



THEO MURPHY HIGH FLYERS THINK TANK 2011

STRESSED ECOSYSTEMS

BETTER DECISIONS FOR
AUSTRALIA'S FUTURE



PROGRAM

HOTEL GRAND CHANCELLOR, BRISBANE
29–30 SEPTEMBER 2011

FOREWORD

Each year since 2002, the Australian Academy of Science has held a High Flyers Think Tank to bring together some of Australia's brightest young minds to consider a topic of national importance.

Many human activities including mining, agriculture, urbanisation, invasive species, tourism, as well as natural events, impact upon Australia's diverse ecosystems. The devastating flooding and cyclone in Queensland earlier this year are a case in point. For this reason Brisbane was selected as a particularly appropriate location for the 2011 Think Tank on *Stressed ecosystems: better decisions for Australia's future*.

The development of accurate methods of predicting the effects of stress on Australia's ecosystems is critical for policymakers to make robust decisions regarding the management of these complex systems. The Think Tank represents a valuable opportunity for leading early to mid career researchers from a diverse range of disciplines to explore ways in which researchers can supply useful scientific information to inform policy formulation so that Australia's unique ecosystems will be preserved and sustained into the future.

The 2011 Think Tank is generously supported by funds from the Theo Murphy (Australia) Fund provided by the UK Royal Society. The Academy is pleased to have this funding available to enable some of Australia's outstanding young scientists to engage in fresh thinking about an issue of great importance to the nation and to develop networks that will sustain their careers into the future.

Professor Suzanne Cory AC PresAA FRS
President, Australian Academy of Science



8.15 am Registration

SESSION 1 INTRODUCTORY SESSION

Chair: Professor Hugh Possingham FAA

2011 Theo Murphy High Flyers Think Tank Organising Committee, Chair

9.00 am Welcome

Professor Suzanne Cory AC FAA FRS
President, Australian Academy of Science

9.05 am Opening address

The Honourable Rachel Nolan MP
Queensland Minister for Finance,
Natural Resources and the Arts

9.20 am Risk and uncertainty

Professor Mark Burgman FAA
Director, Australian Centre of Excellence
for Risk Analysis and Adrienne Clark Chair
of Botany, School of Botany, University
of Melbourne

9.40 am Science advising policy

Anthony Swirepik
Manager, Climate Science Team,
Department of Climate Change
and Energy Efficiency

**10.00 am Modelling for natural resource
management**

Professor Hugh Possingham FAA
ARC Federation Fellow, Director of
The Ecology Centre and ARC Centre of
Excellence for Environmental Decisions,
University of Queensland

10.30 am MORNING TEA

SESSION 2 BREAKOUT GROUPS

11.00 am Introduction

Group Experts

11.20 am Breakout Group Discussion

Group A – Bowen and Surat Basins

Chair: Anthony Swirepik
Expert: Professor Sue Golding
Venue: Chancellor 6

**Group B – Melbourne's peri-urban
grasslands**

Chair: Professor Mark Burgman
Expert: Dr Sarah Bekessy
Venue: Chancellor 1

Group C – Ningaloo Marine Park

Chair: Professor Peter Mumby
Expert: Dr Martial Depczynski
Venue: Boardroom 1

Group D – Murray-Darling Basin

Chair: Professor Hugh Possingham
Expert: Ian Burns
Venue: Boardroom 2

1.00 pm LUNCH

2.00 pm Return to breakout groups

3.30 pm Afternoon tea

4.00 pm Return to breakout groups

5.30 pm Close Session 2

**6.30 pm Coaches depart Hotel Grand Chancellor
for dinner venue**

**7.00 pm Pre-dinner drinks at the
Botanic Gardens Mt Coot-tha**

**7.30 pm Dinner at the Botanic Gardens
Mt Coot-tha**

Speaker: Dr Geoff Garrett AO FTSE
Queensland Chief Scientist

**10.00 pm Coaches depart Botanic Gardens
Mt Coot-tha for Hotel Grand Chancellor**

DAY 2

FRIDAY 30 SEPTEMBER 2011

8.00 am Return to breakout groups to finalise rapporteur presentations

SESSION 3 RAPPOREUR PRESENTATIONS

9.30 am Chair: **Professor Suzanne Cory AC PresAA FRS**
President, Australian Academy of Science

Reports from each group
Rapporteurs to be given 15 minutes plus 10 minutes discussion

9.40 am **Group A – Bowen and Surat Basins**

Dr Tiffany Morrison
Dr Cholachat Rujikiatkamjorn

10.05 am **Group B – Melbourne’s peri-urban grasslands**

Dr Bernd Gruber
Dr Kerrie Wilson

10.30 am **MORNING TEA**

11.00 am **Group C – Ningaloo Marine Park**

Dr Kirsty Douglas
Associate Professor Ryan Lowe

11.25 am **Group D – Murray-Darling Basin**

Dr Samantha Capon
Dr Philip Wallis

11.50 am **Open discussion**

Chair: Professor Hugh Possingham

12.40 pm **Summary**

Professor Hugh Possingham

1.00 pm **LUNCH**

2.00 pm **Closed session: outcomes and recommendations**

Organising Committee, experts, rapporteurs and Academy secretariat

2.30 pm **Coaches depart for airport**

5.00 pm **End of Think Tank program**

INTRODUCTION

2011 THINK TANK – STRESSED ECOSYSTEMS: BETTER DECISIONS FOR AUSTRALIA'S FUTURE

Many human activities including mining, agriculture, urbanisation, invasive species, tourism, changed disturbance regimes as well as natural events, impact Australia's diverse ecosystems. Robust decision-making for Australia's ecosystems depends on accurate data, reliable models of ecosystems under stress, and an understanding of the uncertainties in these analyses. Prediction of the consequences of different actions or policies is the foundation of wise, informed decisions. *Models* (quantitative or qualitative) are important for understanding the interplay between human activities and ecological effects, identifying methods to mitigate negative impacts on ecological systems, to foreshadow adverse ecological events, and to make plans for preserving and sustaining ecosystems.

The Think Tank will use four Australian ecosystem case studies for discussion:

- A** Queensland's Surat and Bowen Basins
- B** Melbourne's peri-urban grasslands
- C** Ningaloo Marine Park
- D** Murray-Darling Basin.

The 2011 Think Tank *Stressed ecosystems: better decisions for Australia's future* is a valuable opportunity for some of Australia's leading early and mid career researchers to identify and propose new approaches to understanding the effects of stresses on complex ecological systems. Participants will focus on identifying cross-disciplinary research opportunities, methods to overcome the current impediments to accurate modelling, data collection and decision-making, and will suggest future research priorities. They will discuss ways in which science can facilitate a better understanding of the stresses experienced by Australia's ecological systems, with the ultimate aim of providing useful scientific information to advise policy development and management.

THE PROCESS

As outlined in the program, the Think Tank theme – *Stressed ecosystems: better decisions for Australia's future* – will be introduced with three brief presentations.

These presentations are aimed at stimulating lateral thought in the discussions that form the remainder of the Think Tank rather than providing comprehensive coverage of the theme or any of the four specialist topics.

The afternoon session of the first day of the Think Tank is dedicated to discussions in small breakout groups. Each participant has been assigned to one of four breakout groups, each of which will also comprise a chair, and an 'expert' who will provide background information and answer any specific questions arising during discussion of the group's ecosystem case study. Each group comprises a mix of skills and experience in order to stimulate lateral thinking and to challenge participants to extend themselves and think dynamically. Each chair has pre-selected two participants to act as the group's rapporteurs. The role of the rapporteurs is to collate the group's discussions and distil the discourse into a 15 minute presentation. Breakout groups are asked to examine and address their group's discussion questions (below) but are also encouraged to move beyond these questions to other topics identified during the discourse.

On the second day of the Think Tank, after a final review by the breakout group, the rapporteurs will present the findings of their breakout group. There will be an opportunity for questions and discussion following each presentation, during the general discussion and in response to the final summing up.

OUTPUTS

Proceedings from the event, including all PowerPoint slides and transcripts of the rapporteur presentations, will be made available on the Academy's website. The event proceedings, available in electronic and print formats, will also provide contextual information, identify knowledge gaps and summarise the major outcomes from the Think Tank. These proceedings will offer options for a 'way forward' and subsequently can be used to underpin policy development and research prioritisation.

Please note that you can follow the Australian Academy of Science on Twitter [@science_academy](https://twitter.com/science_academy). If you wish to tweet about the Think Tank during the event, please use the hashtag [#TMThinkTank](https://twitter.com/TMThinkTank).

BREAKOUT GROUPS

GROUP A

BOWEN AND SURAT BASINS

CHAIR

Anthony Swirepik

EXPERT

Professor Sue Golding

RAPPORTEURS

Dr Tiffany Morrison

Dr Cholachat Rujikiatkamjorn

Dr Grace Chiu

Dr Thomas Ford

Dr Eddie Game

Dr Andrew Harford

Dr Gunnar Keppel

Dr Peter Kopittke

Dr Leo Lymburner

Dr Nadine Marshall

Dr Jessica Northey

Dr Kelly Scheepers

Dr Leonie Seabrook

Dr Davina White

Dr Fiona Young

GROUP B

MELBOURNE'S PERI-URBAN GRASSLANDS

CHAIR

Professor Mark Burgman

EXPERT

Dr Sarah Bekessy

RAPPORTEURS

Dr Bernd Gruber

Dr Kerrie Wilson

Dr Nigel Andrew

Dr Remko Duursma

Dr Georgia Garrard

Dr Christopher Ives

Dr Brett Murphy

Dr Firuza Mustafa

Dr Dale Nimmo

Dr Megan O'Shea

Dr Dan Pagendam

Dr Libby Rumpff

Dr Justine Shaw

Dr Rhiannon Smith

Dr Rachel Standish

GROUP C

NINGALOO MARINE PARK

CHAIR

Professor Peter Mumby

EXPERT

Dr Martial Depczynski

RAPPORTEURS

Dr Kirsty Douglas

Associate Professor Ryan Lowe

Dr Natalie Ban

Dr Line Bay

Dr Nicholas Graham

Dr Mia Hoogenboom

Dr Alison Jones

Dr David Lloyd

Dr Joshua Madin

Dr Jessica Melbourne-Thomas

Dr Ben Radford

Dr Tyrone Ridgway

Simon Vieira

Dr Thomas Wernberg

Dr Shaun Wilson

GROUP D

MURRAY-DARLING BASIN

CHAIR

Professor Hugh Possingham

EXPERT

Ian Burns

RAPPORTEURS

Dr Samantha Capon

Dr Philip Wallis

Dr Kane Aldridge

Dr Christy Briles

Dr Jane Catford

Dr Morteza Chalak

Dr Yung En Chee

Dr Shaun Cunningham

Dr Katherine Daniell

Dr Patrick-Jean Guay

Dr Mark Kennard

Dr Sama Low Choy

Dr Eve McDonald-Madden

Dr Maksym Polyakov

Dr Sarah Wheeler

BREAKOUT GROUP CASE STUDY DESCRIPTIONS AND QUESTIONS

GROUP A – BOWEN AND SURAT BASINS

The Great Artesian Basin (GAB) is the largest artesian basin in the world and the main source of freshwater for agriculture and human use in inland Queensland. The GAB is defined on hydrological grounds such that its boundaries are different from the constituent sedimentary basins. Most of the extracted groundwater is sourced from the Surat and Eromanga Basins, however, groundwater is also produced from the upper part of the Bowen and Galilee Basins (Figure 1).

Queensland's GAB has a long agricultural history. Many grains and pulses, and cotton are grown in the better soils and livestock, particularly cattle, are a mainstay of the region. The constituent basins are rich in coal at varying depths and therefore offer the full range of extraction options and uses although development to date has been focused in the Bowen Basin and recently the Surat Basin.

Commercial production of coal-seam gas (CSG) was initiated in the Bowen Basin in 1996 and the Surat Basin in 2006 and production has increased steadily each year to 212 Petajoules (PJ) in 2009–10. The proved and probable reserves of CSG in the Bowen and Surat were 27 992 PJ as of June 2010, making the region the most CSG-rich in the country. To put these reserves in context, the Queensland power grid utilises some 192 PJ per year so the proved and probable CSG reserves could provide Queensland with power for 145 years. However, several environmental and economic concerns have been raised in relation to CSG drilling and production including possible contamination of groundwater and reduced artesian pressures in the GAB aquifers above and below the coal seams in the Surat and southern Bowen Basins. Farmers and pastoralists in the region are also concerned about the effect of coal mining and gas extraction on their land and livelihoods.

QUESTIONS

Which models of the effects of coal mining and gas extraction on groundwater interactions in the Surat and Bowen Basins have been useful for land-use planning?

How, if at all, do the consequences of extraction of artesian groundwater for farming and human use differ

from the effects of coal mining and gas extraction on groundwater-dependent ecosystems and agriculture in the Surat and Bowen Basins?

Can good decisions about management of groundwater resources in the Surat and Bowen Basins be made without models? Is expert judgement enough?

What has impeded accurate data collection and the development of useful models?

What systems/technologies/innovations could be developed to better model the effects of coal mining and gas extraction on groundwater-dependent ecosystems and agriculture in the Surat and Bowen Basins?

What additional resources or capabilities are required to achieve this?

How could these models be applied more broadly to other ecosystems (eg other groundwater-dependent regions, or to the other breakout group scenarios)?

REFERENCES

Draper J & Boreham C (2006). Geological controls on exploitable coal seam gas distribution in Queensland. *APPEA Journal* 343–366

Fensham R, Fairfax R & Sharpe P (2004). Spring wetlands in seasonally arid Queensland: floristics, environmental relations, classification and conservation values. *Australian Journal of Botany* 52: 583–595

Rolfe J (2010). Valuing reductions in water extractions from groundwater basins with benefit transfer: The Great Artesian Basin in Australia. *Water Resources Research* 46: W06301, doi: 10.1029/2009WR008458

Department of Employment, Economic Development and Innovation (2011). *Queensland's coal seam gas overview*

GROUP B – MELBOURNE'S PERI-URBAN GRASSLANDS

Temperate native grasslands form one of the most endangered ecosystems in Victoria, with less than 0.5% of their pre-European extent remaining. Historically, vast areas of grasslands, including most of the Victorian

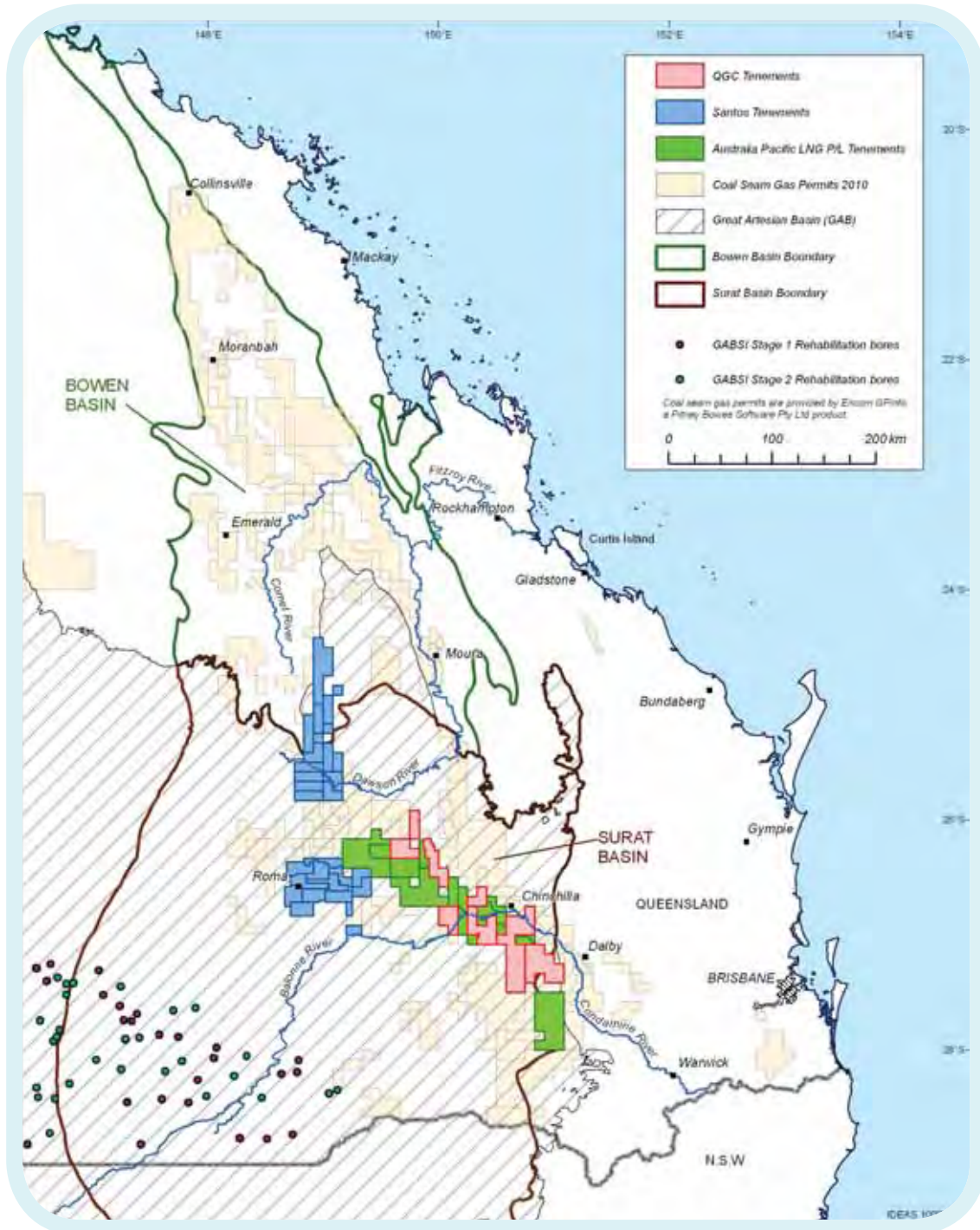


Figure 1: Map showing the boundaries of the Surat, Bowen and Great Artesian Basins with locations of existing and proposed coal seam gas permits. Geoscience Australia, and Habermehl (2010). Advice in relation to the potential impacts of coal seam gas extraction in the Surat and Bowen Basins, Queensland)

volcanic plain, have been destroyed or substantially altered by agricultural practices such as grazing and cropping (Figure 2). As a consequence, some of the largest and most intact grassland remnants in Victoria occur on the western and northern fringes of Melbourne, where they are now vulnerable to urban expansion. Temperate native grasslands around Melbourne support a range of threatened species including the matted flax-lily, spiny rice-flower, button wrinklewort, golden sun moth, growling grass frog, striped legless lizard and grassland earless dragon.

Existing ecological models of this system include:

- Statistical models demonstrating that the probability a patch of grassland will be degraded or destroyed is much higher if it is on private land, is close to the CBD and/or close to a major road.
- Models showing that the probability that populations of grassland plants will be extirpated is a function their of life-history characteristics or traits, encroaching urbanisation and changing disturbance regimes.

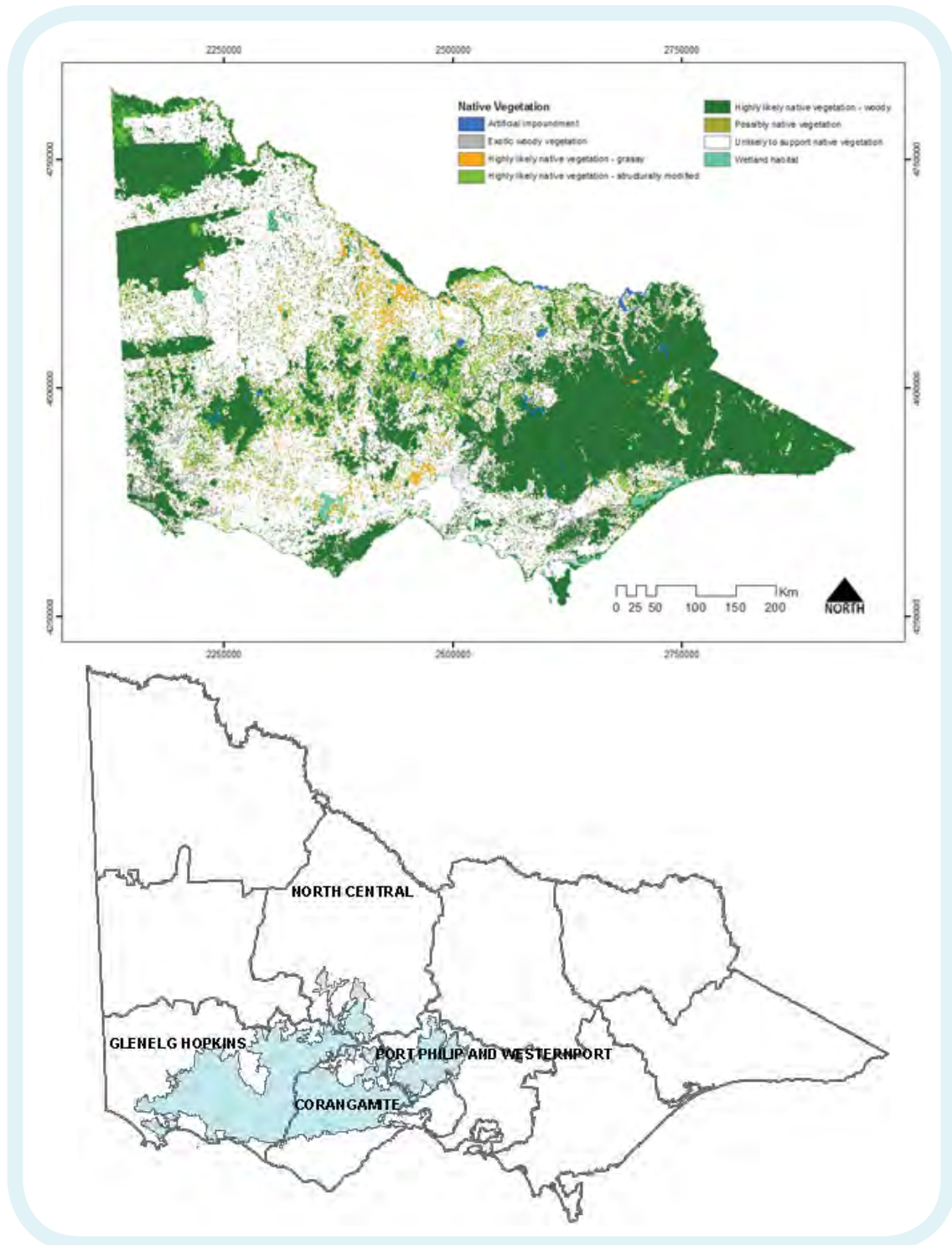


Figure 2: Maps of Victoria showing a. remaining native vegetation, with grasslands in orange. [Department of Sustainability and Environment (undated) Native vegetation extent, Victoria. Government of Victoria]; b. the location of the Victorian volcanic plain (pale blue). [Biodiversity Action Planning (2003) Strategic Overview for the Victorian Volcanic Plain bioregion – May 2003. Government of Victoria]

- Models of the mean time to extinction for grassland plants showing that small patches of grassland (eg 10–20 ha) are sufficient to support populations for at least 100 years.
- An algorithm identifying the optimal size of nature reserves to protect multiple species of grassland plants, which shows that many small reserves would be more efficient than fewer, larger reserves.
- Metapopulation models of the growling grass frog in northern Melbourne, indicating the importance of both habitat quality and connectivity for this species.
- A variety of modelling tools that integrate conservation planning and land-use planning on the urban fringe.

QUESTIONS

Which models of the effects of threatening processes on this ecosystem have been useful for conservation or land-use planning?

Could good decisions about management of grasslands have been made without models? Is expert judgement enough?

What, if anything, has impeded data collection and the development of useful models?

How can existing data and models be better used to inform land-use planning decisions that affect temperate grasslands on Melbourne's urban fringe?

What systems/technologies/innovations could be developed to better model the effects of urban expansion and land-use policies on temperate grasslands?

What additional resources or capabilities are required to achieve this?

How could models of this ecosystem be applied more broadly to other ecosystems (eg to other urban landscapes, or to the other three breakout group scenarios)?

REFERENCES

Gordon A, Simondson D, White M, Moilanen A & Bekessy SA (2009). Integrating conservation planning and landuse planning in urban landscapes. *Landscape and Urban Planning* 91: 183–194

McCarthy MA, Thompson CJ & Williams NSG (2006). Logic for designing nature reserves for multiple species. *American Naturalist* 167: 717–727

Williams NSG, Morgan JW, McDonnell MJ & McCarthy MA (2005). Plant traits and local extinctions in natural grasslands along an urban-rural gradient. *Journal of Ecology* 93: 1203–1213

GROUP C – NINGALOO MARINE PARK

Ningaloo Marine Park (NMP) is a remote coastal reef strip of 300 km covering approximately 170,000 ha (Figure 3). Already iconic to the people of Western Australia, the NMP has recently been attributed UNESCO World Heritage status. Managed by the state, the NMP has a resident population of just 7,000 but is visited annually by over 200,000. The main drawcards of the NMP are reflected in visitor activities and include the chance to swim with whale sharks, viewing the abundant marine life and recreational fishing. Unlike its big brother, the Great Barrier Reef (GBR), activities in the NMP are all close to shore and concentrated in both space and time at localised camping areas and

towns during the cooler winter months prompting suggestions that Ningaloo might be in danger of being 'loved to death'.

Despite a plethora of recent biological, physical and tourism data, the development of a clear understanding of how the Ningaloo ecosystem actually functions and the impact of anthropogenic and oil and gas related stresses on it remains elusive and lags far behind our current general understanding of the GBR (Figure 4). With tourism and oil and gas activities in the NMP expected to rise and the state government's eye and purse now firmly focused on the Kimberley region of WA, there has never been a more important time to maintain the focus on Ningaloo and utilise the vast data sets that have recently been gathered. To date, summarised relevant existing science and models of this ecosystem include:

- West Australian Marine Science Institute (WAMSI 1): A plethora of inter-institutional studies covering baseline oceanographic, biochemistry, biodiversity, human usage, geomorphology, socio-economic and trophic data
- A series of economic, ecological, oceanographic and tourism models including the Ningaloo Ecosim, InVitro, Destination and SOHC Models.

QUESTIONS

What are the key ecological attributes of the NMP that should be considered when planning and developing models of ecosystem stress?

What early warning indicators should be chosen to provide the best (sensitivity, ease of detection etc) indication of ecosystem stress?

Can we use surrogate models from other systems as a template for the development of Ningaloo-specific models?

What efforts to model the effects of stress on this ecosystem have been successful for conservation?

What has impeded accurate data collection and the development of these models?

What systems/technologies/innovations could be developed to better model the effects of ecosystem stress and the consequences of visitor use on the NMP, and to help determine which activities should occur in which places, both on the land and in the sea?

What additional resources or capabilities are required to achieve this?

How could models of this ecosystem be applied more broadly to other ecosystems (other three breakout group scenarios)?

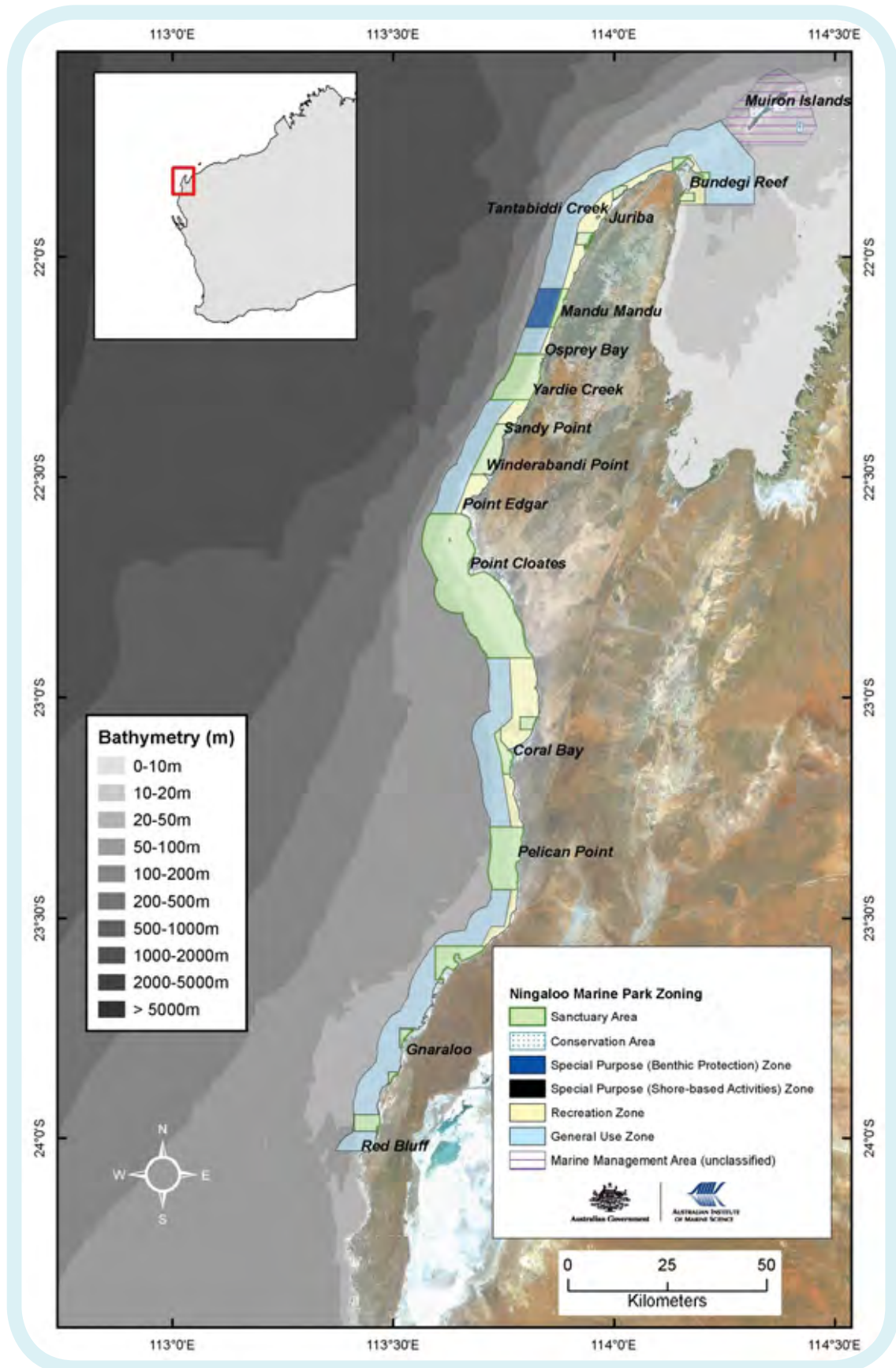


Figure 3: Ningaloo Marine Park location and zoning (Ben Radford, Australian Institute of Marine Science)

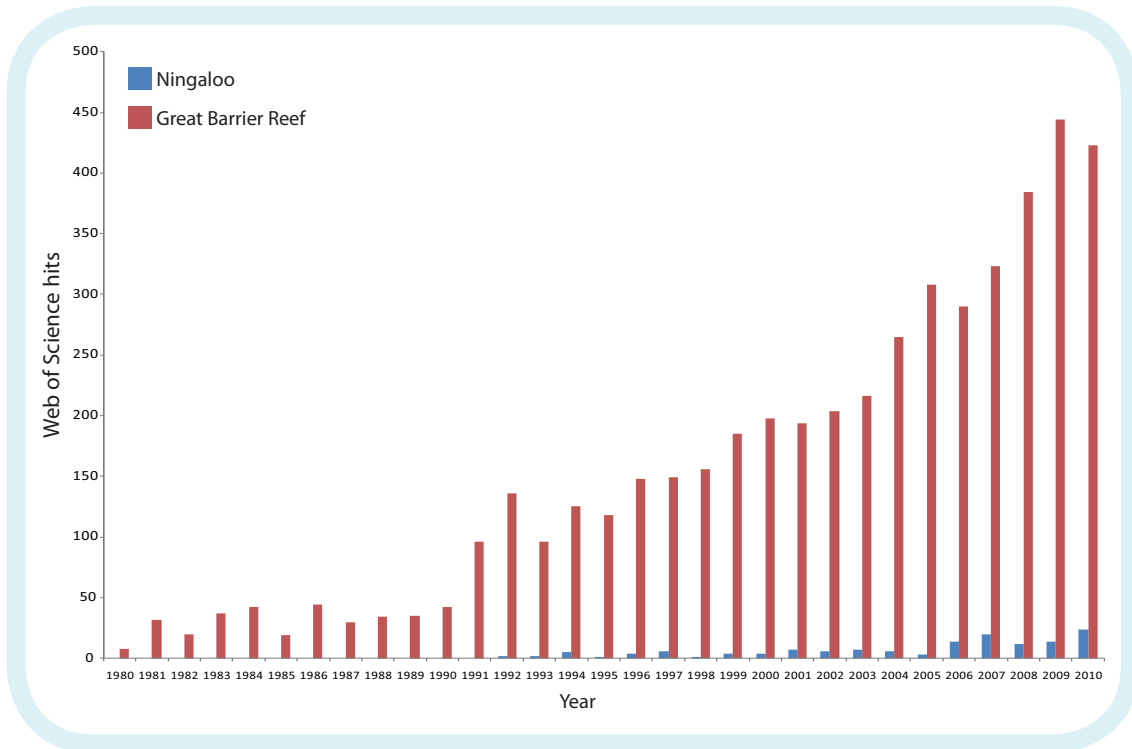


Figure 4: Number of hits from the Web of Science by year for the keywords Ningaloo and the Great Barrier Reef (Tyrone Ridgway, Australian Institute of Marine Science)

REFERENCES

Commonwealth of Australia (2002). *Ningaloo Marine Park (Commonwealth Waters) Management Plan*. Environment Australia, Canberra

Waples K & Hollander E (2008). *Ningaloo Research Progress Report: Discovering Ningaloo – latest findings and their implications for management*. Ningaloo Research Coordinating Committee. Department of Environment and Conservation, WA

GROUP D – MURRAY-DARLING BASIN

The Murray-Darling Basin is the ‘food basket’ of Australia generating about \$15 billion/year in agricultural production, a third of which is produced by irrigation. Irrigation (including conveyance) uses about 11,000 GL/year, representing 90% of the surface water consumed. On average these extractions reduce annual flows in the lower Murray by about 60%, and in dry periods flows are reduced by up to 96%.

This level of water use has contributed to wide ranging decline in the aquatic ecosystems of the basin. Evidence of this degradation led to the capping of surface water extractions in the mid-1990s. This was followed by the *2004 National Water Initiative* and the *Water Act 2007* (Cth) in which governments agreed to ‘...complete the return of all currently over-allocated or overused systems to environmentally sustainable levels of extraction’. The imperative for change was

heightened by the Millennium drought which contributed further to environmental decline and involved previously unforeseen water scarcity for many consumptive users.

The *Water Act 2007* established the Murray-Darling Basin Authority and tasked the Authority with preparing a Basin Plan to set sustainable diversion limits. The Basin Plan is likely to recommend significant reductions in extractions. Any reductions will involve socio-economic impact while a failure to significantly reduce extractions may result in further environmental decline.

A robust understanding of the relationships between water resource use, ecology and socio-economic impact is important in making the key policy decisions and communicating the basis of these decisions to stakeholders. Over many years Government and research institutions have developed an array of models that can assist. These include:

- hydrologic river system models
- hydraulic and ecosystem response models
- economic models of water trade and water resource use.

The application of these models to support whole-of-Basin policy is challenging due to the different spatial/temporal timescales, baselines and extension of the models beyond the purpose for which they were developed.

QUESTIONS

What models can, and have been used, to reconcile the competing claims over how much water should be allocated for environmental flows and how much for irrigation purposes?

What might be impeding accurate data collection and the development of models (ecosystem, hydrological, socio-economic) and their acceptance by decision-makers?

What systems/technologies/innovations could be developed to better model the consequences of policy decisions in the Murray-Darling Basin (eg the response of different vegetation types and fauna species to variable flow regimes)?

What additional resources or capabilities are required to achieve this?

What modelling and research, in addition to ecosystem models, may be required to inform the debate about water reform and to assist decision makers in their policy development for the Basin?

How important is a notional 'baseline' or pre-European system state for our management decisions, and can we determine that state?

What are some of the major uncertainties that must be considered in using models to inform policy?

How could models of this ecosystem be applied more broadly to other ecosystems (such as the other three breakout group scenarios)?

REFERENCES

Lester RE, Webster IT, Fairweather PG & Young WJ (2011). Linking water-resource models to ecosystem-

response models to guide water-resource planning – an example from the Murray-Darling Basin, Australia. *Marine and Freshwater Research* 62, 279–289. <http://dx.doi.org/10.1071/MF09298>

Jiang Q (2011). Modelling Challenges. Chapter 16 of *Basin futures: water reform in the Murray-Darling Basin* / edited by Daniel Connell and R Quentin Grafton. http://epress.anu.edu.au/basin_futures/pdf/ch16.pdf

Shiquan R & Kingsford R (2011). Statistically Integrated Flow and Flood Modelling Compared to Hydrologically Integrated Quantity and Quality Model for Annual Flows in the Regulated Macquarie River in Arid Australia. *Environmental Management* 48, 177–188. <http://www.springerlink.com/content/u25vk12t571760u8/fulltext.pdf>

GENERAL QUESTIONS (TO BE ADDRESSED BY ALL GROUPS)

What are the critical gaps in the current scientific data for these ecosystems and how could they be filled?

What is the cost of waiting and thinking and how much time do we have to study the systems further?

Is there a role for active adaptive management of these ecosystems, i.e. learning by doing?

Would an all-encompassing, complex model of these systems be worthwhile?

How can we use models to balance ecological, economic and social demands/values in relation to these systems?

PRESIDENT

Professor Suzanne Cory

AC PresAA FRS

President, Australian Academy of Science

Professor Suzanne Cory is one of Australia's most distinguished molecular biologists. She was born in Melbourne, Australia and graduated in biochemistry from The University of Melbourne. She gained her PhD from the University

of Cambridge, England and then continued studies at the University of Geneva before returning to Melbourne in 1971, to a research position at The Walter and Eliza Hall Institute of Medical Research. From 1996 to 2009 she was Director of The Walter and Eliza Hall Institute and Professor of Medical Biology of The University of Melbourne. She is currently a Vice-Chancellor's Fellow

at the University of Melbourne and Honorary Professorial Fellow at the Walter and Eliza Hall Institute. Her research has had a major impact in the fields of immunology and cancer and her scientific achievements have attracted numerous honours and awards. In 2010 she was elected President of the Australian Academy of Science.

ORGANISING COMMITTEE AND BREAKOUT GROUP CHAIRS

Professor Hugh Possingham FAA CHAIR

ARC Federation Fellow, Director of The Ecology Centre and ARC Centre of Excellence for Environmental Decisions, University of Queensland

Aside from his day job, Hugh has a variety of broader public roles advising policy makers and managers sitting on 16 committees and boards outside the University including: The Wentworth Group



Hugh Possingham

of Concerned Scientists (founding member), Queensland Smart State Council, Chief Editor of Conservation Letters (an international scientific journal), Council of the Australian Academy of Science, and ENGO scientific advisory committee. He and Dr Barry Traill wrote *The Brigalow Declaration*, used by Premier Beattie to stop land clearing in Queensland thereby securing at least 1 billion tonnes of CO₂.

The Possingham lab developed the most widely used conservation planning software in the world. Marxan www.ecology.uq.edu.au/marxan.htm was used to underpin the rezoning of the Great Barrier Reef and is currently used in over 100 countries by over 2500 users – from the UK to Brazil.

Hugh has coauthored over 300 refereed publications covered

by the Web of Science (21 in Science, Nature or PNAS) and has 7500 Web of Science citations. He currently directs two research centres, each of c\$15 million, and he has supervised (or is supervising) 51 PhD students and 32 postdoctoral fellows.

ABSTRACT

The word 'modelling' means different things to different people. In this presentation we will discuss the ways in which modelling can best be defined for the purposes of the Think Tank. This will involve consideration of process versus statistical models, incorporation of variation and uncertainty (and what these terms might mean for us), inclusion of other information such as expert knowledge, and so on. Importantly, we will address the argument that 'if you can't model it, you can't make decisions about it'.



Mark Burgman



Kerrie Mengersen



Anthony Swirepik



Peter Mumby

Contentious issues around modelling for natural resource management will be discussed, such as:

- Decisions demand some sort of modelling, because models predict the future, and you cannot make a decision unless you can predict the consequences of different actions.
- All models are wrong but some models are useful.
- When asked to provide information and/or policy advice for government, many scientists simply say they don't know and they ask for more research money.
- Some scientists believe that reducing uncertainty in model parameters is always important and makes them applied scientists. It has been argued that reducing uncertainty is only valuable if that reduction in uncertainty is likely to change your decision.
- Doing nothing is a popular management option for complex systems and should always be considered. Indeed the expected net benefit of an action is best quantified as the expected benefit of that action above and beyond what we would have achieved if we did nothing.

Professor Mark Burgman FAA

Director of the Australian Centre of Excellence for Risk Analysis and the Adrienne Clarke Chair of Botany, School of Botany, University of Melbourne

Mark A Burgman is Director of the Australian Centre of Excellence for Risk Analysis and the Adrienne Clarke Chair of Botany in the School of Botany at the University of Melbourne. He works on ecological modelling, conservation biology and risk assessment. His research has included models on a broad range of species a range of settings including marine fisheries, forestry, irrigation, electrical power utilities, mining, and national park planning. He received a BSc from

the University of New South Wales (1974), an MSc from Macquarie University, Sydney (1981), and a PhD from the State University of New York (1987). He worked as a consultant ecologist and research scientist in Australia, the United States and Switzerland during the 1980s before joining the University of Melbourne in 1990.

ABSTRACT

Despite many interpretations of the words 'risk' and 'uncertainty', both have useful, formal definitions. This presentation will outline their meanings and will introduce a taxonomy of uncertainty that partitions natural variation, lack of knowledge and language-based uncertainty. The talk will highlight the imperatives to use expert judgment that arise when making decisions. It will outline how uncertainty may be partitioned to create well-calibrated, verifiable and relatively accurate judgment data. These judgments may be incorporated as priors in Bayesian analyses, they may corroborate field measurements, or they may be used as the sole source of information when critical data are missing. It will emphasise the importance of separating judgments about facts from judgments about values and preferences. The presentation will conclude by arguing that judgments of facts should be subjected to the same rigorous standards as are more conventional forms of data.

Professor Kerrie Mengersen

Research Professor in Statistics and Member, Collaborative Centre for Data Analysis, Modelling and Computation, Queensland University of Technology

Kerrie Mengersen is a Research Professor in Statistics and member of the Collaborative Centre for Data Analysis, Modelling and Computation at QUT in Brisbane. She is an applied statistician with expertise in both fundamental statistical research and applied statistical modelling and data analysis. Her current work

involves the development and application of Complex Systems models, Bayesian models, spatio-temporal models, mixtures and other meta-analysis. She actively collaborates with researchers and practitioners in the fields of biostatistics, environment, biometry and industry.

Anthony Swirepik

Manager, Climate Science Team, Department of Climate Change and Energy Efficiency

Anthony Swirepik completed a Bachelor of Science at the University of Canberra in 1989. He joined CSIRO Entomology in the same year and held a number of technical and experimental scientist roles in the field of weed biological control until 2005. Primary research foci were around insect herbivory, system ecology and risk assessment.

During 2005–06, Anthony worked as the Executive Officer for the Chief Executive of CSIRO. In 2006, he sought employment with the Australian Greenhouse Office where he joined as a senior policy officer focused on Adaptation in Agriculture. Over the past five years, Anthony has gained significant exposure to policy advising and development and research administration.

Anthony now manages the Department of Climate Change and Energy Efficiency's Climate Science team. He has responsibility for advising the Government on Climate Change Science, administering the Australian Climate Change Science Program, supporting national engagement in the IPCC and developing an implementation plan for the National Climate Change Science Framework.

ABSTRACT

A key element of evidence based policy development is the provision of sound technical advice based on peer reviewed science. In my experience the policy process is rarely unduly influenced by a single piece of information, rather it relies on the balanced, critical synthesis of often complex multidisciplinary science. Climate change policy is a classic example of this process. Scientists often voice frustration that their science is not being adequately recognised in the policy process, or that they can see the science is being observed in the process but the policy doesn't go far enough. As a scientist it is important to recognise that science is but one input – economics and the social concerns of communities are also influential forms of evidence in the policy process. I will give some tips on how to best engage with the public service and government with a vision for improving the application of science in the policy process.

Professor Peter Mumby

ARC Laureate Fellow, School of Biological Sciences, University of Queensland

Peter is a coral reef ecologist that combines experimental, observational, and modelling studies to answer questions underpinning reef management. His primary interest is creating system models that quantify the impacts of interventions on the ecological resilience, functions, and services of reefs. He moved to Australia in 2010 as an ARC Laureate Fellow and is based in the School of Biological Sciences, University of Queensland. Peter is also a Pew Fellow in Marine Conservation.

BREAKOUT GROUP EXPERTS

Dr Sarah Bekessy

Senior Lecturer, School of Global Studies, Social Science and Planning, RMIT University

Sarah Bekessy is a senior lecturer in environmental studies at RMIT University, Australia. Sarah specialises in the emerging field of sustainability science, which seeks to understand the fundamental character of interactions between society and our environment. Sarah is involved in an interdisciplinary range of research projects, including a Centre of Excellence for Environmental Decisions research hub that seeks to develop and test tools to support transparent decision-making for environmental management

(www.ceed.edu.au). Sarah teaches a large course in sustainability to over 400 students, and several other courses in environmental studies.

Ian Burns

Director, Environmental Hydrology, Basin Plan Division, Murray-Darling Basin Authority

Ian Burns is Director of Environmental Hydrology in the Basin Plan Division of the Murray-Darling Basin Authority. In this role, Ian has lead the Authority's assessment of the environmental water requirements of the Basin's stressed aquatic ecosystems, and guided the program of hydrologic modelling used to inform the Plan. This



Sarah Bekessy



Ian Burns



Martial Depczynski



Sue Golding

work has included using ecosystem response modelling and other research to assist in translating environmental objectives into flow targets, and using river system models to assess the consequences of different policies on flows and ecosystems across the Basin. Prior to this, Ian managed The Living Murray environmental works and measures program, a circa \$300M program aimed at enhancing environmental outcomes and improving the efficiency of environmental watering at six icon sites along the River Murray.

Dr Martial Depczynski

Research Scientist, Exploring Marine Biodiversity, Australian Institute of Marine Science

Martial Depczynski is a research scientist in the Exploring Marine Biodiversity group at the Australian Institute of Marine Science in Western Australia. His early research was focused on quantifying the broad-scale relationships needed to predict the role of fish communities within coral reef ecosystems. His work over the past few years has been centred on projects at Ningaloo funded through the Western Australian Marine Science Institute and in collaboration with the Department of Environment and Conservation, the CSIRO and UWA. Included within this, has been research encompassing a diverse range of marine flora, vertebrate and invertebrate fauna and its role in maintaining ecosystem health. Martial was awarded his PhD in 2007 from James Cook University, has published

his work in journals such as Current Biology, Ecology and Oecologia and holds a position as an Adjunct Assistant Professor at UWA.

Professor Sue Golding

Professor, School of Earth Sciences and Senior Researcher, Cooperative Research Centre for Greenhouse Gas Technologies, University of Queensland

Suzanne D Golding has been involved with resource geology and stable isotope geochemistry research since 1977, following some 8 years industry experience in Australia and Africa. She has published more than 100 journal articles and book chapters and is a Professor in the School of Earth Sciences at the University of Queensland. Sue is an international expert on coal seam gas and carbon dioxide sequestration in coal measures and a senior researcher with the Cooperative Research Centre for Greenhouse Gas Technologies (CO₂CRC) since 2006. In addition, she has a long standing interest in the early evolution of the Earth and is currently using sulfur isotope records in ancient sedimentary rocks and seafloor hydrothermal systems to reveal a more refined history of atmospheric oxygen levels and the role of different microbial metabolisms in the surface chemistry of the early Earth. She holds BSc (Hons) and PhD degrees from the University of Queensland in geology and geochemistry.

CHAIRS

Professor Hugh Possingham FAA

ARC Federation Fellow, Director of The Ecology Centre and ARC Centre for Excellence in Environmental Decisions, University of Queensland

Biographical details available on page 12.

Dr Sue Meek FTSE

Chief Executive, Australian Academy of Science

Appointed Chief Executive of the Australian Academy of Science in May 2008, Dr Sue Meek has 25 years of experience working in a variety of capacities at the interface of industry, academe and government. Her particular interests are in promoting awareness and understanding of science and technology, and

the formulation of policies and programs to stimulate the conduct and application of research and development.

Sue held the position as Australia's inaugural Gene Technology Regulator from December 2001, and previously was the Executive Director, Science and Technology in the Western Australian Department of Commerce and Trade.

Sue has a PhD in marine biology, MSc in oceanography and a BSc(Hons) in microbiology. She is a Fellow of the Australian Institute of Company Directors and of the Australian Academy of Technological Sciences and Engineering, an inaugural member of the Advisory Council of the

International Life Sciences Institute's Centre for Environmental Risk Assessment (CERA) for Genetically Modified Organisms (GMOs), and is a member of the Expert Working Group for Developing an Evidence Base for Science Engagement in Australia.



DINNER SPEAKER



Dr Geoff Garrett AO FTSE

Queensland Chief Scientist

Dr Geoff Garrett was appointed Queensland Chief Scientist in January 2011.

A Cambridge graduate in metallurgy and an academic for 13 years, Geoff led two of the world's major national research institutions – CSIR in South Africa (1995–2000) and CSIRO in Australia (2001–08).

A former South African 'Boss of the Year' (1998) and 'Engineer of the Year' (1999), he is a recipient of the Centenary Medal for service to Australian society through science. In June 2008 he was appointed as an Officer of the Order of Australia (AO) in the Queen's Birthday Honours List.

A Fellow of the Australian Academy of Technological Sciences and Engineering, the Royal Society of South Africa and the Australian Institute of Company Directors, Geoff served on the Prime Minister's Science, Engineering and Innovation Council in Australia for eight years.

He is the co-author with Sir Graeme Davies, formerly Vice-Chancellor of the University of London, of the book *Herding Cats – Being advice to aspiring academic and research leaders* (Triarchy Press, UK).

Geoff's interests include fishing and tennis, and his one (so far!) grandchild, Liam.

RAPPORTEURS

Dr Samantha Capon

Coordinator NCCARF Water Resources and Freshwater Biodiversity Adaptation Research, and Research Fellow, Australian Rivers Institute, Griffith University

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Sam's current research interests relate to climate change adaptation for natural resource management and conservation of freshwater and coastal ecosystems. In particular, she is interested in the resilience of floodplain and wetland systems and the capacity of their biota to adapt to future climate change autonomously. Sam is also keenly interested in approaches to integrating ecological and socio-economic/cultural knowledge and values to develop natural resource management (especially water) and climate change adaptation strategies and is presently involved in (and leading) numerous initiatives which aim to achieve such integration. In her current role as Coordinator of the National Water Resources and Freshwater Biodiversity Adaptation Research Network (NCCARF), she has gained considerable experience in organising, facilitating and communicating the results of large, interdisciplinary groups tackling complex scientific issues for management and policy outcomes. Her background (and PhD) research is in floodplain vegetation ecology.

Sam brings to this workshop expertise on climate change adaptation strategies for stressed ecosystems as well as a perspective on integrating biophysical and socio-economic knowledge in decision making processes. With respect to the target ecosystems, she has considerable expertise on the resilience and management of riverine and floodplain ecosystems throughout the Murray-Darling Basin and also some knowledge with regards to Ningaloo as a result of having just completed a large synthesis project on climate change responses of Australian coastal ecosystems.

Dr Kirsty Douglas

Assistant Manager, Marine and Climate, Research Infrastructure Branch, Department of Innovation, Industry, Science and Research

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Following seven years as a postgraduate or postdoctoral fellow working on projects that span the life sciences, earth sciences and humanities, and a further six years of public sector experience working

with the research community across ecology, biology and geology, Kirsty has a sophisticated understanding of many important issues in science and research policy. Her cross disciplinary academic and work experience lies in the natural sciences and their intersection with the humanities: the assessment, management and promotion of the biological, ecological and geological values of Australian heritage. Five years working in natural heritage assessment has helped her to situate her intellectual interests (already grounded in practical science and science communication as well as the history of science, the politics of ecology and the environment) within a public policy framework.

Kirsty spent four years working on the successful Ningaloo World Heritage nomination. The nomination's scientific rigour and the reactive management system implemented in the property contributed significantly to the World Heritage Committee's decision to include Ningaloo on the List. However, the listing was almost derailed by a small number of lobbyists from the region adjoining the property. Such experiences have convinced her that perceived environmental conflict is the greatest impediment to sound ecological decision-making and is a failure of public policy. Managing this conflict could contribute to improving local husbandry and avoiding or mitigating negative impacts on sensitive ecosystems.

Dr Bernd Gruber

Assistant Professor, Faculty of Applied Science, University of Canberra

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Bernd has substantial experience in the field of ecological modelling generally, and spatial analysis in particular. He is familiar with a wide variety of tools such as programming languages for agent based models (stochastic and discrete) and also with standard mathematical and statistical techniques such as linear regression, (partial) differential equations, habitat modelling using spatial statistics, and GIS techniques (including ArcGIS and GRASS). Specifically, he has used spatially structured modelling to quantify the effects of movement on survival and reproduction in an arboreal gecko, implemented spatially explicit (agent-based) models for a number of species including geckos, earless dragons, aphids and bees, developed new methods and approaches for analysing ecological field data such as counting tracks, capture-recapture and

genetic data to inform spatially explicit population models.

Through his current activities at an interdisciplinary and research oriented institute, Bernd is deeply involved in the ongoing discussion on biodiversity and ecosystem services. A major goal is to quantify different biological-based ecosystem services (ESS) such as pollination, bio-control and biodiversity using GIS based techniques. Based on this experience, he is confident he will contribute to the development of new ideas as to how ESS can be evaluated (especially as they often compete against each other) to be able to manage important ecosystems such as the Murray-Darling Basin in such a way that both nature and people benefit from its ESS.

Associate Professor Ryan Lowe

Associate Professor, School of Earth and Environment, University of Western Australia

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Ryan has a unique background in environmental engineering and oceanography that he utilises to tackle complex (and often multidisciplinary) research problems in the coastal zone. For his research, he employs a wide range of field and numerical modelling approaches. Ryan's research, in particular, has helped to advance our understanding of how oceanic and meteorological forcing drives the circulation and distribution of wave energy in coral reef environments. Much of his current research focuses on applying a new generation of numerical models to understand and predict complex coastal ocean processes across a range of spatial scales (from shelf-scales down to the much finer scales of reefs). Through the strong multidisciplinary collaborations he has formed with marine biologists, ecologists, and biogeochemists, Ryan's research has helped elucidate how physical forcing within reefs controls a range of biophysical processes, such as nutrient dynamics as well as community rates of production and calcification.

Since arriving at UWA in 2007, Ryan's research has largely focused on the oceanography of Ningaloo Reef. This work (both physical and biogeochemical) has examined the dynamics within both nearshore (reef) and shelf waters. He has been the Chief Investigator on three ARC grants devoted to Ningaloo Reef and has supervised four PhD students (two completed) whose research also focuses on Ningaloo. Through these research activities, Ryan can contribute to discussions on how physical and biogeochemical ocean processes shape Ningaloo's ecology (both presently and under future scenarios).

Dr Tiffany Morrison

Senior Lecturer in Environmental Planning, Geography, Planning and Environmental Management, University of Queensland

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Tiffany is a Senior Lecturer in Environmental Planning at the University of Queensland. Her research is concerned with the interactions between and among multi-level public sector agencies, a highly diversified civil society, and an array of market actors, and the implications of these interactions for effective, coordinated environmental planning. She has published on environmental planning and decision-making planning systems in Australia, the USA and Japan, and is currently pursuing a new ARC funded program of research in climate adaptation planning.

Tiffany has significant experience informing planning and decision-making relating to Australian ecosystems under stress. The theme proposed for this workshop is a natural extension of her work on regionalised and integrated land use policy and planning. Her previous work on this topic has influenced the Commonwealth policy setting on natural resource management and has also been used by the CSIRO and the Queensland Government to assess the efficacy of institutional arrangements for environmental planning. Tiffany also has specific expertise in issues relating to the environmental planning and management of Queensland's Surat and Bowen Basin. She has been working as a researcher in this region since 1998 and is currently leading a funded research project on planning for the impacts of the expansion of coal seam gas mining in this region.

Dr Cholachat Rujikiatkamjorn

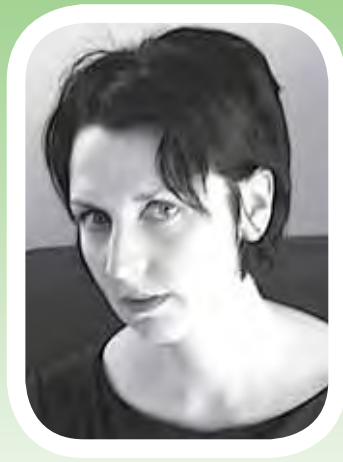
Senior Lecturer, Centre for Geomechanics and Railway Engineering, University of Wollongong

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Cholachat's research interests are in the areas of ground improvement technology, soft clay engineering and railway engineering. His PhD thesis received commendations from both external examiners who are experts in this area, and he was honoured with the coveted Australian Geomechanics Society award for doctoral research in 2006. He developed his research from the basics, a mathematically challenging Constitutive Model, to capture the behaviour of soft and unstable soil consolidation improved by vacuum preloading, which had never been done before. The model, then combined with previous UOW research, was translated into an innovative practical design and performance verification procedure to suit industry. The two-part



Samantha Capon



Kirsty Douglas



Bernd Gruber



Ryan Lowe

paper describing this procedure and published in the Canadian Geotechnical Journal (ERA A* rating) has been downloaded more than 1000 times. This methodology was adopted by an international geotechnical firm (Arup Geotechnics) and Australian Rail Track Corporation (ARTC) recently for the performance verification of a new rail track built on soft estuarine clays in the Newcastle area.

Prolonged droughts and warmer temperatures affect the properties of shallow soil deposits attributed to reduced moisture and increased rates of soil desiccation. These effects not only reduce the load bearing capacity of soils, but also increase erosion during sudden precipitation thus making soils become unstable. Cholachat's engineering knowledge on soft and unstable soils and associated optimum improvement approaches could be used during workshop discussion. He hopes that his expertise in this area will lead to future tangible plans for sustainable land use.

Dr Philip Wallis

Research Fellow, Monash Sustainability Institute, Monash University

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Philip's research interest is in the inter-disciplinary area of water governance research. His research mostly focuses on the Murray-Darling Basin, including the development of models for decision-making, as well as exploring the 'water managing system' through the theoretical framework of social learning. Philip is involved in developing different catchment-based, collaborative modelling approaches. One is looking at whole-of-ecosystem dynamic modelling of the ecological consequences of climate change and management decisions. Another approach is the development of a game-play based model for

exploring stakeholder relationships and processes for managing environmental water. A third approach blends quantitative spatial prioritisation techniques with systemic inquiry into governance arrangements to support the conservation of thermal aquatic refugia across eastern Australia. Common to these approaches is a desire to understand how environmental modelling is used in practice for 'wicked situations' of water governance and climate change adaptation decision-making.

Philip will contribute to the workshop by providing an inter-disciplinary perspective on environmental modelling and decision-making. In his research, he considers river catchments as coupled social-ecological systems; a powerful conceptualisation for developing environmental models. Philip is well versed in the governance and environment of the Murray-Darling Basin and has much to offer on this front. He has actively researched in this space for four years and was awarded as a Fellow of the Peter Cullen Trust in 2010. He recently co-authored a book chapter for 'Basin Futures' and is co-editing a special issue of Water Resources Management on water governance.

Dr Kerrie Wilson

Senior Lecturer/ARC Future Fellow, School of Biological Sciences, University of Queensland

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After completing her PhD in Conservation Biology at the University of Melbourne in collaboration with the UNEP-WCMC in Cambridge, Kerrie undertook postdoctoral research at the The University of Qld. She then took the role of Director of Conservation with The Nature Conservancy Australia program, before being awarded an ARC APD (and subsequently an ARC Future Fellowship) and Senior Lectureship at UQ. Kerrie has a particular interest in applied conservation resource



Tiffany Morrison



Cholachat Rujikiatkamjorn



Philip Wallis



Kerrie Wilson

allocation problems, such as where to invest limited resources to protect biodiversity, to restore habitat, or manage systems. Her research requires an understanding of both the ecological and socio-economic context and has led to the development of frameworks and decision support tools to inform how funds should be allocated between different activities to maximise conservation outcomes.

Kerrie's research in conservation ecology has incorporated ecological dynamics and economics into the identification of priority areas and actions

for conservation and has resulted in new theory for how funds should be allocated (published in Nature, Science, PLoS Biology, and PNAS). Her research program also focuses on the analysis of uncertainty (with a particular focus on the impact of climate change and other institutional and socio-political factors that influence the likelihood of investment success) and landscape dynamics (eg the evaluation of land use scenarios and threatening processes). Her primary research interests are therefore strongly aligned with the workshop's theme.

EARLY AND MID CAREER RESEARCHERS

EARLY AND MID CAREER RESEARCHERS

Dr Kane Aldridge

Research Fellow, School of Earth and Environmental Sciences, University of Adelaide

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Kane has a broad interest in the ecological functioning of inland water ecosystems. His research has focused on human impacts upon inland waters and providing knowledge and tools for improved water resource management. In 2006, Kane began a Postdoctoral Fellowship at The University of Adelaide on the project 'Flow requirements and resource delivery to the Lower Lakes and Coorong'. This project examined the influence of River Murray inflows on the ecological functioning of the Lower Lakes and Coorong and developed a hydrodynamic-biogeochemical model.

Knowledge resulting from this work has been used extensively by management agencies to assess the response of these ecosystems to various hydrological conditions, particularly extreme droughts. Since 2009, Kane has been working on various projects coupling biogeochemical and ecological responses to hydrologic extremes. Much of this work has been conducted within three icon sites of the Murray-Darling Basin (River Murray, Coorong-Lower Lakes and Chowilla Floodplain).

Kane will be able to actively and positively contribute to the Think Tank as his research is dedicated to identifying major stressors upon ecosystems and mechanisms for management to alleviate these stressors. A vast majority of this work has been

conducted within the Murray-Darling Basin, one of the four case studies of the Think Tank. Kane has also recently been engaged to write a synthesis paper on the management of water resources in Australian to promote the resilience of inland water ecosystems to climate change. Kane will openly contribute information obtained in researching this paper into discussions.

Dr Nigel Andrew

Senior Lecturer in Entomology, Centre for Behavioural and Physiological Ecology/Zoology, University of New England

nigel.andrew@une.edu.au

Nigel's research interests span a range of interlinked topics of significance in both natural and agricultural systems. He focuses on identifying whether behavioural, ecological and physiological traits of insect species are predictable and repeatable, and whether these traits can then be scaled up to predict changes within and between ecological communities: this is fundamental to understanding biotic adaptations to a rapidly changing climate. He has published 17 peer-reviewed manuscripts: most in high-impact high-profile international journals. Nigel has received over \$1,181,000 in grant funding, including two grants from the Australian Research Council Discovery scheme. He is a grant reviewer for a range of national and international granting agencies and an Associate Editor of *Austral Ecology* and on the Review Editorial Board of *Frontiers in Invertebrate Physiology*. He is currently Treasurer of the Ecological Society of Australia (ESA). This includes managing over \$1 million in funds and over 1400 current Society members.

As a curator of the UNE Zoology Museum and a tertiary educator, Nigel has excellent communication skills. He has advised local MPs about climate change issues, given regular media interviews and provided expert opinion. Nigel's research interests are linked to how organisms will respond to changes to climate stresses; however, many biotic responses can be generalised across a range of stresses including general anthropogenic changes. This expertise, as well as a point of view from a regional centre and one that has strong interests crossing both environmental and agricultural issues, would be of immense value to the AAS Think Tank.

Dr Natalie Ban

Research Fellow, ARC Centre for Excellence for Coral Reef Studies, James Cook University

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Natalie's research explores how conservation planning can be improved to protect biodiversity while

minimising impacts on humans, focusing on linking and integrating ecological and social considerations. She is developing techniques for including ecosystem dynamics such as disturbances (eg coral bleaching) and range-shifting species into conservation planning through explicit conservation objectives and use of satellite imagery. Regarding social considerations, she and collaborators are developing a framework to link conservation planning with social-ecological systems thinking. Throughout her career, Natalie has taken an interdisciplinary approach to linking ecological and social considerations in marine conservation planning, providing one of the first empirical comparisons of ecological goals and community preferences, and comprehensively assessing mismatches of scales between regional ecological conservation goals and local considerations. Since completing her PhD in 2008, her research projects are global and regional (Australia, Canada, Coral Triangle) in scope, with an expanding network of international collaborators.

Natalie's interest is in developing science to minimise biodiversity loss and making it relevant for policy. She has thought extensively about how science can inform policy, and plans to contribute her experiences and suggestions. For example, she sits on the Great Barrier Reef Foundation's Attributes of a Sustainable Reef working group, which discussed projects to test a range of options to address predicted climate change effects, and she is an academic representative on a multi-stakeholder marine planning team in Canada. Pertinently, her current research explores the development of conservation objectives that could link data on dynamic disturbances with spatial decisions.

Dr Line Bay

Climate Change Scientist (Corals), Climate Change and Ocean Acidification, Australian Institute of Marine Science

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Line's research is focused on understanding the mechanisms and rates at which corals can acclimatise and adapt to climate change. She uses a cross-disciplinary approach that combines genetic and genomic techniques, with physiological and life-history data to reveal how corals respond to environmental variation, and the cost of coping with stress. Line also uses field and laboratory experiments to reveal the genetic basis to acclimatisation, required for adaptation to occur. Since completing her PhD, Line has published 21 papers and has supervised seven graduate students. She has experience in identifying research priorities, evidenced by her record of attracting research funding. Line has a fundamental interest in the practical outcomes of research and regularly engages with end-users (eg GBRMPA co-funded her research



Kane Aldridge



Nigel Andrew



Natalie Ban



Line Bay

2007–10; She co-authored a NCCARF report for the Dept Climate Change in 2011) and communicates with the general public (eg *Scientist in Schools* participant since 2007).

Line will be able to contribute directly to identifying cross-disciplinary research opportunities and to develop models to predict the effects of stress on ecosystems, in particular relating to the cost of acclimatisation and potential for adaptation to climate change. Line's background in public outreach and end-user engagement also enables her to contribute to discussion regarding the interplay between human activities and natural ecosystems to achieve practical outcomes of scientific research. The diversity of Line's experience, therefore, puts her in a great position to identify useful scientific information to advise policy and resource management, and to identify future research priorities.

Dr Christy Briles

Lecturer, School of Geography and Environmental Science, Monash University

christybriles@gmail.com

Christy is a paleoecologist with interests in biogeography, environmental change and variability, and ecosystem management. Specifically, she is interested in the vegetation and climate history of diverse ecosystems since the last ice age, and the role of disturbance, specifically fire, as a catalyst for environmental change. Pollen, macrofossils and charcoal preserved in lake and wetland sediments are the main proxies she uses to reconstruct vegetation, fire regimes, and climate. She began conducting paleoenvironmental research in 1997 as an undergraduate at the University of Denver (Colorado), obtained advanced degrees at the University of Oregon in Geography (MSc 2003, PhD 2008), specialising in the paleoenvironmental change,

and now is a Lecturer at Monash University in Biogeography and Paleoecology. While the western United States has been her region of focus, especially northern California, she is interested in expanding it to other regions, including Australia, to determine common drivers of environmental change.

The past is the key to the present and future. Historical data provides baseline information on how ecosystems have developed under environmental stresses in the past (i.e. climate change, human activities, pathogens, invasive species, etc). For example, the data are useful for determining interactions among climate, vegetation and fire, and how other key factors, such as humans, further influence those interactions. Ultimately, paleodata can be used to evaluate the impact of our current and future footprint on the landscape. During the Think Tank, Christy is interested in exploring how paleodata can be used to understand and manage the four Australian ecosystems of interest.

Dr Jane Catford

Research Fellow, Applied Environmental Decision Analysis CERF, School of Botany, University of Melbourne

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Jane aims to use ecological theory to increase understanding of human impacts on the structure and function of plant communities, and to inform environmental management and policy. Biological invasions and modification of environmental conditions and disturbance regimes can affect community composition, biodiversity and ecosystem function.

Jane is an empirical ecologist by training but uses various approaches to undertake applied and theoretical research. Her research has primarily focused on ways in which different stresses (eg invasion, grazing, river regulation, urbanisation, eutrophication) affect communities and ecosystems. As part of her



Christy Briles



Jane Catford



Morteza Chalak



Yung En Chee

postdoc, she modelled hotspots of weed invasion in Victoria; she will use the predictions to spatially prioritise management using formal decision theory. For her PhD, she examined factors that influence plant community composition and exotic invasion in River Murray wetlands. She demonstrated the potential of using environmental flows to inhibit weed invasion and facilitate native vegetation.

Jane recognises the importance of trans- and multidisciplinary approaches for managing environmental problems. To this end, she has studied politics, geography and ecology, worked with managers, landholders and physical and social scientists, and has engaged in multi-disciplinary research projects (eg river health and environmental flows in China) and workshops (eg invasion, climate change adaptation and riparian ecosystems). As such, she will be able to contribute to discussion on a range of topics, and will offer particular expertise in plant invasions, freshwater ecology and issues facing the Murray-Darling Basin, including flow regulation.

Dr Morteza Chalak

Research Assistant Professor, School of Agricultural and Resource Economics, Centre for Environmental Economics and Policy, University of Western Australia

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Morteza was born in Shiraz, Iran. He did his BSc in Natural Resource Engineering at Gorgan University and received his MSc in the same area from Tehran University. He completed his PhD at Wageningen University in the Netherlands. His PhD thesis was on the economics of controlling invasive species in New Zealand. He visited Massey University in New Zealand where he built relationships with scientists to get data and calibrate his models. Morteza graduated from Wageningen University in 2009 and since then he has been employed as a Research Assistant Professor at the

University of Western Australia. His main research focus now is bio-economic modelling.

Morteza will contribute to the programme in the following ways:

- discussing how he has incorporated uncertainty and stochasticity into the models
- discussing how to deal with a lack of published data. This can include how to obtain the best expert estimate and perform sensitivity analysis to deal with uncertainty in the parameter values
- how he simplified complex systems to incorporate spatially explicit information in them
- how to build general models that can be used in broad ecosystems.

Dr Yung En Chee

Research Fellow, School of Botany, University of Melbourne
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Yung is a quantitative ecologist with research experience and strong technical expertise in statistical, spatial and ecological modelling. Her research interests and experience lie in applying ecological and decision-analytic theory, models and methods to conservation and ecosystem/natural resource management problems. Many such problems involve complex biophysical, social and economic interactions and are often fraught with uncertainty. This has led her to multidisciplinary and collaborative research to inform the development of innovative methods and tools for transparent, rigorous, pragmatically-informed and robust decision support on a wide range of environmental problems. Yung has worked on developing:

- risk assessment and decision support tools and monitoring and evaluation plans for environmental flows management



Grace Chiu



Shaun Cunningham



Katherine Daniell



Remko Duursma

- spatial and quantitative tools for modelling freshwater biodiversity patterns
- integrated modelling, monitoring and management of overabundant wildlife
- a reference resource of tools to assist with the conduct of Strategic Assessments under the *EPBC Act 1999*.

Yung's research activities in a variety of stressed ecosystems including the Murray-Darling Basin, drought-affected regulated river systems and ecosystems around urbanising landscapes have given her a deep appreciation of the challenges associated with managing and restoring stressed ecosystems in the context of multiple competing interests. Yung will contribute to discussions from the perspectives of risk assessment, quantitative modelling, decision analysis under uncertainty, science-policy interactions and approaches to bridging the 'know-doing gap' between research and implementation.

Dr Grace Chiu

Senior Research Scientist, CSIRO Mathematics, Information and Statistics

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Since 1998, Grace has been developing statistical methodologies for research in the environmental sciences, especially statistical models for ecology / ecosystems; this is evident from her publications <http://faculty.washington.edu/gchiu/cv.pdf>. Prior to joining CMIS in 2009, Grace was tenure-track Assistant Professor at the University of Waterloo Department of Statistics and Actuarial Science (Canada), with which she is now adjunct faculty. Under her supervision, all Grace's former graduate students conducted statistical research with an environmental focus. In 2003–05, she was Postdoctoral Fellow at the Northwest Research Center for Statistics and the Environment at the

University of Washington (USA); since 2006 she has been an affiliate faculty member there with the Statistics Department. Grace is Associate Editor of *Environmetrics*, and Webmaster for The International Environmetrics Society (TIES). She leads the CSIRO Strategic Project called 'Constructing Hybrid Nutrient Budget Models via Bayesian Melding' under the Water for a Healthy Country Flagship – Healthy Water Ecosystems Theme.

As a statistician, Grace believes that quantitative rigour for assessing and reducing uncertainty is key to ecosystem research from which policies are derived. Through developing statistical-based ecosystem health indices (DOI:10.1002/env.744; DOI:10.1002/env.1055; works in progress), she has interacted with scientists from policy-making bodies (Environment Canada, USDA, USEPA); through them Grace has developed an understanding of challenges in making quantitative research integral to policy making. She is skilled with expressing quantitative and technical concepts in layman's terms, which greatly encourages policy makers to welcome quantitative science into their work. Grace will share her experiences with and solicit input from the Think Tank.

Dr Shaun Cunningham

Research Fellow, School of Biological Sciences, Monash University

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Shaun is a forest ecologist whose interests include forest dieback, restoring vegetation and ecological processes in degraded landscapes, and physiological explanations for plant distribution. He has developed a robust method for mapping the condition of river red gum forests across the whole Murray River floodplain, which has been adopted by the Murray-Darling Basin Authority. This mapping method was then used to

quantify the potential drivers of this dieback including altered flood regimes and groundwater conditions. He is now determining whether this condition assessment can be used to predict biodiversity across landscapes. Recently, he has been determining the potential for widespread reforestation of degraded agricultural landscapes to provide multiple biodiversity benefits (composition, structure and ecosystem process). His research into the physiological explanations for how climate determines the distribution of trees, gives him valuable insights into how climate change will affect native and production forests.

Shaun will provide valuable input to the discussion as his research is designed to and has provided important quantitative information for management decisions. Information from the river red gum project has been used by government organisations to target and assess managed floods across the Murray River floodplain. Through his continued interact with managers and policy makers, he has a strong understanding of what information is needed to improve the management and condition of native ecosystems. His research on reforestation will provide a tool that can predict the ecological outcomes of different planting scenarios to be assessed at a catchment scale.

Dr Katherine Daniell

Research Fellow, Centre for Policy Innovation, Australian National University

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Katherine has a wide range of interests related to environmental management, based on her training in Civil Engineering and Arts at an undergraduate level and through her PhD research on water management and sustainable development. Katherine has a particular interest in how natural resources management can be enhanced through the use of collaborative or participatory approaches that actively involve a wide range of stakeholders including from the local community, governments, businesses and NGOs. In this area, she has worked in Australia and Europe on projects including the creation of the Lower Hawkesbury Estuary Management Plan (NSW), and the AquaStress European Project, which included participatory modelling studies for water management in France and collaborative flood and drought risk management in Bulgaria. She is currently managing Australia's contribution to the PACE-Net project, which focuses on enhancing European–Pacific dialogue on science and technology priorities, including related to ecosystem and climate-change related science.

Considering Katherine's broad ranging interests and experience in both the technical and social aspects of environmental management (eg hydrological and environmental modelling, decision science, organisational management, policy and governance), she will be able to contribute to many facets of the planned discussions. These might include: how scientists can more effectively develop models to aid ecosystem assessment and management that could be more easily understood and accepted by policy makers and local communities, allowing them to more effectively support decision-making processes; as well as how collaborative processes for environmental management can be developed to manage conflict over scarce and valuable resources.

Dr Remko Duursma

Research Lecturer, Hawkesbury Institute for the Environment, University of Western Sydney

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Remko's main research interest is in developing quantitative models to understand vegetation function and dynamics. He has studied responses of forest water use and carbon uptake to soil water availability (drought), elevated carbon dioxide (CO₂), and other environmental variation. Remko has nearly twenty publications in international peer-reviewed journals, and is a co-editor for *Biogeosciences*. He has a strong international background and collaborations. Some of his work as a post-doc in Finland on improving forest growth models is being used to inform forest management and policy development. Remko is also involved with the Hawkesbury Forest Experiment, an experiment on the effects of elevated CO₂, drought and temperature on growth, water use, and carbon uptake of Eucalyptus. Synthesis of this work will also form the basis to inform policy makers on climate change impact on Australian forests.

Effects of climate change on forest functioning are difficult to understand, in part because the experimental results that are supposed to inform policy are diverse in outcomes, and specific to certain locations. Remko's modelling work is focusing on synthesising diverse experimental outcomes, to be able to make broader statements about Australian forests. These broader statements are more easily understood by policy makers, but are no less firmly based on the underlying science. My contribution to this workshop will be on the discussion on how we can summarise and synthesise scientific results to inform policy makers in a transparent and unambiguous manner.



Thomas Ford



Eddie Game



Georgia Garrard



Nicholas Graham

Dr Thomas Ford

ARC Postdoctoral Fellow, Humanities Research Centre, Australian National University

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Tom's research identifies the early nineteenth century as a formative moment in the cultural history of climate change, a moment when the modern sciences of atmosphere first came into being and when atmosphere and weather became newly central to art and literature. Climate provided the conceptual vehicle for representing and understanding these disparate scientific and aesthetic practices as belonging to a common, unified cultural field. Because atmosphere was positioned as a collective medium of culture in this way, cultural changes could then be seen to lead to climatic changes. This work establishes historical links between science and literature, climate and culture, that can help re-engage the humanities with ecological debates today. More broadly, this research examines the history of disciplinarity to extrapolate possible futures of the disciplines, including the potential for a functional reunification of the fragmented universe of knowledge. For more information, see: <https://researchers.anu.edu.au/researchers/ford-th>

Unless it is correlated with normative cultural values, science can struggle to influence public policy. Without the political will to carry them through, the best-informed decisions remain empty. Knowledge can help sustain ecosystems only when it becomes a material force – only when it grips society. This is particularly true of complex, highly politicised issues – ‘wicked problems’ – where apparently rational actions lead to paradoxical and unwanted outcomes. At this workshop, Tom Ford hopes to position models of communicative action and political rationality alongside natural scientific models as essential

theoretical requirements for the preservation and recuperation of stressed ecosystems.

Dr Eddie Game

Senior Conservation Planner, Conservation Science, The Nature Conservancy

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Eddie is a conservation scientist with The Nature Conservancy's www.nature.org global science program, and has an adjunct faculty position at the University of Queensland's School of Biological Sciences. Broadly, Eddie's research focuses on the application of decision theory to conservation problems – ensuring that conservation uses its resources well by making good decisions. Within The Nature Conservancy he works with teams across the globe on planning and prioritisation of conservation projects. Although Eddie has published and worked on a wide variety of conservation related issues, he is particularly interested in how our knowledge socio-ecological systems can be translated into good conservation decisions, and how to approach conservation decision making in highly dynamic social and ecological environments. Working for an NGO, Eddie has the role both of collaborating to advance the science of conservation, and also of ensuring its rapid transition to application in the field.

Eddie has both the academic expertise and practical experience to be a strong contributor to any discussion about robust decision making for conservation and environmental management. In addition to a doctorate on the application of decision theory in conservation (focusing on incorporating risk, uncertainty and resilience into decision making), he leads a team tasked with making recommendations on how the world's largest conservation NGO (The Nature Conservancy) can improve its decision making to meet the

challenges of today's diverse and complex conservation work.

Dr Georgia Garrard

Postdoctoral Research Fellow, Centre for Excellence for Environmental Decisions, School of Botany, University of Melbourne

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Georgia is a quantitative ecologist with interests in urban ecology, threatened species and ecosystem policy, ecological modelling and grassland conservation. Georgia is particularly interested in improving the link between science and policy. She has conducted research in Melbourne's grasslands, investigating ways in which ecological modelling and quantitative science can better inform environmental impact assessments. Since 2009, Georgia has been employed as a postdoctoral researcher with the Centre of Excellence for Environmental Decisions (CEED) and Applied Environmental Decision Analysis (AEDA) research hubs, where she has had the opportunity to develop new quantitative and modelling skills. Georgia is currently conducting research into the use and influence of Bayesian statistical methods in ecology, and recently undertook training in Structured Decision Making. She is passionate about the conservation of threatened ecosystems, particularly in urban areas, and is a member of the Technical Advisory Group overseeing the restoration and management of Melbourne's new Western Grassland Reserves.

Georgia understands the drivers of stress on ecosystems and has experience with a range of quantitative models available for assessing the status and recovery of threatened ecosystems. She has developed and contributed to detectability and state-and-transition models that help to improve our understanding of how best to manage grassland ecosystems in the context of data and surveillance constraints. She will contribute to discussions around robust decision-making and management for long-term success of ecosystem conservation and recovery in the face of uncertainty.

Dr Nicholas Graham

Senior Research Fellow, ARC Centre for Excellence for Coral Reef Studies, James Cook University

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Nick's research focuses on large-scale ecological questions directly relevant to the management of coral reef ecosystems. His PhD research at Newcastle University in the UK assessed the longer-term impacts of climate driven coral bleaching events on coral reef benthic and fish communities. He is also interested in the impacts of fishing and marine protection on reef

fish assemblages including the time scales necessary for full recovery in no take areas and the effects of fishing and protection on the size structuring of fish communities. Increasingly, he collaborates with social scientists to develop novel ways for policy to tackle climate change impacts to coral reefs in a socio-ecological framework and to assess how people interact with their resources and respond to different management strategies. Nick is also currently assessing recovery dynamics of degraded coral reefs with the aim of understanding the factors that enable reefs to recover between disturbances.

The majority of Nick's research has been based on Indian Ocean reefs, often across large biogeographic scales. This work has focused on two of the main drivers of change on reef systems, including Ningaloo; climate change and exploitation. He will therefore bring knowledge of how key threats to coral reefs interact with existing management, and which management decisions are likely to succeed or fail. Further, his research on social-ecological systems will be useful in informing the kinds of policy instruments that may be successful under differing scenarios.

Dr Patrick-Jean Guay

Research Fellow, School of Engineering and Science and Institute for Sustainability and Innovation, Victoria University

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Patrick-Jean has been studying Australian waterbirds for more than 8 years. His research focuses on the ecology, behaviour and conservation of waterbirds. His current research projects include the use of artificial wetlands, such as waste stabilisation ponds, by waterbirds and how such wetlands can provide essential non-breeding habitat, the nomadic movement of waterfowl across the Australian landscape and how they can contribute to spread of diseases like avian influenza, human-waterbird conflicts and how elaboration of efficient buffer zones can shelter waterbirds from the detrimental impacts of human disturbance, hybridisation between introduced Mallards and native dabbling ducks around the world and how proper management of introduced Mallards in Australia can secure the future of Pacific Black Ducks. Patrick-Jean Guay's work on waterfowl has provided him with knowledge of their ecology, habitat use and movement which he will contribute to the discussion on ecosystem degradation in the Murray-Darling Basin. Furthermore, he will be able to discuss human-wildlife conflicts in all four case study ecosystems. Although it is a factor that is often neglected, human disturbance will be a very important threatening process in the future. As Australia's population is set to increase



Patrick-Jean Guay



Andrew Harford



Mia Hoogenboom



Christopher Ives

rapidly in the next 50 years, management of human-wildlife conflicts will increase and, if no steps are taken, many species will likely suffer further habitat loss.

Dr Andrew Harford

Research Scientist, Supervising Scientist Division, Department of Sustainability, Environment, Water, Population and Communities

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Andrew is an ecotoxicologist with six years of postdoctoral experience, who is employed by the Environmental Research Institute of the Supervising Scientist (ERISS, DSEWPaC). He uses concentration-response and Species Sensitivity distribution models to predict the impact of contaminants on the environment. His primary interests include environmental impacts of mining effluents, metals/ major ions and suspended sediments on aquatic biota, and the associated application of novel assessment and prediction techniques. Current research areas include:

- effects of pulse exposures of mining-related contaminants
- development of methods to assess impacts of suspended sediments on freshwater species
- development of sediment quality guidelines for uranium, which involves the use of Next Generation Sequencing (ecogenomics) to characterise microbial/microinvertebrate communities.

Andrew's previous research experience includes assessing the immunotoxicity of environmental contaminants and nanoparticles in fish and mammalian models. He manages complex multi-disciplinary projects that require close collaborations with ecologists, chemists, hydrologists, geomorphologists, material scientists and statisticians.

Andrew's research is used directly by the Office of the Supervising Scientist (OSS, DSEWPaC) to recommend regulatory limits of contaminants in water/sediment, which aim to protect the Rasmars-listed Magela wetlands of Kakadu. Additionally, his expertise is used by the Approvals and Wildlife Division (AWD, DSEWPaC) to comment on Environmental Impact Statements for new uranium projects across Australia. He also engages in commercial studies that inform industry and State and Territory governments on the impacts of mining operations. Thus, he will bring to the workshop a comprehensive knowledge and personal experience of how science informs policy regarding high profile and contentious issues.

Dr Mia Hoogenboom

Postdoctoral Research Fellow, ARC Centre for Excellence for Coral Reef Studies, James Cook University

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Mia's research develops mathematical models that explain ecological patterns based on physiological processes. She has broad research interests and has worked on tropical and temperate corals and freshwater fish during her career to date. After completing her PhD, Mia sought opportunities to broaden the scope of her research and to develop a network of international collaborators. In 2008, she was awarded a postdoctoral fellowship at the Centre Scientifique de Monaco where she worked on the ecology of temperate corals. In 2009, Mia was recruited to work in an international collaborative group investigating the causes of intra-specific variation in metabolic rate of freshwater fish. In 2011, she subsequently took up a fellowship at the ARC Centre of Excellence for Coral Reef Studies. Her current research investigates how changes in the structure of coral assemblages will affect the primary productivity of coral communities under climate change scenarios.



Alison Jones



Mark Kennard



Gunnar Keppel



Peter Kopittke

Mia's research investigates species and community responses to environmental variation. She has detailed knowledge of the biological processes that underpin changes in organism performance, and her knowledge spans across taxonomic and ecosystem boundaries. Mia's skills provide a unique 'bottom-up' perspective on the interplay between human activities and ecological impacts. She will contribute to the workshop by sharing knowledge of the mechanisms through which stress impacts individuals within ecosystems. Through understanding these mechanisms we are able to make better decisions for the management of Australia's reefs, rivers and grasslands in the future.

Dr Christopher Ives

Postdoctoral Research Fellow, Melbourne Sustainable Society Institute, University of Melbourne

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Christopher's research interests lie principally in the assessment and management of biodiversity in urban and peri-urban landscapes, and the application of ecological science to planning policy. His PhD research investigated patterns of ant and plant diversity in urban riparian corridors in northern Sydney using a range of biodiversity assessment techniques. Results were applied specifically to a local government riparian protection policy, while broader implications for environmental and riparian legislative frameworks in Australia were considered. Christopher takes a multidisciplinary approach to research, with experience in the fields of ecology and urban planning and environmental law. His post-doctoral research maintains an applied, multidisciplinary approach in seeking to develop assessment tools to assess the sustainability of urban growth. This work is being applied directly to areas of proposed future development within the ecologically-sensitive grasslands of outer Melbourne and will integrate

both biophysical and socioeconomic aspects of sustainability.

Christopher's study of relationships between ecological data and urban land-use and environmental planning processes has equipped him with an understanding of issues pertinent to the management of many stressed ecological systems. He is particularly interested in contributing to discussions of how scientific complexity, data insufficiency and socio-political pressures can be reconciled with the expectations and responsibilities of management authorities commissioned with protecting the ecosystems nominated as case studies. Furthermore, his recent focus on peri-urban grasslands in Melbourne provides him with direct insight into issues critical to their sustainable management in the face of increasing development pressure.

Dr Alison Jones

Postdoctoral Researcher, Centre for Environmental Management, Central Queensland University

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Dr Alison Jones is an early career marine biologist working largely in the southern section of the Great Barrier Reef Marine Park. Her interests encompass the protection of Australia's maritime future through the use of a system of connected marine reserves only along the coastline and those of developing countries in the wider Pacific region. The idea was first raised by Lieutenant Colonel Nick Floyd, a visiting Army Fellow at the Lowy Institute, after hearing Dr Jones present the results of her research identifying marine refuges in the Keppel region. The research was funded by the Australian Naval Institute through the Maritime Advancement Award 2008–10. The project involved fine scale mapping of coral biodiversity to identify a model for marine managers to enhance the protection of reefs in the region.

The concept of marine refuges that protect both fish and coral biodiversity is an important one for the protection of the WA Ningaloo Marine Park as this will improve the capacity of WA reefs to cope with catastrophic disturbance. In a climate changed scenario, protecting food and maritime security will become paramount. The establishment of a well connected system of marine reserves that serve as seed stock for fish and coral regeneration will serve as a model for both Australia's national marine reserve system and those of our Pacific neighbours.

Dr Mark Kennard

Senior Research Fellow, Australian Rivers Institute, Griffith University

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Mark is a Senior Research Fellow at the Australian Rivers Institute, Griffith University. He specialises in biodiversity assessment, conservation planning, ecological modelling and assessing human impacts on aquatic ecosystems. His PhD research pioneered the development of a quantitative basis for the use of freshwater fish in river health assessments in Australia. His PhD thesis won an Academic Excellence award from Griffith University and the research now underpins a broad-scale ecosystem health monitoring program in south-eastern Queensland. He currently leads several projects through the National Environmental Research Program (Northern Australia Hub) and the CSIRO Flagship Cluster (Ecological responses to altered flow regimes in the Murray-Darling Basin). His expertise is widely sought for project steering committees, international workshops, expert panels and reviews, commissioned projects and advice to government departments, and he has a strong track record in winning external research funding through collaborative national competitive research grants, tenders and consultancies.

Mark is looking forward to actively contributing to the Think Tank discussion by drawing on his expertise in the following areas relevant to the workshop theme:

- diagnosing human impacts on aquatic ecosystems
- developing predictive ecological-response models
- quantifying and propagating uncertainty in ecological analyses (eg using Monte-Carlo, Bayesian and expert elicitation methods)
- identifying appropriate management strategies for threat mitigation, restoration and conservation of biodiversity
- familiarity with several of the case-study areas.

Mark is particularly interested in sharing his experiences and learning new strategies to help bridge the gap between science and policy implementation and

achieve effective environmental management in Australia.

Dr Gunnar Keppel

Research Fellow in Climate Change Refugia and Conservation, Centre for Biodiversity and Climate, Department of Environment and Agriculture, Curtin University

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Gunnar's research interests are biogeography, community ecology, islands, evolution, population genetics, the interfaces of these disciplines, and utilising multi-disciplinary information for conservation planning. His MSc project studied the conservation, ecology and population genetics of Pacific cycads, while his PhD investigated the diversity, ecology and biogeography of lowland rainforests in the Pacific. Gunnar worked as a lecturer in plant biology at the University of the South Pacific for four years, focusing research on the vegetation ecology and conservation of rainforests and dry forests in the Pacific. In 2009, he was a temporary lecturer in rainforest management at the School for Field Studies in North Queensland and a research assistant on long-term vegetation change in Queensland's semi-arid ecosystems. Currently Gunnar is a research fellow in climate change refugia and conservation, focusing on the role of granite outcrops as refugia for species under climate change and the conservation of endangered Fijian tree species.

Gunnar has extensive research experience in stressed ecosystems in Australia and the tropical Pacific and he can therefore contribute towards the discussion of requirements for accurate collection species diversity, vegetation and environmental data in the field and using remote sensing. Because he has collaborated with government departments and NGOs to achieve informed conservation planning, Gunnar can also provide insights on the need for cross-institutional and inter-disciplinary approaches. Stressed ecosystems are often highly fragmented and Gunnar's knowledge of insular environments may therefore benefit the discussion, as could his analytical skills in multivariate analyses and linear models.

Dr Peter Kopittke

Senior Research Officer, School of Agricultural and Food Sciences, University of Queensland

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Peter is Senior Research Officer at UQ and conducts both research and teaching in plant/soil science. Since completing his PhD in 2004, he has authored 49 articles in peer-reviewed journals and one book chapter. He has served as the President of the Australian Society of Soil Science Inc (ASSSI)



David Lloyd



Leo Lymburner



Joshua Madin



Nadine Marshall

Queensland, he is on the Editorial Board for the Australian Journal of Soil Science and the Journal of Plant Nutrition, and he has served on the Science Committee for the 19th World Congress of Soil Science. His primary research investigates soil degradation and stresses, including the importance of plant–soil interactions in salinity and aluminium (Al) toxicity. Indeed, his research aims to improve our understanding of plant–ion interactions, thereby providing the fundamental underpinnings required to advance research in several important disciplines, including:

- improving nutrient use efficiency in order to reduce nutrient losses and water pollution
- managing acid soils, in which aluminium (Al) toxicity reduces agricultural yields
- regulation and management of sites contaminated with trace metals at levels which are potentially toxic to plants.

Soil acidity (which directly results in Al toxicity) limits plant growth on approximately 50% of Australia’s agricultural soils, and causes > \$1.5 billion per year in lost productivity. Similarly, salinity (excess salt) and sodicity (excess Na) are significant plant-limiting factors in the Australian landscape, impacting upon both environmental quality and agricultural production. By 2050, it is estimated that 17 million ha of land in Australia will be affected by dryland salinity. Consideration of limiting factors such as these are of utmost importance in understanding stressed ecosystems.

Dr David Lloyd

Senior Lecturer, Southern Cross Environmental Innovations Research Centre, Southern Cross University

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David has extensive community development experience, in areas ranging from remote aboriginal

communities to the Solomon Islands, Indonesia, East Timor, Tonga, Tuvalu, New Guinea and Fiji, including Project Manager involved in developing and implementing a ‘Representative Areas’ program within the Great Barrier Reef World Heritage Area. David also assisted in the coordination of a UN workshop on ‘Biological and Social Indicators of the Health of Coral Reef Systems’. He is currently working on research and training projects in East and West Timor, and PNG. In particular, David is working on community-based projects to provide value adding for coffee in East Timor and curriculum development for the East Timor Coffee Academy. David is also the Chair of the Cape Byron Marine Park Advisory Committee.

David has a good knowledge across most of the issues being discussed, and feels he can contribute to the human dimensions of the discussions in particular the social and cultural impacts of alternate scenarios. He also has extensive experience in facilitation and problem solving techniques.

Dr Sama Low Choy

Senior Research Fellow, Discipline of Mathematical Sciences, Queensland University of Technology

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As a government statistician and academic, Sama’s research interests have coalesced on statistical methodology to support pioneering studies in environment and ecology (especially conservation and biosecurity) where inherent variability and uncertainty are substantial issues. In the face of high uncertainty, she has focused on targeting, distilling and combining multiple expert opinions for input into statistical models, and designing initial data collection, including collation of existing information.

Sama’s work has harnessed the hierarchical Bayesian statistical modelling paradigm, which facilitates

integration of information from diverse sources (eg empirical data, modelling outputs, literature and expert assessments). It facilitates more appropriate and intuitive inference in pioneering studies by addressing 'What models are plausible, given the information at hand?' rather than the classical concern of 'What data is likely under specific models?' A holistic approach has ensured feasible application of this research, by examining elicitation technology, statistical computation, visualisation and teaching probability concepts.

Sama has specific skills in eliciting expert judgments (statistical methods and software), for modelling consensus and diversity among experts, parameterisation or validation of complex models; and guiding collection of empirical data or selection of modelling scenarios. She has expertise in developing models for complex systems that accommodate multiple sources of uncertainty and diverse information, using hierarchical Bayesian frameworks. Sama has a solid foundation and cross-disciplinary collaborative experience in several quantitative and qualitative modelling paradigms, to provide a bridge between modelling approaches. She has extensive experience (statistical consulting, teaching and expert elicitation) to help discern requirements and suggest appropriate modelling approaches.

Dr Leo Lymburner

Team Leader, National Earth Observation, Science and Strategy Team, Geoscience Australia

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Leo's research focuses on using earth observation to characterise the dynamics of biophysical variables on the Earth's surface. This includes using time series of vegetation greenness to characterise land cover at national scales, and using moderate and coarse resolution satellite imagery to characterise the extent, duration and frequency of inundation. Leo's team has developed a national land cover map based on greenness time series, and the dataset that was used to create this map can potentially be used to provide insight into ecosystems in stress, depending on what the stressors are, and whether they impact the greenness dynamics of the ecosystem. Leo is also working on a major project that will enable better access to a calibrated national archive of satellite imagery.

The land cover map that Leo's team has developed has the potential to provide insight into the impact of various stressors on ecosystems and can be used to inform our understanding of how ecosystems recover from or respond to stressors such as severe bushfires, floods, droughts or severe tropical cyclones. The

dataset shows impacts on specific ecosystems such as mangroves, tropical forests, and alpine areas although additional ancillary data is required to characterise the stressors acting on these ecosystems.

Dr Joshua Madin

Senior Lecturer, Department of Biological Sciences, Macquarie University

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Josh is primarily interested in the ecological consequences of environmental change. He and his research group explore a range of ecological systems and combine empirical and modelling approaches in order to understand and predict the ecological and evolutionary effects of climate change on plants and animals. Josh has broad-based training and experience, ranging from mechanical engineering, mathematics and computer science through to ecology and evolution. This training has allowed him to approach scientific questions in new ways, and has led to several high-profile publications and international media attention. For instance, Josh developed engineering theory for predicting the dislodgement of coral colonies based on shape and size and thereby produced a predictive model for ecological change in relation to tropical storm disturbances. This new theory led to insights into how coral communities might respond to increasing storm intensities (by sea surface warming) and weakening reef materials (by ocean acidification) anticipated under climate change.

Josh's primary line of research combines modern modelling techniques with large data sets in order to understand and predict the ecological consequences of environmental change. He encourages his research group, the Computational Ecology Group, to consider how their research outputs can inform policy. Josh's multi-disciplinary and cross-ecosystem interests will allow him to contribute effectively in discussions about the appropriate use of predictive models, how they should inform policy and management, and how model uncertainty should be incorporated to avoid misrepresentation of conclusions.

Dr Nadine Marshall

Senior Social Scientist, Ecosystems Sciences, CSIRO

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Nadine's research interests centre on understanding how social and ecological systems might be resilient to change, on understanding vulnerability to change and developing strategies to ensure our sustainability into the future. These interests are addressed through understanding 'resource dependency', the linkages between people and the environment. The drivers of change that she is most interested in include climate



Eve McDonald-Madden



Jessica Melbourne-Thomas



Brett Murphy



Firuza Begham Mustafa

change, regulatory change, voluntary change, environmental change and cultural change. Nadine's experiences to date are mostly within the Australian primary industry context. She currently works with the commercial fishing industry and marine-based tourism industries in the Great Barrier Reef, the cattle grazing industry across northern Australia and the peanut industry in Qld and NT. These industries are particularly sensitive to climate change impacts.

Nadine would thoroughly enjoy the opportunity to discuss the future of Australian ecosystems facing stress with this esteemed group – especially if it could inform decision making. Her work in other contexts may be useful to help understand the social or human dimension of ecosystem management within the four case studies presented. No doubt, management of these four systems will require decisions to be made that require people to change; they will need to adopt new practices and adapt to the new conditions. Unless the social dimension is considered, management decisions are likely to be contested and ineffective.

Dr Eve McDonald-Madden

Postdoctoral Researcher, Centre for Excellence in Environmental Decisions, School of Biological Sciences, University of Queensland

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Recent years have seen an increasing recognition and development of decision-making frameworks to aid the effective allocation of conservation funds. However, these frameworks require information about ecosystems and species that more often than not we do not have. This information could be obtained with money and time, but – and here is the crux of the problem – conservation is a crisis discipline. Environmental degradation is not waiting for us to know enough to make better management decisions. The pressing question is whether it is best to use the

money and knowledge that we have now, to save the world's biodiversity. Eve's research focuses on helping make better conservation decisions by analysing the tradeoffs between available dollars, our need for information, and the urgency of the conservation issue at hand.

In the past 10 years, Eve has been confronted by the multitude of issues faced by those managing the environment 'on the ground' and has become adept at setting up clear objectives for conservation problems and framing the right questions for which solutions can be found, an essential skill for dealing with the complex and novel problems proposed for this Think Tank. Asking the right questions is only one part of the process, it is also essential to find solutions to these problems. During her PhD and as a postdoctoral researcher, Eve has developed exceptional analytic skills, including tools from mathematics and Artificial Intelligence, which will enable her to aid this Think Tank in addressing the complex problem of decision-making in light of critical uncertainties.

Dr Jessica Melbourne-Thomas

Ecological Statistician, Antarctic Climate and Ecosystems CRC, University of Tasmania

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Jessica has a background in marine ecosystem modelling and has been involved with research relating to a range of marine systems. Her PhD research focused on the development of regional scale biophysical models for complex coral reef ecosystems. The culmination of this research was the development of a decision support tool that can be applied to tropical reef systems anywhere in the world. Prior to her PhD, Jess worked as a coral reef researcher in Indonesia (2004–06), and was a Rhodes Scholar from 2003–05. She has coauthored several publications examining coral disease dynamics in Australia and

Indonesia. Jess joined the Antarctic Climate and Ecosystems CRC in 2011 and is currently engaged in developing 'end-to-end' models for physical, biogeochemical and foodweb dynamics in the East Antarctic region. She is also developing qualitative models to explore climate change impacts on Antarctic marine foodwebs, as part of a broad-scale ecosystem impacts risk assessment.

Jessica's contributions to discussion around the workshop's theme will be informed by her experience in developing marine ecosystem models and in using these models to evaluate potential futures under different scenarios for managing multiple stressors. She is particularly interested in how scientific research and modelling can contribute to management decisions and policy making, and has some experience in this area from her PhD and as a Wentworth Group Scholar. Jess is also looking forward to opportunities for networking and career development as part of the Think Tank.

Dr Brett Murphy

Postdoctoral Research Fellow, School of Plant Science, University of Tasmania

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Brett's research focuses on the role of fire in Australian ecosystems, and how fire can be managed for biodiversity conservation and greenhouse gas abatement. He is currently studying:

- drivers of fire regimes and the impacts of global environmental change
- demographic changes taking place in savannas and rainforests in response to changes in fire regimes, climate and atmospheric CO₂
- positive and negative feedbacks between vegetation and fire, and whether feedbacks are responsible for alternative stable states in tropical vegetation
- optimal prescribed burning strategies in northern Australia for biodiversity conservation and greenhouse gas abatement.

Brett recently completed a postdoctoral fellowship with the University of Tasmania, investigating impacts of global environmental change on rainforest–savanna boundaries, and is now employed jointly by UTAS, South Dakota State University and Bushfires NT on a project investigating climate change impacts on Australian fire regimes and the available mitigation options.

Brett's experience modelling ecological fire impacts is highly relevant to the workshop's theme. Fire is an exemplary ecological stressor, integral to many ecosystem processes but potentially destructive. Abrupt shifts in ecosystem properties, such as

flammability and fire response, are frequently driven by failures of stabilising feedbacks, and Brett has a track record of thinking about these issues from fundamental and applied perspectives. Additionally, he will bring to the workshop experience in ecological modelling using large, noisy datasets characterised by complex interactions and feedbacks, precluding simple correlative analyses, plus an understanding of the virtues and limitations of predictive modelling.

Dr Firuza Begham Mustafa

Senior Lecturer, Department of Geography, Faculty of Arts and Social Science, University of Malaya

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Firuza is a Senior Lecturer in the Department of Geography, University of Malaya, Kuala Lumpur, Malaysia. Her main research interests include agriculture, geography and environmental management. Her main focus is on poor agricultural practices affecting environment, land use planning using remote sensing and the impact of aquaculture on the coastal environment. Her research also covers coastal zone management and resource utilisation in traditional and commercial agricultural activities in Malaysia. Her PhD research was related to large scale commercial aquaculture development projects in coastal areas affecting coastal communities and environment including impacts on coastal mangrove. Firuza's other interests include aquaculture ecosystems, the involvement of indigenous people in environmental protection, public participation in environmental management, ecological diversity in the agriculture landscape, water quality, biodiversity and forest management.

Firuza can contribute to the discussion and share her experiences from Malaysia, particularly her knowledge of the diverse tropical ecological habitats including coastal wetland habitats and resources (peat swamp forest, freshwater swamp forest, coastal mangroves, etc) resource depletion due to human perturbation including unplanned land clearing activities and unproductive agricultural practices. Her experience from a tropical and multiracial country like Malaysia would be useful and provide different perspectives, deepening the discussion, and bring effective solutions to address the issues and problems for effective management of natural resources based on ecosystem values and functions.

Dr Dale Nimmo

Postdoctoral Research Fellow, School of Life and Environmental Sciences, Deakin University

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Dale recently completed his PhD, which focused on the response of reptiles to fire in the semi-arid region



Dale Nimmo



Jessica Northey



Megan O'Shea



Dan Pagendam

of south-eastern Australia. This work involved collaborating towards developing a framework for modelling ecological succession over long time frames, at multiple spatial scales, and including non-linear dynamics. Currently, Dale is working as a Research Fellow with Professor Andrew F Bennett at Deakin University, where he is involved in a large-scale natural experiment investigating how existing disturbances interact with climate change to determine patterns of species loss in woodland bird communities. This work combines cross-sectional and longitudinal datasets to gain unique insights into the spatial predictors of ecological change.

Dale's research has a focus on the way species and communities respond to ecological disturbance. He has experience in modelling such responses in two systems, across a broad range of taxa, and with an emphasis on large spatial scales and long time-frames. Dale's work has an applied focus, with close ties with land management agencies. Dale will contribute to the workshops theme of modelling the response of ecosystems to stress by sharing his experience and knowledge gained through previous work in other systems.

Dr Jessica Northey

Hydrogeologist, Groundwater Group, Geospatial and Earth Monitoring Division, Geoscience Australia

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Jessica's main research interest is in the field of hydrogeology and groundwater chemistry. Jessica was awarded a PhD in 2006 from the University of New South Wales in collaboration with CSIRO, which examined the hydrogeological and hydrochemical processes contributing to soil and groundwater salinisation under irrigated agriculture. After finishing her PhD, Jessica worked as a consultant before moving to the public sector and working at the science-policy

interface. She regularly provides independent scientific information and advice to support national groundwater policy development and program administration in relation to groundwater resources, environmental and mining impacts. Much of this work is in stressed systems with multiple competitive water users such as in areas of coal seam gas and other mining developments. Jessica has a strong interest in communicating the complexity and uncertainty around groundwater behaviour and recommending strategies to deal with these factors when developing policy options.

Jessica contributes to groundwater information and advice on coal seam gas (CSG) developments in the Surat and Bowen Basins. This often involves the assessment of models to predict the possible impacts of CSG development on groundwater resources and therefore requires an understanding of the limitations and uncertainties around such models. Providing scientific advice to government also requires an understanding of the varied issues that are considered during policy development. Jessica will contribute to discussions on the reliance of models to predict impacts on natural systems, the limitations of these models and how scientific uncertainty can be integrated into policy development.

Dr Megan O'Shea

Lecturer, School of Engineering and Science, Victoria University

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Megan's research interests are with the temperate grasslands of the Victorian Volcanic Plains. Her focus has been on a flagship species of this ecosystem, the Striped Legless Lizard *Delma impar*, which was the subject of her honours and doctoral theses, as well as six research/consultant reports. She is a long-standing member of the Victorian Striped Legless Lizard Working

Group and has contributed to a Population Viability Analysis (PVA), National Recovery Plan, Flora and Fauna Guarantee Action Statement and Translocation Field Trial project for the species. Megan has supervised one honours project on *D. impar* and one doctoral project (near completion) on the ecology of the threatened Victorian grassland shrub Spiny Rice-flower *Pimelea spinescens*. She also lectures on the restoration ecology and conservation of temperate grasslands in Victoria. Her current interests are in understanding the relationship between habitat patch characteristics and viability of *D. impar* populations.

Megan's specialist knowledge of the ecology of Melbourne's peri-urban grasslands, will contribute to discussions on the impact of fragmentation, isolation and the influence of the surrounding landscape and management on the conservation biology of two threatened flagship species – *D. impar* and *P. spinescens*. She will be able to contribute insights on the impacts of fire, environmental weeds and human disturbance in remnant grasslands and the need for well-directed active management and assessment. She will also provide thoughts on current rehabilitation actions and future research and management strategies.

Dr Dan Pagendam

OCE Postdoctoral Research Fellow, CSIRO Mathematics, Information and Statistics, CSIRO

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Dan has broad interests in ecology, hydrology, environmental modelling and statistics, but is particularly interested in the application of stochastic models in the environmental sciences. In 2002, he was awarded a Bachelor of Environmental Science in Ecology (Hons I) from UQ. He then commenced work for the Queensland Department of Natural Resources and Water where he was employed as a water quality modeller for 4 years. During this period he completed an MSc in Statistics part-time (UQ) and in 2006, was awarded an Australian Postgraduate award and MASCOS top-up scholarship to undertake a PhD at UQ. Dan's PhD topic was estimation and experimental design for stochastic population models and was awarded in 2010. He is currently OCE Postdoctoral Research Fellow with CSIRO Mathematics, Informatics and Statistics in Brisbane where he is developing novel statistical methodology for hydrological applications.

Dan believes he can contribute to the Think Tank as a statistician/modeller who has an understanding of decision theory and the mathematics behind making conservation decisions. In addition, his background in ecology and environmental science means that he is well informed and equipped to interact in discussions regarding environmental problems. Dan's previous

work experience in the Queensland government also means that he has an understanding of the interface between science and policy making.

Dr Maksym Polyakov

Research Assistant Professor, School of Agricultural and Resource Economics and Policy, University of Western Australia

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Maksym received his doctorate degree in applied economics from Auburn University. Prior to coming to UWA, he had postdoctoral positions at Auburn and NCSU studying the anthropogenic effects on diversity of forest trees, impact of property tax policy, urbanisation, and markets on land use change, and analysing harvest behaviour of private forest owners. His research interests include environmental and resource economics, land economics, biodiversity conservation, and spatially explicit bio-economic modelling. Maksym is interested in the integration of ecology and economics to better understand the choices humans make concerning natural resources and consequences of these choices for the environment. His current research programme is part of the Investment Framework for Environmental Resources (INFFER) project and focuses on prioritising investment in biodiversity in fragmented landscapes in Australia. It involves development of spatially explicit bio-economic model that optimises provision of biodiversity services subject to minimising loss to agricultural production.

Robust decision making in managing natural resources and the environment requires not only accurate and reliable models of the ecosystems, but also reliable socioeconomic models, which facilitate efficient use of limited resources for preserving, sustaining, or restoring ecosystems. Maksym will be able to contribute to the workshop's theme based on his experience in integrating biophysical and socio-economic disciplinary approaches to support decision making in natural resource management.

Dr Ben Radford

Spatial Modeller, Exploring Marine Biodiversity, Australian Institute of Marine Science

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Ben's research has focused on applying novel spatial modelling methods to areas ranging from the production of habitat models to the prediction of biodiversity patterns. These models are based upon an understanding of how biophysical surrogates reflect ecological processes. More recently Ben has incorporated direct physiological parameters into these models so as to speculate how changes in



Maksym Polyakov



Ben Radford



Tyrone Ridgway



Libby Rumpff

parameters such as temperature and light may affect fitness and distribution of major biotic groups. His research primary focuses on coral reefs and associated deeper water mesophotic communities. Since finishing his PhD (Sept 2007), Ben held a teaching and research/ position at the University of Western Australia and joined the Australian Institute of Marine Science in September 2008. His work has been recognised with a number of awards including the CRC Chair's Innovation Award for novel and unique interdisciplinary research. Ben has 12 publications in journals such as *Journal of Biodiversity*, *PLoS One* and *Conservation Letters*.

Ben's research interest relevant to Ningaloo Marine Park revolves around spatial models including the range and extent of spatial habitat and biodiversity patterns, and human impacts. These models can be used for exploring questions of how representative current protected 'no take' areas are of known biodiversity assets. With his involvement in Western Australian Marine Science Institution (WAMSI) projects, Ben has already produced broad scale models including key habitats, biodiversity patterns and hotspots for key invertebrate communities, spatial models for target invertebrates species, and spatial models for human accessibility to target invertebrates.

Dr Tyrone Ridgway

Ningaloo Atlas Scientific Editor, Exploring Biodiversity, Australian Institute of Marine Science

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Tyrone has a broad interest in tropical marine system dynamics and management – particularly coral reefs. His research from his PhD focused on connectivity of coral reef systems in both East Australia and East Africa, followed by a postdoctoral appointment focusing on coral bleaching and climate change impacts on coral reefs. During his postdoctoral employment, Tyrone worked in a part-time advocacy role for WWF before

moving to a faculty position at Pennsylvania State University. In 2009, Tyrone returned to Australia to transition from pure science to translating science into management and policy and held the position of Project Manager of Climate Change at the Great Barrier Reef Marine Park Authority. Tyrone's experience in stakeholder liaison and his detailed knowledge of science and its translation into resource management and communication led to the recruitment to his current position to build and manage the Ningaloo Atlas project.

Tyrone has direct experience in translating the science to manage Australia's largest coral reef ecosystem (the Great Barrier Reef) under the uncertainties of climate change and multiple-use, and he is currently collating, facilitating and communicating science for the Ningaloo Marine Park (NMP) through the development of a knowledge management system (the Ningaloo Atlas) to assist in informed decision making for the NMP – through direct liaison with key stakeholders including the resource management regulator of the NMP (WA Department of Environment and Conservation).

Dr Libby Rumpff

Postdoctoral Research Fellow, School of Botany, University of Melbourne

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Libby is a plant ecologist interested in the structure, composition and function of ecological communities, and modelling trajectories of change in vegetation in response to management and changing environmental conditions. She has been working to develop and test an adaptive management strategy for continuous improvement of vegetation management practices that maximises the value of local and expert knowledge and monitoring data. This work includes the development of vegetation restoration process models (in the form of Bayesian Networks) for grassy



Kelly Scheepers



Leonie Seabrook



Justine Shaw



Rhiannon Smith

woodland ecosystems. She is particularly interested in how we can develop quantitative systems models that are conceptually easy to grasp and can be developed with stakeholders, as she believes this to be a significant step toward implementing a working example of Adaptive Management. More broadly, Libby has been working with various government agencies to provide tools to minimise uncertainty and develop structured decision making approaches.

Libby's career as an ecologist has benefited from combining extensive field experience, modelling and decision-theoretic approaches. Her experience working with practitioners, developing Bayesian process models, facilitating expert elicitation workshops, and applying structured decision making to various environmental management problems provides a good basis for discussing the theme of this workshop. In particular, the quantitative state-and-transition model she has developed for grassy woodlands will be of interest. One of the aims of Libby's current work is to demonstrate how Bayesian Networks could be used to integrate monitoring data in a learning and prioritisation strategy.

Dr Kelly Scheepers

Postdoctoral Fellow and Socio-ecologist, CSIRO Ecosystems Sciences

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With a PhD in Environmental Science, six years employment with South African National Parks, and one year into a postdoctoral fellowship at CSIRO, Kelly has strong interests in Indigenous Community-Based Natural Resource Management. Kelly has worked extensively with local communities in South Africa, and more recently in Australia, to develop sustainable livelihood options for people that recognise the close linkages between biodiversity conservation, best practice natural resource management and broader

socio-economic and cultural values attributed to ecosystems. This work has entailed an interdisciplinary focus that draws on principles and paradigms from different fields of study, combines traditional and scientific knowledge, and develops new methodologies to explore the complex ways in which people live, work and relate to their surrounding environment. The emphasis has been on understanding the factors that make for resilient communities, able to adapt and cope with environmental threats and externalities.

Kelly has extensive theoretical and experiential knowledge of socio-ecological systems gained from working on natural resource management projects with Indigenous communities in regional Australia. Indigenous communities are especially tightly coupled with the ecosystems within which they live and have cultural obligations for. Kelly has experience at multiple levels of organisation, from that of the local community to integrated regional conservation and development initiatives, which have provided for a broad perspective on sustainable ecosystem management. Reconciling multiple stakeholder values requires a participatory approach, and Kelly has extensive experience with participatory research techniques.

Dr Leonie Seabrook

Australian Postdoctoral Industry Fellow, School of Geography, Planning and Environmental Management, University of Queensland

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Leonie's principal research interests are in the fields of landscape change (including interactions with climate change and the potential to mitigate loss of biodiversity through restoration), ecological history, and landscape ecology. She studies human-environment interactions in landscapes at different spatial and temporal scales, with an aim to understand and improve environmental management for better

biodiversity outcomes. Her current research looks at the species–habitat dynamics of koalas in semi-arid western Queensland. These populations form the contracting edge of current koala distribution and are vulnerable to more frequent climate extremes arising from global warming. She is experienced in the use of spatial and ecological modelling to quantify the drivers, patterns and rates of landscape change. Leonie has collaborated on a number of publications, most addressing facets of human–environment interactions in theoretical and applied research. She teaches sustainable development courses, providing a broad knowledge base of ecosystem stressors.

Leonie will contribute through her experience in identifying and modelling the interactions between natural and human systems. She has an understanding of many of the complex causes of ecosystem stress, including the drivers of competing land uses, the attitudes of landholders to native vegetation, and the effects of climate extremes on native species. She also has experience in using decision support tools to model and communicate relationships between management actions and environmental outcomes to policy makers and other stakeholders. Leonie's PhD research into the drivers and patterns of landscape change was carried out in the Surat and Bowen Basins.

Dr Justine Shaw

Ecologist, Terrestrial Nearshore Ecosystems, Australian Antarctic Division

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Justine's current research examines species distributions across different spatial scales; she studies species interactions, with particular focus on invasive species and their interactions with indigenous and other non-native species. Justine explores how management interventions (large scale) can successfully eradicate or cause ecosystem meltdowns through predator/herbivore release. Her research experience is in plant demography, plant pathogens, ex situ conservations, invasive species across many different ecosystems from sub-tropical rainforests to temperate eucalypt forests to offshore islands. She has been involved in long-term monitoring programs that explore invertebrates populations (caterpillars, ants, weevils) and the drivers distributions across environments (sub-Antarctic islands, plantations, mountain heath and coastal vegetation). Her work has explored the influence of climatic change (warming, drought, humidity, seasonality) on species distributions, productivity, reproduction and vulnerability to pathogens. As an adjunct fellow (Spatial Ecology Lab UQ), she is investigating the application of conservation decision theory to Antarctic conservation.

Since completing her PhD, Justine has worked for state and federal government (DPIPWE Tas, DSEWPAC Aust.) and at Australian and overseas universities (UTAS, UQ, Stellenbosch University). She engaged a wide range of stakeholders, addressing complexities of ecosystem management under different tenures and legislations. As a postdoctoral fellow (South Africa) she facilitated land manager and research scientist interaction to improve management of invasive plant species (published). Her current work is examining the complexity of multi-species management. She will contribute as a conservation ecologist, who has worked under several different frameworks. She is interested in decision making for the management of stressed ecosystems.

Dr Rhiannon Smith

Junior Research Fellow, Ecosystem Management, School of Environmental and Rural Science, University of New England

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Rhiannon's PhD investigated biodiversity and ecosystem services in native vegetation remnants on cotton farms of the lower Namoi floodplain. The project allowed her to work with 36 landholders and resulted in an appreciation of the importance of biodiversity and ecosystem services in the cotton industry. Rhiannon's thesis was one of the first studies in the world to:

- measure provision of multiple ecosystem services in several ecosystems over a large region
- measure the effects of native vegetation management on service provision
- explore the interdependence of multiple services and potential trade-offs and synergies between services.

Rhiannon's thesis was also one of the first to explore vegetation condition in relation to ecosystem service provision and articulate targets for management to maximise vegetation condition for service provision in various ecosystems.

Rhiannon's PhD gave her an excellent understanding of social – ecological systems, the factors underpinning various components and drivers of change in these systems. Building on that understanding by exposing her to different systems with new foundations, players and drivers, Rhiannon's postdoctoral research is investigating soil health and function at sites experiencing woody encroachment on the Cobar Pediplain.

Rhiannon believes science-informed policy aimed at increasing resilience in social – ecological systems is essential for maintaining a healthy planet and human



Rachel Standish



Simon Vieira



Thomas Wernberg



Sarah Wheeler

wellbeing. Rhiannon advocates the cross-disciplinary approach provided by the ecosystem services concept and modelled in the Millennium Ecosystem Assessment as a solid platform for discussion and policy development and is keen to contribute in this area.

Dr Rachel Standish

Research Assistant Professor, School of Plant Biology, University of Western Australia

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Rachel has a broad interest in ecology and its application to the management and restoration of native ecosystems. Her research is grounded in theory but driven by an interest in developing practical outcomes for conservation and restoration in a rapidly changing world. Rachel is a senior member of a strong research group led by Laureate Fellow Professor Richard Hobbs. Her research has been applied to the management of a variety of stressed ecosystems including forest remnants affected by invasive weeds in New Zealand, old-fields affected by land-use legacies in south-western Australia and banksia woodlands affected by climate change and human activity in urban landscapes. While her research has focused on plants in terrestrial ecosystems in recent years, she started her career researching marine systems and therefore feels comfortable thinking about stressed ecosystems on land and under water. Finally, Rachel has some experience translating research outcomes into policy.

Rachel brings considerable and relevant research experience to bear on the question of how to manage stressed ecosystems. She has contributed to recent conceptual advances in this field. Rachel would bring to the discussion some of the current thinking on how to intervene to manage ecosystems in the face of the rapid environmental change. For example, she has

recently attended workshops on the utility of the concept of resilience for ecosystem management as well as one on how to manage 'novel ecosystems' (eg stressed ecosystems). Overall, Rachel is well-placed to contribute to the workshop's theme.

Simon Vieira

Economist, Australian Bureau of Agricultural and Resource Economics and Sciences

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Simon has a multi-disciplinary background given his double degree in marine science and economics (with first class honours) from Murdoch University, Western Australia. Much of his research experience has been gained at ABARES since 2006 where his main responsibility is undertaking a broad range of fisheries economic research to assess economic performance of fisheries and make policy recommendations. Between 2005 and 2006, Simon was employed by Murdoch University to undertake economic research on shark fisheries in Indonesia. He contributed to the project by leading field work in Indonesia and assessing the social and economic impact of shark fishing. He was also employed with Fisheries WA in 2005 to undertake research on different economic and social evaluation methods for fisheries and to recommend methods suitable for use by the Department. Simon undertook similar research for the Department as a private consultant between 2007 and 2008.

Simon's multi-disciplinary background will allow him to contribute to the discussion from both an economic and scientific perspective. Additionally, he has over six years experience undertaking research on fisheries issues, which has included research focused on ecosystem-based fisheries management and how to achieve it. Simon's work on fisheries in Indonesia also provided him with experience modelling social and economic dependence on ecosystems under stress.

Dr Thomas Wernberg

Assistant Professor Research, UWA Oceans Institute and School of Plant Biology, University of Western Australia

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Thomas has a broad experience in marine ecology, where much of his work has focused on temperate rocky reefs dominated by seaweeds. He has studied the influence of invasive species, eutrophication, disturbance and climatic stress on the distribution and abundance of species and communities. By highlighting links between environmental drivers and ecological processes (including reproduction and recruitment, ecosystem engineering, habitat connectivity, herbivory and community recovery), Thomas' research has contributed to an integrated understanding of ecological dynamics in near-shore marine habitats. Increasingly, Thomas' research focuses on the nexus between physiology, ecology and biogeography, and the need to understand interactions between local to global processes. His research aims to provide information on how coastal habitats might respond to anthropogenic stressors now and in the future, to inform recommendations for conservation strategies needed to ameliorate their impacts.

Thomas will contribute a broad ecological perspective relevant to prominent ecosystem stressors (eg climate change, invasive species, eutrophication, physical disturbance). He has worked across sub-arctic to tropical ecosystems, where he has experience in assessing and interpreting interactions between multiple concurrent pressures, and physical drivers of ecological resilience. His research has always been oriented towards field observations and experiments, and he will bring expertise in data collection, experimental design and assessment of ecosystem function.

Dr Sarah Wheeler

Senior Research Fellow, Centre for Regulation and Market Analysis, School of Commerce, University of South Australia

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Sarah's research interests include organic farming, water markets, economics of entomology, farmer behaviour and crime and gambling issues. She has won a number of travel awards, best paper at conferences and scholarships, and has contributed to the development of resource economics in South Australia. Sarah's work is often multi-disciplinary and covers a variety of research fields. Her recent work has focused on farm viability issues in the Murray-Darling Basin, and issues surrounding the buy-back of water entitlements. Prior to undertaking her PhD, Sarah

worked as a natural resource economist within Australia and overseas at places including SA Centre for Economic Studies (University of Adelaide), Primary Industries South Australia, United Nations (Bangkok) and Environment Agency (UK). Sarah currently has published 13 journal articles and 9 book chapters, generally as the lead or sole author, and she is also the lead chief investigator on a large ARC linkage project on water market behaviour.

Sarah has been researching two main areas of relevance to the workshop's theme of stressed ecosystems, water market policy in the southern Murray-Darling Basin, and organic farming policy. Both these topics involve analysis of farmer behaviour and its relationship with environmental, scientific, agricultural and social outcomes. Sarah's contribution would be to emphasise the need for research that is more holistic, flexible, long-term, trans-disciplinary, externality encompassing, cost-efficient, on-farm and region-specific – and in addition, the economic and policy tools that could be used to change individual and institutional behaviour.

Dr Davina White

Postdoctoral Research Fellow, School of Earth and Environmental Sciences, University of Adelaide

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Davina's specialisation is in hyperspectral remote sensing of vegetation for environmental management decision making. She successfully attained her PhD in hyperspectral remote sensing of sub-surface soil disturbance associated with arable crop stress from The University of Newcastle, UK Davina is currently involved with a large National Water Commission funded research project, partnered by SA Arid Lands NRM, DENR, NT government and CSIRO, investigating advanced hyperspectral and multispectral remote sensing techniques for monitoring the extent, composition and distribution of mound spring wetland vegetation. The advanced remote sensing techniques developed from this project will be used to determine the sensitivity of mound spring wetland vegetation to water allocations from the Australian Great Artesian Basin (GAB), thus influencing and improving the effectiveness of water allocation plan management decisions and associated policies.

Davina is currently on the Technical Advisory panel for the Queensland GAB springs monitoring project. The Queensland Water Commission is currently involved in the management and regulation of cumulative impacts resulting from the coal seam gas industry upon the Surat Basin.

The current GAB project Davina is working on is highly relevant to the Think Tank theme and case studies,



Davina White



Shaun Wilson



Fiona Young

particularly case study A, which is providing remote sensing tools and solutions to monitor the sensitive ecological systems the GAB springs. Outputs from this work are being used to assist in implementing environmental protection and improved groundwater allocation policy. Davina's background in applying remote sensing to a number of differing ecosystems with differing stress impacts would provide a different perspective on the Think Tank discussions, given her PhD research was conducted in the UK and her postdoctoral research in South Australia.

Dr Shaun Wilson

Senior Research Scientist, Marine Science Program, Department of Environment and Conservation WA

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Shaun's research links large-scale ecological studies with rigorous analysis of functional biology to gain a mechanistic understanding of ecological processes. He is particularly interested in the effects of anthropogenic, climate driven and natural disturbances on coral reefs. Over the past five years, Shaun has published 34 papers, including 7 in ERA top tier journals. Most of his work focuses on assessing and understanding the ecological consequences of disturbance on coral reefs. Since 2008 he has worked for the Department of Environment and Conservation (DEC), carrying out and developing research and monitoring programs in the Western Australia's topical marine parks. Shaun is currently researching the effects of climate change and fishing on fish, coral and algal communities in the Ningaloo Marine Park. Prior to this position Wilson held teaching and research posts at internationally recognised marine science institutions in the USA, UK and Australia.

As a senior member of the Marine Science Program (MSP) at DEC, Shaun has an excellent understanding

of current and proposed management strategies, research and monitoring programs at Ningaloo. This includes the Ningaloo research program, managed by MSP under the WAMSI banner, which covers a broad range of ecological and social topics. Combined with his research experience on coral reefs, Shaun's knowledge affords him the ability to discuss the ecological and anthropogenic threats at Ningaloo, their consequences and potential solutions. As such, Shaun welcomes the opportunity to participate in the workshop.

Dr Fiona Young

Senior Lecturer, Medical Biotechnology, Flinders University

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Fiona completed a PhD in reproductive endocrinology in Edinburgh, Scotland, and since then has developed novel human in vitro human cell line bioassays that quantify cytotoxicity, endocrine disruption, immunotoxicity, reproductive toxicity and aspects of disruption to embryonic development for application to water and other environmental samples. These bioassays are combined with ELISAs sensitive enough to quantify nM levels of endocrine disrupters, and with traditional analyses of water quality. Fiona has used bioassays to examine the effects of pesticides, individually and in mixtures, at environmentally relevant concentrations, as well as endocrine disrupting activity in treated wastewaters.

Collaborations with the water industry have generated data useful for establishing Guideline concentrations for algal toxins. She is currently working on a 'Thirsty Mouse' project for the Australian water industry, and consulting for the Tasmanian Government to assess specified characteristics of the St Helens water supply.

Eucalypt plantations and dairy farms in the George River (Tasmania) catchment may be the source of

toxins adversely affecting oyster farmers, but the cause(s) of human and wildlife (eg Tasmanian Devil) diseases in the area are unclear. Fiona can contribute to the workshop by drawing on the experience she gained through interacting with multiple stakeholders, designing and implementing quantitative tests to describe toxicity and water quality, and through

engaging with the challenges of relating human health to environmental factors. She has worked within the context of a complex interplay between multiple human activities and the environment, and appreciates the difficulties inherent in managing an ecosystem to maximise sustainable outcomes for people and the environment.

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The 2011 Think Tank is supported by the Royal Society – the national academy of science of the UK and the Commonwealth – through the Theo Murphy (Australia) fund.

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