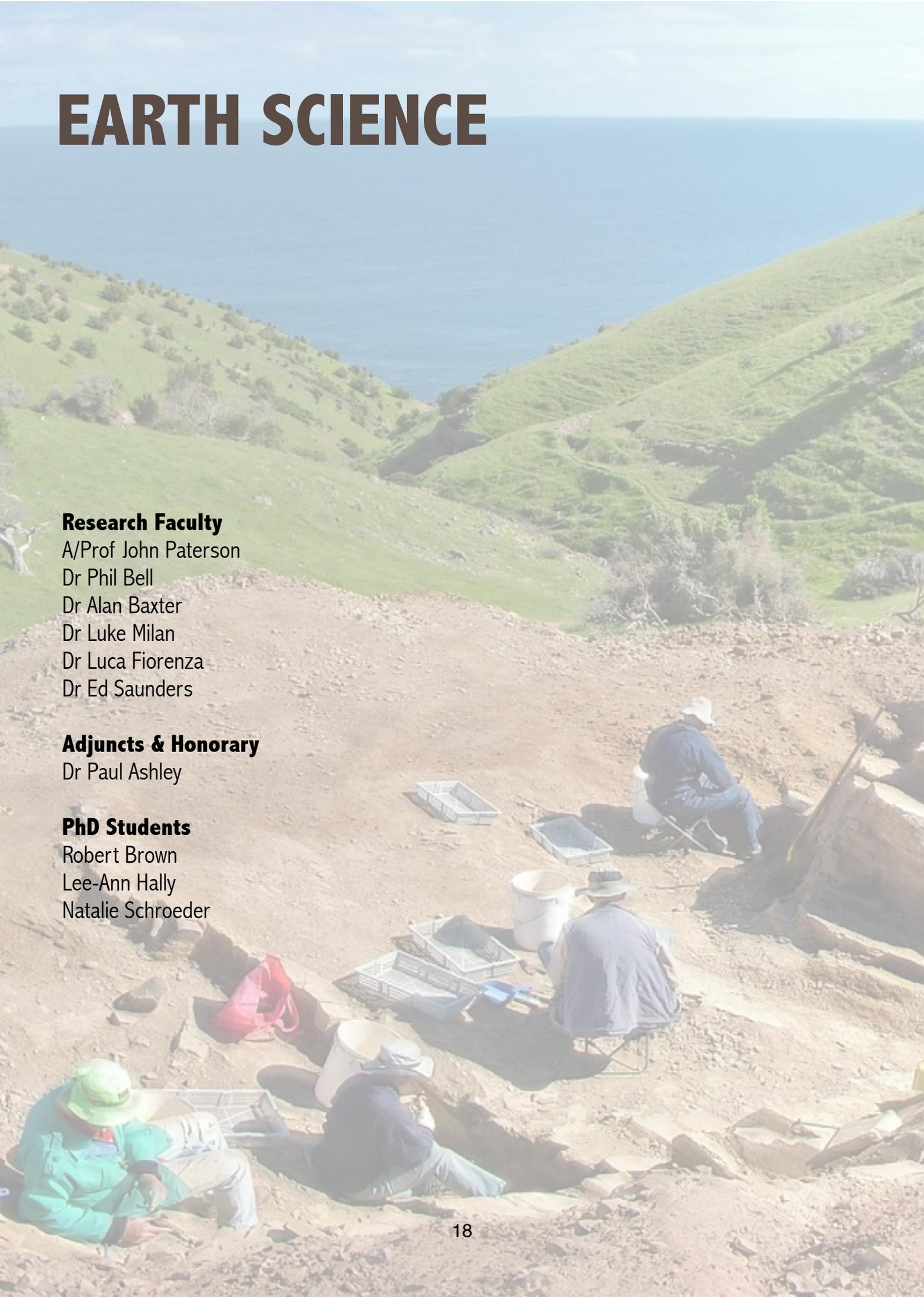
Our first foray into feral cat research has been made by Deane Smith, who has undertaken an Honours project on population genetics. He tested Illumina-based Genotyping-by-Sequencing using two restriction enzymes as a technique for assessing population structure and adaptive divergence in feral cats. Deane's results show that the source of tissue affects the success of this approach and identified regions in the genome that are highly divergent between feral and domestic cats.



Wildlife and weeds

Ahmad Barati (PhD candidate cosupervised with Paul McDonald) genotyped hundreds of Noisy Miners, which will tell him about their cooperative behaviour and social structure. Social behaviour is also at the heart of a study of the Yakka Skink, an endangered burrowing lizard, by Steve McAlpin (PhD candidate cosupervised with Hamish McDonald). He has completed an extensive survey of their habitat use diet. Weeds are a growing focus in the lab, with Elizabeth Pleskun (Masters candidate cosupervised with Caroline Gross) investigating the ecology and breeding system of Bitou Bush, and Abdul Rehman (MAGSci student) conducting a study of self-compatibility in weedy sunflowers.

EARTH SCIENCE



Research Faculty

A/Prof John Paterson

Dr Phil Bell

Dr Alan Baxter

Dr Luke Milan

Dr Luca Fiorenza

Dr Ed Saunders

Adjuncts & Honorary

Dr Paul Ashley

PhD Students

Robert Brown

Lee-Ann Hally

Natalie Schroeder

PALAEOZOIC FOSSIL ARTHROPODS

John's research contributions have primarily focused on documenting the palaeo-biodiversity of Australian Cambrian and Ordovician biotas (ca. 444 to 541 million years ago) and using these key fossils to answer major questions relating to evolution, biogeography and palaeoecology during this critical time interval. He has also used these fossils in the relative dating and correlation of strata around the globe in order to refine the geologic timescale. The multidisciplinary nature of his work includes numerous publications on taxonomy, phylogeny, biostratigraphy, biogeography, taphonomy and palaeoecology.



Assoc Prof John Paterson
jpater20@une.edu.au

2015 RESEARCH HIGHLIGHTS

Unearthing ancient seafood in South Australia



For almost a decade, ARC Future Fellow Prof John Paterson and his colleagues have been discovering and describing exquisitely preserved marine fossils from the Cambrian (515 million-year-old) Emu Bay Shale on Kangaroo Island. This deposit is exceptional because it contains soft-bodied fossils, including structures such as eyes, muscle and digestive glands, which are otherwise exceedingly rare in the fossil record. This type of preservation provides a critical window into the Cambrian world by giving a glimpse of complete organisms rather than the more common preferential preservation of hard parts, as well as shedding new light on the lifestyles, affinities and evolution of the earliest animals. Excavations since 2007 have unearthed over 35 new species, most of which are arthropods, the group that includes crustaceans, insects, spiders and centipedes. Many of these have been documented by Paterson and his team, but several are yet to be described. The Emu Bay Shale animals, in addition to information about their ecology and modes of preservation, are highlighted in a new review article by Paterson and co., published in the *Journal of the Geological Society*. The PDF of the article can be downloaded for free on the journal's website (<http://jgs.lyellcollection.org/content/173/1/1.full.pdf+html>), and is accompanied by a story on the Geological Society of London's blog site: <http://blog.geolsoc.org.uk/2015/11/24/eye-opening-fossil-deposits/>.



MESOZOIC VERTEBRATES AND PALAEOECOLOGY

Phil is especially interested in Australia's own Mesozoic past, particularly the range of dinosaurs and other vertebrates. Working with the Australian Opal Centre in Lightning Ridge, Phil is investigating an exciting new cache of dinosaur and other vertebrate fossils from the Early Cretaceous of Australia. His other main research focus lies with the dinosaur fauna of the Late Cretaceous Wapiti Formation (Alberta, Canada) and its intermediate position between the polar dinosaurs from Alaska and the better-known fauna from southern Alberta and Montana. Phil's research is multifaceted, covering a range of subject areas systematics including taphonomy, behaviour, palaeopathology, and palaeoecology.



Dr Phil Bell
pbell@une.edu.au

STRUCTURAL & METAMORPHIC GEOLOGY

Alan's main research interests are in subduction and volcanism, that occur at tectonic margins. This has led him to work on the extant Central American subduction system, as well as ancient examples such as the India-Asia collision zone and the New England Orogen. The geological history of convergent margins can be understood by studying the marine fossils found in these environments, so that we can apply time constraints to major events that occurred over their evolution. His current focus in micropalaeontology spans calcareous nannofossil and radiolarian biostratigraphy.



Dr Luke Milan
lmilan@une.edu.au

THE CRUST, THE MANTLE AND ORE DEPOSITS

Ed's research focusses on the link between the upper mantle and the crust, and especially in the role that the mantle may play in the mineralisation process. Much of his work over the last several years has involved sulfide minerals in upper mantle rocks. In late 2015, he shifted focus to zircon minerals in crustal rocks. Trace elements and Hf-isotope analysis of these minerals provides us with a great deal of information about the ore formation process and the role, if any, that the mantle has played in this process. Ed is interested in investigating other trace phases within crustal and mantle rocks in order to understand the relationships between these two domains.



Dr Ed Saunders
jsaund26@une.edu.au

2015 RESEARCH HIGHLIGHTS

Mobility of sulfides in the upper mantle

Sulfide minerals are a small component of the Earth's upper mantle (~600 ppm). However, these small and rare minerals are the primary host of important metals including copper, gold and the platinum group elements. They are also the sole host of the elements Re-Os, which form the main radiometric dating system for mantle events. Despite the importance of these minerals, there is still little known about how they are mobilised and transported in the deep Earth. Ed has focussed on geochemical analysis of these minerals and combined this with detailed petrological investigation of mantle xenoliths to develop a conceptual model for how these minerals might be mobilised and modified in the upper mantle.



Project: Can pyroxenites enrich Au in the upper mantle?

Pyroxenites are rocks that have crystallised from magmas that have intruded and crystallised the upper mantle. These represent mobile agents, and have been inferred to be responsible for mass transfer and enrichment of metals. Experimental studies have shown that these rocks are more fusible than peridotites, which are the most common rocks of the upper mantle. Therefore, they are likely to be source of many igneous rocks that we see in the crust. If they are inherently enriched in gold or other metals, then this has implications for mineralisation models. Ed's results indicate that these pyroxenites are not enriched in gold, contrary to previous suggestions. This is now being followed up by geochemical modelling to understand what other parameters may be important for producing gold-rich melts.



TECTONICS, SEDIMENTOLOGY AND BIOSTRATIGRAPHY

Alan's main research interests are in subduction and volcanism, that occur at tectonic margins. This has led him to work on the extant Central American subduction system, as well as ancient examples such as the India-Asia collision zone and the New England Orogen. The geological history of convergent margins can be understood by studying the marine fossils found in these environments, so that we can apply time constraints to major events that occurred over their evolution. His current focus in micropalaeontology spans calcareous nannofossil and radiolarian biostratigraphy.



Dr Alan Baxter
alan.baxter@une.edu.au
@alantbaxter

VIRTUAL ANTHROPOLOGY

Luca is a Palaeoanthropologist, expert in Virtual Anthropology and in Neanderthal Ecology. Luca's main research interests focus on functional morphology of the masticatory apparatus in human and non-human primates, and on the importance of the diet in human evolution. He is currently working on the reconstruction of African Plio-Pleistocene hominin diets from dental wear studies, combining 3D digital modeling, biomechanics and functional morphological analysis. During 2015, Luca took a position at the Monash Biomedicine Discovery Institute, Department of Anatomy and Developmental Biology, Monash University.



Dr Luca Fiorenza
Luca.Fiorenza@monash.edu

ZOOLOGY

Research Faculty

Prof Fritz Geiser
A/Prof Nigel Andrew
A/Prof Stephen Wroe
Dr Tommy Leung
Dr Paul McDonald
Dr Stuart Cairns

Research Fellows

Dr Julia Nowack
Dr Clare Nowack
Dr James Neenan
Dr Laura Wilson
Dr Maria Attard
Dr William Parr
Dr Jean Drayton
Dr John McEvoy

Adjuncts & Honorary

A/Prof Phillip Clausen
A/Prof Graham Hall
Dr Kirsti Abbott
Dr Steve Debus

PhD Students

Ahmad Barati
Martin Dillon
Kathryn Lambert
Leah Tsang
Ada Klinkhamer
Alannah Pearson
John Cook
Dr Peter Aquilina
Matt Binns
Isobel Roberts

Behnaz Ghaedi
Zac Hemmings

Masters Students

Matthew Godson
Phillip Hannay
Ellie Saadati
Tina Roshan

THE TORPOR LAB

Fritz is Professor of Zoology and the Director of the Research Centre for Behavioural and Physiological Ecology. His research focus is on ecological physiology, comparative physiology and biochemistry with a specific interest in thermoregulation and energetics relating to hibernation and daily torpor. His studies include an extensive range of vertebrates including monotremes (Echidnas) and marsupials (Dasyurids, Pygmy possums, Gliders, Opossums) placentals (Bats, Rodents, Elephant Shrews), Honeyeaters and other passerines (Kookaburras, Owllet-nightjars, Tawny Frogmouths) and reptiles and amphibians.



Prof Fritz Geiser
fgeiser@une.edu.au

2015 RESEARCH HIGHLIGHTS FOR THE TORPOR LAB

Responses of mammals to catastrophic events: behavioural and physiological aspects

Climate change is predicted to increase the occurrence of destructive wildfires and storms, and some of these changes are already apparent. Whereas the response of populations to environmental catastrophes is known to some extent, there is essentially no understanding of the physiological and behavioural adjustments that may enable individuals to survive these events. Our work provided the first data on how mammals respond to fire cues, how they cope with the post-fire decrease in resources, and how they deal with an increase in predation pressure. We also provided the first data on how mammals respond to extreme weather events, such as storms. We tested the hypothesis that the persistence of small mammals during or after extreme events is made possible by the use of torpor, which reduces energy expenditure and therefore foraging requirements.

Response of brown antechinus to a prescribed fire

Physiological and behavioural data were collected on free-ranging brown antechinus (*Antechinus stuartii*) at Guy Fawkes NP before (pre-fire group) and after a prescribed fire (post-fire group) in comparison to a control site. Most antechinus survived the fire and substantially increased torpor use and decreased activity after the fire, when ground cover was obliterated and foxes, feral cats and wild dogs had invaded. Ours is the first quantitative observation on how small mammals respond after fires.

See:

- Stawski C, Körtner G, Nowack J, Geiser F. (2015) The importance of mammalian torpor for survival in a post-fire landscape. *Biology Letters* 11:20150134
- Stawski C, Körtner G, Nowack J, Geiser F (submitted). Sex-specific changes in post-fire activity and thermal biology of a small mammal.

The work attracted a lot of media attention. A further two manuscripts are in preparation.



Response of sugar gliders to a severe storm

Storms provide an extreme environmental challenge to many organisms. We studied a population of sugar gliders (*Petaurus breviceps*) in a coastal subtropical habitat during spring when a storm with heavy rain and category 1 cyclone wind speeds passed the area. This arboreal marsupial is vulnerable to inclement weather due to their small body size and mode of locomotion. All twelve individuals remained in their established home ranges during the storm and either stayed inactive in their tree hollows or reduced foraging times during the cyclone. Although this species is reluctant to use torpor, most sugar gliders entered deep and prolonged torpor during the storm to minimise energy demands. All animals survived the storm and continued normal foraging during the following nights. It thus appears that torpor use may be an important survival strategy for small, non-flying vertebrates that cannot avoid storms. Nowack J, Rojas AD, Körtner G, Geiser F. (2015) Snoozing through the storm: torpor use during a natural disaster. *Scientific Reports* 5: 11243. The work was reported in *Science*.

Initial responses of mammals to fire cues

We established that torpid mammals can respond to smoke. The initial response of captive dunnarts (*Sminthopsis crassicaudata*) to smoke exposure was to arouse immediately from torpor and to increase activity. In contrast, a charcoal/ash substrate, which would be present shortly after a fire, resulted in a decrease in activity and torpor use. See: Stawski C, Matthews J, Körtner G, Geiser F. (2015) Physiological and behavioural responses of a small heterothermic mammal to fire stimuli. *Physiology and Behavior* 151:617-622.

Response of yellow-footed antechinus to a severe wild fire

A severe forest fire destroyed 88% of Warrumbungle National Park. Some populations of antechinus (*Antechinus flavipes*) survived the fire in situ apparently by hiding deep in rocky outcrops. Post-fire survival in the charred landscape evidently was achieved by using torpor frequently, basking to further reduce energy expenditure, and consuming mainly ants and some plant material; foraging was largely restricted to the night. As for the controlled fire, and supporting our hypothesis, torpor expression in both male and female antechinus was substantially higher (>2-fold) and torpor was deeper and longer than in a colder unburnt area and also in comparison to a



Other projects in 2015:

- Ecology and physiology of microbats: responses to a severe wild fire.
- Physiological implications of roost choice in an Australian microbat.
- Metabolism and heart rates of Gould's wattled bats at very low temperatures.
- Effect of temperature on the development and phenotypic plasticity of antechinus.
- The importance of fur colour and properties for basking: implication for the evolution of endothermy.

Torpor Lab Members in 2015

Shannon Currie, Marine Delesalle, Anna Doty, Fritz Geiser, Taylor Hume, Gerhard Körtner, Julia Nowack, Clare Stawski, Chris Wacker

FUNCTION, EVOLUTION AND ANATOMY RESEARCH (FEAR) LAB



Our primary interest is to improve our understanding of relationships between shape and function in living and fossil animals. We use computer based 3D modelling (Finite Element Analysis) and geometric

morphometrics to predict and analyse mechanical behaviour in skulls and other biological structures.

In addition to providing detailed information on how animals are adapted to particular behaviours and predictions for behaviour in fossil species, we apply these techniques to answer a wide range of biomedical questions. Other areas on which we have published and maintain an active interest in include vertebrate palaeontology, extinction of the Australian megafauna and marsupial carnivore phylogeny and biogeography.



Assoc Prof Stephen Wroe

swroe@une.edu.au

@StephenWroe

2015 RESEARCH HIGHLIGHTS



Sauropod in the Spotlight

An Australian dinosaur believed to be almost 100 million years old has become the oldest patient ever to visit the I-MED Radiology clinic in Mount Isa. Mount Isa Hospital and I-Med Radiology joined with the Australian Age of Dinosaurs Museum at Winton to make history on March 7 when CT scans were performed on Matilda – believed to be 95 million years old.

Recently Completed Projects in the FEAR Lab

- Virtual Reconstruction and Prey Size Preference in the Mid Cenozoic Thylacinid
- Comparison of cranial mechanics in marsupial and placental sabretooths
- Finite Element Analysis of terror bird crania

INSECT ECOLOGY

My current research focuses on a range of interlinked topics of significance to biological and geographical diversity. We are answering questions relating to responses of insects to habitat change along environmental gradients, and climate change. Our current research focuses on the impacts climate change will have on insect behaviour, ecology and physiology, insect community structure along environmental gradients, and insect-plant interactions.



Assoc Prof Nigel Andrew

nigel.andrew@une.edu.au

@nigel_andrew

AVIAN BEHAVIOURAL ECOLOGY LAB (ABEL)

<http://abel.une.edu.au/>

Research in the ABEL concentrates on better understanding the behaviour of animals, with a particular focus on avian systems. Our focus covers a range of fields, from bioacoustics through to genetics, movement ecology and the conservation/management issues that follow. To accomplish these aims, we employ techniques such as acoustic playbacks in the field and lab, molecular analysis of relatedness and paternity, GPS-based movement tracking through to survey taxa with passive acoustic recorders and UAVs or drones.



Dr Paul McDonald
paul.mcdonald@une.edu.au

2015 RESEARCH HIGHLIGHTS

New survey methods for monitoring gamebirds in NSW

One of the first steps in identifying how to conserve a group of animals is to first work out how big the populations are. For nomadic taxa such as waterfowl, quail and pigeons, across an area the size of NSW, this is not a trivial task. Together with Dr John McEvoy and Assoc. Prof. Graham Hall, we've been investigating new and more efficient ways of monitoring these species. The research has quantified a way of using drones to take high quality images that provide permanent records of waterfowl present in given areas, all without disturbing the birds. This provides a logistically simpler and more efficient monitoring tool to survey waterfowl than current techniques. The use of GPS tracking tags has enabled use to further identify movement of some waterfowl between different drainage systems in the state, and even interstate, confirming that management of waterfowl needs to consider actions outside of NSW. Finally, we have adapted passive acoustic biorecorders to survey cryptic taxa like Stubble Quail in areas that would otherwise require dogs or teams of volunteers to adequately survey.



Uncovering a complex acoustic signalling system

Noisy Miners have long been known to have one of the more complex social systems in the animal kingdom, but recent research led by students by Lucy Farrow and Ahmad Barati have uncovered a strikingly complex communication system to accompany this social existence.

Noisy Miners use a range of different vocalisations, and for predator detection different kinds of predators invoke different alarm calls from focal birds. This is termed 'referential signalling', a communication system that has only rarely been described in birds. Further, this research has provided the first example of 'true' individual recognition in avian acoustic communication, achieved by demonstrating that birds transfer habituation to the presence of an individual across different calls in their vocal repertoire. Effectively, this indicates that individuals are able to assign a particular vocalisation to a given individual, a strategy that is likely highly beneficial in social species that regularly interact.



Uncovering the drivers of Bell Miner Associated Dieback (BMAD)

Kathryn Lambert successfully submitted her PhD thesis on this topic in 2015, and was able to uncover some of the chief factors that underpin eucalypt dieback where Bell Miners, and thus BMAD, is found. The process is highly complex, but despite its name, little evidence of Bell Miners being the primary mechanism driving dieback was found. Instead, the research identified a number of other likely areas of interest for future research, as well as outlining protocols and developing techniques needed to achieve the much needed long-term monitoring of BMAD affected forests into the future.



PARASITE EVOLUTION AND ECOLOGY

Because parasitism is such a common way of life and has independently evolved in many different groups, parasites are useful study organisms for asking various different questions which are applicable to most free-living organisms like fish, birds, or trees. At the same time, there are interesting challenges. Parasites are often overlooked due to their comparatively small sizes and because they are tucked away inside the body of their hosts. The study of parasitism offers us a glimpse into a hidden world of biological drama and intrigue which sometimes can have larger ramifications for the rest of the ecosystem.



Dr Tommy Leung
tleung6@une.edu.au
@The_Episiarch

2015 RESEARCH HIGHLIGHTS

Parasitic nematodes in migratory birds

Many birds undergo migration journeys that cover enormous distances. This is an energetically and physiologically demanding exercise. Like other vertebrate animals, each bird harbours a rich community of parasites which can have various effects on the host's health. While most studies have looked at the relationship between blood parasites and migratory birds, our study focused on an overlooked, but important, group of parasites - the nematodes (roundworms). We found that overall, migratory birds have more diverse communities of roundworms compared with their non-migratory relatives. We also found that bird species with proportionately larger spleens also have richer nematode fauna. The factors that are responsible for driving this divergent pattern will be the focus of ongoing research. (For further information, see: Koprivnikar, J., & Leung, T. L. (2015). Flying with diverse passengers: greater richness of parasitic nematodes in migratory birds. *Oikos* 124(4), 399-405.)

MAJOR RESEARCH FACILITIES

NEWHOLME FIELD RESEARCH STATION

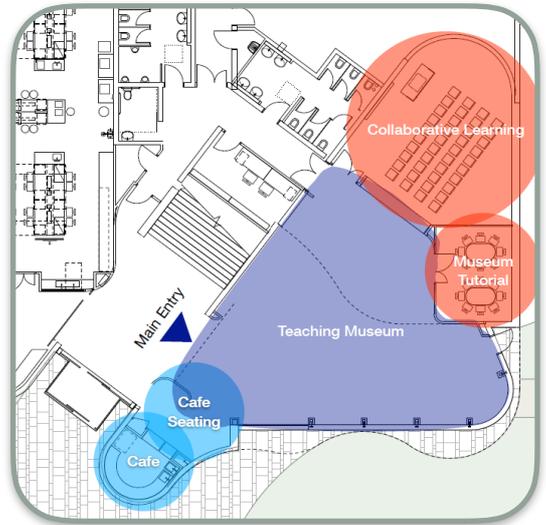
'Newholme' is unique among UNE's rural property estate in having large tracts of natural forest cover (with several forest types) giving it an overall high conservation value. Much of the forest and woodland types, and several riparian zones, have been de-stocked (since 1982). Most of the property is managed in an agriculturally un-manipulated manner other than grazing, to maintain research and teaching options (e.g. imposition of particular land and water treatments) as well as land and water uses representative of the surrounding region. Embedded in the property is Mt Duval Nature Reserve, supporting old-growth native forest and surrounded by Newholme's main conservation zone, the 300 ha Mountain Paddock.

Newholme has a strong tradition as an outdoor classroom for the teaching of undergraduate students in theoretical and practical methods related to natural resource management, zoology, botany, ecology and agricultural sciences. One of the great practical strengths of Newholme as a field laboratory is its close proximity to the UNE campus - few other universities can have their students in the field within 15 minutes of leaving the classroom, and at a research site that is rich with long-term research data, and the support of laboratory and other research facilities. The lab at Newholme includes seating for about 30 students, and has a fully equipped kitchen for overnight stays. The lab can be adapted as workstations for student projects, or as a 'lecture theatre' for student presentations and lectures.



UNE NATURAL HISTORY MUSEUM

The new science building that will house the UNE Natural history Museum is due for completion in late April 2016. The Natural History Museum is set to be an exciting and interactive museum space and will be a regional draw card for school groups and members of the general public, as well as serving an important role in natural history teaching and research at UNE. The 140 square metre space will include display cabinets and plinths showcasing a full life-size cast of an Australovenator dinosaur skeleton (only the second such specimen in existence, and the only one in NSW), vertebrate and invertebrate diversity, New England plants and animals and UNE research. The space will include a separate collaborative learning centre, specimen preparation and storage areas, and a tutorial room. LEE Theme member **Dr Romina Rader** is overseeing the interior design of the museum, in preparation for its opening in 2016. UNE has employed two expert museum contractors to facilitate the relocation of the Zoology Museum and exhibit design process: Dean Smith from *Environmental Creations*, who has expertise in taxidermy, scale models and specimen restoration, and Nich Brown from *Thylacine* in Canberra, who has expertise in exhibit design and installation. As of late 2015, the dinosaur has been ordered and is currently being prepared, and the cabinet drawings and audio-visual components have all been finalised. Meanwhile, LEE theme members eagerly await the opening of New England's first Natural History Museum!



HERBARIUM

The N.C.W. Beadle Herbarium (NE) at UNE consists of c.100 000 vascular plant specimens, housed in a purpose built facility with excellent stereomicroscopes and specimen imaging equipment.

Herbarium NE was the first university-only herbarium to deliver data to Australia's Virtual Herbarium and Atlas of Living Australia (c. 83 000 records from 2013). Herbarium NE is internationally recognised, and is able to exchange specimens with, borrow from and lend to other recognised herbaria. For more details and contacts please look on our website, <http://www.une.edu.au/about-une/academic-schools/school-of-environmental-and-rural-science/facilities/ncw-beadle-herbarium>.



ZOOLOGY MUSEUM

The Zoology museum was established in 1969 as a teaching museum with displays primarily designed to support the teaching of the Zoology department's own students. The displays stress form, anatomy, taxonomy and evolutionary relationships within all of the major Zoological groups and include several fine sequences of associated fossils.



Anyone is welcome to visit the museum, and entry is free of charge. Teachers proposing to make use of this facility need firstly to make a booking and perhaps visit the museum beforehand to work out a study schedule for the class to use on its visit. Due to space limitations, numbers should be limited to 25. Guided visits for more senior students with specific interests can be arranged by appointment. In April 2016, the existing Zoology Museum will be closed, and relocated to the new UNE Natural History Museum, currently under construction (see previous page).

GEOLOGY COLLECTION

The School maintains a comprehensive collection of rock and fossil samples from research collections. These are predominantly from the New England region (the most comprehensive collection of New England rocks worldwide). Approximately 75,000 rock samples are catalogued.

The School also maintains a small core library, with a selection of drill core from Eastern Australia. The Mineral, Rock, Fossil and Drill Core Collection is available for research work undertaken by all students and staff of UNE, as well as other universities and research institutions. Some of this material will find a home in the UNE Natural History Museum from 2016.



2015 GRANTS & AWARDS

TABLE 1: Grants awarded in 2015. Where funding commences in 2016, the funded amount is not shown, and does not contribute to the total. This table does not include funds awarded before 2015, that may be ongoing.

| Lead CI | Research Team | Project Title | Funding Scheme | Funding Amount |
|-----------------------|---|---|---|----------------|
| Andrew | A/Prof Nigel Andrew Dr Ian Oliver | OEH, UNE Research Partnership to test the impacts and benefits of domestic stock grazing on terrestrial invertebrate biodiversity in Red Gum and Cypress reserves | Office of Environment and Heritage | \$170,180 |
| Andrew | A/Prof Nigel Andrew Dr Alan Anderson A/Prof Robert Dunn Prof Nathan Sanders | Future Keepers: impacts of climate change on ecosystem function providers | Australian Research Council - Discovery | \$325,600 |
| Bruhl | Mr Tim Collins Dr Boyd Wright Mr Ben Edward Vincent Prof Jeremy Bruhl | Bush Blitz of Vascular Plants within Oxley Wild Rivers Reserve | Director of National Parks - Bush Blitz | \$4,000 |
| Campbell | Dr Hamish Campbell | Determining the behaviour and social dynamics of southern cassowaries around anthropogenic food sources: Ecological source or sink? | Birds Queensland | \$4,880 |
| Campbell | Dr Guy Ballard Dr Hamish Campbell Dr John Hunter Miss Dana Lee Vickers | Ecological dynamics in a semi-arid ephemeral floodplain landscape | Holsworth Wildlife Research Endowment | \$5,000 |
| Falzon | Dr Gregory Falzon A/Prof Karl Vernes Mr Paul Meek Dr Guy Ballard Dr Peter Fleming | Wild dog alert: Getting Ahead of the Pack | Invasive Animal CRC | \$732,410 |
| Hall | Dr Graham Hall A/Prof Nigel Andrew Ms Sue Roslyn Jaggar | Interactions between natural enemies of greenhouse whiteflies as control agents on greenhouse tomatoes | Costa Group - PHD | \$15,000 |
| Hinch | Prof Geoffrey Hinch Prof James Rowe Prof Iain Young Dr Stephen Wroe Dr Mark Trotter | Smart data management for Smart livestock production | National Landcare Programme National Scheme | \$539,000 |
| Hobley | Dr Nellie Hobley Dr Brian Wilson Dr Geraldine Jacobsen | Contribution of pyrogenic carbon to long-term soil carbon storage | Australian Institute of Nuclear Science and Engineering | \$10,495 |
| Lerosey-Aubril | Dr Rudy Lerosey-Aubril Dr Robert R. Gaines Dr Javier Ortega-Hernandez Dr Peter Van Roy Dr Thomas A. Hegna | The Weeks Formation Lagerstätte (Utah, USA): a unique window on the evolution of animal life during the late Cambrian | National Geographic Society | \$20,766 |
| Mahini | Dr Mahini | The assessment of the load capacity of the culvert at the Armidale Airport | Armidale Dumaresq Council | \$4,500 |
| McDonald | Dr Paul McDonald Dr Rose Andrew Prof Hugh Ford Mr Ahmad Barati | Cooperative breeding dynamics in the Noisy Miner (<i>Manorina melanoccephala</i>) | Holsworth Wildlife Research Endowment | \$7,000 |
| Mika | Dr Sarah Mika Dr Adrienne Burns A/Prof Darren Ryder | Water Quality Monitoring of the Bellinger and Kalang Rivers | Bellingen Shire Council | \$14,414 |

| | | | | |
|--------------|---|--|---|-----------|
| Mika | Dr Sarah Mika Mr Ben Edward Vincent A/Prof Darren Ryder | Mapping Macrophyte beds in the freshwater Macleay main stem | Kempsey Shire Council | \$19,995 |
| Prior | Dr Richard Koech Mr Julian Prior | Ext. Ref. C2014/288 - South Asia sustainable intensification scaling out guidelines, with special reference to agribusiness engagement | ACIAR | \$45,000 |
| Prior | Dr Lisa Lobry De Bruyn Mr Julian Prior Dr Richard Koech Ms Michelle Carnegie | Evaluation of the Collaborative Delivery model between the Landcare Networks and Northern Tablelands Local Land Services | NSW Government Local Land Services Northern Tablelands | \$77,981 |
| Prior | Mr Julian Prior Ms Jennifer Bellamy | Towards a multidisciplinary program for improving rural livelihoods through integrated management of the Inle Lake catchment, Myanmar | University of Queensland | \$11,378 |
| Rader | Dr Romina Rader Dr Saul Cunningham | Quantifying the role of wild insect pollinator biodiversity in the provision of pollination ecosystem services | Ian Potter Foundation | \$140,000 |
| Reid | Ms Heidi Kolkert Prof Nick Reid Dr Rhiannon Smith Dr Romina Rader Mr Karrar Al-Hajjya | Role of native vegetation as habitat for invertebrate and vertebrate natural pest control agents in cotton, and impact on growers' profits | High Profile Site Program- North West Local Land Services | \$50,000 |
| Reid | Prof Nick Reid Dr Rhiannon Smith Dr Romina Rader Sarah Ellen McDonald Dr John Hunter Dr Cathy Waters Mr David Tongway | Grazing management for biodiversity conservation and landscape function in the semi-arid rangelands of North-West NSW | Local Land Services Western | \$5,000 |
| Reid | Prof Nick Reid Dr Romina Rader Dr Rhiannon Smith Ms Heidi Kolkert | Pest control provided by microbats as an incentive for habitat restoration on agricultural land | Holsworth Wildlife Research Endowment | \$7,000 |
| Reid | Prof Nick Reid Dr Rhiannon Smith Ms Jacqueline Reid Mrs Sharon Brown Dr David Carr | Northern Tablelands direct seeding experimental trials | On-Ground partnerships grant scheme | \$5,000 |
| Reid | A/Prof Karl Vernes Dr Guy-Anthony Ballard Prof Nick Reid Dr Gerhard Koertner Mr Michał Krzysztof Smielak | Responses of critical-weight-range, terrestrial mammals to wild canid control. | Holsworth Wildlife Research Endowment | \$7,500 |
| Ryder | A/Prof Darren Ryder Mr David Mackay Prof Caroline Gross A/Prof Ralph Whalley Dr Maurizio Rossetto | Can the native Rusty Fig, <i>Ficus rubiginosa</i> , beat climate change? | Australia Flora Foundation | \$10,780 |
| Ryder | Mr David Mackay A/Prof Darren Ryder | Can the native Rusty Fig, <i>Ficus rubiginosa</i> beat climate change? | Holsworth Wildlife Research Endowment | \$7,500 |
| Ryder | A/Prof Darren Ryder Dr Sarah Mika | Ecohealth: A catchment health monitoring program for the Macleay catchment | Kempsey Shire Council | \$172,000 |
| Ryder | A/Prof Darren Ryder | Northern Tablelands Local Land Services Upland Wetlands Scoping Project (897) | EcoLogical Australia | \$3,500 |
| Ryder | Dr Sarah Mika A/Prof Darren Ryder | Ecohealth: Coffs Harbour City Council | Coffs Harbour City Council | \$3,500 |
| Ryder | Dr Paul Frazier A/Prof Darren Ryder | Warrego Darling LTIM Stage 2: Warrego-Darling Rivers Long term Intervention Monitoring | EcoLogical Australia | \$325,000 |

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|----------------|--|---|---|------------------------|
| Smith | Prof Nick Reid Mr David Tongway Dr Rhiannon Smith A/Prof Darren Ryder | Managing riparian corridors on cotton farms for multiple benefits | Cotton Research and Development Corporation | \$404,999 |
| Stawski | Dr Clare Stawski | Key mammalian survival strategies in a rapidly changing environment | Australian Research Council - Discovery Early Career Researcher Award (DECRA) | \$372,000 |
| Trotter | Dr Mark Trotter Dr Hamish Campbell Dr Mitchell Welch Prof David Lamb Mr Zachary Economou Mr Michael Moodle Mr Jamie Barwick Dr Rick Llewellyn | Maintaining Ground Cover in Mixed Farming Systems | CRC for Spatial Information | \$70,520 |
| Trotter | Dr Mark Trotter Dr Hamish Campbell Dr Mitchell Welch Prof David Lamb Mr Zachary Economou Mr Jamie Barwick Mr Michael Moodle Dr Rick Llewellyn | Spatially Enabled Livestock Management: Maintaining ground cover in mixed farming systems | CRC for Spatial Information | \$30,000 |
| Vernes | A/Prof Karl Vernes Mr Brad Nesbitt | Modelling Feral Horse Populations in the Guy Fawkes River National Park | National Parks and Wildlife Service | \$3,650 |
| Vernes | A/Prof Karl Vernes Mr Trent Andrew Forge Dr Gerhard Koertner Dr Peter Fleming Dr Guy Ballard | Determining reproductive success and juvenile mortality rates in spotted-tailed quolls | Australia New Zealand Holsworth Wildlife Research Endowment | \$7,500 |
| Vernes | Ms Frances Zewe A/Prof Karl Vernes | Genetic profile of Feral Cats in the New England | Holsworth Wildlife Research Endowment | \$7,500 |
| Vernes | A/Prof Karl Vernes | Endeavour Research Fellowship - Bhutanese student: Phuntscho Thinley | Endeavour Scholarships and Fellowships | Funding commences 2016 |
| Wilson | Dr Brian Wilson | Identify carbon storage potential for NSW lands to participate in ERF and carbon markets | Office of Environment and Heritage | \$30,000 |
| Wilson | Dr Brian Wilson Prof David Lamb | Improved high-resolution carbon accounting in diverse landscapes for participation in carbon markets | CRC for Spatial Information | \$108,000 |
| Wilson | Dr Brian Wilson | Endeavour Research Fellowship - Indian student: Debarati Bhaduri | Endeavour Scholarships and Fellowships | Funding commences 2016 |
| Wilson | Dr Susan Wilson Dr Matthew Tighe | Endeavour PhD Scholarship - Sri Lankan student: Sajanee Ganga Gunadasa Hene Kapuralalage | Endeavour Scholarships and Fellowships | Funding commences 2016 |
| Wilson | Dr Oliver Knox A/Prof Lily Pereg Dr Gunasekhar Nachimutha Prof Heiko Daniel Dr Nellie Hobley Mr Brendan Griffiths Dr Brian Wilson | Soil Systems Research - physical, chemical and biological processes for plant growth and nutrient cycling down the whole soil profile | Cotton Research and Development Corporation | \$517,251 |
| Wroe | AssocProf Stephen Wroe Dr Gerald Grellet-Tinner | Endeavour Research Fellowship - American student: Gerald Grellet-Tinner | Endeavour Scholarships and Fellowships | Funding commences 2016 |
| TOTAL | | | | \$4,295,799 |

HDR GRADUATES IN 2015

DOCTOR OF PHILOSOPHY

Shannon Elizabeth Currie (School of Environmental and Rural Science) 'Cardiorespiratory Function and Metabolism of Heterothermic Bats' Principal Supervisor: Professor Fritz Geiser (Conferred on 28th July, 2015)
- **Recipient of the Chancellor's Doctoral Research Medal**

Karlie Sara McDonald (School of Environmental and Rural Science) 'Integrated Modelling of Spatial and Temporal Heterogeneity in Trophic Shifts: A Bayesian Network Approach Based on Empirical Data Collection' Principal Supervisor: Associate Professor Darren Ryder

Nukunu Awuku Nanedo (School of Environmental and Rural Science). 'A Critical Analysis of Decentralisation and Community-Based Irrigation Water Resource Governance in Ghana'. Supervisors: Dr Julian Chisholm Prior, Dr Graham Marshall, Dr Lisa Lobry De Bruyn,

Ana Daniella Rojas (School of Environmental and Rural Science) 'Thermal Biology and Activity Patterns of Antechinus (Marsupialia) in Relation to Reproduction' Principal Supervisor: Professor Fritz Geiser

Hanieh Saremi (School of Environmental and Rural Science) 'Use of LiDAR Data to Quantify the Influence of Topography on radiata pine (*Pinus radiata* D. Don) at the Sub-Compartment Level' Principal Supervisor: Associate Professor Lalit Kumar

Peter Andrew Serov (School of Environmental and Rural Science) 'The Systematics and Phylogenetics of the Anaspidacea (Crustacea: Malacostraca: Syncarida)' Principal Supervisor: Associate Professor Nigel Andrew,

Ian Robert Hall Telford (School of Environmental and Rural Science) 'Revisionary Studies in Synostemon (Phyllanthaceae, Phyllanthae): Morphological and Molecular Data Corroborate Generic Recognition of Synostemon and with Increased Species Diversity' Principal Supervisor: Professor Jeremy Bruhl

Lisa Thurtell (School of Environmental and Rural Science) 'The Response of Aquatic Communities to Water Quality, Land Use, Flow Variability and Extraction in an Unregulated Australian Coastal River' Principal Supervisor: Associate Professor Darren Ryder

MASTER OF SCIENCE

Iain Samuel Fraser Moore (School of Environmental and Rural Science) 'Systematics in the *Bulbine glauca* Complex (Asphodelaceae or Xanthorrhoeaceae subfam. Asphodeloideae)'. Supervisor: Professor Jeremy Bruhl

Andrew Peter Smolders (School of Environmental and Rural Science) 'From Catchment to Consumer: Safeguarding Potable Water Supply through Understanding Contamination Risks in Source Water Catchments' Principal Supervisor: Associate Professor Darren Ryder.

2015 RESEARCH OUTPUTS

SELECTED PUBLICATIONS

Peer-reviewed Papers

Andrew RL, Albert AYK, Renaut S, Rennison DJ, Bock DG, and Vines T. 2015. Assessing the reproducibility of discriminant function analyses. *PeerJ* 3:e1137

Bahemmat. M, Farahbakhsh, M, Shabani. F., (2015) "Compositional and metabolic quotient analysis of heavy metal contaminated soil after electroremediation", *Environmental Earth Sciences* DOI: 10.1007/s12665-015-4429-0

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LEE SEMINAR SERIES

The LEE Seminar Series brings exciting speakers from around the world to UNE and showcase our UNE talent. The two aims are to bring our diverse theme together and as a community, and to facilitate collaboration and networking with researchers at other institutions. Together with advertising the seminars through emails and posters, staff have been persistent in encouraging their postgraduate students to attend. This is essential to both the success of the seminar series and to the students' own development. The series has been well attended by staff and students of the LEE theme, as well as undergraduates and members of the other two themes in the School. Dr Rose Andrew and Dr Emma Sherratt brought together a fantastic seminar line-up for 2015. All of these presentations are available as podcasts - see the link below.

Presenters and Titles

Dr Nellie Hobley, University of New England. "The depth distribution of soil organic carbon in the soils of NSW". 8 April, 2015.

Dr Heinrich Mollison, Museum für Naturkunde, Berlin, Germany. "Virtual Vertebrate Palaeontology – from scanning to motion modelling". 16 April, 2015.

Dr Robert Gaines, Pomona College, California USA. "The Cambrian Explosion: new fossil assemblage from The Burgess Shale". 23 April, 2015.

Dr Luca Fiorenza, University of New England. "To meat or not to meat? New perspectives on Neanderthal diet". 7th May, 2015.

Dr Stephan Lautenschlager, Bristol University, UK. "How to build a dinosaur: digital reconstruction and biomechanical modelling in vertebrate palaeontology". 21st May, 2015

Dr John McEvoy, University of New England. "From farm ducks to desert nomads: the movement of arid zone waterfowl". 4th June, 2015

Dr Sarah Mika, University of New England. "Processes driving aquatic biodiversity: from rocks to regions". 17th June, 2015.

Professor Fritz Geiser, University of New England. "Hibernation and Daily Torpor for non-Physiologists". 1st July, 2015.

Professor Jim Trappe, Oregon State University, Corvallis, USA. "Why Australia needs truffles: co-evolved interactions of fungi, animals and plants in an era of climate warming". 15th July, 2015.

Professor Chris Dickman, University of Sydney. "Risks and rewards: the ecology of boom-bust cycles in arid Australia". 29th July, 2015.

Dr Greg Edgecombe, Natural History Museum, London, UK. "Large centipedes, larger datasets and the role of morphology in the genomic era". 5th August, 2015.

Dr Alan Baxter, University of New England. "IODP Expedition 354: Bengal Fan | Understanding the roof of the world from the bottom of the ocean". 12th August, 2015.

Dr Paul McDonald and Dr Graham Hall, University of New England. "The good, the bad and the ugly: a review of UNE's recent Botswanan tour". 26th August, 2015.

Dr Jasmine Janes, University of New England. "Genomics to management: studies of the mountain pine beetle system in Canada". 9th September, 2015.

Presenters and Titles

Dr Jamie Gorrell, University of New England. “Fitness and social behavior in an asocial species: Highlights from 30 years of chasing red squirrels”. 23rd September, 2015.

Dr Jodi Rowley, Australian Museum Research Institute. “Misty Mountains and Moss: Frogs In search of Southeast Asian Amphibians” 30th September, 2015.

Dr Steve Salisbury, University of Queensland. “Palaeontology, song cycles and conservation: tracking dinosaurs in the Kimberley”. 7th October, 2015.

Professor Mike Crisp, Australian National University. “How was the Australian flora assembled over the last 65 million years? A molecular phylogenetic perspective”. 14th October, 2015.

Rex Glencross-Grant, University of New England. “The Changing Face, Pace and Place of Solid Waste Management”. 4th November, 2015.



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Natural Resources Building (W55),
School of Environmental and Rural Science
University of New England, ARMIDALE, 2351