



NCCARF

National  
Climate Change Adaptation  
Research Facility

2009 NCCARF  
Symposium  
Brisbane, Australia

July 22 & 23, 2009

Programme &  
Abstracts

## 2009 NCCARF Symposium Brisbane, 22-23 July

### Programme

<b>Wednesday 22 July, 2009</b>	
8am	Registration
<b>Opening session – Parklands Room</b>	
8:30am	Professor Jean Palutikof (NCCARF) <i>Welcome and overview</i>
8:45 am	Mr Ian Carruthers (Department of Climate Change) <i>Australian Government perspective</i>
9:15am	Mr Greg Withers (Queensland Office for Climate Change) <i>COAG perspective</i>
9:45am	Professor Amanda Lynch (Monash University) <i>Bounded rationality in responding to climate change</i>

10:30am-11am Morning Tea

<b>11am-12:30pm Parallel Session 1</b>	
<i>Parklands Room</i>	
<b>Marine Biodiversity &amp; Resources session chaired by Alistair Hobday (CSIRO)</b>	
Gretta Pecl (University of Tasmania) <i>An integrated approach to assessing climate change impacts and adaptation options in fishery systems</i>	
Quentin Grafton (ANU) <i>Marine protected areas and resilience</i>	
Tim Smith (University of Sunshine Coast) <i>Communities as catalysts of resilience</i>	
Peat Leith (University of Tasmania) <i>Mapping the climate science-policy interface in three marine biodiversity and resource sectors: case studies for adaptation and action</i>	
Paul Marshall (GBRMPA) <i>Eliciting adaptation responses from marine stakeholders</i>	
<i>Panorama Room</i>	
<b>Social, Economic &amp; Institutional Dimensions of Climate Change session chaired by Jon Barnett (University of Melbourne)</b>	
Glenn Albrecht (Murdoch University) <i>Cultural pre-adaptation to climate change in a resilient region</i>	
John Merson (UNSW) <i>Climate change adaptation in the Central Tablelands of NSW: the case for Native Agro-Forestry and Bio-energy Production</i>	
Melissa Nursey-Bray (University of Tasmania) <i>Coastal communities, climate change and institutional learning</i>	
Stephen Dovers (ANU) <i>How easy can adaptation be?</i>	
Rik Thwaites (Charles Sturt University) <i>Understanding rural landholders responses to climate change: outline of progress to date</i>	
Anna Hurlimann (University of Melbourne) <i>Equitable local outcomes in adaptation to sea-level rise: a proposed research agenda of Gippsland, Victoria</i>	

12:30pm-1:30pm Lunch

1:30pm	Strategic session 1 : National climate change adaptation challenges
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3pm-3:30pm Afternoon tea

**Wednesday 22 July, 2009**

**3:30pm-5pm Parallel Session 2**

*Parklands Room*

**Settlements & Infrastructure session chaired by Ron Cox (UNSW)**

Bill Randolph (UNSW) *Climate change challenges for the built environment*

Michael Taylor (University of South Australia) *Vulnerability in transport infrastructure*

Mark Stewart (University of Newcastle) *Impact and adaptation assessment of cyclone damage risks due to climate change*

Andrew Garcia (U.S. Army Corps of Engineers) *Hurricane Katrina: the storm and its effects on planning and design for the U.S. Army Corps of Engineers*

Rodger Tomlinson (Griffith University) *Future coastlines: coastal erosion, inundation and climate change*

Bill Peirson (UNSW) *Water supply for Australian Cities: energy and climate change*

*Panorama Room*

**Terrestrial Biodiversity session chaired by Stephen Williams (JCU)**

Stephen Williams (JCU) *Protecting biodiversity: adapting to global climate change*

Ary Hoffman (University of Melbourne) *Evolutionary adaptation and climate change: maximising evolutionary opportunities for preserving biodiversity*

Lynda Chambers (Bureau of Meteorology) *Biodiversity and climate change: knowledge for adaptation*

Richard Williams (CSIRO) *Climate change, fire regimes and biodiversity in Australia: a preliminary analysis*

David Souter (MTRSF) *The e-atlas: an integrated knowledge management platform for sharing, mapping and delivering information on Australia's tropical lands and seas*

Andrew Lowe (South Australian Government) *How can we help biodiversity adapt to the impending ravages of climate change? Landscape and genetic approaches*

5:00pm-  
5:30pm

Wrap up and close

6:00pm

Pre-dinner drinks (*Panorama Room*)

7:00pm

Symposium dinner (*Parklands Room*)

**Thursday 23 July, 2009**

**8:30am-10am Parallel Session 3**

*Parklands Room*

**Water Resources and Freshwater Biodiversity session chaired by Stuart Bunn (Griffith University)**

Stuart Bunn (Griffith University) *Climate change adaptation and Australia's water resources and freshwater biodiversity*

Bryson Bates (CSIRO) *Climate scenarios: use, misuse and limitations*

Jenny Davis (Monash University) *Climate change and freshwater biodiversity*

John Tibby (University of Adelaide) *Responsiveness and resilience of freshwater systems to climate change: a view from the past*

Ian Prosser (CSIRO) *Adaptation to climate change in water resource management*

John Langford (University of Melbourne) *Activities of the Victorian node of the Adaptation Research Network for Water Resources and Freshwater Biodiversity*

*Panorama Room*

**Emergency Management session chaired by John Handmer (RMIT University)**

Richard Thornton (Bushfire CRC)

Yetta Gurtner (JCU) *Enhancing community capacity in an era of increasing uncertainty*

Karyn Bosomworth (RMIT) *Adaptive capacity in the public policy sector of fire management*

Paul Taylor (Geoscience Australia) *A national assessment of the risk and impact of climate related hazards on the coast*

Russell Stevens (Fire and Emergency Services Authority, WA) *Emergency management and climate change in Western Australia*

Gary Mahon (Queensland Department of Community Safety) *Climate change and emergency management*

*10:00am-10:30am Morning Tea*

10:30am	<b>Vulnerability and Resilience plenary session chaired by John Handmer (RMIT University)</b>  Liz Hanna (ANU) <i>Is Australia's public health infrastructure prepared for climate disasters, or is the system itself vulnerable?</i> Julie Davidson (University of Tasmania) <i>Social-ecological resilience: an approach to adaptation in the marine socio-ecological system</i> Jon Barnett (University of Melbourne) <i>A critical theory of vulnerability</i>
11:30am	Strategic Session 2: The role of NCCARF in addressing national climate change adaptation challenges

*1:00pm-2:00pm Lunch*

**2:00pm-3:30pm Parallel Session 4***Parklands Room***Primary Industries session chaired by Snow Barlow (University of Melbourne)**Snow Barlow (University of Melbourne) *Climate change adaptation in primary industries*Ross Kingwell (UWA) *Farmers' adaptation to a drier climate: some initial observations*David Ellsworth (UWS) *Influence of rising carbon dioxide on water and carbon fluxes in maturing Eucalyptus trees: lessons learnt from the Hawkesbury Forest Experiment*Leanne Webb (UM/CSIRO) *Developing adaptive capacity to extreme climatic events: a bottom-up approach*Peter Grace (QUT) and Richard Eckard (University of Melbourne) *The ultimate adaptation challenge: avoiding perverse mitigation outcomes*

Panel discussion: presenters, Graham O'Hara (Murdoch University), Mark Howden (CSIRO)

*Panorama Room***Human Health session chaired by Tony Capon (ANU)**David McRae (QCCCE) *Collaborative climate change research between QUT and the Queensland Government*Dianne Katscherian (Department of Health WA) *The health impacts of climate change: using health impact assessment*David Harley (ANU) *Climate change and infectious disease*Peng Bi (University of Adelaide) *Heatwave and population health in Australia*Jennifer Bowers (CRRMH) *The impact of climate change on mental health of people in rural and remote areas including Indigenous communities*Keith Dear (ANU) *Modelling the effects of heat and cold on mortality**3:30pm-4pm Afternoon tea*

4pm	Final plenary session chaired by Jean Palutikof (NCCARF) – Brief overviews/commentary of thematic session for themes 1-8 provided by session chairs followed by questions/discussion
5pm	Symposium close

# 2009 NCCARF Symposium

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## Keynote address:

# Bounded Rationality in Responding to Climate Change

Amanda Lynch

*Monash University*

### **Abstract**

We are already committed to a certain degree of climate change beyond that already observed, even if atmospheric greenhouse gas concentrations were stabilized today. Our vulnerability to the impacts of climate change is increasing for reasons not associated with emissions, including social exclusion, unsustainable development and economic inequities. It is inevitable, then, that damaging and even catastrophic events will continue to occur regardless of efforts to mitigate emissions. In this context, it is worth being explicit in defining our goal: to clarify and secure the common interest in the face of climate change, present and future. A good approximation to this common interest is to reduce the vulnerability of things valued in the world's many and diverse communities. Stabilization and reduction of concentrations is one means for reducing vulnerability. Making adaptations to inevitable impacts is another.

Adaptation to reduce vulnerability typically arises from a perceived threat to existing values, a perceived window of opportunity, or both – rather than a change in the values, or preferred outcomes, themselves. Meanwhile, the quest for mandatory targets and timetables for reductions in greenhouse emissions has not risen above politics on a scientific and technical foundation. In both cases, political will is an important limiting factor.

At a deeper level, understanding this limitation may be grounded in the behavioral model of bounded rationality. The most basic constraint on our capacity to find better strategies arises from our highly simplified internal representations of the external real-world situation. The direct corollary of this constraint is that the focus of attention in a community or institution is typically structured by an formalized division of labor – in public safety, education, or finance, for example – that are separable or nearly so from other areas. But the allocation of attention in this way is subject to disruption by exogenous events such as natural disasters. A solution to disruption is feedback to correct for unexpected or incorrectly predicted events. The behavioral model of bounded rationality emphasizes feedback over predictions. Thus, when the more realistic assumption of bounded rationality is taken into account, the problem of responding to climate change can change from choosing the *right* course of action to finding a way of determining, very approximately, where a *good* course of action lies.

# An Integrated Approach to Assessing Climate Change Impacts and Adaptation Options in Fishery Systems

Gretta Pecl<sup>1</sup>, Stewart Frusher<sup>1</sup>, Caleb Gardner<sup>1</sup>, Marcus Haward<sup>2</sup>, Alistair Hobday<sup>3</sup>, Sarah Jennings<sup>4</sup>, Melissa Nursey-Bray<sup>5</sup>, André Punt<sup>6,7</sup>, Hilary Revill<sup>8</sup>, and Ingrid van Putten<sup>4</sup>

<sup>1</sup>Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart, Tasmania, Australia; <sup>2</sup> School of Government and Antarctic Climate and Ecosystems CRC, University of Tasmania, Hobart, Tasmania, Australia; <sup>3</sup> Climate Adaptation Flagship, CSIRO, Hobart, Tasmania, Australia; <sup>4</sup> School of Economics and Finance, University of Tasmania, Hobart, Tasmania, Australia; <sup>5</sup> National Centre for Marine Conservation and Resource Sustainability, Australian Maritime College – a specialist Institute of the University of Tasmania, Launceston, Tasmania, Australia; <sup>6</sup> Pop Model ,LLC; <sup>7</sup> School of Aquatic and Fishery Sciences, University of Washington, United States; <sup>8</sup> Wild Fisheries Management Branch, Department of Primary Industries and Water, Hobart, Tasmania, Australia.

## Abstract

Fisheries management is facing unprecedented challenges requiring the scientific community to deliver spatially-explicit, rigorous, priority-based advice about species, fisheries and ecosystems adaptation options. However, analysis needs to incorporate human as well as biophysical systems, and be based on a thorough understanding of connections among all components of the fishery system – social, economic, cultural, ecological and policy. In marine domains, climate-induced changes in water temperature and ocean currents change productivity of resources which, in turn, alter the spatio-temporal distribution of users (e.g. fishers) with social and economic flow-on effects to communities. Additionally, it is the human component of fishery systems that will be undertaking any adaptation actions, requiring development of frameworks and models that effectively integrate the many disciplinary approaches. This presentation, based on one of six case studies from the recent National Coastal Vulnerability Assessment, identifies potential impacts of climate change for the Tasmanian rock lobster fishery, determines key climate change information needs, and explores solutions and opportunities for adaptation. Predicted direct impacts, related to forecast changes in growth and recruitment correlated to downscaled temperature models, demonstrate the uncertainty of, and interplay among, different parameters and the need for ongoing validation of predictions to provide strong stakeholder engagement and confidence. Indirect impacts are also demonstrated through links between lobster and sea urchin biomass and subsequent formation of barrens and associated feedback mechanisms. While our survey of stakeholders showed climate change adaptation was generally viewed as a “future decision” because incremental changes appear small, we demonstrate that this journey is already in “full-swing” and pro-active management decisions are required today. The Tasmanian rock lobster fishery is a relatively well-researched and data-intensive fishery, located in a region predicted to be the fastest-warming in the southern hemisphere, and therefore provides an early opportunity to indicate critical issues for consideration in fisheries globally.

# Marine Protected Areas and Resilience

Quentin Grafton<sup>1</sup> and Sarah Jennings<sup>2</sup>

<sup>1</sup> *Australian National University*; <sup>2</sup> *University of Tasmania*

## **Abstract**

Using data from what was once one of the world's largest capture fisheries, the northern cod fishery, the economic value of a marine reserve is calculated. The counterfactual analysis shows that with a stochastic environment an optimal-sized marine reserve in this fishery would have prevented the fishery's collapse and generated a triple payoff: raised the resource rent even if harvesting had been 'optimal'; decreased the recovery time for the biomass to return to its former state and smoothed fishers' harvests and resource rents; and lowered the chance of a catastrophic collapse following a negative shock.

# Communities as Catalysts of Resilience

Tim Smith

*University of the Sunshine Coast*

## **Abstract**

Successful management responses to climate change often hinge on effective social processes. Central to effective social processes is the notion of community engagement. Three rationales for community engagement have been cited in various publications regarding natural resource management, including: (i) a democratic rationale; (ii) a substantive rationale; and (iii) a pragmatic rationale. These rationales have utility in the case of the climate change adaptation in marine environments. For example, firstly, in democratic societies there is an inherent value in involving communities in democratic processes; secondly, marine resource users may offer unique knowledge and perspectives that may enhance adaptation strategies; and thirdly, if communities are involved in the decisions that affect them, they are more likely to not only support but also help to implement the decision outcomes. In summary, communities are critical to the design and implementation of climate change adaptation strategies in the marine environment.

# Mapping the Climate Science-Policy Interface in Three Marine Biodiversity and Resource Sectors: Case Studies for Adaptation and Action

Rosemary Sandford and Peat Leith

*University of Tasmania*

## **Abstract**

This presentation outlines the processes and potential outputs of the ARN-MBR policy research project. Three case studies will be undertaken to analyse where and how particular sectors and various tiers of government have, or have not, taken climate science into account in developing and/or amending legislation, policies, management strategies and action plans relevant to managing Australia's MBR. The first case study, to be piloted in 2009-10, will be the oyster industry (aquaculture), followed by Marine Protected Areas (MPAs) (conservation) and the Commonwealth Trawl Sector (fisheries). For each case study, a participative research process will be developed to actively engage key stakeholders in dialogue and collaboration. Together, researchers and stakeholders will identify and 'map' synergies, needs, knowledge gaps, contradictions, barriers and opportunities at the interface between climate science and MBR policy. Outputs from the study will include specific recommendations and proposals for climate change adaptation in MBR. These will include approaches to building adaptive capacity and resilience, and informing adaptation policy and action.

# Eliciting Adaptation Responses from Marine Stakeholders

Paul Marshall<sup>1</sup> and Alistair Hobday<sup>2</sup>

<sup>1</sup>*Great Barrier Reef Marine Park Authority*, <sup>2</sup>*CSIRO*

## **Abstract**

We will describe a participatory framework for engaging stakeholders, delivering and receiving information, and prioritising climate adaptation solutions. We have developed and tested our approach in workshops with a range of stakeholders involved in marine fisheries and aquaculture industries, including fishers, researchers, managers, and policy makers. Our first step involves leading the group through a rapid vulnerability assessment, by detailing the exposure and then eliciting information on sensitivity of key biological and technological assets, and their adaptive capacity. Together we then generate a range of adaptation options, and illustrate where the adaptive options sit with regard to efficiency, appeal, and rationality. Finally, the workshop group considers how to identify and prioritise the decisions that can be made now and should be proactive, and those that can be reactive and can be deferred.

# Cultural Pre-adaptation to Climate Change in a Resilient Region

Glenn Albrecht

*Institute for Sustainability and Technology Policy, Faculty of Sustainability, Environmental and Life Sciences, Murdoch University*

## **Abstract**

The Cape to Cape region in south-west WA is a cultural, biodiversity and climate change hotspot that offers a potentially informative case study in the concept of cultural pre-adaptation to climate change. Despite the twin pressures of development and climate change, the region remains relatively resilient to internal and external shocks. It is also better positioned than most areas in Australia to make necessary transitions in the face of a warming and changing climate. This presentation will discuss the reasons why the Cape to Cape Bioregion can be seen as an exemplar of a resilient region where personal values, eco-entrepreneurial activity and community-driven conservation have delivered a diverse cultural and natural landscape, but one still reflective and respectful of regional distinctiveness. Human values sensitive to such diversity have perhaps unintentionally created a situation where some eco-entrepreneurial activities will be favoured under future change regimes while others will not. Activities favoured by the change process then become the basis of an ongoing resilient economy. In areas where monocultures of the mind and economy prevail, incapacity to deal with negative change will have devastating social and economic consequences. In addition to unintentional pre-adaptive capacity, some individuals within the region are anticipating change and are actively planning in ways they hope will prove advantageous in the face of perturbations. Individuals are intentionally experimenting with new approaches to emergent problems and this creativity, combined with sharing of results with multiple common interest groups, is increasing the resilience of the social-ecological system taken as a whole. The foundations of cultural pre-adaptation; unity- in-diversity, resilience, protection of ecosystem services and health and respect for endemism (regionality) have important relevance for other regions and the nation as a whole in the face of relentless climate change pressures.

# Climate Change Adaptation in the Central Tablelands of NSW: the Case for Native Agro-forestry and Bio-Energy Production

John Merson

*Institute of Environmental Studies, UNSW*

## **Abstract**

This presentation reviews three interrelated research projects that address potential climate change impacts and adaptation strategies in the Sydney Basin, Greater Blue Mountains World Heritage Area, and Central Tablelands region of NSW. Given the limited time available the presentation will focus on the development of a native agro-forestry and bio-energy project in the Central Tablelands. It will outline the project and its potential for farm-based and plantation-level reforestation in relation to second generation biofuel and bio-energy systems. It will also outline the development of a GIS-based decision support tool to assist farmers and land management agencies identify potential species that under climate change conditions (e.g., higher temperatures, prolonged drought and extreme weather conditions) could replace unsustainable pine plantations, and also allow farmers to gain an additional income stream by reforesting degraded agricultural land. Such reforestation of the Central Tablelands could have economic benefits for the rural communities of the region, as well as improving biodiversity and catchment functions at a landscape level.

# Coastal Communities, Climate Change and Institutional Learning

Melissa Nursey-Bray

*National Centre for Marine Conservation and Resource Sustainability,  
AMC, TAS*

## **Abstract**

Instituting adaptation frameworks that can assist professionals in coastal communities to respond to climate change, yet that are also tailored to specific sectoral needs is crucial. Professionals working at the coalface of the climate change challenge need to build new skills and create innovative solutions in social and political contexts. Using case studies, this paper reflects on the experience of developing climate change curricula at multiple levels and the obstacles to implementation of the links between curriculum and practice. This includes reflections on the necessity of interlinking political, social and economic aspects together to create real opportunities for institutional learning. The paper concludes by examining the utility of such educational initiatives to build community resilience, forge networks between multiple sectors and contribute to achieving social/institutional, political and economic outcomes for adaptation to climate change.

# How Easy Can Adaptation Be?

Stephen R. Dovers

*Fenner School of Environment and Society,  
Australian National University College of Medicine, Biology and Environment*

## **Abstract**

We have seen recently a big shift in climate change debates, from a (necessarily) science-led debate over whether and by how much change would occur, to a discussion of what should be done. This invites contributions from a wider range of disciplines and other knowledge systems, and attention to scales that match human decision-making rather than the resolution of climate models. Mitigation debates, dominated by a limited menu of policy instruments, are politically fraught, but should agreement (miraculously) be obtained, the way forward is comprehensible.

Adaptation is altogether a messier task, across a bewildering array of environments, socio-economic contexts, sectors, jurisdictions, climate impacts, capacities, etc. Current adaptation literature is strong on generalities, instructions about the ends of policy change, and random examples, but thin on the means to these ends and available strategies. This paper tries to make a practical contribution, and to guide thinking about (at least near-term) adaptation. For Australia, is adapting to climate change going to be: (i) more of the same in a variable climate; (ii) more than that, but within our intellectual and institutional capacities; or (iii) a challenge beyond these capacities? What do we already know we should do? The paper prosecutes the case that we have available adaptive strategies that would collectively, across a variety of sectors and issues and justifiable on non-climate grounds, equal a believable adaptation strategy. The argument is supported by examples from a range of sectors.

# Understanding Rural Landholder Responses to Climate Change: Outline of Progress to Date

Rik Thwaites, Allan Curtis, Maureen Rogers, Nicky Mazur, Digby Race

*Institute for Land, Water and Society,  
Charles Sturt University*

## **Abstract**

This paper outlines ongoing social research which seeks to understand rural landholders' responses to recent climate variability and their perceptions of 'climate change' and their adaptation options.

Over generations, Australian rural landholders have learned to manage their properties under a highly variable climate including extended periods of 'drought'. In south eastern Australia, below average rainfall has been experienced for over a decade placing stress on rural enterprises and on ecosystems. Drawing on literature from the fields of climate change, risk perception and adoption of innovation by landholders, the authors developed a model to explain landholder responses to climate change. The model has been adopted as a theoretical framework in subsequent field research projects in regional Victoria.

Qualitative social research approaches were adopted in two case study areas in North Central Victoria to explore the issues influencing landholder decisions, particularly the role of climate, and landholder beliefs and responses to climate change. The research confirmed that landholder decision making is a complex process, but that changing climate is forcing them to make decisions. The research also confirmed that responses are very context specific, there are a great range of responses available and individual responses vary considerably, sometimes in opposite directions. The research identified two broad approaches to managing risk, but raised a number of questions about drivers of decisions.

Follow up research is currently being undertaken in two further case study areas in north east Victoria incorporating both qualitative and quantitative research approaches. The qualitative approach seeks to replicate much of the research undertaken in the previous case studies, to further explore the specifics of local context (including biophysical and enterprise characteristics). The quantitative research seeks to better understand the role of beliefs, world views and self assessed capacity to adapt, in determining the type of adaptation responses being explored by rural land holders - ranging from reactive to anticipatory to transformative.

# Equitable Local Outcomes in Adaptation to Sea-Level Rise: A Proposed Research Agenda of Gippsland, Victoria

Jon Barnett, [Anna Hurlimann](#) and Ruth Fincher

*University of Melbourne*

## **Abstract**

This presentation details a proposed research agenda which aims to develop an approach for identifying the social and equity outcomes of various strategies to adapt to sea-level rise. There is a need for such research, given methods of understanding the socio-economic contexts for decision making about adaptation are sparse. While there has been a considerable amount of research on the risks sea-level rise poses to places, most of this research identifies risks of loss and damage (e.g. land subsumed, numbers of settlements at risk) at scales of analysis which are often large (e.g. global, national). While this research has been important with regard to answering significant questions about the existence of and scale of climate change, thus informing broad policy options, it has been of limited use to people and groups who have to make decisions about how to adapt to sea-level rise. This requires information about specific environmental, social and economic characteristics of places.

In response to this need there has been a new generation of research to emerge which has investigated social vulnerability and adaptation to sea-level rise at meaningful scales for decision makers. This research has been valuable in identifying barriers and limits to the implementation of various adaptation options, identifying that adaptation is not a value neutral process, and identifying that processes for decision-making about adaptation will be crucial for outcomes that are effective, efficient and equitable. However there is a need for more research to further understand the social and equity impacts of adaptation, particularly in developed nations. This research need is identified in various Victorian Government Policies including the 2008 Victorian Coastal Strategy and the Gippsland Coastal Board's 2008 report on climate change and sea-level rise along the Gippsland Coast.

The proposed study will contribute to this new generation of adaptation research by developing an approach for identifying the social and equity outcomes of various strategies to adapt to sea level rise. It will use the case of Gippsland in Victoria to apply and refine the developed approach. The research will examine the likely social outcomes of a range of adaptation strategies in four communities in Gippsland who are vulnerable to sea level rise. The aim is to develop a method to identify the social and equity outcomes of various adaptation strategies, which is applicable in other communities and to other climate change impacts (not just sea-level rise).

# Climate Change Challenges for the Built Environment

Bill Randolph

*Built Environment Node, Climate Change Adaptation Research Network for Settlements and Infrastructure; Faculty of the Built Environment, UNSW*

## **Abstract**

The built environment, especially that of our largest cities, faces substantial change if it is to meet the increasing challenges of climate change. The industries that design, build, retrofit, manage and maintain the built environment face equally significant changes in organisation, working practices and skills development, approaches to design and construction and materials development if they are to meet these challenges.

Equally important will be the behavioral changes needed on the part of consumers of urban resources – households and businesses – which will need to adapt to new costs and constraints. However, capacity among consumers to adapt will vary considerably.

To facilitate these changes, the institutional and governance structures within which these key actors operate will need to undergo fundamental changes, not least in terms of changed regulatory and incentive structures to stimulate innovation and adaptation of new sustainability goals and outcomes, and changes to behavior and consumption patterns.

This paper reviews the key drivers of change facing the built environment in a period of increasing uncertain climatic conditions and analyses the major challenges facing the built environment industry and other key stakeholders, broadly constituted, in adapting to these drivers. A range of strategic urban policy initiatives around the globe are briefly reviewed. A summary of key challenges concludes the presentation.

# Vulnerability in Transport Infrastructure

Michael A. P. Taylor

*Institute for Sustainable Systems and Technologies,  
University of South Australia*

## **Abstract**

Resilience of infrastructure systems is of increasing concern. In particular, the social and economic impacts of system failure or degradation have become important considerations, along with planning and design measures to mitigate these impacts. Transport networks are good cases in point. The vulnerability of a transport system or network to full or partial failure of a network element (node or link) is then of interest, with the identification of critical locations in a network – those locations where failure will cause the most severe impacts – now seen as a key planning objective. Network vulnerability analysis is now recognised as an important area for research under the umbrella of transport network reliability. This presentation outlines the development of a methodology for transport network vulnerability analysis, based on considerations of the socio-economic impacts of network degradation and seeking to determine the most critical locations in a network. Critical locations in a network may be taken to be those that will show the most severe (socio-economic) impacts as a consequence of network failure at those locations. The methodology therefore considers vulnerability assessment in terms of a planning systems process in which the performance of network components is tested against established performance criteria, based on the notion of accessibility as a key driver in the planning, design and management of transport networks. The risks and consequences associated with failures at different locations need to be accounted for.

The vulnerability analysis considers changes in the levels of accessibility provided by a degraded network. A number of standard indices of accessibility are considered, including the Hansen accessibility index, the Primerano-Taylor accessibility framework for multimodal urban networks, and the ARIA index of remoteness in rural areas. While a general methodology has been formulated, a suitable accessibility index (or set of indices) representing the primary characteristics related to accessibility in the specific network under study is required. For instance, a major distinction could be drawn between rural regions and urban areas. In the former, population centres can be represented by distinct nodes. This is not valid for urban areas where the population is distributed across the area which encompasses the road network. Accessibility indices suitable for different networks are therefore required. Case study applications for regional road networks in South Australia and for metropolitan Adelaide are used to illustrate the approach.

# Impact and Adaptation Assessment of Cyclone Damage Risks Due to Climate Change

Mark G. Stewart

*Director, Centre for Infrastructure Performance and Reliability  
The University of Newcastle*

## **Abstract**

The time and spatially dependent uncertainties and variabilities associated with climate change impact and adaptation lends itself to stochastic modelling, and The University of Newcastle has internationally recognised expertise in probabilistic risk assessment of water, structural and other civil infrastructure. This presentation will show the utility of probabilistic risk assessment by assessing the impact and adaptation assessment of cyclone damage risks in North Queensland due to climate change.

Increases in wind damage are expected if the intensity and/or frequency of tropical cyclones increase due to enhanced greenhouse conditions. The presentation estimates cyclone damage risks and fragility curves due to enhanced greenhouse conditions for residential construction in North Queensland, and then assesses the economic viability of several climate adaptation (hazard mitigation) strategies. The analysis includes probabilistic modelling of cyclone intensity and frequency, time-dependent increase in wind speed from enhanced greenhouse conditions, and vulnerability functions of building damage. Increases in mean annual maximum wind speed from 0% to 25% over the next 100 years are considered to represent the uncertainty in changing wind hazard patterns as a result of climate change. The effect of regional changes to building inventory over time and space, rate of retrofitting, cost of retrofit, reduction in vulnerability and discount rate will be considered. The risk-cost-benefit analysis considering temporal changes in wind hazard and building vulnerability can be used to help optimize the timing and extent of climate adaptation strategies.

The presentation will then describe other infrastructure climate adaptation research at The University of Newcastle, such as climate change impact on risks of concrete infrastructure deterioration.

# Hurricane Katrina: the Storm and its Effects on Planning and Design for the U. S. Army Corps of Engineers

Andrew W. Garcia

*U. S. Army Engineer Research and Development Center  
Vicksburg, Mississippi, USA*

## **Abstract**

Hurricane Katrina was the most costly hurricane in United States history. In addition to the immense damage and loss of over one thousand lives, Katrina caused profound changes in the social organization and built infrastructure of New Orleans and surrounding communities. The U. S. Army Corps of Engineers is the Federal agency responsible for the design, construction and maintenance of the New Orleans hurricane protection system. Because of the intensity of Katrina, very few complete observational records were obtained in the New Orleans area. No water-level records were obtained in the immediate vicinity of the levee breaches. The forensic efforts to determine the Katrina-caused flood levels and compare them to design conditions will be presented and discussed along with findings and lessons-learned. One result of the failure of the protection system and flooding of much of the New Orleans area is the Corps undertaking a thorough review and assessment of its planning, design, and risk assignment procedures. The development and implementation of the revised procedures is termed *Actions For Change* and include project planning, design, and management which incorporate adaptation to a changing climate. The presentation focuses on the effects of Katrina, from both physical and management perspectives, and the subsequent revision of the Corps policies for incorporating sea-level change effects. An example project application is included and discussed.

# Future Coastlines: Coastal Erosion, Inundation and Climate Change

Rodger Tomlinson<sup>1</sup> and Peter Helman<sup>2</sup>

<sup>1</sup>*Coastal Settlements Node, Climate Change Adaptation Research Network for Settlements and Infrastructure; Griffith Centre for Coastal Management;* <sup>2</sup>*Griffith Centre for Coastal Management*

## **Abstract**

Open coastlines and coastal waterways respond to wave, wind and sea level changes which occur over a wide range of temporal and spatial time scales. These responses are usually evident in long-term shoreline movement, or in terms of short-term inundation and destructive impact. An assessment of the likely future for our coastal communities in terms of coastline stability will require an understanding of what constitutes a major storm or a healthy beach, and what level of variability we can expect in coastal processes. Without this understanding it is difficult to put the postulated long-term changes due to global climate change into perspective. Climate change is likely to present three major outcomes which will impact on coastal erosion, namely: sea level rise, wave climate shifts and intensification of major storm events. It is clear however, that our coastline is influenced by large scale natural variability in these processes which is little understood and is not accounted for in current coastline planning and management.

Research into climate variability and projected climate change impacts will be presented in the context of the Northern NSW and southern Queensland coastline. Planning and management options for climate change adaptation will be discussed.

# Water Supply for Australian Cities: Energy and Climate Change

Bill Peirson

*UNSW Water Research Centre,  
UNSW*

## **Abstract**

Australia is a continent with unique hydrology. A major concern associated with climate change is the potential changes in mean rainfall patterns that may have significant impacts on urban water supply.

There is a strong link between water supply and energy use. Traditional options for urban water supply in Australia have been the low energy options – local capture and storage of rainwater, use of solar heating.

To address emerging urban water problems, future options that are presently being implemented include recycling, desalination, and remote storage. Such processes require greater movement of water, its heating or membrane filtration. These processes come at the price of higher energy demand.

How can industry and governments effectively deal with these challenges, when water is a management issue relying on energy supply?

Australian society is confronted by some immediate key decisions that will be made over the next decade in relation to water and energy. In this presentation, these key decisions are highlighted in the context of anticipated climate change impacts.

# Protecting Biodiversity: Adapting to Global Climate Change

Stephen Williams

*Centre for Tropical Biodiversity & Climate Change, School of Marine & Tropical Biology,  
James Cook University*

## **Abstracts**

We now face the inevitability of global climate change with serious long-term consequences for the sustainability of Australia's natural ecosystems. We need to determine which species, habitats and ecosystems will be most vulnerable, exactly what factors determines their vulnerability and how we can target management that mitigates impacts on the most sensitive species and ecosystems and avoids wasting resources where there is sufficient natural adaptive capacity. Optimising the efficient allocation of resources for adaptation will be a balance of relative vulnerability, consequences of inaction, social/political/scientific will and available resources. Development of such a strategy will require:

1) Comprehensive and reliable approaches for assessing vulnerability with estimates of uncertainty,

2) quantitative predictions of impacts that include all facets of vulnerability including

a) factors affecting exposure to regional climate change

b) factors affecting sensitivity that are broadly applicable across ecosystems

and;

c) analysis of adaptive capacity (evolutionary, ecological and management) and;

3) novel approaches to systematic conservation planning that account for a shifting climate.

I will discuss the research frameworks we have developed to address these goals and the recent initiatives instigated within Australia to maximise the efficiency of adaptation research.

I will illustrate the approach using examples and data from the rainforests of the Australian Wet Tropics.

# Evolutionary Adaptation and Climate Change: Maximizing Evolutionary Opportunities for Preserving Biodiversity

Ary Hoffman

*University of Melbourne*

## **Abstract**

Natural populations are responding to global climate change both through altered timing of life history traits, geographical shifts in species ranges and potentially altered ecosystem interactions. While predicted extinction rates are high, these rates can be substantially reduced if populations change genetically and evolve. Ecologists now generally recognize rapid rates of evolution are possible within species. There is already evidence for rapid evolution in response to climate change in several short lived species in different parts of the world including Australia, suggesting that many organisms have the capacity to respond to climate change within a timeframe of tens of years. These responses depend on the presence of genetic variation in populations. In the absence of variation, there is now strong evidence for an increased risk of extinction in wild populations in nature. Managers currently tend to ignore evolutionary factors when devising ways to protect biodiversity under climate change. It is instead suggested that management plans for species and habitats should aim to develop resilient landscapes where the evolutionary potential of species/populations can be conserved. This will require different approaches, depending on the species involved, their distributions and the extent to which they are isolated within the landscape as a consequence of habitat loss. If genetic diversity for adaptive evolution can be conserved, or restoration practices put in place which help promote adaptive processes, there are implications that go well beyond the long term persistence of species. For instance high genetic diversity within different plant populations maintains an increased diversity of invertebrates, and thereby promotes the health of communities more generally. The concept of evolutionary resilient landscapes provides a way of emphasizing evolutionary considerations in conservation. These landscapes need to allow *in situ* selection and capture high levels of genetic variation for responding to effects of climate change. A couple of examples of how such approaches might alter management decisions around threatened species are presented.

# Biodiversity and Climate Change: Knowledge for Adaptation

Lynda E. Chambers

*Centre for Australian Weather and Climate Research, Bureau of Meteorology, Melbourne*

## **Abstract**

By monitoring changes in biological systems, and developing models to relate these changes to changes in the climate system, there is considerable opportunity to improve management of natural resources and to aid adaptation (both natural and assisted).

Assessing or modelling the impact of climate change on species requires high quality information. This can come from a variety of sources, including government departments, non-government organizations, universities, published literature or private journals. Australian experiences highlight that long-term biological data is often difficult to locate or access and can have irregular coverage, both temporally and spatially. Despite these limitations valuable insights have been gained, indicating climate is already altering the timing of natural events, species distributions, productivity and survival, and influencing population size. In contrast to many northern hemisphere studies, changes in rainfall (with or without temperature changes) may be driving many of these changes, particularly in waterbirds and species associated with littoral zones.

However, knowledge gaps persist. Most Australian studies cover limited spatial areas, with few covering the northern tropical regions or arid interior. Few studies include information on climate-species relationships prior to the 1950s, when global temperatures began to rise rapidly. Little is known of interactions between species or with other threatening processes, particularly under a changing climate, all of which are important for assessing species' natural abilities to adapt to environmental change.

To further understand the links between natural systems and climate in Australia and improve data availability, to better coordinate research efforts, and inform adaptation options, a three step approach is suggested.

**Search:** Although often difficult to locate, there are considerable organisational and non-mainstream data sources (e.g. the general public) that are yet to be accessed. This step involves searching and documenting potentially suitable long-term biological data sets, e.g. through existing databases such as the National Ecological Meta Database (<http://www.bom.gov.au/nemd>). This database aims to improve natural resource management decisions, aid policy development, and increase public awareness of climate change and its impacts in Australia. It also improves knowledge sharing between regions and institutions and can be used to identify baseline data for future monitoring programs.

**Compile:** The creation of new datasets through systematic searches of the literature and other sources (e.g. photographic records, art work or egg collections). PhenoArc, a joint project between the Bureau of Meteorology and the University of Melbourne, is a good example of this.

**Generation:** The creation of new datasets, through monitoring programs such as Climate Watch.

Climate Watch (<http://www.climatewatch.org.au>) engages the public in science at national scales. The project uses a dispersed observer network to monitor trends and patterns vital to the understanding of a national perspective on natural resource management and climate change. The project allows the public and natural resource managers to generate displays of trends and patterns in natural resources nationwide and investigate the timing and variation of key biotic events and their responses to climatic conditions. The primary output is a coordinated national indicator program to monitor the impacts of climate change in Australia; a step towards Australia's first national phenological monitoring network.

# Climate Change, Fire Regimes and Biodiversity in Australia: A Preliminary Analysis

R.J. Williams

*CSIRO Sustainable Ecosystems; CSIRO Climate Adaptation Flagship*

## **Abstract**

Climate change will affect fire regimes in Australia through the effects of changes to temperature, rainfall, humidity, wind – the fire weather components - and through the effects of increases in atmospheric CO<sub>2</sub>, and changes in moisture, on vegetation, and therefore fuels.

Examination of weather data from south-eastern Australia over the period 1973-2007 shows that fire danger (as measured by the annual sum of the commonly-used Forest Fire Danger Index,  $\Sigma$ FFDI) rose by 10-40% at many sites from 2001-2007 relative to 1980-2000. Increases in  $\Sigma$ FFDI have also been detected in some other parts of Australia.

Climate change projections are for warming and drying over much of Australia, and hence an increased risk of severe fire weather, especially in south-eastern Australia. Modelling suggests an increase of 5 to 65 per cent in the incidence of extreme fire danger days by 2020 in this region. Climate change will have complex effects on fuels. On one hand, elevated CO<sub>2</sub> may enhance vegetation production and thereby increase fuel loads. On the other hand, drought may decrease long-term vegetation production (thereby decreasing fuel loads) and may decrease fuel moisture (thereby increasing potential rates of spread). The outcomes of these processes on fuels, and hence fire regimes, are highly uncertain, and require further research.

Fire regimes within Australia differ because of variation in key drivers such as fuel accumulation and drying, fire weather and ignitions. Climate change may be expected to affect fire regimes more in regions where the constraining factor(s) are fire weather-related (e.g. temperate forests of the south-east), than in places where the fire regimes are determined more by fuel or ignition rather than fire weather (e.g. tropical savannas of the north). Future fire regimes will also be affected by other agents of change, such as invasions of exotic species that may affect fuel loads. Simulation modelling of climate change impacts on fire regimes in the Australian Capital Territory (ACT) predicted that a 2°C increase in mean annual temperature would increase the landscape measure of fire intensity by 25%, increase the area burnt, and reduce intervals between fires.

Climate change and changed fire regimes will have complex feedback (positive and negative) interactions with biodiversity, with different potential outcomes for different Australian biomes. There may be increased risks to both interval and intensity-sensitive species, as a consequence of changed climate and changed fire regimes. Climate change will probably have the most significant impacts on both the fire regimes and biodiversity of sclerophyll dominated vegetation such as the forests of south-eastern Australia and south-west Western Australia. Managing fire regimes to reduce risk to property, people and biodiversity under climate change will be increasingly challenging. In Australia, management of fire regimes for biodiversity conservation has variously emphasized fire detection and suppression, and fuel management. There needs to be an enhanced research effort on the complex interactions between fire, biodiversity, people, fuel management and landuse change, to help meet these challenges.

# The e-Atlas: an Integrated Knowledge Management Platform for Sharing, Mapping and Delivering Information on Australia's Tropical Lands and Seas

Eric Lawrey<sup>1</sup>, Glenn De'ath<sup>1</sup>, Pauline Perren<sup>1</sup>, Katharina Fabricius<sup>1</sup> and David Souter<sup>2</sup>

<sup>1</sup>*Australian Institute of Marine Science*; <sup>2</sup>*Reef and Rainforest Research Centre*

## Abstract

The long-term well-being of many of Australia's valuable marine and terrestrial ecosystems, particularly the Great Barrier Reef and Wet Tropics rainforests is at risk from various threats, not least climate change. Identifying and ameliorating or mitigating the impacts of climate change and other threats on these systems is a significant scientific, policy and management challenge. One of the keys to successfully meeting this challenge will be the effective collation, synthesis, analysis and dissemination of credible bio-physical and socio-economic information to policy makers, natural resource managers, scientists and the general public. At present, such information is generally ineffectively used and rarely shared, leading to hasty or ill-informed decisions.

In order to provide a framework to facilitate effective use and sharing of information, the e-Atlas has been developed for the Great Barrier Reef, its catchments, the Wet Tropics Rainforests and Torres Strait as part of the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF). The e-Atlas is a new web-based integrated knowledge management system designed to enhance evidence-based decision making for effective management and long-term sustainable use of North Queensland's natural assets. The e-Atlas is a portal ([www.e-atlas.org.au](http://www.e-atlas.org.au)) that provides access to the data, meta-data and information handling, spatial mapping and analytical tools to collate, integrate, share and analyse the vast array of bio-physical and socio-economic required to manage these environmentally, economically and culturally valuable systems effectively.

The e-Atlas is founded on the philosophy of sharing, with the e-Atlas team developing the tools to upload data, metadata, reports, create web pages and add images without having technical or programming knowledge, and experts (data owners and knowledge providers) contributing the content. The e-Atlas is built on a robust, flexible, modular open-source platform that incorporates a sophisticated interactive mapping system that allows side-by-side mapping and panning of several data sets simultaneously. The e-Atlas already provides access to maps of more than 600 marine and terrestrial variables (layers) derived from numerous long-term data sets describing the condition of North Queensland's natural environment. In addition, the e-Atlas will be the primary meta-data repository of the MTSRF program and is already incorporating the outcomes of climate change research conducted under that program.

# How Can We Help Biodiversity Adapt to the Impending Ravages of Climate Change? Landscape and Genetic Approaches

Andrew Lowe

*Australian Centre for Evolutionary Biology and Biodiversity, University of Adelaide; State Herbarium and Bioknowledge SA Department of Environment and Heritage*

## **Abstract**

Climate change is predicted to, and is, impacting on the distribution range, phenology and ecological interactions of species and ecosystems. Large-scale biodiversity corridors have been proposed to help biodiversity and ecosystems adapt to climate change pressures in the future, but are we really putting in place the correct landscape planning systems to allow natural adaptation processes to take place? In this talk I will outline a number of rapid evolutionary adaptational processes that may be promoted by climate change or may be harnessed in landscape planning activities; including inbred population shifts, admixture, hybridisation and environmental-stress-induced genomic changes. How these processes are combined with landscape refugia (past, present and future), landscape connectivity and matrix permeability issues, and restoration practises will be of critical importance to the outcome of effect climate change adaptation planning for biodiversity and native ecosystems.

# Climate Change Adaptation and Australia's Water Resources and Freshwater Biodiversity

Stuart E. Bunn<sup>1</sup> and Brendan Edgar<sup>2</sup>

<sup>1</sup> *Australian Rivers Institute, Griffith University;* <sup>2</sup> *Edgar and Partners Pty Ltd, ACT*

## **Abstract**

Our planet is facing a water crisis, not only in relation to public health and the environment but increasingly in other key sectors such as agriculture, energy and mining. While much of this emerging crisis is driven by population growth and rapid economic development, some is driven, or at least exacerbated by, climate pressures. Current water management practices are unlikely to be adequate to fully mitigate the negative impacts of climate change on water supply reliability, flood risk, human health, energy production, and aquatic ecosystems. There is an urgent need to understand the risks to Australia's surface and groundwater resources and freshwater biodiversity due to climate change (in the context of other pressures) as well as the technical and policy interventions that will be required to meet future human water needs without further degrading freshwater ecosystems and the important natural assets and values they provide. The Water Resources and Freshwater Biodiversity adaptation network brings together Australia's top water scientists with interests and skills in water resources and freshwater biodiversity, and the implications of climate change. The network is supported by over 20 partner research institutions from across the country. The primary goals of the network are: to facilitate the development of collaborative and cross-disciplinary research at the national scale; build research capacity through support and mentoring of early career scientists; synthesise relevant knowledge to give Australian water and biodiversity managers the best chance of coping with a difficult climate future. Activities of the network will be largely coordinated around five key 'adaptation' themes: Climate scenarios; Governance; Water Resources; Freshwater Biodiversity and Capacity Building.

# Climate Scenarios: Use, Misuse, and Limitations

Bryson C. Bates

*CSIRO Climate Adaptation Flagship; CSIRO Marine and Atmospheric Research*

## **Abstract**

Climate is a determining factor in Australian water resources planning and management. Precipitation is distributed unevenly both geographically and seasonally across Australia and the annual variability of streamflow is well in excess of the global average. Water supplies in southern and eastern Australia have been identified as one of our most vulnerable sectors to anthropogenic climate change. This vulnerability is due to projected decreases in precipitation and increases in temperature, evaporation and human and environmental water demand. Thus concerns about the persistence of the current drought across southern Australia and future climate change, and their impacts on our society, economy and environment, have led to their emergence as a key problem for policy and decision-making in the water resources sector.

Discussions and debate about future climatic conditions often include terms such as predictions, forecasts, scenarios and projections. In many cases these terms are used interchangeably and are rarely carefully defined in practice. In my opinion, this has subsequently led to confusion amongst scientists and policy makers about what climate change impact assessments actually represent and how they should be carried out. The current emphasis on poorly-constructed probabilistic scenarios and subsequent estimates of high levels of uncertainty has meant that these assessments have had, to date, little or no impact on practice in Australian water resources planning and management.

This presentation will examine the climate change impact assessment process from the perspective of water resources management. While it will highlight the inherent desirability of probabilistic scenarios, it will identify and discuss the many limitations of current approaches to their construction and the large number of knowledge gaps that exist. It will be argued quite strongly, that given the state-of-the-art of climate change impact assessments, they should be used as a means of increasing preparedness rather than viewed as a means of prediction. This entails the development of climate adaptation strategies that are robust to a small number of carefully constructed, alternate and plausible futures ('storylines'). This is contrary to the prevailing practice of attempting to identify strategies within the context of a very wide envelop of projections from a large combination of emissions scenarios and model runs that may, or may not, encompass the future trajectory of water availability.

# Climate Change and Freshwater Biodiversity

Jenny Davis

*Australian Centre for Biodiversity and School of Biological Sciences,  
Monash University*

## **Abstract**

Australian inland waters are particularly vulnerable to the impacts of climatic change because many are already degraded by pre-existing stressors. These include hydrologic changes, eutrophication, salinisation, acidification, sedimentation, habitat loss and the invasion of exotic species. The predicted increase in the frequency and intensity of storms and floods, prolonged periods of drought and increased incidence of wildfires, will create additional stressors on aquatic ecosystems already suffering multiple and chronic impacts. Recognising and reducing the impacts of pre-existing stressors will be an important component of adaptation strategies for inland waters. Supporting and extending restoration activities, including riparian revegetation programs and provision of environmental flows, will be particularly important in southern Australia. Strategic planning and development of policies to protect in-stream flow regimes will be important in northern Australia, where agricultural expansion is a likely response to increased precipitation.

The 'boom and bust' ecosystems that have evolved to cope with the arid and highly variable climatic conditions that characterise much of the Australian continent are potentially resilient to climatic change. However, much of this resilience has already been lost where rivers are heavily regulated. A major challenge exists to ensure that the pathways for ecosystem recovery following large, episodic rainfall events are maintained in both regulated and unregulated systems. One of the most important strategies to maximise resilience is the identification and protection of refugia.

Niche modelling of the distribution of iconic species, such as the platypus, based on physiological tolerances, ecological requirements, and hydrological parameters such as discharge, depth and temperature, is needed to identify the habitats to which populations will contract and thus the sites where management activities would achieve the greatest protection.

The establishment of a climate change observation network for inland waters is needed to reduce the uncertainties associated with predicting and detecting climate change impacts on systems already experiencing multiple anthropogenic impacts. Long term datasets collected for other purposes (e.g. assessment of water quality and ecological condition) also need to be interrogated to determine trends arising from climatic impacts. In addition, sentinel sites need to be established where the only impact will be climate change. Potential sites include the Franklin River and Central Plateau Lakes in the Tasmanian World Heritage Wilderness Area, relict streams within the George Gill and West MacDonnell Ranges in central Australia, selected rivers and wetlands within protected areas in northern Australia (the Kimberley, Kakadu, Arnhem Land and Cape York regions), headwater streams in protected areas along the Great Divide, dune lakes and estuarine-freshwater systems within protected coastal areas. Although a program to track climate-driven hydrological and ecological change in inland waters will require new funding, the ultimate economic costs associated with not truly distinguishing climatic impacts from other stressors, will be far greater.

# Responsiveness and Resilience of Freshwater Systems to Climate Change: A View from the Past

John Tibby

*Geographical and Environmental Studies,  
University of Adelaide*

## **Abstract**

The record of past environments has framed much climate change debate over the past few decades, focussing particularly on the degree to which human-induced climate warming is outside natural variability.

This presentation draws on this theme, but specifically focuses on how the record of past aquatic ecosystem changes preserved in sediment can be used to assess the likely extent of future changes. Importantly, it focuses not only on those changes that relate directly to climate forcing, but also those that come about through management responses to climate change (such as increases in, or changes to, water abstraction).

Using case studies from a variety of locations including North Stradbroke Island lakes and The Lower Lakes of the River Murray this presentation will demonstrate how understanding of the natural history of these systems can provide a more solid basis for future management decisions.

# Adaptation to Climate Change in Water Resource Management

Ian Prosser

*CSIRO Water for a Healthy Country Flagship*

## **Abstract**

Australia's water resources are under pressure from a range of drivers, one of which is climate change. In rural areas the other pressures on water availability include land use change, bushfires, unregulated extraction of water and drought. These pressures are causing socially unacceptable degradation of river environments and are eroding the security of water supply. Demands on water exceed supply and climate change just accentuates this difference. Major water reforms and government investments are being made to address the shortfall. If done well, these reforms will make rural water management more resilient to climate change. Examples will be given from the Murray-Darling Basin of how research can contribute to sustainable water management under current and future climate.

A similar argument will be made for urban water. Demand for water is growing with population growth and increasing urbanisation and current supplies no longer meet the demands in most Australian cities. The gap between supply and demand will increase further with climate change in the largest cities. Major investments are being made to meet the shortfall in demand and these are focussing on diversified supplies which are less directly dependent upon rainfall, thereby increasing resilience to climate change. However the new supplies are posing significant questions over cost effectiveness, energy use, public health, and integrated urban water system management. Research which helps answer these questions is also helping the cities adapt to climate change.

The presentation will finish by highlighting a few counter examples of where climate change brings in additional considerations not being addressed in response to broader pressures on water resources.

# Activities of the Victorian Node of the Adaptation Research Network for Water Resources and Freshwater Biodiversity

John Langford

*University of Melbourne*

## **Abstract**

The Victorian Node of the *Adaptation Research Network for Water Resources and Freshwater Biodiversity* consists of the Murray Darling Freshwater Research Centre (MDFRC – a joint initiative of MDBA, CSIRO & Latrobe University) together with the University of Melbourne and Monash University (brought together by Uniwater). Monash Sustainability Institute is providing leadership of the Node. The geographic spread of the Node members covers the southern Murray-Darling Basin and the Victorian coastal basin south of the Divide.

The Victorian Node has initiated preparation of a draft research strategy for the Node focusing on three of the research themes identified in the National Adaptation Research Plan for Water Resources and Freshwater Biodiversity:

- 1) Governance;
- 2) Water resources; and
- 3) Freshwater biodiversity.

The Victorian Node has been consulting with water researchers at Monash University, the University of Melbourne and the Murray-Darling Freshwater Research Centre (MDFRC) in order to identify common research opportunities and key knowledge gaps that limit the ability to adapt to climate change. This consultation will extend to interested water researchers at other universities and research organisations in Victoria that were not originally listed on the network bid. Key Victorian water managers will then be invited to share their views on knowledge gaps and research needs to get an idea of where the Adaptation Research Network can develop research proposals to inform water policy and management

Some of the emerging research topics are:

- Systemic and adaptive water governance, systems thinking and social learning research. Monash and Melbourne Universities, along with the Murray Darling Basin Authority (MDBA), have already begun exploring the potential of this topic;
- Water markets as tools for adaptation (the University of Melbourne through Uniwater has completed a scoping study for the MDBA “Understanding trends, drivers and dynamics of water markets within the Murray Darling Basin”); and
- Development of more ecologically tuned management of river flows made possible by more comprehensive measurement, improved understanding of relationships between flow and ecological benefits, and application of closed loop control to river operations (the Farms, Rivers, and Markets Project funded by the National water Commission – involving collaboration between Melbourne and Monash Universities and the MDFRC – all 3 members of the Victorian Node).

## **Presentation title to be confirmed**

Richard Thornton

*Bushfire CRC*

# Enhancing Community Capacity in an Era of Increasing Uncertainty

Yetta Gurtner

*Centre for Disaster Studies, James Cook University*

## **Abstract**

While debate over climate change causes and implications continues to dominate contemporary research agendas, the only clear and consistent public message seems to be one of “uncertainty”. Compounded by critical factors of population growth, globalisation and environmental change it is apparent, however, that most local communities have become increasingly vulnerable and susceptible to hazard impacts. As such uncertainty, threats, and risks, continue to develop, the challenge for the disaster management sector is to transform fundamental practices and approaches to maintain relevance in a changing world.

A multidisciplinary research unit within James Cook University, the Centre for Disaster Studies advocates that “We learn today to serve tomorrow...” Reflecting a diversity of research backgrounds, interests, and projects, the primary objective of the Centre is to foster safer sustainable communities. With strong collaborative links with other research institutions, emergency services, government and community, current research focuses on enhancing community capacity through flexible, local, community-based and stakeholder driven strategies. In a complex and dynamic global environment this, by necessity, remains an ongoing and iterative process.

As uncertainty regarding future climate change impacts prevails, communities need to proactively prepare and adapt. For disaster management to remain effective and progress beyond traditional mitigation and adaptation, communities must be understood, integrated and engaged. Rather than an extension of existing knowledge and practice, the ambiguities of climate change represent an opportunity to develop a new direction for emergency management and social research.

# Adaptive Capacity in the Public Policy Sector of Fire Management

Bosomworth, K and Handmer, J.

*RMIT*

## **Abstract**

Fire management occurs at a nexus of disaster risk reduction (DRR) and ecological management which, according to the IPCC and others, are key climate change adaptation (CCA) strategies. Questions of social and ecological vulnerabilities and resilience are fundamental to these strategies. Consequently, a myriad of public policy issues are relevant to fire management, many of which are 'wicked problems' (Rittel and Webber 1973). Typically characterised by technical, social and biophysical complexities, wicked problems have fragmented governance landscapes involving many players who tend to have different interests in and views on the issues and their 'solutions'. Climate change will exacerbate many of the existing policy challenges, meaning that adaptation for fire management is akin to managing interacting wicked problems. Adaptive governance is increasingly seen as addressing such challenges (Dietz, Ostrom et al. 2003; Folke, Hahn et al. 2005; Lebel, Anderies et al. 2006). The need for integrated and adaptive approaches is not a new idea in public policy, and many fire management sectors have strategic statements to that effect. This research seeks to learn from their experience. If we are interested in understanding governance, then we need to understand the institutional settings (Ostrom 2005) – the formal and informal "rules" that guide and constrain behaviour (North 1990). These "rules" influence the learning and stakeholder interactions that are central to adaptive governance. The learning described in the adaptive governance and CCA literatures is collective and systemic, drawing on concepts of double-loop learning (Argyris 2004 and; Stacey 2007). This learning is not just about reflection upon (and possible changes to) formal rules or the attainment of new knowledge and skills. It also involves learning through practice, through reflecting on governing values, assumptions, and even sectoral purpose. Arguably, without a capacity for such learning, a fire management sector has little capacity for adaptive governance, and potentially therefore reduced capacity for adaptation to climate change. Both learning and institutions are social phenomena. Much research regarding the adaptive capacity of public policy focuses on institutions that facilitate learning in 'government' and community interactions. What appears to be less explored is the role of bureaucratic institutions in this adaptive capacity. Bureaucrats (policy administrators) co-ordinate a diversity of stakeholder inputs including those of 'political masters', facilitate negotiation between different values, and enable management. Policy and governance outcomes are shaped by existing organisational structures, institutional settings, *and* informal networks of communication between bureaucrats that are in turn the products of values and expectations (Jordan and O'Riordan 2005). This research is exploring how bureaucratic networks and institutions in the fire management sector of Victoria may influence a capacity for learning. To explore this, we are using institutional and network analysis techniques – primarily interviews and a survey. We hope to elucidate the institutions and networks; to appreciate how those settings may influence learning; and ultimately to inform future efforts aimed at climate change adaptation in public policy.

# A National Assessment of the Risk and Impact of Climate-Related Hazards on the Coast

Paul Taylor and John Schneider

*Geoscience Australia*

## **Abstract**

This presentation will provide an overview of some of the work currently being undertaken at Geoscience Australia (GA) as part of the National Coastal Vulnerability Assessment (NCVA), funded by the Department of Climate Change (DCC). The presentation will summarise the methodology applied, and highlight the issues, including the limitations and data gaps. The NCVA aims to assess the risk to coastal communities from climate related hazards including sea-level rise, storm surge and severe wind from tropical cyclones. Both an understanding of the current, or baseline risk and how climate change might vary that risk is required. This understanding is derived from a number of factors, including: the frequency and intensity of the hazard(s); community exposure and the relationship with stressors; vulnerability related to socio-economic factors; impacts that result from the interaction of those components; and capacity of communities, particularly vulnerable communities and groups, to plan, prepare, respond and recover from these impacts. These factors and resulting impacts from hazard events are often complex and often poorly known, but such complexity and uncertainty is not an excuse for inaction. Given these limitations, the NCVA has been undertaken using the best information available to understand the risk to coastal areas on a national scale, and to prioritise areas that will require more detailed assessment. The NCVA incorporates a number of assessments undertaken by a range of agencies and consultancies, and is due for completion and launch by the DCC later this year. The work undertaken to date by GA, in conjunction with the University of Tasmania, has included the development of SMARTLINE, a nationally-consistent database of coastal morphology for the entire country. This fundamental dataset provides critical information on the geology and landforms and their potential susceptibility to instability or degradation due to environmental or climatic factors. In a first-order attempt to assess the climate-change induced hazard to the coastal landscape, SMARTLINE data have been combined with sea-level rise projections for 2030 and 2100, and 1 in 100 year storm surge estimates to determine potential areas of inundation and zones of instability where coastal recession due to SLR is predicted. Additionally, cyclonic wind hazard along Australia's northern coastline has been estimated using GA's Tropical Cyclone Risk Model, using synthetic tropical cyclone event sets derived from global climate models. The wind hazard levels have been modified for terrain, topographic and shielding effects to reflect localised variations in wind hazard. The resulting hazard maps for inundation, instability and severe wind have been integrated with GA's National Exposure Information System (NEXIS) to provide an analysis of impact, in terms of property and infrastructure affected and the cost of replacement, which can then be visually presented to help identify areas of concern. The NCVA has identified a number of limitations due to the approaches applied and quality of the data available. Since the commencement of the assessment, improved data, such as detailed topographic information from extensive Light Detection And Ranging (LiDAR) surveys, has become available, which will allow improved modelling techniques to be applied. GA is in the process of commencing a more detailed assessment for the DCC, which will consider the impact and risk of inundation from storm surge and coastal recession in three case study areas. This assessment will build on and enhance the work undertaken as part of the NCVA. In collaboration with state and local governments and private industry, this assessment can provide information for application to policy decisions for, inter alia, land use, building codes, emergency management and insurance applications.

# Emergency Management and Climate Change in WA

Russell Stevens

*Fire and Emergency Services Authority, WA*

## **Abstract**

There is now broad consensus that climate change is impacting on areas of WA. With the severe declines in rainfall in south-west WA since 1970s there is now tangible proof that climate has changed the landscape. With the vastness of WA occupying a third of Australia's land mass, with the same geographic spread as Cairns to Geelong on the eastern seaboard, there is considerable exposure to natural hazards and many communities, urban, rural and remote, will be vulnerable to the changing climate.

WA research to date has relied heavily on the Indian Ocean Climate Initiative a partnership of the WA Government, CSIRO, and the Bureau of Meteorology, formed by the Western Australian Government to support informed decision-making, on climate variability and change in WA. This collaborative research has provided finer scale information on likely impacts WA and driven the knowledge required to shape climate change adaptation in WA. This research initiative commenced in the late 1990s and has just commenced its third phase and will be providing valuable climate science to shape WA emergency management practices and planning. The current work on tropical cyclones in the north-west is of particular interest to FESA.

In analysing potential climate change impact on future emergency services, it is difficult to not include some consideration to the extensive adaptation that will take place in other sectors and the social and demographic changes our communities will undergo. The first step in any emergency management planning process is to understand what communities will look like in the future and the cross sectoral flow of information NCCARF will embrace will provide that insight. Importantly, with volunteers comprising the vast bulk of emergency service response capacity across much of the nation, will the future landscape still provide sufficient emergency service volunteers to meet the anticipated increases in risks.

Indeed social research will be vitally important in shaping emergency management agencies response to climate change adaptation.

WA considers the following research should be included to enhance the knowledge required to adapt emergency service management to the challenges posed by climate change climate

- Regionally specific prognosis of hazard changes as a result of climate change is needed. The potential north-south shift of impact zones for severe storm and cyclone are of particular significance. Better mapping of the storm surge and tsunami hazards and how these hazards are modified by sea level rises are also important. New tools may be required for riverine flood mapping which currently relies heavily on historic data.
- Under what climatic changes will the current vegetation structure and composition commence significant collapse, particularly in the forest and woodland areas.
- In the south-west of WA we have experienced substantial rainfall reductions since the 1970s with no catastrophic bush fire events. Is it possible climate change may not lead to a significant increase in the bush fire threat? This potential increase in the bush fire threat needs to be quantified.
- Integrate indicators of community and individual coping capacity with the ability of local and states EMS to respond to extreme events as a multi-scale analysis.

# Climate Change and Emergency Management

Gary Mahon

*Strategic Policy Division,  
Department of Community Safety, QLD*

## **Abstract**

Climate change poses real challenges to the emergency management sector as it brings a shift in the intensity and behaviour of natural hazards, including flooding, storm surge, cyclones, severe storms, bushfire, and heatwave. Our communities must progressively adapt to the impacts of climate change and the process of adaptation must begin now. Adaptation has three components: understanding the extent and pace at which natural hazard risks will change; where feasible and cost-effective, treating or mitigating the risk, for example through land use planning constraints and building codes; and managing residual risk, not only with more effective emergency response but also through increased resilience and self-reliance by individuals, businesses and communities. Disaster resilience is a concept attracting significant effort at the national and State level. Research provides the intellectual vitamins to understand elements to adaptation. And NCCARF, through its research networks, is an important mechanism for harnessing research expertise in partnership between government and the research community: a partnership in which solutions will evolve as our understanding develops.

# Is Australia's Public Health Infrastructure Prepared for Climate Disasters, or is the System Itself Vulnerable?

Liz Hanna

*Australian National University; Adaptation Research Network for Human Health*

## **Abstract**

Climate change emerging by stealth or via catastrophic events will undoubtedly affect human health, either directly, or indirectly. What we are anticipating in a new climate is essentially not new health risks, but rather more of the same, merely more intense, more frequent, and in areas not previously exposed to such problems. However, human health vulnerabilities will largely depend upon the efficacy of our public health infrastructure. 'Public health' combines the practice of health protection and health promotion, research to identify who is vulnerable to specific health risks - and why, monitoring and surveillance, and policy development to establish infrastructure that effectively protects the needy and prevents poor health outcomes. Australia's public health machinery is exquisitely designed to protect population health, and in many aspects we are world leaders, and all this on a meagre 1.4% of the national health budget.

Whilst our strengths are numerous, there is no room for complacency. The heatwaves, fires and floods of summer 2009 provided a snapshot of what may lie in store. These contemporaneous weather related events occurred on such a massive scale that our public health systems and sections of the health care sector, were stretched to capacity. Further stress would overwhelm our capacity to respond.

Whilst pondering Australia's capacity to respond to future scenarios, we need also to consider indirect impacts of climate change. These are hard to characterise and predict, but we expect them to be many and varied. They will include shifts in the geographic spread and behaviour of vector - borne disease outbreaks, deteriorating air quality, deepening water stress, more food-borne diseases, more mental health problems, decline of rural communities, possibly food shortages, more poverty, more social isolation with added potential for conflicts over resource scarcity and violence. Declining social cohesion coupled with stretching of infrastructure capacity and recovery times, migration and demographic shifts of an unknown scale present serious challenges not only to public health, but to our entire social fabric. It is against this backdrop of diminishing resilience that Australia needs to boost our surge capacity and preparedness, to face disasters.

Disasters are increasing globally. We have been warned. Summer of 2009 demonstrated that we are not adequately prepared for a worsening climate. There is much work to be done.

# Social-Ecological Resilience: An Approach to Adaptation in the Marine Social-Ecological System

Julie Davidson

*Climate Change Adaptation Research Network for Marine Biodiversity and Resources; University of Tasmania*

## **Abstract**

The concept of the social-ecological system, which is foundational to resilience thinking as proposed by the Resilience Alliance, is generating increased interest among natural resource managers and researchers, largely because it is perceived as a better representation of the interactions between social and ecological systems and as a more appropriate conceptual basis for modelling change under conditions of uncertainty and complexity. Acknowledgement of the realities of climate change has further enhanced its appeal.

Social-ecological resilience has its origins in complex adaptive systems, in which change, vulnerability and adaptation are accepted as fundamental system characteristics. Such acceptance of the inevitability of change shifts the policy emphasis from controlling change in assumed-to-be-stable systems to managing the capacity of social–ecological systems to cope with, adapt to, and shape change.

Understanding of the resilience discourse's implications for ecosystem and resource management is slowly emerging and the number of case studies applying its tenets to particular regions and ecosystems is growing. In Australia the most well-known application in the marine environment is the resilience study of the Great Barrier Reef.

This presentation includes an introduction to social-ecological resilience thinking – its origins, core ideas, and limitations - and an outline of its use as a framework to structure and integrate the Marine Biodiversity and Resources Adaptation Network's activities. Discussion for the latter will show how a systems dynamics framework is being deployed to (i) determine the current state of the marine social-ecological system; (ii) identify the potential for abrupt, non-linear change and surprise in this linked system; and (iii) identify potential policy, economic and social adaptation interventions to enhance the resilience of the marine system.

# A Critical Theory of Vulnerability

Jon Barnett

*University of Melbourne*

## **Abstract**

This presentation offers a thumbnail sketch of a critical theory of vulnerability. Much of the writing about vulnerability to climate change involves the representation of others. It highlights the dangers in such representations, which may ignore the strengths and adaptive capacity of the groups being discussed, reinforce stereotypes about them, and justify inappropriate adaptation responses.

# Climate Change Adaptation in Primary Industries

Snow Barlow

*University of Melbourne*

## **Abstract**

The primary industries are an interesting and perhaps unique sector with regard to adaptation to climate change. The sector 'manages' approximately 60% of the Australian land mass under the full range of land tenures and operating in owner/operator to full corporate modes. Component industries in the primary industries sector are predominantly exported orientated, exporting 60-70% of total production. Research underpinning productivity and sustainability in the sector is supplied in roughly equal amounts by Universities, CSIRO and State Departments of Primary Industries. The sector has a well organized research and development funding system that is largely concentrated on productivity gains and international market access and has only recently begun to give attention to climate change adaptation. DAFF has recently made a considerable research and development investment in climate change both mitigation and adaptation. The recently announced adaptation program has concentrated on the larger industry sectors and to date has not addressed significant cross cutting issues such as, water availability, human health and regional community resilience.

Given the above profile the Primary Industries Adaptation Research Network (PIARN) has been established around a research leadership group and a series of national research nodes in key areas of adaptation research priority within primary industries such as farming systems, soils, water, regional socio-economic adaptation and assessment, animal biosecurity and productivity and plant productivity. Through these nodes with the direction of the research leadership group PIARN will produce a series of "state of the adaptation science" reports in areas of need within primary industries.

PIARN will place particular emphasis in the development of research capacity in climate change adaptation through the recruitment of new researchers by honours scholarships and the mentoring of existing researchers within the primary industries sector.

# **Farmers' Adaptation to a Drier Climate: Some Initial Observations**

Ross Kingwell

*University of Western Australia*

# Influence of Rising CO<sub>2</sub> on Water and Carbon Fluxes in Maturing *Eucalyptus* Trees: Lessons from the Hawkesbury Forest Experiment

David S. Ellsworth<sup>1</sup>, Remko Duursma<sup>1</sup>, Craig Barton<sup>2</sup>, Belinda Medlyn<sup>3</sup>, David Tissue<sup>1</sup>, and Ross McMurtrie<sup>4</sup>

<sup>1</sup>Centre for Plants and the Environment, University of Western Sydney; <sup>2</sup>Forest Science Centre, NSW Department of Primary Industries; <sup>3</sup>Dept. of Biological Science, Macquarie University; <sup>4</sup>School of Biological, Earth and Environmental Science, UNSW

## Abstract

Forest plantations are subject to many demands for the important ecosystem services and functions that they provide. These major functions are anticipated to be altered by climate change and rising atmospheric CO<sub>2</sub> concentration ([CO<sub>2</sub>]), but there are significant questions regarding how long-term adjustments of trees to these factors will affect these anticipated responses. Plant species can vary greatly in the magnitude of their primary responses to atmospheric [CO<sub>2</sub>], including responses in photosynthesis and stomatal conductance. However, few long-term studies combining elevated [CO<sub>2</sub>] and environmental stress have been conducted on native plantation trees in Australia. At the Hawkesbury Forest Experiment (HFE) we have investigated the growth and physiology of *Eucalyptus saligna* (Sydney blue gum) trees exposed over two years to an elevated atmospheric [CO<sub>2</sub>] of ambient +240 ppm CO<sub>2</sub> using whole-tree chambers. Results from the experiment to date have tested and challenged a number of paradigms regarding the response of trees to elevated CO<sub>2</sub>. Here, we ask if stomatal conductance and water-use of evergreen *Eucalyptus* trees adjust to long-term growth in elevated CO<sub>2</sub>, and how these responses affect water-use efficiency at the leaf and whole-tree scale.

We found strong stomatal responses to growth in elevated [CO<sub>2</sub>] in *Eucalyptus saligna* at the HFE, which contributed to enhancement of water-use efficiency of these trees. Reductions in water-use due to stomatal closure in elevated CO<sub>2</sub> were large, roughly equivalent to a savings of half a millimetre or more of rain per day under summer conditions. Whilst it is commonly expected that such water savings would protect trees against drought, during an 80-day drought experiment there were similar drought effects on photosynthesis and stomatal closure at different atmospheric CO<sub>2</sub> levels, but improvements in plant water status under elevated CO<sub>2</sub>. We expect further experimentation will yield important tools for modelling tree C sequestration and forest catchment water use under different climate change scenarios, to permit more sustainable forest management to adapt to atmospheric CO<sub>2</sub> and climate change.

# Developing Adaptive Capacity to Extreme Climatic Events: A Bottom-Up Approach

Leanne Webb<sup>1,2</sup>, Andrea Watt<sup>1</sup>, Tom Hill<sup>1</sup>, John Whiting<sup>3</sup>, Fiona Wigg<sup>1</sup>, Greg Dunn<sup>1</sup>, Sonja Needs<sup>1</sup> and Snow Barlow<sup>1</sup>

<sup>1</sup>*School of Agriculture and Food Systems, University of Melbourne;* <sup>2</sup>*Centre for Australian Weather and Climate Research, a partnership between CSIRO and the Bureau of Meteorology, VIC;* <sup>3</sup>*John Whiting Viticulture Consulting, VIC*

## Abstract

A survey of 92 vineyards, representing ten winegrowing regions in south-eastern Australia, soon after they were exposed to a severe heat wave, revealed that there was variation in the level of reported heat-related impact. This variation was observed between regions, within regions and within vineyards. Notably the estimates of losses were not always related to the amount of heat above a certain threshold but more so to the management practices employed in the lead-up and through the event.

Agricultural practitioners have a suite of management tools available to them that will enable them to cope within the range of typical climate variability. When an industry occupies a diverse range of climate regimes, as is the case with the Australian wine industry, these management tools will vary, though some overlap will occur. The success of the management techniques employed across the industry through this severe climate event were assessed and quantified. Applicable and achievable recommendations for managing severe heat events have resulted from this assessment. Quantification of the effectiveness of watering options, canopy structure, and vineyard design as these affected the response to the extreme heat has led to identification of both better and also less effective management strategies. Timeframes for the implementation of these options from vineyard planning phase through to daily management are suggested.

We believe this method of capturing information from the diverse knowledge-base of managers within an industry is a very effective way to reveal potential adaptive capacity. Furthermore, the recommendations resulting from this bottom-up approach will be more readily accepted as the proof of success has already been tested in the field

# The Ultimate Adaptation Challenge - Avoiding Perverse Mitigation Outcomes

Peter Grace<sup>1</sup> and Richard Eckard<sup>2</sup>

<sup>1</sup>Queensland University of Technology. <sup>2</sup>University of Melbourne and Dept Primary Industries, VIC

## Abstract

Predicted changes in seasonal climate patterns associated with global warming will place great pressures on our ability to increase food production. Increased atmospheric CO<sub>2</sub> concentrations and predicted higher temperatures will only provide a boost to plant productivity if both water and nitrogen requirements can be met. Judicious nitrogen management is a critical strategy in the development of productive and profitable farming systems. Potential shifts in growing season initiation and length associated with climate change will also place limitations on the performance of current cultivars and require changes to nitrogen management to maintain yield and quality.

The amount and timing of nitrogen application required for an optimal outcome is dependent on the growth characteristics of the plant in response to the prevailing climatic conditions, the rotation sequence (if applicable) and the opportunities to apply multiple applications of nitrogen fertiliser in a cost-effective manner. Whilst the opportunity exists to increase nitrogen inputs to take advantage of increased atmospheric CO<sub>2</sub> concentrations, this will also increase the potential for nitrous oxide (N<sub>2</sub>O) emissions, a greenhouse gas 300 times as potent CO<sub>2</sub> in terms of its Global Warming Potential (GWP). The challenge will be to increase nitrogen use efficiency and maintain nitrogen application rates whilst increasing yield and quality.

# Heat Wave and Population Health in Australia

Peng Bi

*University of Adelaide*

## **Abstract**

Numerous studies have associated high ambient temperatures with adverse health outcomes. Extreme environmental heat can trigger the onset of acute conditions as well as exacerbate a range of underlying illnesses. Australians are largely acclimatised to hot summers and regular heatwave; however morbidity and mortality associated with extreme heat is a regular occurrence and may in the absence of adaptation, increase in a warming climate.

The presenter will review what is currently known about this issue for Australia, what are the likely projections in this area, who are the most vulnerable, what can we deduce from overseas experience, and what have we done at policy and practical levels. He will then summarise future research areas.

# Climate Change and Infectious Diseases

David Harley

*Australian National University*

## **Abstract**

Climate change will alter the distribution and incidence of infectious diseases. However, there remains much uncertainty and debate about the magnitude and direction of change. While climate determines when and where infectious diseases may occur, interventions such as public health surveillance, medical treatment and mosquito control programs impact significantly on where diseases actually do occur.

The presenter will discuss mechanisms by which climate will potentially influence infectious disease incidence and some research carried out to date in Australia. He will then point towards future research directions and suggest areas in which these researches will inform health policy.

# Modelling the Effects of Heat and Cold on Mortality

Keith Dear

*Australian National University*

## **Abstract**

Modelling the rate of temperature-related deaths is important for two reasons. Firstly, such models are essential to permit projections into a climate-changed future under a range of scenarios, as part of estimating the overall burden of disease from climate change. Secondly, careful modelling will permit adaptative strategies to be better targeted, for example between cities and rural areas, or towards the elderly or other high-risk groups.

Such models must grapple with many factors including thresholds and non-linear risk functions, lag effects and interactions with other atmospheric variables such as humidity. All these factors may vary according to people's age, between locations (especially latitude) and by time of year. In this presentation, I will briefly survey some of the alternative model formulations that have been used, and then focus on the particular difficulty of accounting for the likely moderating effects of physiological acclimatisation to a gradually warming world.

# The Impact of Climate Change on Mental Health of People in Rural and Remote Areas including Indigenous Communities

Jennifer Bowers

*Centre for Rural & Remote Mental Health, QLD*

## **Abstract**

Drought, floods and other natural disasters such as cyclones have a significant impact on the mental health of people living in rural and remote areas and the resilience and sustainability of their communities. The Centre for Rural and Remote Mental Health Queensland has recognised this and taken a lead role in two key areas.

Firstly, it has formed a state-wide group which grew from individuals and organisations representing regional Queensland to advise on and influence how Queenslanders respond to the impact of the changing climatic conditions in rural and remote communities. This group assisted the collection of information which contributed to the preparation of “Mental Health and Drought in Rural and Remote Queensland – Service Mapping Report” in November 2008. The Queensland Mental Health Advisory Group on Environmental Adversity has gained momentum over the past two and half years and now shares grass-roots information from their communities and provides direction and advice about new and innovative interventions. Initiatives currently underway include building leadership and mental health awareness in rural women and youth (funded by the Australian Department of Agriculture, Fisheries and Forestry) and mental health promotion and increased access to services through a Mobile One Stop Service bus. Other initiatives will include raising awareness through better access to information and services as well as building the capacity of all regional communities to plan for and strengthen resilience in the face of environmental changes. The Centre facilitates linkages between these projects as well through the Advisory Group, which in turn ensures a consistent and collaborative approach to evaluation and research.

Secondly, in collaboration with the Adaptation Research Network for Human Health, the Centre recently hosted a Roundtable which explored the impact of climate change on the social and emotional wellbeing of rural and remote Aboriginal and Torres Strait Islander communities. Aims for the future are, in collaboration with Indigenous communities, to foster climate change research, interventions and new initiatives that will support and improve Indigenous rural and remote mental health in the face of climate change. Another objective is to forge strategic alliances and partnerships with key stakeholders including Indigenous and scientific organisations in order to collect evidence which influences policy and informs governments and key stakeholders.

# The Health Impacts of Climate Change: Using Health Impact Assessment

Dianne Katscherian<sup>1</sup> and Jeff Spickett<sup>2</sup>

<sup>1</sup>*Environmental Health Directorate, Department of Health WA;* <sup>2</sup>*Curtin University*

## **Abstract**

The type and extent of health impacts that may arise from climate change are a reflection of the unique environmental, climatic and socio-economic parameters of Australia. A joint project, between the Environmental Health Directorate of the Department of Health and the WHO Collaborating Centre for Environmental Health Impact Assessment at Curtin University was undertaken in collaboration with Government and other stakeholders to consider the implications of climate change on the health of the people of WA and to develop a range of adaptive responses to provide Government with the basis for future decision making.

The general Health Impact Assessment (HIA) framework provided an appropriate means by which the potential impacts of climate change could be initially assessed. The framework was used to identify potential health impacts, vulnerable groups and regions, assessed risks of potential impacts and considered the suitability and implementation of adaptation measures. Knowledge gaps and research needs for policy development were highlighted. The process has also since been modified for use in other sectors to consider vulnerability and the development of appropriate response policies.

# Collaborative Climate Change Research Between QUT and the Queensland Government

David McRae

*Queensland Climate Change Centre of Excellence*

## **Abstract**

Two collaborative research projects between the Queensland Government and QUT have been developed under the ARC Linkage Project Scheme.

The first project is titled "Development of a framework for assessing the vulnerability of eco-environmental health to climate change". There is increasing concern about potential impacts on eco-environmental and public health due to climate change. However, it remains unclear how the vulnerability of eco-environmental health to these changes can be assessed and which framework for assessing these changes should be adopted. The study aims to develop a conceptual framework and identify practical processes to assess this vulnerability. This will include identifying knowledge and information gaps on the consequences of climate variability and change on major eco-environmental health hazards.

The second project "An evaluation of the environmental health risk of heatwaves associated with global warming" aims to identify and quantify the potential impacts of heatwaves on the health and welfare of the community. The study will highlight community health risks associated with heatwave events, develop a profile of people most at risk including identifying social, demographic, prior health and environmental factors contributing to the risk and consider likely community strategies to mitigate the impacts of these events.

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