



Australian Academy of Science

Theo Murphy
High Flyers
Think Tank
2016

AN INTERDISCIPLINARY APPROACH TO

LIVING IN A RISKY WORLD

PROGRAM

20–22 JULY 2016

THE SHINE DOME

CANBERRA

CONTENTS

Foreword	1
Program of events	2
The process	3
Introduction	3
Breakout groups	4
Group 1: Risk in international security	4
Group 2: Risk and resource allocation for the environment	5
Group 3: Antimicrobial resistance in a connected world	6
Group 4: Uncertainty, ignorance and partial knowledge	7
Presentation abstracts	8
What do we mean by risk? And are we certain?	8
What is <i>good</i> decision-making in a risky world?	8
Risk acceptance	8
One statistician's view of risk	8
Emergence of risk in complex systems	9
Steering Committee	9
Professor Hugh Possingham	9
Associate Professor Melanie Bahlo	9
Professor Roger Bradbury	10
Professor Mark Colyvan	10
Professor James Franklin	10
Professor Tom Kompas	10
Professor Robert Melchers	10
Professor Kerrie Mengersen	11
Professor Terry Speed	11
Dr Deborah Williamson	11
Invited experts	11
Professor Lisa Bero	11
Professor Mark Burgman	12
Dr Naomi Cogger	12
Professor Anne-Marie Grisogono	12
Dinner address	13
Opening address	13
Participants	14
Map	29

To tweet about
the Think Tank during
the event, please
use the hashtag
#TMThinkTank



FOREWORD

The Australian Academy of Science has been hosting annual High Flyers Think Tanks on nationally important topics since 2002. These events bring together outstanding early- and mid-career researchers with expertise in a broad range of disciplines to discuss novel applications of science and technology, and to identify gaps in knowledge that need to be addressed.

This year, the Academy has chosen 60 of the brightest early- and mid-career researchers from around Australia and neighbouring countries from a variety of fields. Together they will explore how we evaluate risk in relation to real world events. Internationally renowned senior scientists will also provide insights into current perspectives in the field of risk analysis and assessment.

The Think Tank participants will examine four areas which impact on our lives and how we can best assess, understand and address risk in these areas:

- Risk in international security
- Risk and resource allocation for the environment
- Antimicrobial resistance in a connected world
- Uncertainty, ignorance and partial knowledge

For the participants, the Think Tank will be an outstanding opportunity to develop expertise in operating in a multi-disciplinary context and in understanding the contribution of science to evidence-based policy formulation. The event will be a unique networking and career development opportunity for the nation's next generation of science leaders.

Following the event, the findings of the Think Tank will be published in a recommendations report which will be made available to government, stakeholders, interested parties and the public. Reports from previous Think Tanks have been timely, well received and instrumental in influencing policy development.

The 2016 Think Tank is generously supported by the Theo Murphy (Australia) Fund, which is administered by the UK Royal Society. The Academy is delighted to have this funding available to enable some of Australia's brightest young scientists to engage in fresh thinking about fundamental issues for our nation's future, and to develop networks that will enrich their careers.

Professor Andrew Holmes AM PresAA FRS FTSE
President, Australian Academy of Science

PROGRAM OF EVENTS

DAY 1 WEDNESDAY 20 JULY

6.30 pm	Registration
Session 1: Welcome session Jaeger Room	
7.10 pm	Welcome Professor Hugh Possingham Steering Committee Chair, 2016 Theo Murphy High Flyers Think Tank
7.15 pm	Introduction of Ms Meegan Fitzharris Professor Andrew Holmes President of the Australian Academy of Science
7.20 pm	Opening address Meegan Fitzharris MLA ACT Minister for Higher Education, Training and Research
7.30 pm	Reception and networking
9.30 pm	End of welcome session

DAY 2 THURSDAY 21 JULY

8.30 am	Registration
Session 2: Introductory presentations Ian Wark Theatre	
Chairs: Professor Rob Melchers, Associate Professor Melanie Bahlo	
9.00 am	Welcome from the President of the Australian Academy of Science Professor Andrew Holmes
9.05 am	<i>Introduction to the Think Tank</i> Professor Hugh Possingham
9.20 am	<i>What do we mean by risk? And are we certain?</i> Dr Naomi Cogger, Massey University
9.40 am	<i>What is good decision-making in a risky world?</i> Professor Anne-Marie Grisogono, Flinders University
10.00 am	<i>Risk acceptance</i> Professor Rob Melchers, University of Newcastle
10.20 am	MORNING TEA
10.50 am	<i>One statistician's view of risk</i> Professor Terry Speed, Walter and Eliza Hall Institute of Medical Research
11.10 am	<i>Emergence of risk in complex systems</i> Professor Roger Bradbury, Australian National University
Session 3 (part 1): Breakout groups	
11.30 am	Group 1 Risk in international security—Library
	Group 2 Risk and resource allocation for the environment—Downstairs boardroom, Ian Potter House
	Group 3 Antimicrobial resistance in a connected world—Becker Room
	Group 4 Uncertainty, ignorance and partial knowledge—Upstairs boardroom, Ian Potter House

12.30 pm	LUNCH
1.30 pm	Return to breakout groups
3.30 pm	Afternoon tea
3.30 – 3.45 pm	Closed session to discuss progress of group work Becker Room (Steering Committee, rapporteurs, Academy secretariat)
4.00 pm	Return to breakout groups
5.30 pm	End of breakout sessions (part 1)
6.20 pm	Coaches depart for dinner venue
6.30 pm	Pre dinner drinks and viewing of Old New Lands gallery
7.15 pm	Dinner at the National Museum of Australia
8.25 pm	Guest speaker Associate Professor David Caldicott Calvary Hospital and Australian National University
10.00 pm	Dinner concludes and coaches depart

DAY 3 FRIDAY 22 JULY

Session 3 (Part 2): Breakout groups	
8.30 am	Return to breakout groups—draft recommendations
10.00 am	MORNING TEA
10.30 am	Return to breakout groups—finalise rapporteurs' presentations
12.30 pm	LUNCH
Session 4: Rapporteurs' presentations Ian Wark Theatre	
Chair: Professor James Franklin	
1.30 pm	Group 1 Risk in international security
1.50 pm	Group 2 Risk and resource allocation for the environment
2.10 pm	Group 3 Antimicrobial resistance in a connected world
2.30 pm	Group 4 Uncertainty, ignorance and partial knowledge
2.50 pm	General open discussion
3.30 pm	Wrap up by Chair Professor Hugh Possingham
3.45 pm	AFTERNOON TEA
4.00 pm	End of Think Tank for general participants
4.00 – 5.00 pm	Closed session to prepare recommendations document Steering committee, rapporteurs, Academy secretariat
4.00 pm	Coach departs for airport

THE PROCESS

DAY 1

Session 1—Welcome session: Opening address and social event

DAY 2

Session 2—Introductory presentation session

The plenary presentations are aimed at stimulating lateral thought in the discussions during the Think Tank, rather than providing comprehensive coverage of the theme or any of the four specialist topics.

Session 3—Breakout groups (extends until morning of Day 3)

Each participant is assigned to one of four breakout groups and each group will be chaired by a member of the steering committee and will include relevant invited experts. Each group is made up of 15 researchers from across Australia and neighbouring countries with a mix of skills and experience, to stimulate lateral thinking and challenge the participants to extend the way they approach problems. Two participants are preselected to act as the group's rapporteurs. The role of the rapporteurs is to collate the group's discussion and distil the discourse into a 15-minute presentation. The groups are asked to examine and address their discussion questions but are also encouraged to move beyond these questions to other topics identified during the discourse.

DAY 3

Session 4: Rapporteurs' presentations

The final half-day of the Think Tank will enable the group rapporteurs to synthesise the discussions and present a series of recommendations from each breakout group. There will be opportunities for questions and discussion after each presentation and during the general discussion.

At the end of the afternoon a closed session with the Steering Committee, experts, rapporteurs and Academy secretariat will summarise the outcomes of the meeting and plan the production of the recommendations document.

OUTPUTS

The rapporteurs, in consultation with their group, will be responsible for producing their group's contribution to the recommendation report. Each group report of about three printed pages (1500 words) will provide:

- a narrative summary of the key issues discussed
- recommendations for scientific research and science-based action that are needed in the short, medium and long terms.

The recommendations report from the Think Tank will be published and launched in late 2016. As has been the case for previous Think Tanks, it is expected that this report will be instrumental in influencing national policy development and research prioritisation.

INTRODUCTION

Risk and uncertainty pervade every aspect of human life. From a practical perspective it is the decisions that we make in the face of this risk and uncertainty that are most crucial. While humans are generally intrinsically risk averse (like most animals) and willing to take lower expected benefits from their actions if they are more certain, different kinds of risk and uncertainty affect us in diverse ways. For example we know many Australians prefer to drive between major cities rather than fly, despite much greater risk to their life, and often at greater net cost. Indeed there are now innumerable examples of human decisions that seem irrational in the face of risk and uncertainty, especially poorly understood risks like nuclear power and genetically-modified organisms.

From a scientific perspective, one approach to how we make decisions is to try to reduce risks and uncertainties through research. In this Think Tank we will consider four

broad areas: international security, resource allocation for the environment, antimicrobial resistance, and uncertainty, ignorance and partial knowledge. We will inspect these areas through the lens of better decision-making given risk and uncertainty.

The group of researchers chosen to attend the Think Tank is deliberately interdisciplinary—while a few disciplines dominate we range from mathematicians to lawyers. We see this as a challenging topic needing brilliant minds from diverse disciplines. Together we will ask what kind of research is most useful for understanding and managing risk and uncertainty? Where can we invest in learning to help us solve impending problems identified during these horizon scanning exercises? For example should we carry out blue-sky research into the fundamentals of bacterial growth to fight superbugs, or simply speed up the process of antibiotic creation? Should we carry out more social

science research into irrational human behaviour, or devise education schemes and tools that help people make better decisions in the presence of risk and uncertainty? Is the cost of reducing risk and uncertainty for certain problems a waste of time and money? I look forward to working with you all to

tackling some of these practical and interesting problems in July at the Theo Murphy High Flyers Think Tank in Canberra.

Professor Hugh Possingham FAA
**Chair of the Steering Committee of the
2016 Theo Murphy High Flyer Think Tank**

BREAKOUT GROUPS

Colour coding:

Group **1** Group **2** Group **3** Group **4**

GROUP **1** RISK IN INTERNATIONAL SECURITY

Chair: Professor Roger Bradbury

There is a strong sense that risks in international security are the most potent of all because they threaten the existence of states. And the threats to one state can cascade, engulfing neighbours. We've seen this most recently with the Arab Spring—instability in Tunisia cascaded across the Maghreb and on to Egypt, Syria and Iraq. But we've also seen it throughout history, for example with the collapse of the Roman Empire and subsequent Dark Ages. A collapse of national security can result in a failed state, a collapse in international security can result in a collapse of civilisation itself.

Today the risks have grown and changed and entangled—and become global in scale. To the traditional risks of war and pestilence, and perhaps the weather, we must now add the planetary risks inherent in the transition from the Holocene to the Anthropocene epoch and the risks of disruptive technology inherent in the looming 'technology singularity'.

The international order, already under stress from traditional strategic competition among the major powers, must now try to cope with these novel 21st century risks. We now live in a world where the risk of thermonuclear war is not the only major risk. Runaway global warming, ocean acidification, and cyber war—to name only a few—must be added to our risk calculus.

Questions to get you thinking

1. Do we need nation states? There is a lot of chatter within the commentariat that states are so 20th century, that states are the problem and not the solution to today's international security challenges, that state sovereignty gets in the way of resolving complex planetary problems, and that some sort of pooled sovereignty—perhaps an extension of the EU model—is needed to address planetary risks to international security.

2. Do we need international organisations? On the other hand, there is also a continuing line of realpolitik commentary that many international problems are the result of the abject failure of international organisations—think of Rwanda, Bosnia, Somalia, Libya, COP—and their inbuilt 'designed-to-fail' structures.
3. Will we see entanglement of risks? Water security, food security, war and population displacement could make a tidy package in places like the Mekong and the Nile, while pandemics, urbanisation, corruption and poverty will sit happily together in places like West Africa, Brazil and Indo-China.
4. Will we see emergence of novel risks? Great power rivalry and the driving need to maximise economic growth to outcompete rivals may create new planetary risks—black swans. India might wish to undertake unilateral geoengineering in the Indian Ocean to restore the failed southwest monsoon, or China and the US might so interpenetrate each other's internet of things that neither's can be reliably stabilised.

Recommended reading

- Steffen W, Richardson K, Rockström J, Cornell SE, Fetzer I, Bennett EM, Biggs R, Carpenter SR, de Vries W, de Wit CA, Folke C, Gerten D, Heinke J, Mace GM, Persson LM, Ramanathan V, Reyers B, Sörlin S (2015) Planetary boundaries: Guiding human development on a changing planet. *Science* 347 (6223) DOI: 10.1126/science.1259855. <http://science.sciencemag.org/content/sci/347/6223/1259855.full.pdf>
- Osterholm MT (2014) What we're afraid to say about Ebola. *The New York Times*, New York (12 September 2014). http://www.nytimes.com/2014/09/12/opinion/what-were-afraid-to-say-about-ebola.html?_r=0
- Rees M (2013) Denial of catastrophic risks. *Science* 339 (6124): 1123. <http://science.sciencemag.org/content/339/6124/1123.full>
- Sagarin RD, Alcorta CS, Atran S, Blumstein DT, Dietl GP, Hochberg ME, Johnson DDP, Levin S, Madin EMP, Madin JS, Prescott EM, Sosis R, Taylor T, Tooby J, Vermeij GJ (2010) Decentralize, adapt and cooperate. *Nature* 465: 292–293. <http://www.nature.com/nature/journal/v465/n7296/full/465292a.html>
- Taleb NN, Treverton GF (2015) The calm before the storm: Why volatility signals stability, and vice versa. *Foreign Affairs* 94:86–95. <http://www.foreignaffairs.com/articles/142494/nassim-nicholas-taleb-and-gregory-f-treverton/the-calm-before-the-storm>

Hsiang SM, Burke M, Miguel E (2013) Quantifying the influence of climate on human conflict. *Science* 341 (6151) DOI: 10.1126/science.1235367. <http://science.sciencemag.org/content/sci/341/6151/1235367.full.pdf>

Manyika J, Lund S, Bughin J, Woetzel J, Stamenov K, Dhringra D (2016) Digital globalization: The new era of global flows. McKinsey Global Institute. <http://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-globalization-the-new-era-of-global-flows>

Group 1 participants (*rapporteurs)

Dr Ashir Ahmed
Dr Alexander Fraser
Dr Sanzhuan Guo
Dr Vandra Harris
Dr Matthew Kopec
Dr Seth Lazar
Dr Nengye Liu
Dr Amy Maguire*
Dr Tanya Notley
Dr Christian Payne
Dr Lesley Pruitt
Dr Marie Segrave*
Dr Simon Williams
Professor Wei Xiang
Associate Professor Ji Zhang

GROUP 2 RISK AND RESOURCE ALLOCATION FOR THE ENVIRONMENT

Chair: Professor Tom Kompas

Australia has limited resources to address ever-increasing environmental risks from, for example, exotic pests and diseases, climate change and the effects of growing population pressure and natural resource use, so it is critical that these resources be used efficiently. Traditional cost–benefit analysis (CBA) is often used to allocate budgets to rank alternative projects by their benefit–cost ratios (BCRs), and to select projects in declining order of BCRs until the budget is exhausted. This approach considers, for each candidate project, the benefit it would provide (per dollar spent on it) if the project received a specific level of funding. The benefits that each project would provide at different levels of funding are typically not considered. Indeed, most applications of CBA in Australia have focused on the evaluation of individual environmental projects, rather than using information to determine how to allocate an overall budget across many possible projects. These single-project evaluations usually ignore issues of uncertainty and risk and people’s attitude to risk and uncertainty.

It is becoming increasingly clear that applying this approach to allocating a budget for the environment may result in a misallocation of resources because the benefits of an environmental project per dollar spent on it can be highly sensitive to its scale, how we perceive risk and who bears those risks. What matters is not the benefit–cost ratio but the extra benefits relative to the extra costs of an investment in the environment; what matters, in other words, is the rate of return on the investment. Budget allocations across alternative projects are especially impacted by this consideration.

The issue is further complicated by two facts. First, the values associated with an environment outcome, or the benefits that an investment in the environment would generate, are difficult to quantify. Advanced techniques and contingent valuation and choice modelling only partly address this problem. Second, the risk to the environment itself, from things like exotic pests and diseases and climate change, are also often difficult to quantify. The use of ‘expert elicitation’ in cases where data is scant is helpful, but this too invokes some concern.

In this subgroup, our main task will be to investigate the issue of how to optimally allocate a given budget at the proper scale for an environmental investment and across a series of environmental projects—highlighting the limits to CBA. We will also briefly examine the use and problems associated with choice modelling approaches to ‘value’ the environment, on the one hand, and the practice of obtaining information on measures of risk through the use of expert elicitation on the other.

Questions to get you thinking:

1. Is an environmental project with a positive ratio of potential benefits to costs always worth funding?
2. Is it best to allocate budgets across different environmental projects simply by their BCRs (i.e. starting with the highest BCR and working down the list)?
3. How would one optimally allocate a budget across different environmental projects? What is the list of priorities?
4. What if the budget is severely constrained, does that change the allocation?
5. If there are risks associated with an action, or inaction, who bears those risks?
6. How important is equity in terms of costs, benefits and risks with respect to environmental decisions?
7. How do you value the environment when there’s no data?
8. Can experts tell us what the risk to the environment is from a given threat or outcome, even when there is no supporting data?

We encourage every participant to bring a particular problem of environmental decision-making that includes significant amounts of risk and uncertainty (in terms of either benefit or cost). These will be used to provide context to the discussion.

Recommended reading:

Akter S, Kompas T, Ward MB (2015) Application of portfolio theory to asset-based biosecurity decision analysis. *Ecological Economics* 117: 73–85. <http://www.sciencedirect.com/science/article/pii/S0921800915002670?np=y>

Boardman A, Greenburg D, Vining A, Weimer D (2011) *Cost-Benefit Analysis* (4th edition). Prentice Hall, Boston.

Burgman MA (2005) *Risks and Decisions for Conservation and Environmental Management*. Cambridge University Press, Cambridge.

Burgman MA (2016) *Trusting Judgements: How to Get the Best out of Experts*. Cambridge University Press, Cambridge.

Game ET, Kareiva P, Possingham HP (2013) Six common mistakes in conservation priority setting. *Conservation Biology* 27: 480–485. <http://onlinelibrary.wiley.com/doi/10.1111/cobi.12051/full>

Pannell J, Gibson FL (2016) Environmental cost of using poor decision metrics to prioritize environmental projects. *Conservation Biology* 30: 382–391. <http://onlinelibrary.wiley.com/doi/10.1111/cobi.12628/full>

Possingham H (2009) Five objections to using decision theory in conservation and why they are wrong. *Decision Point Online*. <http://decision-point.com.au/article/five-objections-to-using-decision-science-in-conservation/>

Group 2 participants (*rapporteurs)

Dr Lucie Bland

Dr Alienor Chauvenet

Dr Penelope Crossley*

Dr Zoe Doubleday

Dr Joanne Enticott

Dr Rebecca Fisher

Dr Tracey Hollings

Dr Gwen Iacona

Dr Patrick Mitchell

Dr Ruth Morgan

Dr Sam Nicol*

Associate Professor Jonathan Rhodes

Dr Tim Trudgian

Dr Phillipa Watson

Dr Anusuya Willis

GROUP 3 ANTIMICROBIAL RESISTANCE IN A CONNECTED WORLD

Chair: Dr Deborah Williamson

Antimicrobial resistance is one of the biggest public health threats of the modern age. As the prevalence of resistance increases, modern health systems and treatments that rely heavily on antibiotics such as organ transplantation, intensive care and neonatology are compromised, and may lead to a return to the ‘dark ages of medicine’.

Over recent years, several factors have combined to create a ‘perfect storm’ for the emergence and dissemination of antimicrobial resistance. These include:

- the use and misuse of antimicrobials in human and animal health
- a lack of coordinated surveillance to monitor the emergence of resistance
- a relatively ‘dry’ pharmaceutical pipeline for the development of new antibiotics
- increasing globalisation, promoting the rapid spread of resistant pathogens.

There are many reports detailing the potential societal and economic impact of antimicrobial resistance, although far less publicly available information on strategies to combat the antimicrobial resistance crisis. In this cross-disciplinary panel, we will assess the risks posed by antimicrobial resistance in Australia and globally, and identify strategies to combat this risk. We will also discuss the barriers to implementing these strategies, and identify solutions to overcome these barriers.

Questions to get you thinking

1. Is the risk posed by antimicrobial resistance real or largely perceived?
2. What are the key drivers of antimicrobial resistance?
3. Where does the accountability for reducing antimicrobial resistance lie? Is it with patients, practitioners, regulators or policy makers?
4. Given the common use of the media term ‘superbugs,’ is there a risk of promoting a ‘cry wolf’ perception of the antimicrobial resistance crisis? How do we best educate the public about appropriate use of antimicrobials?

Recommended reading

Australian National Antimicrobial Resistance Strategy 2015–2019. <http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-amr.htm>

World Health Organization, Global Action Plan on Antimicrobial Resistance, 2015. http://apps.who.int/iris/bitstream/10665/193736/1/9789241509763_eng.pdf?ua=1

Antimicrobials: access and sustainable effectiveness. *The Lancet*, 2015. <http://www.thelancet.com/series/antimicrobials-access-and-sustainable-effectiveness>

Tackling drug-resistant infections globally: Final report and recommendations by The review on antimicrobial resistance. http://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf

Group 3 participants (*rapporteurs)

Dr Katie Attwell

Dr Brendon Conlan

Dr Chris Degeling

Associate Professor Erica Donner

Dr Fatima El-Assaad

Professor Amanda Ellis

Professor Anne-Maree Farrell

Dr Edward Fox

Dr Karen Hawke

Dr Amy Jones

Dr Maurizio Labbate*

Dr Roisin McMahon*

Dr Dimitri Perrin

Dr Lisa Pont

Associate Professor Alpha Possamai-Inesedy

GROUP 4

UNCERTAINTY, IGNORANCE AND PARTIAL KNOWLEDGE

Chair: Professor Mark Colyvan

In many risk situations agents are forced to make decisions despite the large uncertainties typically involved. Fortunately there is a fairly standard account of how such decisions are made: expected utility theory. This theory counsels the agent to calculate the expected utility for each act under consideration, then choose the act with the highest expected utility (if there is such an act). This is all well and good if the uncertainties in question are reasonably well behaved, but this is not always the case. In order to use expected utility theory, the agent must have precise probability and utility assignments for all the outcomes under consideration. But we can be uncertain about these for a variety of reasons. For example, in environmental policy decisions, there can be a great deal of disagreement about the appropriate utilities and this gives rise to uncertainty about which utilities ought to be used in the expected utility calculations. On the probability side, we can have uncertainty about the appropriate statistical model. In such cases, precise probability and utility assignments to each outcome are at best an idealisation and at worst a serious misrepresentation that hides the extent of our ignorance. Worse still, there are arguably cases where probabilities are not even the right tools (when the uncertainty arises from

linguistic sources, for instance). In short, we very often face meta-uncertainty: uncertainty about the extent and nature of the uncertainty we face.

There are various formal tools that can help with some of these uncertainties. These include imprecise probabilities and preference aggregation functions. But these tools have their limits. In this subgroup we will investigate existing and new formal methods for quantifying meta-uncertainty as well as more qualitative approaches such as qualitative probability and utility assignments, precautionary reasoning, and maxi-min decision making.

Questions to get you thinking:

1. Is all uncertainty amenable to probabilistic treatment? If some uncertainty is not amenable to probabilistic treatment, what does the corresponding decision theory look like?
2. How can we represent uncertainty about uncertainty (e.g. uncertainty about a probability distribution)?
3. Is precautionary reasoning any help in decision making under massive uncertainty?
4. When there is disagreement over the value of outcomes, how can these values be aggregated?
5. How can we take these fairly complex mathematical and conceptual issues and make them accessible to the general public and politicians?

Recommended Reading

Bradley S (2015) Imprecise Probabilities. In E.N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2015 Edition). <http://plato.stanford.edu/archives/sum2015/entries/imprecise-probabilities/>

Briggs R (2015) Normative Theories of Rational Choice: Expected Utility. In E.N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2015 Edition). <http://plato.stanford.edu/archives/win2015/entries/rationality-normative-utility/>

Possingham HP, Wilson KA (2005) Biodiversity—Turning Up the Heat on Hotspots. *Nature* 436: 919–920. <http://www.nature.com/nature/journal/v436/n7053/full/436919a.html>

Regan HM, Colyvan M, Burgman MA (2002) A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology. *Ecological Applications* 12(2): 618–628. [http://onlinelibrary.wiley.com/doi/10.1890/1051-0761\(2002\)012\[0618:ATATOU\]2.0.CO;2/full](http://onlinelibrary.wiley.com/doi/10.1890/1051-0761(2002)012[0618:ATATOU]2.0.CO;2/full)

Steele KS (2006) The Precautionary Principle: A New Approach to Public Decision-Making? *Law, Probability and Risk* 5 (1): 19–31. <http://lpr.oxfordjournals.org/content/5/1/19.full.pdf+html>

Burgman MA (2005) *Risks and Decisions for Conservation and Environmental Management*. Cambridge University Press, Cambridge.

Paris JB (1994) *The Uncertain Reasoner's Companion: A Mathematical Perspective*. Cambridge University Press, Cambridge.

Shafer G (1976) *A Mathematical Theory of Evidence*. Princeton University Press. Princeton, NJ.

Walley P (1991) *Statistical Reasoning with Imprecise Probabilities*. Chapman and Hall, London.

Group 4 participants (*rapporteurs)

Dr Luke Bennetts
Dr Patricia Durance
Dr Benjamin Galton-Fenzi
Dr Gery Geenens
Dr Kyra Hamilton
Dr Adrien Ickowicz

Dr Madhura Killedar
Dr Kirsty Kitto*
Dr Petra Kuhnert
Dr Mark Lindsay
Dr Keith Pembleton
Dr Mark Quigley*
Dr Melanie Roberts
Dr Antonio Verdejo-Garcia
Dr Christopher White

PRESENTATION ABSTRACTS

WHAT DO WE MEAN BY RISK? AND ARE WE CERTAIN?

Dr Naomi Cogger

Within science the concept of risk has evolved to encompass both the likelihood that hazard occurs and consequences associated with the hazard. We often express risk using the equation $\text{Risk} = \text{Likelihood} \times \text{Consequence}$. To ensure that the assessment of risk is measured and transparent a key element that must be addressed in any assessment is uncertainty. Folks working in risk are rather frustrating and have devised different taxonomies for uncertainty. Personally, I find it useful to divide uncertainty into epistemic uncertainty and linguistic uncertainty. The most common reasons for epistemic uncertainty are incomplete knowledge as a result of incertitude, variability, measurement error, model uncertainty and subjective judgement. Linguistic uncertainty arises because language is not exact and words mean different things to different people. However, when all is said and done scientist working in risk must remember that risk is not just equations, measurement and probability distributions. We must make room at the table for the people. In doing so it is useful to think of risk in terms of the equation, made famous by Peter Sandman: $\text{Risk} = \text{Hazard} + \text{Outrage}$.

WHAT IS GOOD DECISION-MAKING IN A RISKY WORLD?

Professor Anne-Marie Grisogono

Decisions made with good intentions, but in the face of risks—uncertainty, ignorance, error, and conflicted agendas in a rapidly changing situation—often result in unwelcome consequences. Yet one cannot decline the challenge—decisions do have to be made, and even inaction is a de facto decision. Is it possible to do better? How? Can science help? There are some answers—not quite where

one might look for them, and not quite in the shape one might wish for.

RISK ACCEPTANCE

Professor Rob Melchers

Living is a risky business, even more so in an uncertain world. Understanding the levels of uncertainty and risk are important, but in the end 'we' have to make decisions. What level of risk can (or do) 'we' accept? Our decisions can be built only on what we know or can predict. This short talk will briefly review some direct and indirect approaches to risk acceptance across a wide range of applications, including infrastructure such as bridges and offshore platforms, defence systems such as submarines, nuclear facilities and their management, waste disposal and containment, and microbiological experimentation, and open up the closely associated cultural and economic aspects.

ONE STATISTICIAN'S VIEW OF RISK

Professor Terry Speed

Before statisticians like me think about risk, they think about probabilities of events occurring. That's already a challenge for others. Think of tossing coins or dice, or a ticket winning a lottery, where we count equally probable cases; or the chance of dying as a result of a frequently performed medical procedure, where we can rely on a large body of past experience. These are different. Think of the probability (or odds against) Phar Lap winning the Melbourne Cup on November 4th, 1930. Think of the probability that your local nuclear reactor will experience a melt down in the coming decade similar to that seen at Three Mile Island in 1979, in Chernobyl in 1986, and in Fukushima in 2011. Different again. The assessment of probabilities can be quite hard, some say impossible, but they seem to be an essential part—just a part—of risk. The other part involves the

consequences of events. I'll get to that. In the book *The Norm Chronicles: Stories and Numbers about Danger and Death*, Michael Blastland (writer and broadcaster) and David Spiegelhalter (Professor for the Public Understanding of Risk at Cambridge University) ask 'Can risk claim to be true to the numbers and to you at the same time?' They conclude 'It can't. For people, probability doesn't exist.' Despite this, I would like to spend this talk discussing it.

EMERGENCE OF RISK IN COMPLEX SYSTEMS

Professor Roger Bradbury

In complex systems, risk lurks in nooks and crannies. It emerges, often unexpectedly. And complex systems, especially complex adaptive systems, are the stuff of our world. They are the financial systems, social systems, geopolitical systems, climate systems, indeed they are the planet itself. In such systems, risk bubbles up from deeper layers in the system to engulf the whole. An assassin's shot in Sarajevo leads to World War I, lax home lending in Florida leads to the GFC. Risk also cascades across a system. In

1965, an incorrectly set protective relay on a transmission line in Ontario tripped, and caused a cascade of tripped lines, eventually blacking out Ontario and north-eastern US—30 million people—for 13 hours. Risk can jump from system to system—given our interconnected world. If the 1965 blackout happened today, the internet, the banking system, and the transport systems would also all fail. Risk can emerge when we nudge a complex system, as we often need to do to get it to do our bidding. We might see forceful dynamics—involving risk to us—as the system tries to restore itself. Think of the regrowth of fire-prone eucalyptus woodlands on land previously cleared for habitation. Think of the Black Saturday bushfires in Victoria in 2009—173 people died. We also might see forceful dynamics—involving risk to us—as the system seeks a new metastable state after we've perturbed it. Think of the post-GFC global economic system, still not settling back to its old state, almost impossible to predict. Think of destabilising invasions of foreign animals and plants everywhere in the world as new ecosystems build themselves. Risk lurks everywhere.

STEERING COMMITTEE

PROFESSOR HUGH POSSINGHAM FAA

Professor of Mathematics and Ecology, The University Of Queensland



Aside from his day job, Hugh Possingham has a variety of broader public roles advising policy makers, conservation groups and managers by sitting on 15 committees and boards outside the University of Queensland including: The Wentworth Group of Concerned Scientists (founding

member), founding editor of *Conservation Letters* (an international scientific journal) and several Environmental NGO scientific advisory committees. He and Dr Barry Trill wrote 'The Brigalow Declaration', used by Premier Beattie to halve land clearing in Queensland thereby reducing greenhouse gas emissions in Australia by more than 5% per annum and saving an area the size of Portugal from conversion into farmland. The Possingham lab uses mathematics to formulate and solve problems for saving plants, animals and ecosystems. It developed the most widely used conservation planning software in the world. *Marxan* (<http://www.uq.edu.au/marxan/>) was used to underpin the rezoning of the Great Barrier Reef and is currently used in more than 150 countries by over 6000 users—from the UK and USA to Madagascar and Brazil—to build the world's marine and terrestrial landscape plans.

Marxan can be used to achieve conservation outcomes while maximising development opportunities. In addition, many governments and NGOs use the group's research for the allocation of funding to threatened species recovery and solving other conservation conundrums. Hugh has co-authored 560+ refereed publications covered by the *Web of Science* (27 in *Science*, *Nature* or *PNAS*). He currently directs two national research centres across 11 institutions (\$15 million per annum) and he has supervised (or is supervising) 80 PhD students and 50 postdoctoral fellows. He has one psychological disorder: a compulsive desire to watch birds.

ASSOCIATE PROFESSOR MELANIE BAHLO

Joint Division Head—Population Health and Immunity, Walter and Eliza Hall Institute of Medical Research



Melanie Bahlo is the co-Division Head of the Population Health and Immunity Division at the Walter and Eliza Hall Institute of Medical Research. She graduated in 1998 with a PhD in population genetics from Monash University. She currently holds a National Health and Medical Research

Council Senior Research Fellowship. In 2009 she was awarded the Moran Medal by the Australian Academy of Science and in 2015 the Genetics Society of Australasia's

Ross Crozier medal. Her research covers statistical genetics, bioinformatics and population genetics with a focus on neurological disorders and infectious disease. Her statistical analyses have led to the identification of novel genes for disorders such as epilepsy and deafness. She has also developed new methods and software for the analysis of genetic data.

PROFESSOR ROGER BRADBURY

Head of Strategy and Statecraft in Cyberspace Research Program, Australian National University



Roger Bradbury is a Professor in the National Security College at the Australian National University. He is a complex systems scientist and leads the interdisciplinary and international Strategy and Statecraft in Cyberspace program at the College. He also advises on international science and

technology issues for the Office of National Assessments. He has a background in the modelling and analysis of ecological and socio-technical systems and is currently particularly interested in the complex strategic interactions between states in cyberspace.

PROFESSOR MARK COLYVAN

Professor of Philosophy, University of Sydney



Mark Colyvan is a philosopher, specialising in decision theory, risk analysis, philosophy of mathematics, logic, and philosophy of science (especially ecology and conservation biology). He holds a PhD in philosophy from the Australian National University and a BSc (Hons) in mathematics from

the University of New England. He currently works at the University of Sydney but has worked previously at a number of universities in Australia and the USA. He has held visiting appointments at: the Stellenbosch Institute for Advanced Study, the Centre for Philosophy of Science at the University of Pittsburgh, the Department for Logic and Philosophy of Science at the University of California Irvine, the Department of Philosophy at the University of Otago, and the Munich Centre for Mathematical Philosophy at the Ludwig-Maximilians University. He is the author of *The Indispensability of Mathematics* (Oxford University Press, 2001), *An Introduction to the Philosophy of Mathematics* (Cambridge University Press, 2012), and (with Lev Ginzburg) *Ecological Orbits: How Planets Move and Populations Grow* (Oxford University Press, 2004). He has published numerous articles in leading journals in risk analysis, biology, ecology, conservation biology, logic, artificial intelligence, law and philosophy. His is a past president of the Society for Risk Analysis (Australia and New Zealand).

PROFESSOR JAMES FRANKLIN

Professor of Mathematics, UNSW Australia



James Franklin is Professor in the School of Mathematics and Statistics at UNSW. He is the author of *The Science of Conjecture: Evidence and Probability Before Pascal* (John Hopkins University Press), *What Science Knows: And How It Knows It* (Encounter Books), and *Corrupting the*

Youth: A History of Philosophy in Australia (Macleay Press), among other books. He has also worked on 'advocacy methods' for evaluating extreme risks, which aim to combine sparse data with expert opinion by having different teams of experts in controlled competition.

PROFESSOR TOM KOMPAS

Chief Investigator, University of Melbourne



Tom Kompas is a specialist in the economics of biosecurity, with a recent emphasis on optimal surveillance, environmental costs and benefits, and the allocation of investments across the spectrum of biosecurity threats and measures. Along with being a Chief Investigator in the Centre of

Excellence for Biosecurity Risk Analysis (CEBRA), he is also Director of the Centre for Environmental and Economic Research (CEER) at the University of Melbourne, a research consultancy group that supports CEBRA, and has dedicated much of his time and effort to public policy in Australia. Until recently, he was a part-time Senior Economist at the Australian Bureau of Agricultural and Resource Economics (ABARE); a Commonwealth Environment Research Facilities project leader on biosecurity; and Editor-in-Chief of the *Australian Journal of Agricultural and Resource Economics*. He also serves as the Foundation Director of the Australian Centre for Biosecurity and Environmental Economics at the Australian National University and is a Fellow of the Academy of Social Sciences in Australia.

PROFESSOR ROBERT MELCHERS FTSE

Professor of Civil Engineering, University Of Newcastle



Robert Melchers is Professor of Civil Engineering and ARC DORA Research Fellow at the University of Newcastle. He holds a BE and M Eng Sc from Monash University and a PhD from the University of Cambridge, UK. He has researched extensively in structural engineering, structural reliability and

corrosion. His most recent awards for research include the 2009 Australasian Corrosion Association Corrosion Medal, the 2012 Jin S Chung Award (International Society of Offshore and Polar Engineers) and the 2013 John Connell Gold Medal (Engineers Australia). He was the 2014 Eminent Speaker for the College of Structural Engineers, Engineers Australia.

PROFESSOR KERRIE MENGERSEN

Research Chair, Statistics, Queensland University of Technology



Professor Mengersen is a Professor of Statistics in the School of Mathematical Sciences and Institute for Future Environments at QUT. She has around 25 years of experience in statistical modelling, analysis and computation, with particular focus on applications in health, environment and

industry. Her expertise includes analysis and integration of complex datasets, encapsulation and effective use of expert information, spatio-temporal analysis and complex systems modelling. In addition to academic outputs comprising over 250 journal articles, she has a continuous record of commercial consultancies with selected relevant clients including Corrs Chambers Westgarth (risk), Goronickel (design), Qld Environmental Protection Agency and Healthy Waterways (water quality), Port of Brisbane (prediction), Qld Dept Natural Resources (environmental statistical modelling and analysis), Western Mining Company (analysis) and Dairy Australia (triple bottom line sustainability). Professor Mengersen is a Deputy Director of the ARC Centre of Excellence in Mathematical and Statistical Frontiers for Big Data, Big Models and New Insights (ACEMS), and an ARC Laureate Fellow.

PROFESSOR TERRY SPEED

Honorary Research Fellow and Laboratory Head, Walter and Eliza Hall Institute of Medical Research



Terry Speed completed a BSc (Hons) in mathematics and statistics at the University of Melbourne and a PhD in mathematics and Dip Ed at Monash University. He has held appointments at the University of Sheffield, UK, the University of Western Australia in Perth, and the University of California

at Berkeley, and with the CSIRO in Canberra. In 1997 he took up an appointment with the Walter and Eliza Hall Institute of Medical Research, where he is now an Honorary Fellow and lab head in the Bioinformatics Division. His research interests lie in the application of statistics and bioinformatics to genetics and genomics, and related fields such as proteomics, metabolomics and epigenomics, with a focus on cancer and epigenetics.

DR DEBORAH WILLIAMSON

Deputy Director, Microbiological Diagnostic Unit Public Health Laboratory, University of Melbourne



Deborah Williamson is a Clinical Microbiologist and academic researcher, and is Deputy Director of the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL). She is involved in the delivery of specialist public health laboratory services, and in the diagnosis and

surveillance of communicable diseases. Her research interests include the molecular epidemiology and pathogenesis of infections caused by antimicrobial resistant pathogens, and the translation of genomic technologies to questions of public health importance.

INVITED EXPERTS

PROFESSOR LISA BERO

**Professor of Pharmacology
University of Sydney**



Lisa Bero is Chair of Medicines Use and Health Outcomes at the University of Sydney, Charles Perkins Centre where she directs a Program in Research Integrity and Science Policy. She is Co-Chair of The Cochrane Collaboration. From 1991–2014, she

was Professor of Health Policy and Clinical Pharmacy, University of California, San Francisco. Lisa is a pharmacologist who studies how science is translated into clinical practice and health policy. She has developed and validated methods for assessing bias in the design, conduct and dissemination of research on pharmaceuticals, tobacco, chemicals and complex public health interventions. Lisa has also conducted analyses to examine the dissemination and policy implications of research evidence. Her international activities include member and chair of the World Health Organization (WHO) Essential Medicines Committee,

member of the Pan American Health Organization (PAHO) Advisory Committee on Health Research, and Cochrane Collaboration liaison to WHO. Lisa serves on several committees related to evidence and decisions, such as the Institute of Medicine Committee on Conflict of Interest in Medical Research, Education and Practice and the National Academy of Science Committee to review the Environmental Protection Agency Integrated Risk Information System Process.

PROFESSOR MARK BURGMAN FAA

**Head, School of Biological Sciences
University of Melbourne**



Mark Burgman is Managing Director of the Centre of Excellence for Biosecurity Risk Analysis, the Adrienne Clarke Chair of Botany in the School of Botany at the University of Melbourne and Editor-in-Chief of the journal *Conservation Biology*. He works on ecological modelling, conservation

biology and risk assessment. His research has included models on a broad range of species and 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, an MSc from Macquarie University, and a PhD from the State University of New York. 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. He has published over two hundred refereed papers and book chapters and authored seven books. He was elected to the Australian Academy of Science in 2006.

DR NAOMI COGGER

**Senior Lecturer
Massey University**

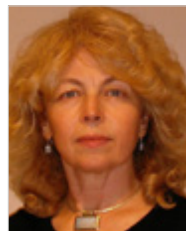


Naomi Cogger is a Senior Lecturer at the EpiCentre, an OIE (World Organisation for Animal Health) collaborating centre at Massey University, New Zealand. Naomi has worked on a range of projects to better understand issues that impact on the health of people

and the health and welfare of livestock, farm working dogs and horses. Much of her research has been used to inform policy and decision making in government agencies including New Zealand's Ministry of Primary Industry, Australia's Department of Agriculture and the UK Food Standards Agency.

PROFESSOR ANNE-MARIE GRISOGONO

**Adjunct Professor
Flinders University**



Anne-Marie Grisogono is a physicist by training, and worked in experimental and theoretical atomic and molecular physics, and lasers and nonlinear optics for 14 years in various universities. This was followed by 20 years at the Defence Science and Technology Organisation (DSTO)

where she held national and international leadership roles in the fields of simulation, systems engineering and systems science, human sciences and complexity science. Anne-Marie has worked on systems design, modelling and simulation, developing DSTO's Synthetic Environment Research Facility for defence capability development. She also raised an enabling research program into applications of complex systems science to address defence problems and future warfare concepts, with many of the results of this research being taken up by the Australian Army and incorporated into their doctrine and organisation. Anne-Marie also worked with Army Headquarters to reframe the Army's approach to strategic planning in research. She is a member of the Australian Research Council's College of Experts, Director of Research for Ionic Industries, and holds an adjunct professor appointment in the Engineering Faculty of Flinders University. Her current research interests include fundamental questions of complexity science, and improving the methodologies and tools that can be applied to dealing with complex problems.



DINNER ADDRESS

ASSOCIATE PROFESSOR DAVID CALDICOTT

**Emergency Consultant and Clinical Senior Lecturer,
Australian National University and Calvary Hospital**

David Caldicott is an Emergency Consultant at the Emergency Department of the Calvary Hospital in Canberra and a Clinical Senior Lecturer in the Faculty of Medicine at the Australian National University. He is a spokesperson for the Australian Science Media Centre on the issues of illicit drug use and the medical response to terrorism and disasters. He has acted as an independent advisor to politicians from all parties, most recently on the practicalities and implications of creating a medical cannabis system for Australia. David designed and piloted the Welsh Emergency Department Investigation of Novel Substances (WEDINOS) project in the UK, a unique program using regional emergency departments as sentinel monitoring hubs for the emergence and spread of novel illicit products associated with harm. He has replicated this work in Australia with the ACT Investigation of Novel Substances (ACTINOS) Group. He has published widely in the peer-reviewed literature, and presents nationally and internationally on the subject of the use of the emergency department as an observatory for the surveillance of novel psychotropic substances as they evolve, as well as their effects in acute overdose. He remains a staunch advocate for harm reduction, maintaining that drugs policy is an issue of public health, and not political morality.



OPENING ADDRESS

MEEGAN FITZHARRIS MLA

ACT Minister for Higher Education, Training and Research

Originally from New Zealand, Meegan Fitzharris has lived in Canberra since 2000, and in Gungahlin since 2007 with her family. She loves exploring Canberra's playgrounds, walking around the local nature reserves and spending time with her three young children. Meegan is passionate about her local community and has been involved in various community groups, including the Gungahlin Community Council. Meegan's professional background has included working for the NSW Police, the Australian Federal Police and the Commonwealth Attorney-General's Department. Most recently Meegan worked in the office of ACT Chief Minister, Andrew Barr. She has also been a stay-at-home mum and ran her own small business from home. Since starting in the Legislative Assembly, Meegan has been involved as a member with the Standing Committees on Health, Ageing and Community Services; Education, Training and Youth Affairs; and Public Accounts. She also chairs the Planning, Environment and Territory and Municipal Services Standing Committee and is currently the Labor Caucus Secretary. Meegan is a passionate advocate for fairness in the community and a strong believer in supporting growth and opportunity for all Canberrans.

PARTICIPANTS

DR ASHIR AHMED 1

Swinburne University of Technology

azahmed@swin.edu.au



Ashir Ahmed is a Lecturer of information systems at Swinburne University of Technology, Australia. He earned his PhD in information systems from Monash University. His research interests focus on the role of technologies such as IT and Web 2.0/

Web 3.0 for creating positive social impact. Some of his research projects include the use of social media for suicide prevention, evaluating the role of community consultation for anti-radicalisation through e-education, and the framework for using web 2.0 in disaster management. He has published his research findings in leading journals and conferences such as Pacific Asia Journal of the Association for Information Systems (PAJAIS), International Conference on Information Systems (ICIS), European Conference on Information Systems (ECIS), Hawaii International Conference on System Sciences (HICSS) and Pacific Asia Conference on Information Systems (PACIS).

DR KATIE ATTWELL 3

Murdoch University

k.attwell@murdoch.edu.au



Katie Attwell is Capstone Coordinator and Lecturer with the Sir Walter Murdoch School of Public Policy and International Affairs and an Honorary Research Fellow of Telethon Kids Institute. She is an early career researcher in political science with a background in nationalism and ethnic

conflict. She now specialises in community engagement around public health dilemmas, particularly researching strategies for addressing vaccine hesitancy. Her research includes investigating social norming and social identity as the motivators of behaviour change—strategies applicable to addressing antibiotic overuse by health professionals and communities. In 2014 Katie researched, designed, delivered and evaluated an internationally recognised public health campaign. ‘I Immunise’ explicitly drew upon political ideology, identity and values in challenging vaccine hesitancy amongst alternative lifestyle parents. She has also researched the values and attitudes of midwives towards immunisation and the discourses they use around the topic, with a focus on how the midwifery model of care may

encourage the promotion of some practices benefiting infant health but not others. Current projects include analysing governance strategies for addressing vaccine refusal, and exploring the epistemology of vaccine-hesitant parents with regards to Western medicine, complementary and alternative medicine and the perceived role of commercial interests.

DR LUKE BENNETTS 4

University of Adelaide

luke.bennetts@adelaide.edu.au



Luke Bennetts is a Senior Lecturer in applied mathematics at the University of Adelaide. His research interests are in mathematical and laboratory experimental modelling, particularly of ocean waves and sea ice. For the last three years he was an ARC DECRA

Fellow, working on a project to integrate a model of sea ice breakup into a large-scale model for use in climate studies. Within Australia, Luke collaborates with members of CSIRO, the Bureau of Meteorology and the Antarctic Climate and Ecosystems CRC, and internationally, most often, with members of the Finnish Meteorological Institute and the Nansen Environment and Remote Sensing Centre, Norway.

DR LUCIE BLAND 2

University of Melbourne

l.bland@unimelb.edu.au



Lucie Bland is a postdoc in ecosystem risk assessment at the University of Melbourne. She creates simulation models of ecosystem collapse to inform the IUCN (World Conservation Union) Red List of Ecosystems. She focuses on integrating ecosystem modelling and risk assessment in

terrestrial, marine, and freshwater ecosystems. Her areas of expertise include biodiversity risk analysis (species and ecosystems); ecosystem modelling; and global biodiversity indicators and conservation policy. Lucie is an award-winning scientist and was part of a team that received the 2015 Eureka Prize in Environmental Research from the Australian Museum. She is a member of the IUCN Commission on Ecosystem Management, the Red List of Ecosystems Committee for Scientific Standards, and the ANZ Society for Risk Analysis.

DR ALIENOR CHAUVENET 2

University of Queensland

a.chauvenet@uq.edu.au



Originally from France, Alienor Chauvenet completed an MSc in Conservation Science and PhD in Ecology at Imperial College London, UK. Her PhD focused on understanding and modelling the dynamics of translocated populations, to develop a method to use

translocations as an adaptation tool to climate change. In 2012 she began work for the British government, in the National Wildlife Management Team as an ecological modeller. There, she used her quantitative skills to work on applied management problems for UK species involved in human-wildlife conflict, including foxes, bats and wild boar. In 2014, Alienor returned to academia and took her current position of Postdoctoral Research Fellow at the University of Queensland. At UQ, her main research focuses on how to optimise land management decisions for conservation purposes at the regional, national and global scale, and how to measure the biodiversity benefit of these decisions. Alienor's overall purpose is to address concrete conservation and management problems using state-of-the-art modelling and quantitative approaches, always looking to make better on-the-ground decisions for species and ecosystems.

DR BRENDON CONLAN 3

Australian National University

brendon.conlan@anu.edu.au



Brendon Conlan is interested in plants and food security, and uses biochemical and molecular techniques to investigate methods for supercharging photosynthesis to increase food production for our ever-growing population. He is a member of the ARC Centre

of Excellence in Translational Photosynthesis within the Research School of Biology at the Australian National University.

DR PENELOPE CROSSLEY 2

Sydney Law School

penelope.crossley@sydney.edu.au



Penelope Crossley specialises in the complex legal issues associated with the energy and resources sectors. In particular, her research focuses on the fields of comparative renewable energy and energy storage law, electricity market governance, and the intersection between tort law and the

energy and resources sector. Penelope is the Chair of the Clean Energy Council's Product Listing Review Panel, a Senior Industry Advisor to the Australian Energy Storage Alliance on regulatory and policy issues, and a member of the interdisciplinary Energy Storage Research Network (EStoReN) at the University of Sydney. Her PhD on 'Reconceptualising Renewable Energy Law: A Comparative Study of the National Laws Designed to Accelerate the Deployment of Renewable Energy,' was awarded in 2015. Prior to entering academia, Penelope practised as a solicitor in London and Beijing for a law firm specialising in global energy and infrastructure law. She has also advised an alternative energy division of a multinational energy company on issues related to emissions trading, renewable energy, emerging consumer markets and technologies.

DR CHRIS DEGELING 3

School of Public Health, University of Sydney

chris.degeling@sydney.edu.au



Chris Degeling is a social scientist, philosopher and veterinarian with expertise in normative analysis and qualitative and deliberative methods. Currently a Research Fellow at the Centre for Values, Ethics and the Law in Medicine at the University of Sydney, his research focuses on the social and

ethical dimensions of public health policy development and implementation, and the politics of risk in disease prevention.

ASSOCIATE PROFESSOR ERICA DONNER **3**

University of South Australia

erica.donner@unisa.edu.au



Erica Donner is an Associate Professor and ARC Future Fellow in the Future Industries Institute at the University of South Australia. Her research in the field of environmental biogeochemistry provides a fundamental basis for environmental risk assessment and risk management, focusing on topics

such as soil and water quality, wastewater treatment and reuse, and microbial resistance. Prior to joining UniSA, Erica completed her undergraduate education at UNSW Australia then obtained a PhD in environmental soil chemistry from the University of Reading (UK). She subsequently worked on a pan-European project supporting the implementation of the EU Water Framework Directive until returning to Australia. Erica's ARC Future Fellowship is focused on understanding the prevalence and potential transfer of microbial silver resistance and cross-resistance in the environment, and the implications of this for the biomedical applications of silver nanotechnology. She also leads a project funded by the South Australian Government investigating the transfer/control of antibiotic resistant bacteria and their genes during wastewater treatment and reuse. Erica has a particular interest in understanding the links between chemical selective pressure and microbial ecology and resistance.

DR ZOË DOUBLEDAY **2**

The University of Adelaide

zoe.doubleday@adelaide.edu.au



Zoë Doubleday is an ecologist based at the University of Adelaide. Her research focuses on understanding how human activities and environmental change affects animal populations in marine and freshwater systems (particularly cephalopods, fish and commercial species). Zoë

has used a variety of tools to investigate such effects, including chemistry and growth pattern analysis of hard biomineralised structures (i.e. using bones and shells to reconstruct past environments and the biological histories of aquatic animals); ecological risk assessment; time-series analysis; and controlled experimental research. Bringing together her own experience in undertaking 'screening-level' ecological risk assessments relevant to data-poor marine systems, Zoë is interested in how we can effectively harness the wealth of qualitative information, especially associated with expert opinion, for assessing risk and optimising resource allocation.

DR PATRICIA DURANCE **4**

GNS Science

p.durance@gns.cri.nz



Patricia Durance received a BSc (Hons) in earth sciences and chemistry, and an MSc in stable isotope geochemistry from the University of Waterloo, Canada. In 2009 she received a PhD in igneous petrology and geochemistry from Monash University. She has 20 years'

experience within industry, government and academia on projects that span three continents and the oceanic Southwest Pacific. Her research focuses on precious and critical metals, using geochemistry to investigate mineral formation and wealth. Patricia is vice-chair of physical sciences for the Early Career Researchers Forum at the Royal Society of New Zealand and sits on the national council for the AusIMM Women in Mining Network. The mining life cycle is critical to sustain a modern standard of living and deliver green technologies. However social licence is often difficult to attain due to misinformation and perceptions of risk, highlighting the need for strong policies and progressive social engagement. Patricia welcomes the opportunity to engage with cross-disciplinary researchers to address issues that have a significant impact on how risk is perceived and addressed at multiple levels within our society.

DR FATIMA EL-ASSAAD **3**

UNSW Australia

f.el-assaad@unsw.edu.au



Fatima El-Assaad is a Vice Chancellor's Postdoctoral Research Fellow at UNSW Australia in the field of infection and immunity. Fatima graduated with first class honours in medical science and was awarded her PhD in Medicine in 2013 from the University of Sydney for her

research into brain injury in malaria. Her work was the first demonstration that plasma microparticles previously thought to be inert remnants of cell membrane are in fact active contributors to the microvascular lesions that cause brain injury in malaria. In 2014, Fatima moved to UNSW Australia where she is currently developing biomarker tests for the early detection of infectious diseases, particularly malaria and sepsis, as well as designing new-targeted treatments that have potential for revolutionising personalised medicine and reducing their global burden. Fatima is a committee member of the NSW Early- and Mid-Career Researcher Network as she is passionate about innovative academic and commercial research and their translation. She is also passionate about inspiring young women into considering a

science career and is a mentor for the UNSW Science 50:50 initiatives and is a Thinker in Residence at Flinders University for the STEMM Women, 'Changing the Face of STEMM' Program. She currently serves as a committee member of the NSW Branch of the Australian Society of Immunology and the Australian Society for Medical Research.

PROFESSOR AMANDA ELLIS 3

Flinders University

amanda.ellis@flinders.edu.au



Amanda Ellis graduated with a PhD in applied chemistry from the University of Technology, Sydney. She then undertook postdocs in the USA at Rensselaer Polytechnic Institute and New Mexico State University. After these she returned to New Zealand as a prestigious Foundation of Research Science and Technology Postdoctoral Research Fellow at Industrial Research Ltd (now Callaghan Innovations). In 2006 Amanda commenced at Flinders University as a teaching/research academic. Since then she has secured over \$20 million in funding from the Australian Research Council (ARC) and non-ARC/industry sources and published over 128 peer reviewed journal articles with 2500 citations and has 5 full patents on projects involving novel polymer coatings, functionalised carbon nanotubes and graphene, microfluidics, genotyping and DNA nanotechnology. Currently, she is an Australian Research Council Future Fellow (2014–18). Amanda is a Fellow of the Royal Australian Chemical Institute (RACI) and serves on the RACI Board. She is also on the Board of the Membrane Society of Australia and is the past-Chair of the RACI Polymer Division (2013–15).

DR JOANNE ENTICOTT 2

Synergy, Monash University

joanne.enticott@monash.edu



Joanne Enticott has extensive experience as a Biostatistician and conducting policy-relevant research into health services. Her research priorities are to improve outcomes for vulnerable populations. She is an early-career researcher with multiple leadership positions: Deputy

Director at Synergy, Monash University; plus three Chief Biostatistician roles at OPTIMISE, a NHMRC Partnership Project to improve refugee health-care; PULSAR, a multisite cluster randomised clinical trial across Victoria; and Happy Life Club, a randomised clinical trial for diabetes management in Beijing, China. She had extensive experience prior to receiving a PhD as a biostatistics consultant and lecturer for 11 years.

PROFESSOR ANNE-MAREE FARRELL 3

La Trobe University

A.Farrell@latrobe.edu.au



Anne-Maree Farrell is Professor of Health Law and Society, ARC Future Fellow, and Director of the Centre for Health Law and Society at La Trobe University. She has held academic positions in both the UK and Australia, and has over ten years' experience as a lawyer in private practice. Her

research expertise lies generally in health law, policy and ethics, with a particular interest in the regulation of human tissue and related technologies, which is the topic of her Future Fellowship. She is also interested in ethical, social and legal issues involved in the management of public health risks and their consequences. Anne-Maree has published in a range of internationally recognised journals and edited collections. Books include *Health Law: Frameworks and Context* (Cambridge University Press, 2016, in press, co-authored); *European Law and New Health Technologies* (Oxford University Press, co-edited); *The Politics of Blood: Ethics Innovation and the Regulation of Risk* (Cambridge University Press); *Organ Shortage* (Cambridge University Press, co-edited); *Ethics Law and Pragmatism* (Cambridge University Press, co-edited). She has received external funding for a number of research projects and recently completed work as CI on a five-year UK Wellcome Trust strategic program grant: *The Human Body: Its Scope Limits and Future*.

DR REBECCA FISHER 2

Australian Institute of Marine Science

r.fisher@aims.gov.au



Rebecca Fisher has a PhD in Marine Ecology with post-doctoral experience across a broad range of topics, including larval performance and survival; trade-offs in early life history strategies; recruitment dynamics; patterns and drivers in biodiversity; anthropogenic impacts on tropical

marine ecosystems; and characterising uncertainty in expert knowledge. She has worked in commercial environmental consulting and is committed to environmental science research that is of direct relevance to government and industry end users. Rebecca now focuses primarily on quantitative environmental risk and assessment, and is currently developing methods to manage and alleviate environmental risks associated with dredging in Australia's tropical coastal ecosystems. She has published widely on topics relevant to environmental risk and resource allocation, including a global analysis showing how coral reef research effort is currently miss-matched to environmental values and

relative risk; the influence of anthropogenic pressures and management strategies on the environment; and the hazard characteristics associated with dredging in tropical marine environments. Rebecca also has experience with expert elicitation and quantitative methods for capturing uncertainty and partial knowledge.

DR EDWARD FOX 3

CSIRO

edward.fox@csiro.au



Ed Fox is a researcher working with the CSIRO Food Safety and Stability Group. His research is focused on improving food safety of food production systems to produce safe foods and lower the public health burden of foodborne microbial disease. This includes determining

the ecology of pathogenic bacteria through food chains, and utilising genomics to understand aspects such as stress response, antimicrobial resistance, virulence and host-pathogen interactions. Ed is currently the co-ordinator for the Australian Society for Microbiology's (ASM) 'Food Microbiology' Special Interest Group, and sits on the ASM Victoria Branch Committee.

DR ALEXANDER FRASER 1

**Antarctic Climate and Ecosystems
Cooperative Research Centre**

adfraser@utas.edu.au



Alex Fraser is a glaciologist with a particular interest in satellite remote sensing of Antarctic ice. His PhD research was in the area of satellite mapping of Antarctic landfast sea ice. More recently, Alex has worked on radar remote sensing of the Antarctic Ice Sheet. His main interest lies in

large-scale estimation of Antarctic accumulation (snowfall rates) based on parameter retrieval from active microwave polar orbiting satellites. Large-scale estimates of Antarctic accumulation are a major contributor to the uncertainty associated with Antarctic mass balance. The Greenland and West Antarctic Ice Sheets together contain the equivalent of a 12 m sea level rise, and it is evident that these ice sheets are losing mass at an increasing rate. The recent IPCC 5th Assessment Report paints a bleak picture of global mean sea level rise, projecting between 25 and 95 cm rise by the end of the century, depending largely on the greenhouse gas emissions scenario. Many experts argue that these figures underestimate sea level rise. The spectre of irreversible changes to the climate system looms large.

DR BENJAMIN GALTON-FENZI 4

Australian Antarctic Division

Ben.Galton-Fenzi@aad.gov.au



Ben Galton-Fenzi's main interest is in the processes governing the interaction between Earth's ice sheets, the oceans and other parts of the geophysical system. He combines computational methods, theory and available, yet sparse, observations to discover and test our understanding

of the physical relationships in the global climate system. His specific interests include the mechanisms controlling the dynamic interaction between the ice sheets and the oceans; dense water formation in Antarctica; the interactions between the ocean and sea ice, icebergs and ice shelves; and variability and change in the Southern Ocean and Antarctica.

DR GERY GEENENS 4

UNSW Australia

ggeenens@unsw.edu.au



Gery Geenens received his PhD from the Louvain Catholic University (Belgium). He then moved to Australia to take up a post-doctoral research position at the University of Melbourne under the supervision of Professor Peter Hall. He has been a Lecturer at UNSW Australia since 2009. Most of

his research lies in developing nonparametric and semiparametric models in various contexts.

DR SANZHUAN GUO 1

Flinders University

sanzhuan.guo@flinders.edu.au



Sanzhuan Guo is a Chinese international lawyer working in Australia. As a Lecturer at Flinders Law School, she teaches constitutional law (LLB program) and relationship between international law and international relations (Master's Program), and leads Flinders Migration

Clinic (working on refugee matters only). Her research interests include history and theory of international law, human rights and China, migration and citizenship. Before she joined Flinders Law School, Sanzhuan worked as an immigration lawyer at Holding Redlich, Melbourne. She has been admitted to practise law in three distinct jurisdictions: China, Australia and USA. In addition to Holding Redlich, her legal practice experience includes roles at GE (in-house),

Jingtian & Gongcheng (corporate and securities) and the University of Melbourne (as an in-house lawyer). She holds a PhD in Public International Law from Peking University Law School, a JD from Melbourne Law School, and an LLM from School of Law, Northwestern University, USA.

DR KYRA HAMILTON 4

Griffith University

kyra.hamilton@griffith.edu.au



Kyra Hamilton has psychology and nursing qualifications and over 20 years experience in the health field. She is a Senior Lecturer at the School of Applied Psychology, Griffith University, and an Adjunct Senior Lecturer at the School of Psychology and Speech Pathology in the Health

Psychology and Behavioural Medicine Research Group at Curtin University. Her area of research is health psychology with particular interests in child and family health behaviours as well as accident and injury prevention. She applies social cognitive and motivational theories to understand and intervene to change people's health and risky behaviours, focusing on behaviours of national and international importance such as physical activity, nutrition, sun safety, alcohol consumption, patient safety and water safety. She focuses on how psychological factors such as beliefs, attitudes, social support and norms, self-efficacy, and motivation affect people's decisions and what individuals, healthcare professionals, and policy makers can do to change health and risky-related behaviours. She is a Chief Investigator on several large-scale National Competitive Grant Programme-funded projects, is Associate Editor of Applied Psychology: Health and Well-Being, and an Editorial Board member of the British Journal of Health Psychology as well as European Health Psychologist. Kyra is also State Chair (Queensland) of the Australian Psychological Society College of Health Psychologists.

DR VANDRA HARRIS 1

RMIT University

vandra.harris@rmit.edu.au



Vandra Harris is Program Manager of RMIT's Master of International Development and an Executive member of RMIT's Centre for Global Research. Vandra's teaching focuses primarily on humanitarianism and practical ethics. Her research addresses the interface between

different actors in the development space, especially militaries, police, non-government organisations (NGOs) and local actors. Vandra is currently finalising a project

concerning the interaction between NGOs and militaries in complex emergencies and disasters, funded by the Australian Civil-Military Centre. Prior to her university career, Vandra worked in local and international NGOs with a focus on community development for over a decade. She has also served on the boards of a range of NGOs and is a Fellow of the Inter University Seminar on Armed Forces and Society (IUSAFS), and a member of the International Development Ethics Association (IDEA) and the International Humanitarian Studies Association (IHSA).

DR KAREN HAWKE 3

South Australian Health and Medical Research Institute

karen.hawke@sahmri.com



Karen Hawke is a postdoctoral researcher at the South Australian Health and Medical Research Institute (SAHMRI). She was awarded her PhD for her gene sequencing and phylogenetic work that identified and quantified the changing diversity of HIV. Karen comes from a strong

interdisciplinary background and has a special interest in improving the health and well-being of populations most at risk, both within Australia and overseas, currently working in Aboriginal maternal and child health. She is also a strong advocate for gender equity and providing resources for people to reach their potential. Karen has recently been selected along with 77 other female scientists globally, to take part in a program called Homeward Bound, an inspiring initiative designed to increase female leadership in science, and use interdisciplinary approaches to tackle important questions about the sustainability of a healthy future for our planet. In December 2016 the women are heading out on the first Homeward Bound leadership program—a 3 week expedition to Antarctica where they will be challenged to learn state-of-the-art strategic and leadership skills to use in their workplaces, communities, countries, and collaborations globally.

DR TRACEY HOLLINGS 2

University of Melbourne

tracey.hollings@unimelb.edu.au



Since early 2014 Tracey Hollings has worked as an ecologist and research fellow at the Centre of Excellence for Biosecurity Risk Analysis (CEBRA) at the University of Melbourne. Her current research is broad, looking into various aspects of biosecurity risk including preparedness for disease

outbreaks in livestock using species distribution modelling, assessing characteristics of vessels which make them high

risk for carrying biosecurity risk material, and using remotely sensed imagery to aid livestock demographic estimation. Prior to this Tracey completed her PhD in Zoology at the University of Tasmania on 'Ecosystem effects of disease-induced top predator decline: Tasmanian devils and DFTD'. She went on to complete the risk assessment for the potential re-introduction of Tasmanian devils onto mainland Australia, before commencing her position at CEBRA. Tracey has broad interests and experience in mammal and disease ecology, trophic cascades, threatened species conservation and quantitative research.

DR GWEN IACONA 2

University of Queensland
gdiacona@gmail.com



Gwen Iacona is an applied conservation scientist who uses quantitative and empirical approaches to understand how biodiversity outcomes can be improved by better decision making. Her current work uses theoretical tools to study how the costs of conservation interventions

influence the choice of actions and the resulting outcomes.

Gwen has also worked closely with several conservation organisations on projects that include predicting invasive plant cover, modelling protected area effectiveness, and prioritising conservation action. She is currently a post-doctoral research fellow at the Centre of Excellence for Environmental Decisions at the University of Queensland where she is advised by Professor Hugh Possingham, Professor Kerrie Wilson and Professor Jonathan Rhodes. She earned her PhD from the University of Tennessee, under the tutelage of Professor Paul Armsworth, and has an MSc from the University of Florida.

DR ADRIEN ICKOWICZ 4

CSIRO
adrien.ickowicz@csiro.au



Adrien Ickowicz received his PhD in Statistics from Universite de Rennes (France). Since 2012, he has worked for CSIRO where he is now a Research Statistician with the Environment and Ecological Risk team. His research interests include spatial-temporal modelling and monitoring,

computational and Bayesian statistics.

DR AMY JONES 3

Eskitis Institute for Drug Discovery / Griffith University
a.jones@griffith.edu.au



Amy Jones completed her BSc(Hons) in veterinary science at the Royal Veterinary College, University of London majoring in medical microbiology, tropical parasitology and infection and immunity, after which she completed a PhD at the University of Glasgow. Her PhD focused on

investigating two new formulations of melarsoprol for the treatment of the neglected parasitic disease human African trypanosomiasis (HAT). Upon completing her PhD she took up a research fellow position in the Avery lab at the Eskitis Institute for Drug Discovery, Griffith University. At the institute the focus of Amy's research is the identification and biological characterisation of new molecules for the treatment of HAT and leishmania.

DR MADHURA KILLEDAR 4

Burnet Institute
madhura.killedar@burnet.edu.au



Madhura Killedar is a Senior Research Officer at the Burnet Institute, where she develops mathematical models for epidemiology and non-communicable diseases. One of her key research interests is probabilistic uncertainty within the context of Bayesian inference. Madhura received her PhD

in astrophysics at the University of Sydney for her thesis work on cosmological studies using the phenomenon of gravitational lensing, and has conducted postdoctoral research in Italy and Germany. She creates statistical tools to bridge the gap between complex simulations and real-world data for applications across both fields of astrophysics and epidemiology.

DR KIRSTY KITTO 4

Queensland University of Technology
kirsty.kitto@qut.edu.au



Kirsty Kitto is a Senior Research Fellow in the School of Mathematics and the Institute for Future Environments at Queensland University of Technology. She is a highly transdisciplinary researcher with a track record in modelling the ways that humans interact with complex information

environments. Originally trained as a physicist, much of her work now falls into the area of cognitive science. She builds mathematical and computational models of language, memory, attitude change, and learning. Such phenomena display highly contextual behaviour and so it is very difficult to remove uncertainty from models about how an individual will respond to a given set of stimuli, despite increasingly large data sets. Rather than ever more data, Kirsty believes that we require new approaches and theoretical structures with which to explore the complexity of such systems. Kirsty has made use of funding from the ARC, the FP7 and the OLT to extend our capabilities as we seek to understand our increasingly interconnected socio-technical society and its interactions with complex environmental processes.

DR MATTHEW KOPEC 1

Charles Sturt University

matthewckopec@gmail.com



Matt Kopec is an empirically oriented philosopher who works on issues at the intersection of philosophy of science, social epistemology and applied ethics. His main current project aims to devise a set of strategies to help diverse groups of problem solvers make more effective judgements and

decisions. He also has research interests in scientific reasoning, rationality, cooperation, collective action, collective responsibility, the nature of evidence, and individual decision making under risk and uncertainty. He has broad interdisciplinary training and has been involved with interdisciplinary centres or departments at Virginia Tech, University of Wisconsin-Madison, University of Colorado-Boulder and Northwestern University. He is now a Research Fellow at the Centre for Applied Philosophy and Public Ethics in Canberra.

DR PETRA KUHNERT 4

CSIRO

Petra.Kuhnert@csiro.au



Petra Kuhnert is a Research Statistician in Data61, a new research arm of CSIRO that is focused on data innovation. She has a PhD in applied statistics, focusing more recently on incorporating uncertainty into deterministic models, the development of data assimilation methods for

environmental problems, investigating elicitation practices with experts on risk-related issues, the translation and

synthesis of expert opinion into priors to inform Bayesian models, and the quantification and communication of uncertainty and risk for decision making. Petra was a CSIRO Julius Award recipient in 2010, which provided her with an opportunity to develop strong linkages with international collaborators from leading statistics institutions in the areas of spatio-temporal modelling, data assimilation and Bayesian Hierarchical Modelling. Petra was also awarded the 2013 Abdel El-Shaarawi Young Investigator Award for significant interdisciplinary collaboration and impact, the promotion and development of cutting edge statistical methods in the environmental sciences, particularly in water quality, fisheries, and ecological research, and strong contributions to expert elicitation, Bayesian hierarchical modelling, and non-parametric regression. Petra was an associate editor of *Environmetrics* between 2013 and 2014 and has recently edited a special issue of the journal on the topic of physical-statistical modelling.

DR MAURIZIO LABBATE 3

University of Technology Sydney

maurizio.labbate@uts.edu.au



Maurizio Labbate is a Research Microbiologist and Senior Lecturer at the University of Technology, Sydney. His current research interests include the movement of antibiotic resistance genes between bacteria and environments, and the evolution of pathogenic marine bacteria affecting

humans and aquaculture species. He is passionate about antibiotic resistance and has participated in public lectures, student forums and online and newspaper stories on this critical issue. Recognising that antibiotic resistance is a socio-cultural as well as a microbial problem, he is collaborating with a network of researchers from different disciplines to determine stakeholder attitudes to antimicrobial resistance. This project aims to drive improved and more focused education and policy programs to manage use of current and future antimicrobials in order to preserve their effectiveness. Maurizio's other research covers improving detection methods for aquatic pathogens and producing improved models for predicting infectious outbreaks affecting aquaculture species. Maurizio is a committee member of the NSW-ACT Branch of the Australian Society for Microbiology and has been invited to present at national and international conferences. He has published over 36 articles in peer-reviewed journals covering diverse disciplines in microbiology, genetics, environmental and human sciences.

DR SETH LAZAR 1

Australian National University

seth.lazar@anu.edu.au



Seth Lazar is a Senior Research Fellow at the Australian National University, in the RISS School of Philosophy, and a member of the Centre for Moral, Social and Political Theory. Most of his work, published in leading philosophy journals, has been on the ethics of war, self-defence and risk, but he has

also written on corrective justice, the nature of rights, and the moral reasons grounded in our valuable relationships. In his book, *Sparing Civilians* (OUP), Seth defends the special status of civilians in war against political and philosophical attacks that have arisen in recent years.

DR MARK LINDSAY 4

University of Western Australia

mark.lindsay@uwa.edu.au



Mark Lindsay is a Research Fellow at the Centre for Exploration Targeting, School of Earth Sciences at the University of Western Australia. Mark completed his BSc (Honours) at Monash University and received his cotutelle PhD at Monash University and Université Paul Sabatier (Toulouse

III). His research interests focus on the complexities of uncertainty and ambiguity in 3D geological and mineral exploration modelling, and the process and psychology of data interpretation. These themes are an important field of research being addressed by only a few research groups around the world, but have the potential to have a large impact on the current practices of deterministic modelling and risk assessment. Mark is working toward a stochastic approach to modelling that attempts to understand the relative importance of different data types in answering geoscientific questions, including those pertaining to mineral exploration, environmental and ground water management, and landform studies.

DR NENGYE LIU 1

University of New England

nengye.liu@une.edu.au



Nengye Liu is a Senior Lecturer at the School of Law, University of New England. Prior to moving to Australia, Nengye completed his PhD in law at Ghent University (Belgium); conducted a postdoctoral fellowship funded by German Research Foundation 'Future Ocean' Cluster of Excellence,

University of Kiel (Germany); and a Marie Curie Fellowship funded by the European Commission, hosted by the University of Dundee (UK) on the European Union and the protection of marine biodiversity in the Arctic. Nengye's research interests include the law of the sea, international environmental law, Chinese law, European Union law and Polar law. He has produced more than 40 single/first-authored publications in English and Chinese and presented his research results in more than 20 countries across 5 continents. Nengye is a qualified Chinese lawyer with working experience at King & Wood Mallesons, the China International Trade and Economic Arbitration Commission and the Singapore International Arbitration Centre. He also holds a bachelor of law and a master of international economic law from Wuhan University, China.

DR AMY MAGUIRE 1

University of Newcastle

Amy.Maguire@newcastle.edu.au



Amy Maguire is a Senior Lecturer in international law at the University of Newcastle Law School. Her fields of research are public international law and human rights, with particular focus on self-determination, Indigenous rights, climate change, refugees and asylum seekers, the death penalty, and

the Indigenisation of curriculum. Amy has published widely in highly regarded journals, and edited books. Her doctoral research explored the human right to self-determination, with focus on Indigenous peoples in Australia and Irish nationalists in the North of Ireland. She exposed the contemporary colonial experience of peoples in settler

societies and argued that self-determination retains a mission of decolonisation in the 21st century. Amy has emerged as a national and international commentator in her fields of research through a number of online publications, media engagements and submissions to government inquiries. In 2015, she was invited to assist the federal parliamentary inquiry into Australia's advocacy for the abolition of the death penalty. A unifying theme in Amy's research is the accountability of governments to human rights obligations and, through her research, she aims to contribute to policy development and just outcomes for individuals and communities.

DR ROISIN MCMAHON **3**

University of Queensland

r.mcmahon@imb.uq.edu.au



Roisin McMahon is a biochemist, protein enthusiast and pseudoscience adversary. Her research interests are in structural biology, particularly protein crystallography as applied to drug discovery. She is passionate about characterising and targeting the virulence proteins that bacteria use to

cause disease, in order to develop new antimicrobial drugs for life-threatening infections. Her primary research interest is the search for new treatments for melioidosis, a tropical bacterial disease in Northern Australia and South East Asia caused by the bacterium *Burkholderia pseudomallei*. Roisin read natural sciences at the University of Cambridge before training at the University of Oxford in protein crystallography, receiving a PhD for structural investigation of immune protein malfunction in autoimmune disease. Roisin is currently at the Institute for Molecular Bioscience at the University of Queensland.

DR PATRICK MITCHELL **2**

CSIRO

patrick.mitchell@csiro.au



Patrick Mitchell is a research scientist at CSIRO Land and Water, based in Hobart. Patrick's research explores the relationship between vegetation and water using his expertise in plant physiology, ecology and hydrology. He is interested in climate-based risks to forest functioning and plant

productivity; impacts of altered hydrology on ecosystem function and drought; and wildfire effects on the water cycle. He is currently involved in projects involving large ecological risk assessments of mining on water resources as well as defining risk in ecosystems using eco-climatic approaches.

DR RUTH MORGAN **2**

Monash University

ruth.morgan@monash.edu



Ruth Morgan is an environmental historian and historian of science with a particular focus on Australia, the British Empire, and the Indian Ocean. She holds an Australian Research Council Discovery Early Career Researcher Award and is a Research Fellow in the National Centre for

Australian Studies. Ruth has published widely on the history of water and climate variability in Australia. Her first book, *Running Out? Water in Western Australia*, was published by UWA Publishing.

DR SAM NICOL **2**

CSIRO

sam.nicol@csiro.au



Sam Nicol is broadly interested in how we make decisions to allocate resources to biodiversity conservation projects. He uses mathematical optimisation tools to find the best way to manage resources over time to achieve a conservation goal. More technically, this involves looking for the

series of management actions that can be taken to achieve some objective with maximum probability. Sam uses techniques drawn from operations research and artificial intelligence to solve these problems. Sam's current research involves a range of projects, including:

- creating new methods for the adaptive management of ecological networks of endangered and invasive species through space and time
- finding the optimal strategy to manage migratory shorebirds on the East Asia-Australasia flyway under uncertainty about the extent and effect of sea level rise
- prioritising the cost-effective management of threats in the Pilbara, Lake Eyre Basin and Brigalow Belt regions of Australia
- creating tools to better quantify and manage environmental compliance risk for major projects
- occupancy modelling to better target management of invasive mosquitofish and improve protection of the critically endangered red-finned blue-eye.

DR TANYA NOTLEY 1

Western Sydney University

t.notley@westernsydney.edu.au



Tanya Notley is a Lecturer in internet studies and digital media in the School of Humanities and Communication Arts at Western Sydney University and she is a researcher with both the Institute for Culture and Society and the Digital Humanities Research Group. Tanya has 15 years of

experience working as a digital media producer and researcher in the areas of social justice and human rights, community-based and online media initiatives. She has worked primarily in the UK, Germany, Nepal, Sri Lanka, India, Indonesia and Australia. She collaborates with a number of human rights and social justice organisations to design communication initiatives for social impact. Tanya's research focusses on understanding how media and communication technology impacts on social and cultural participation, public accountability and transparency, education and learning, human rights and social justice and, most recently, on the natural environment. To carry out her research, Tanya employs participatory, ethnographic, action and applied research methodologies.

DR CHRISTIAN PAYNE 1

Murdoch University

c.payne@murdoch.edu.au



Christian Payne is a Lecturer in computer science at Murdoch University. His interests include computer security and applied cryptography. However, he is increasingly interested in the interactions between the law and technology, and how each impacts on the other.

DR KEITH PEMBLETON 4

University of Southern Queensland

Keith.Pembleton@usq.edu.au



Keith Pembleton is a Senior Research Fellow and leader of the Agricultural Systems Modelling Research Group at the University of Southern Queensland (USQ). Keith undertakes research on the development of agricultural systems models and decision support tools that assist primary producers to

increase profitability and productivity while minimising the environmental footprint of their enterprises. At the centre of

this program is a focus on understanding and minimising the risks within agricultural production systems. His research group brings together biophysical crop and soil modellers with software developers to develop novel applications of existing models as well as develop new models and tools. Keith works across regional, state, national and international scales and has a strong emphasis on collaboration, working with other research centres and groups at USQ as well as other organisations nationally and internationally. He has published extensively in the areas of agricultural systems analysis, fertiliser and irrigation practices and adapting production systems to a changing and increasingly variable climate.

DR DIMITRI PERRIN 3

Queensland University of Technology

dimitri.perrin@qut.edu.au



Dimitri Perrin is a Lecturer in the Electrical Engineering and Computer Science School at Queensland University of Technology. Prior to joining QUT, he worked as an FPR Fellow in the Laboratory for Systems Biology (RIKEN, Japan), and as an IRCSET Marie-Curie Research Fellow

with the Centre for Scientific Computing & Complex Systems Modelling (Dublin City University, Ireland) and the Department of Information Networking (Osaka University, Japan). His research interests are in the field of complex systems, more particularly in developing new approaches to facilitate the analysis, understanding and optimisation of biomedical and social systems. His work spans the areas of modelling and simulation, computational biology and bioinformatics, operations research and optimisation, data analysis, and high-performance computing. In recent years, he has worked on gene editing (CRISPR), next-generation sequencing (RNA-seq, ribosomal profiling), high-resolution biomedical imaging (CUBIC), and computational modelling of epidemic outbreaks. Dimitri holds a master's degree (Diplôme d'Ingénieur) in computer engineering from ISIMA (Aubière, France) and an MSc in Computing from Université Blaise Pascal (Clermont-Ferrand, France), and received his PhD in computing from Dublin City University.

DR LISA PONT 3

Macquarie University

lisa.pont@mq.edu.au



Lisa Pont is a registered pharmacist and Senior Research Fellow in the Centre for Health Systems and Safety Research at the Australian Institute of Health Innovation, Macquarie University. Lisa has a PhD in clinical

pharmacology on quality use of medicines from the University of Groningen in The Netherlands. Her PhD explored the development and validation of prescribing indicators for measuring quality of prescribing in general practice. Lisa's main research area is understanding and improving the quality and safety of medicine use in older populations. She has extensive experience in analysing large administrative datasets to understand safety and quality issues associated with medication use and in the use of data driven solutions for quality improvement. Lisa is a Fellow of the International Society for Pharmacoepidemiology (ISPE) and is on the Board of directors. She is a fellow and board member of the Society of Hospital Pharmacists of Australia. Lisa is involved in the World Health Organization-led Global Medication Safety Initiative. She was awarded a national NPS Medicinewise award in 2014 for her work leading the development of resources to support health professionals managing heart failure in Aboriginal and Torres Strait patients.

ASSOCIATE PROFESSOR ALPHIA POSSAMAI-INESEDY **3**

Western Sydney University
alpha.possamai@westernsydney.edu.au



Alphia Possamai-Inesedy is an Associate Professor of Sociology at Western Sydney University. She is the editor in chief of the Journal of Sociology (2013– end of 2016) as well as the co-creator of the Risk Societies Thematic Group within the Australian Sociological Association. She has

worked as an Associate Pro-Vice Chancellor of Academia and was responsible for the creation of the Master of Research at WSU (the first centralised degree of the university). Her recent work includes Sociology: A Down-to-Earth Approach (with Henslin and Possamai, Pearsons); as well as upcoming books on Digital Methods (Sage and deGruyter). Alphia is currently involved in ongoing research that focuses on risk society, religion, and methodologies.

DR LESLEY PRUITT **1**

Monash University
lesleypruitt@yahoo.com



Lesley Pruitt is a Senior Lecturer in international relations in the School of Social Sciences at Monash University. Lesley's research focuses on recognising and enhancing youth participation in peacebuilding and promoting gender equity in peace processes. Originally from the US,

Lesley worked in Congress before moving to Australia to

complete her postgraduate studies. A Truman Scholar and Rotary Ambassadorial Scholar, Lesley received her masters and PhD from the University of Queensland. Prior to joining Monash, Lesley held academic appointments at the University of Melbourne, Victoria University and RMIT University. In 2012 she also served as a visiting research fellow at George Mason University's Peacekeeping Operations Policy Program in Washington, DC. Her latest book is *The Women in Blue Helmets: Gender, Policing and the UN's First All-Female Peacekeeping Unit* (University of California Press). Earlier works include her book, *Youth Peacebuilding: Music, Gender and Change* (SUNY Press), and a number of academic journal articles in outlets such as *Australian Journal of Political Science*, *International Peacekeeping*, *Journal of Women, Politics, and Policy*, and *Global Change, Peace and Security*.

DR MARK QUIGLEY **4**

University of Melbourne
mark.quigley@unimelb.edu.au



Mark Quigley is Associate Professor in Active Tectonics and Geomorphology in the School of Earth Sciences at the University of Melbourne. He is an expert in earthquake science, with more than 60 peer reviewed journal publications and numerous awards including the New Zealand Prime

Minister's Prize for Science Communication and Geological Society America Public Service Award. Mark is a Fellow of the Geological Society of America and incoming Science Editor for *Geology*, the top ranked science journal in the earth sciences.

ASSOCIATE PROFESSOR JONATHAN RHODES **2**

University of Queensland
j.rhodes@uq.edu.au



Jonathan Rhodes is an Associate Professor in the School of Geography, Planning and Environmental Management and the Centre for Biodiversity and Conservation Science at the University of Queensland (UQ). He has been at UQ since 2007, prior to which he held a postdoctoral

fellowship at CSIRO Marine and Atmospheric Research, Hobart. His PhD in ecology was obtained in 2005 from UQ. Jonathan's work focuses primarily on developing a fundamental understanding of the drivers of change for biodiversity and ecosystem services and principles for decision-making in conservation under uncertainty. The overarching approach he takes is to integrate ecological, economic and social data and models using decision

theoretic frameworks. This is then applied to evaluate alternative planning and management options to achieve sustainable outcomes for biodiversity and ecosystem services. His work has informed policy decisions for koala conservation and land clearing, in particular.

DR MELANIE ROBERTS 4

IBM Research—Australia

melanie.roberts@au1.ibm.com



Melanie Roberts is a research scientist with the Physical Analytics team at IBM Research—Australia, focusing on weather impacted operations. In particular, Melanie works on integrating modelling with a weather forced component applicable to emergency management, agriculture and

insurance industries. She is currently developing models to understand household-based risk from bushfires in the peri-urban environment, and models of the impact of hail on crops. Melanie is the Chair of the Victorian Branch of ANZIAM (Australian and New Zealand Industrial and Applied Mathematics), a division of the Australian Mathematical Society, and the returning officer for the ANZIAM executive. Melanie's background is in applied mathematics, having received a PhD from the University of Western Australia in the area of asymptotics and fluid dynamics. In addition, Melanie has undergraduate and postgraduate degrees in the areas of mathematics, education and science communication.

DR MARIE SEGRAVE 1

Monash University

marie.segrave@monash.edu



Marie Segrave is a DECRA fellow (2014–18) whose work examines the intersection of regulation, enforcement and exploitation with a focus on temporary and unlawful migrant labourers. She leads the Human Trafficking and Labour Exploitation research agenda of the Border

Crossing Observatory, a high quality, independent research body that seeks to transform understandings of irregular migration and border control. She has written and researched widely in the area of human trafficking, human security and detention and deportation practices. She also founded and leads the Imprisonment Observatory, and has published in the area of women's imprisonment and survival.

Marie is heavily involved in research that explores gendered experiences of exploitation, ranging from border crossings to family violence and the impacts and intersection of security practices in enabling and/or sustaining some forms of harm.

DR TIM TRUDGIAN 2

Australian National University

timothy.trudgian@anu.edu.au



Tim Trudgian is a mathematician at the Australian National University. His area of research is number theory: in particular he is interested in the distribution of prime numbers. Tim's interests outside of mathematics are cricket and politics. Tim enjoys applying mathematics more generally,

and using its combination of analytical and creative thinking to examine problems through a different lens. He is looking forward to the prospect of collaborating with people from diverse fields at this meeting. In cricket Tim is concerned at the lack of attacking flair in modern skippers; in politics he is concerned with issues of inequality and allocation of resources towards education. Tim studied at the ANU and at Oxford, and held a post-doctoral post in Canada before returning to Australia in 2012.

DR ANTONIO VERDEJO-GARCIA 4

Monash University

antonio.verdejo@monash.edu



Antonio Verdejo-Garcia has a PhD in psychology and an MSc in psychological and biomedical aspects of health and disease (both from the University of Granada, Spain). In 2006, he was awarded the prestigious Juan de la Cierva Postdoctoral Fellowship (Ministry of Science), in the Barcelona

Biomedical Research Park, one of the world's leading institutions for neuroscience research. In 2007, Antonio was appointed as Lecturer at the Faculty of Psychology of the University of Granada, where he established a research group, and was subsequently promoted to Senior Lecturer and Associate Professor. In 2012, Antonio was appointed as Associate Professor at Monash University to lead a translational research program in decision-making, obesity and addiction. His current research focuses on the cognitive and neurobiological mechanisms of decision-making in health and disease.

DR PHILLIPA WATSON 2

University of Tasmania

phillipa.watson@utas.edu.au



Phillipa Watson is a Research Fellow in the Housing and Community Research Unit (HACRU) at the University of Tasmania and a consultant at RED Sustainability Consultants. She has been involved in sustainable building consultancy, housing design, sustainable built environments

research, low-income household research and assessment tool development. Phillipa has worked with Brisbane City Council's design team, CSIRO's sustainable building team, in universities and in private design and consulting practice. Creating sustainable change requires grappling with a messy and complex world. Phillipa has developed an understanding of how to engage with this complexity in practice and in research. She has investigated decision making; design; life-cycle assessment; environmental impacts of buildings; household adaptation and transitions; home energy efficiency and comfort; energy use and energy technology; housing quality; community change; low income households; and policy development. Currently Phillipa is chief investigator for the project 'Get Bill Smart' investigating how to support energy efficiency improvements in low-income households. The \$1.4 million project was competitively funded through the Federal Government's Low Income Energy Efficiency Program. She is also looking forward to a new project that is investigating innovative domestic electricity trading technology and how it is received by householders.

DR CHRISTOPHER WHITE 4

University of Tasmania

chris.white@utas.edu.au



Chris White is a Lecturer in environmental engineering at the University of Tasmania in Hobart. He has a PhD in flood risk from the University of Southampton (UK), and conducts research spanning the disciplines of hydrology, natural hazards and natural disaster risk

assessment, extreme events, and climate change. Chris is Vice President of the International Commission on Coupled Land–Atmosphere Systems (ICCLAS), one of the ten commissions of the International Association of Hydrological Sciences (IAHS) within the International Union of Geodesy and Geophysics (IUGG). He is helping to advance the understanding and prediction of natural hazards, including

promoting better integration between the social and physical sciences to improve the communication of risk-based information. He is currently leading the revision of the Tasmanian State Natural Disaster Risk Assessment for the Tasmanian Government, reassessing the state's risk from natural hazards. He is also leading the Floodplain Risk Assessment Process for Tasmania project in partnership with the Tasmania SES, which is producing a consistent method to assess flood risk at the municipal level.

DR SIMON WILLIAMS 1

Flinders University

s.williams@flinders.edu.au



Simon Williams was born in Germany while his father was on sabbatical there, but grew up in Melbourne and then Adelaide, where he did his undergraduate studies in mathematical physics and pure mathematics. He went to Oxford to undertake graduate studies with Roger Penrose on general

relativity and conformal field theory (although both of these reduce to differential equations if you stare at them hard enough!). Since his return to Australia Simon has lectured at Adelaide University, and worked as a radar signal processor at the Defence Science and Technology Organisation (now Group) and Bayesian analyst at CSIRO before joining Flinders University to work on iterative optimisation of parametric Bayesian models for medical image analysis. Since then he has also found fun people to work with on mathematical models of high-rate algal ponds, plasma fusion and automated malaria diagnosis.

DR ANUSUYA WILLIS 2

Griffith University

anusuya.willis@griffith.edu.au



Anusuya Willis, BSc Hons (Melbourne University), PhD (Melbourne University and Paris Sud XI), is a molecular biologist specialising in cyanobacteria. She is a research fellow at the Australian Rivers Institute, Griffith University, and within Professor Michele Burford's group. She is

interested in understanding the interaction between gene expression and the environment and how this translates into cell physiology adaptations. Anusuya's current research explores the biology of the cyanobacteria in the South East Queensland reservoirs to gain a greater understanding of the environmental drivers that stimulate cyanobacteria blooms and toxin yields.

PROFESSOR WEI XIANG ¹

James Cook University

wei.xiang@jcu.edu.au



Wei Xiang received his BEng and MEng degrees, both in electronic engineering, from the University of Electronic Science and Technology of China, Chengdu, China, and a PhD in telecommunications engineering from the University of South Australia. He is currently Foundation Professor

and Head of Electronic Systems and Internet of Things Engineering in the College of Science and Engineering at James Cook University. Between 2004 and 2015, he was with the School of Mechanical and Electrical Engineering, University of Southern Queensland. He is an Institution of Engineering and Technology Fellow, a Fellow of Engineers Australia, and an Editor for IEEE Communications Letters. He was a co-recipient of three Best Paper Awards at 2015 WCSP, 2011 IEEE WCNC, and 2009 ICWMC. He has been named a Queensland International Fellow and a Smart Futures Fellow by the Queensland Government, an Endeavour Research Fellow by the Australian Government, and an Invitational Fellow jointly by the Australian Academy of Science and Japan Society for the Promotion of Science. He has been a visiting scholar at Nanyang Technological University, Singapore and the University of Mississippi, USA,

and an Endeavour visiting associate professor at the University of Hong Kong. He has published over 160 papers in peer-reviewed journal and conference papers. His research interests are in the broad area of communications and information theory, particularly coding and signal processing for multimedia communications systems.

ASSOCIATE PROFESSOR JI ZHANG ¹

The University of Southern Queensland

Ji.Zhang@usq.edu.au



Ji Zhang is currently an Associate Professor in computing at the University of Southern Queensland (USQ), Australia. He is an Australian Endeavour Fellow, Queensland Fellow and Izaak Walton Killam Fellow (Canada). His research interests are information privacy and security, big

data analytics, and data mining. He was a Post-doctoral Research Fellow in CSIRO ICT Centre in Hobart. He received his PhD from the Faculty of Computer Science at Dalhousie University, Canada, his MSc from Department of Computer Science at the National University of Singapore and his bachelor degree from the Department of Information Management and Information Systems at the Southeast University, China. He has published more than 80 papers in major international journals.

ARE YOU A MEMBER OF THE EMCR FORUM?

The Australian Early- and Mid-Career Researcher (EMCR) Forum is the national voice of Australia's emerging scientists, representing researchers who are up to 15 years post-PhD (or other research higher degree), irrespective of their professional appointment.

The EMCR Forum examines critical issues including career structure, job security, funding, education, training and gender equity. It engages with early- and mid-career researchers (EMCRs) from around Australia and advises the Australian Academy of Science on issues relevant to EMCRs, to help inform its policy recommendations to government and develop its EMCR activities. It also liaises with other national organisations to positively contribute to both Australia's scientific research and the future careers of emerging research experts. The Forum provides a vital connection between Australia's most eminent scientists and tomorrow's future scientific leaders.

You can join the EMCR Forum as a member at any time and join your voice with thousands of other EMCRs around the country to create positive changes for your career.

The EMCR Forum is run by an executive of 10 EMCRs and positions on the executive are advertised each year in October.

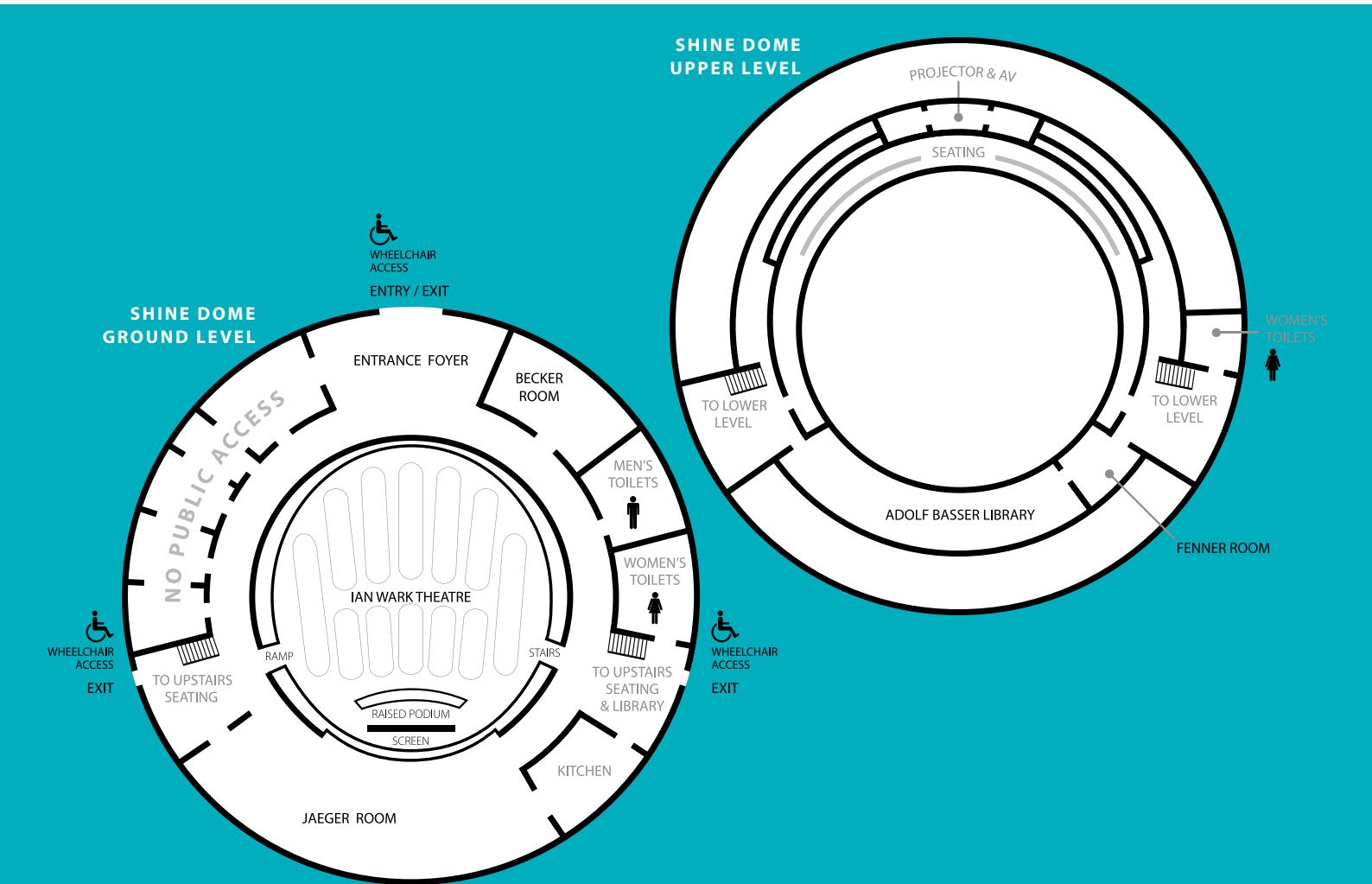
Why join?

- To stay informed about issues relevant to EMCRs and to voice your opinions and help create change
- To hear about awards, funding and educational opportunities for EMCRs
- To have the opportunity to attend EMCR-specific events held by the Australian Academy of Science such as Science Pathways, Theo Murphy High Flyers Think Tanks and Australian Frontiers of Science symposiums.

How to join?

- Find out more about the Forum and sign up online: www.science.org.au/emcr-forum
- Follow **@EMCRForum** on Twitter or Email us at emcr@science.org.au
- Talk to **Roslyn Hickson**, a member of the EMCR Forum executive, who will be attending the Theo Murphy High Flyers Think Tank dinner on Thursday evening
- Talk to **Sandra Gardam**, the EMCR Project Officer at the Australian Academy of Science







THE ROYAL SOCIETY

THE THEO MURPHY (AUSTRALIA) FUND

The 2016 Theo Murphy High Flyers Think Tank is supported by the Royal Society of London—the national academy of science of the United Kingdom and the Commonwealth—through the Theo Murphy (Australia) Fund.

The Royal Society of London is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, reflected in its founding Charters of the 1660s, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.