Connections

research for a sustainable future

From the Director

Research and information and community engagement

One of my long running mantras has been the need to turn our research into plain language information and to engage with local communities whilst doing this – even before starting to do the research.

There is certainly a lot more of this happening than when I started out on my journey across research and policy. There are, however, still many efforts that don’t quite get it right. I could excuse some of these due to “bad luck” but others just make me cringe. I am not about to hammer away at the less successful efforts – I don’t think that is needed. Rather, some of the vagaries of working with communities intrigue me more, and I do not have a set opinion about these. What works at one time may not work at another, and vice versa – timing and clever opportunism can swing the day or bring things to a grinding halt. And you may never realise why, or not accept the reason.

At an international level I have witnessed efforts by technical experts to influence biodiversity and climate change policy. Some were successful, such as getting ecosystem services and benefits for people inserted into the lexicon and then eventually into policy. This took about two decades in the wetland world – ask me separately about the influences that were at play over this time. Then consider whether this has translated into policy or outcomes at a national or a local level. Other efforts have struggled if not failed – do you really understand what is meant by resilience?

Locally I have seen and been subject to community rage about what I considered were science-based outcomes. In some cases it was a genuine misunderstanding. In others it was a bloody-minded repudiation of the science and the experts. How can we advise or influence those who do not want to listen? Or those who may lose out if our evidence-based views held sway? Should the researcher even need to do this? Can we leave it to others and get on with the research?

Personally, this is where I think we need to venture if we are to make a difference. That outcome may not be a surprise – it is part of the mantra – but is it worth our time and energy? We have examples of where it is being done.

Focus on Research

Research in the Lachlan

With six PhD research projects on the go, and two recently completed projects, the Institute, along with partner organisations, has become a major provider of research that will help inform management decisions in the Lachlan catchment in central NSW.

Professor Max Finlayson describes the Lachlan River system as an extremely interesting system in its own right because of its flow patterns. (more next page)
The completed projects are:

- the Lake Cowal Foundation.
- Adaptation Research Facility, CMA
- Research and Training, the Lachlan National Centre for Groundwater include
- Partners involved in various projects
- relate ecological and social research
- just ecological.
- research work we are doing is not
- information
- facilitate the exchange of
- relationships with local managers
- “We are
- objectives.
- CMA’s
- information gaps
- CMA to look at some of these
- opportunity to work with the Lachlan
- agricultural,
- are
- agencies and conservationists
- landholders, the Lachlan
- where there is a lot of interest from
- Lake Cargelligo
- less on the mid reaches
- lower reaches
- The Lachlan River does not flow into
- There has been a lot of emphasis
- There is a lot of information on the
- lower reaches of the Lachlan but
- less on the mid reaches between
- Lake Cargelligo and Wyangala Dam
- where there is a lot of interest from
- landholders, the Lachlan Catchment
- Management Authority, government agencies and conservationists who
- are seeking information for agricultural, Natural Resource Management and conservation purposes.”

The Institute has been given an opportunity to work with the Lachlan CMA to look at some of these information gaps to help inform the CMA’s longer-term management objectives.

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Not just ecological

“We are keen to cement our relationships with local managers to facilitate the exchange of information,” says Max. “The research work we are doing is not just ecological. We are trying to relate ecological and social research for management outcomes.”

Partners involved in various projects include NSW State Water, the National Centre for Groundwater Research and Training, the Lachlan CMA, the National Climate Change Adaptation Research Facility, and the Lake Cowal Foundation.

The completed projects are:

- the Lachlan CMA was one of three CMAs involved in a year-long project (Jan 2012-Jan 2013) funded by the National Climate Change Adaptation Research Facility ($100,000) which identified low risk ways to mitigate and adapt to climate change
- a project, funded by CSU and the Lachlan CMA, on assessing resilience in the Lachlan CMA. A report proposing an approach for measuring at a sub-catchment level, relative levels of resilience in terms of social, human, physical and financial capital has been completed.

Current projects

Ecological responses of aquatic vegetation communities to the water regime and water quality of inland ephemeral lakes (2012-2015) funded by State Water, Lachlan Catchment Management Authority & CSU, ($90,000) with researcher Adrian Clements (PhD student), supervised by Prof Max Finlayson (principal) and Dr Daryl Nielsen (MDFRC).

The project is investigating the ecological response of the aquatic vegetation communities to water quality changes and water regime. The main study site is Lake Brewster with comparisons planned for Lake Cowal and Lake Cargelligo, all of which are situated in the mid section of the Lachlan river catchment, and each with differing levels of human use/impact.

The project will establish whether water quality and water regime (either singularly or in combination) influence plant diversity, growth, biomass, seed viability and/or seed bank emergence, and if the species composition of a wetland has a significant effect on the water quality and chemical composition.

A combination of field vegetation surveys and controlled laboratory experiments is being used to determine what effect water quality and water regime have on aquatic plant communities and provide a basis for developing a conceptualised ecological model of Lake Brewster. This will take into account seasonal changes, known variability and ecological relationships as a means for identifying the hydrological and water quality requirements of the current vegetative communities in each lake.

A report will be prepared in 2014 for the project sponsors. Completion of this project will contribute to the current understanding of the importance and function of inland ephemeral lakes in the temperate regions of the world.

Results from this project will also allow for more informed decision making when the use of constructed and modified wetlands is required to improve outflow water quality.

(Left) Adrian with his experiments
Adaptive Management of Water in the Lachlan Catchment (2013-2015) funded by CSU. Researcher is Jess Schoeman (PhD student) supervised by Dr Catherine Allan (principal) and Prof Max Finlayson.

During the last century, natural resource management has been dominated by a ‘command and control’ paradigm where engineering and technological development has ensured a constant flow of natural resources into the economy. The value of resources was based on the wealth generated from their use or consumption which failed to recognise the dependence of human life on functional ecosystem processes. The legacy of this style of management is degraded and vulnerable ecosystems, inflexible institutions and societies that are unwilling to cope with natural variations in resource availability.

Ecosystem-based approaches and Integrated Water Resources Management (IWRM) are newer paradigms geared towards holism, trans-disciplinarily, participation of stakeholders and consideration of broader spatial and temporal scales. Adaptive management - purposeful learning for improved action - is a useful tool for dealing with uncertainty and improving integration in complex social-ecological systems.

This project is exploring the social factors that constrain and support adaptive management of water in the Lachlan catchment, in the face of institutional change and increasingly unpredictable environmental conditions. It will provide an understanding of how adaptive management is currently manifesting (2012/13) at different scales of environmental water governance and management in the Lachlan catchment; articulate what different stakeholders understand by successful adaptive management; and document and analyse the impacts of State-wide institutional change (the transition from Catchment Management Authorities to Local Land Services) on adaptive management of water in the Lachlan catchment.

It will contribute to adaptive management theory and enhance the capacity of institutions to manage adaptively under global change.

(Below) Wyangala Dam in the Lachlan Catchment

Establishing more acceptable and achievable environmental watering targets in a complex changing world (2012-2015), funded by ILWS, and the National Centre for Groundwater Research and Training ($15,000). Researcher is Saideepa Kumar (PhD student) with supervisors Prof Allan Curtis (principal), Dr Emily Mendham and Dr Wendy Merritt, ANU.

Since the commencement of the Water Act (2007), increased volumes of water are being set aside for environmental use in the Murray-Darling Basin (MDB) in Australia. Settings targets for the use of this environmental water is problematic due to several reasons such as high climate variability, embryonic knowledge on ecological responses to water availability, diverse set of values among stakeholders and the high opportunity costs of allocated water.

This research is seeking to identify guiding principles and ways to address the challenges of establishing achievable and socially acceptable environmental watering targets under complex uncertain conditions.

Response of frogs to environmental factors on a range of scales in the Lachlan Catchment, NSW (2012-2015) funded by CSU with researcher Carmen Amos (PhD student) supervised by Dr Skye Wassens (principal) and Prof Gary Luck.

(Above) Carmen Amos out in the field

This project is examining the relationship between frog species and environmental factors that act at different scales, in the Mid and Lower Lachlan Catchment. These include site hydrology and spatial layout of aquatic habitats, vegetation, water quality and other aquatic organism. The importance of environmental flow upon breeding and calling, and frogs use of microhabitats will also be investigated. This will help identify occupancy patterns of frog species as well as what drives breeding responses on local and landscape scales.

(Above) At Charlie’s Point in the Great Cumbung Swamp, Lachlan

An iterative approach to the research is being adopted, involving literature reviews, discussions with practitioners and interviews with experts. It will focus on two catchments (Lachlan in NSW and Campaspe in Victoria) as case studies. Subsequently, a feasibility study will be undertaken in one of the catchments to identify and address some of the practical challenges involved in the application of the guiding principles.

The results of this research are expected to provide more robust decision making processes for setting acceptable and achievable targets for environmental water. More broadly, it is hoped that it will contribute to the growing body of literature on dealing with complexity and uncertainty in social ecological systems such as rivers.
This project is investigating the current location, condition and hydrologic requirements of the wetlands, using amphibian communities as bio-indicators of wetland health. The Lachlan wetlands are known to provide important habitat for several endangered and vulnerable amphibian species, for example, the Booroolong Frog, Litoria booroolongensis (currently listed as endangered) and Sloane’s Froglet, Crinia sloanei (currently listed as vulnerable in NSW).

Using an organism reliant on a given ecosystem (bio-indicator) is useful for assessing broader ecological function due to their exposure and sensitivity to fluctuating environmental conditions over time.

This project will be conducted in three parts – a desktop inventory (inc. collating information to identify the location and extent of individual wetlands within the mid- to upper catchment); a bio-assessment (inc field surveys to gain an understanding of how frogs and other habitat variables respond to environmental variables); and modelling (the development of conceptual models for each wetland type and explore future scenarios of likely change (e.g. changes in water availability due to policy and/or climate change).

The project will contribute to the natural resource knowledge on the Lachlan Catchment and will potentially assist in prioritising works and water delivery to the wetlands.

Identification and bio-assessment of wetlands in the Upper Lachlan Catchment using occupying frog communities as indicators of wetland health to enable modelling of habitat responses to potential future hydrologies, (2013-2015), funded by CSU.

Researcher is Amelia Walcott (PhD student) with supervisors Dr Andrew Hall (principal), Prof Max Finlayson and Dr Skye Wassens.

There is limited information on the extent and condition of the wetlands in the mid to upper Lachlan Catchment despite the national significance of the wetlands and the delivery of environmental water to key wetlands in the catchment.

The effects of land use and water regime on the ecological character and sediment phosphorus dynamics of the ephemeral Lake Cowal ecosystem in inland Australia, (2012-2015), funded by the Lake Cowal Foundation, ($90,000).

Researcher is Xiaoying Liu (PhD student) with supervisors Prof Max Finlayson (principal supervisor), Dr Darren Baldwin (MDRFC) and Dr Daryl Nielsen (MDRFC).

Lake Cowal is the largest ephemeral lake in inland New South Wales, Australia. It is experiencing unprecedented threats to its ecological character due to deforestation for cropping, grazing, and mining. Recently it has been subjected to an extended drought as a consequence of naturally high climate variability.

This project is examining the chemical composition of lake sediment and evaluating the drivers of changes in the concentrations of phosphorus. It will also analyse the extent of change to the hydrological regime and water quality and characterise the response of selected components of the vegetation to phosphorus.

Mixed methods will be used for the study including remote sensing, ground survey, laboratory experiment and secondary data. Statistical analyses will be used to analyze the data.

A description of the key features of the ecological character of Lake Cowal will provide a context for developing plausible futures in response to selected land/water management scenarios and variable climate regimes.
Conferences/ Workshops

What’s Fair
In April A/Prof Peter Simmons, gave a presentation on ‘What’s fair? Leadership communication in teaching’ to the Western Gateway Educational Community Combined staff development day in Wallerawang, NSW.

Presentations in Indonesia
Also in April, Dr Joanne Millar visited the University of Mataram in Lombok, Indonesia to meet researchers at the Rural Development Research Centre and give a presentation to students studying the role of social capital in rural development. Dr Millar also presented findings of a 2012 socio-economic study of aquaculture farmers in Aceh at Syiah Kuala University in Banda Aceh, and to the annual meeting of the ACIAR project on “Diversification of smallholder coastal aquaculture in Indonesia”.

Food security in developing countries forum
Dr Joanne Millar was an invited presenter at a forum on “Food security and sustainable agricultural development in APEC developing economies” organised by the Australian APEC Study Centre at RMIT University and AusAid on May 24. The forum hosted delegates from China, Indonesia, the Philippines, Papua New Guinea, Vietnam, Thailand, Peru, Mexico and Chile (pictured below). Dr Millar spoke on the importance of social and cultural elements in food security policy design.

Local Landcare Conference
Prof Allan Curtis gave a keynote address on “Engaging volunteers: looking back to go forward” at a Local Landcare Conference organised by Murray Landcare, held in Albury, May 10. About 70 people attended the conference.

Barmah-Milawa Forest Conference
Dr Paul Humphries was one of 22 presenters at a Barmah-Milawa Forest research conference organised by the Goulburn Broken Catchment Management Authority in Shepparton, held April 30 to May 1. Paul spoke on his research project with the Yorta Yorta Nation studying fish middens along the Murray River and Broken Creek. About 110 people attended the conference.

Farming systems
Prof Kevin Parton was an invited participant in an ACIAR and ABARES organised preparatory round table discussion in Canberra on May 9 in the lead up to a workshop for an initial assessment study on farm size dynamics in maize based farming systems in east and southern Africa. A key component of the study was a regional workshop held in June in Bahir Dar, Ethiopia. It was attended by a national and international team of professionals who assessed existing knowledge, shared different perspectives and developed a comprehensive understanding of critical issues and priorities for further investigation through targeted research and development.

Director’s Activities
Are reported on our web page at http://www.csu.edu.au/research/ilws/about/members/profiles/mfinlayson_recent_activities.htm

Over the last few months they include:
As an Invited Expert on Climate Change and Wetlands with the Ramsar Convention on Wetland’s Scientific and Technical Review Panel (STRP), Max attended a STRP meeting in Geneva, Switzerland, Feb 24-28.

On March 10 he met with Dr Jamie Pittock, ANU, and Brian Richter from The Nature Conservancy in the US who were touring the Murray Darling Basin collecting information on water management issues including environmental flows.

(Above) Director’s Activities

On Harmony Day, March 21, Max gave a presentation on leadership and handed out certificates to the 11 participants in the ‘Leading the Way’ Multicultural Leadership Program delivered by Alpine Valleys Community Leadership Program on behalf of the City of Wodonga.

(Above) Dr Millar with colleagues at the Diversification of Coastal Aquaculture project meeting in Banda Aceh, Indonesia

(Below) Institute director Prof Max Finlayson with Ada Musubao
Community Engagement

Easter School
Dr Alison Mathews and PhD students Lisa Smallbone and Alex Knight were once again involved in the Rotary Murray Darling School of Freshwater Research Easter School at Wonga Wetlands. Their involvement included setting harp traps, catching 16 bats, and running a spotlighting activity one evening.

Dr Alison Mitchell with students setting a harp trap. Pic by Rochelle Petrie (MDFRC)

Insectivorous bat. Pic by Rochelle Petrie (MDFRC)

Frogmore Healthy Dams Workshop
PhD student Carmen Amos was one of four presenters at a healthy dams workshop for landholders organised by the Hovells Creek Landcare group in collaboration with the Boroowa Community Landcare group on March 16. Carmen’s presentation was on frogs in the Lachlan Catchment, what environment frogs require and how you can promote them in your dam. “It was a wonderful day and it was great to see so much enthusiasm and interest in not only how to keep your dam healthy for livestock but making it a more desirable place for native fauna,” says Carmen. The day was also interactive with workshops on how best to construct and manage your farm dam and how to identify local frogs. It was held on Byron Corcoran’s property ‘Forest Home’, Frogmore.

Participants in the workshop

Environmental Watering project
Robyn Watts gave a presentation on the Edward-Wakool environmental watering project at the Murray Valley Environmental Water Community Information Session held on Thursday 7 March at the Deniliquin RSL Club. The Information session was hosted by the NSW Office of Environment and Heritage.

Adjunct News
Doing well by doing good
Institute adjuncts Prof John Mullen and Ms Cathy McGowan (who is also an ILWS Advisory Board member) were appointed to a national task force “Doing well by doing good” in March this year. The task force on aid for food security has been established by The Crawford Fund. More details at http://www.crawfordfund.org/trends/doing-well.html

Left to right (back row) Paul Ryan, Dr John Williams AO, Professor Max Finlayson. Professor Andrew Vann (front row) Barbara Hull, Professor Sue Thomas, Professor Kathleen Bowmer, Cathy McGowan AO, Lorne Butt, Nikki Scott. Pic by Paul McCormack

Advisory Board
The Institute’s new Advisory Board had the opportunity to meet with the University’s Vice-Chancellor, Professor Andrew Vann, and Deputy Vice-Chancellor (Research) Professor Sue Thomas at its first meeting held at the Albury-Wodonga campus, on Thursday, March 14.

The Board, chaired by Dr John Williams, were given updates on some of the latest research being undertaken by ILWS members across a number of the Institute’s Strategic Research Areas. After each presentation, Board members were invited to share their ideas and insights as a way of encouraging and guiding ILWS members.

“I was invigorated by the day,” said Dr Williams. “I so enjoyed hearing good science both social and biophysical, meeting with keen minds and engaged staff.”

Dr Williams said the Board’s intention is to add value to ILWS’s work and strategic positioning.

Institute Director Professor Max Finlayson said Dr Williams’ response illustrated a successful first up meeting. “I felt that the AB members felt welcomed and part of ILWS, and were certainly keen to listen and engage….a good start.”
**Visitors**

Visitors to the Institute at the Albury-Wodonga campus on Thursday, March 7, were two representatives from the Lachlan Catchment Management Authority, Fin Martin, the CMA’s Acting Program Manager, and Joanne Lenehan, its Acting Water Theme Leader.

While here the two attended a special ILWS morning tea and then had a meeting with researchers and new Institute PhD students to discuss the projects underway in the Lachlan catchment in NSWs Central West.

*(Above) The Lachlan team*

**Commonwealth Environmental Water Holder**

Institute Director Professor Max Finlayson and researchers Associate Professor Robyn Watts and Dr Skye Wassens had the opportunity to meet with the new Commonwealth Environment Water Holder David Papps *(centre front)* when Mr Papps made a quick visit to the Albury-Wodonga campus on Thursday March 7. Robyn and Skye lead two important ecosystem monitoring of environmental water projects, for the Edward-Wakool and Murrumbidgee River Systems which are funded by the Commonwealth Environmental Water Office. Mr Papps, who was appointed by Water Minister Tony Burke last November, was accompanied by Dr Simon Banks from CEWO *(right)* whose branch is responsible for managing Commonwealth environmental water delivery.

**Robert McInnes**

Independent environmental consultant Robert McInnes from the UK made a brief visit to CSU’s Albury-Wodonga campus on Tuesday, April 30. While here he met with ILWS PhD student Paul Amoateng to discuss their shared interest in urban wetlands in Ghana.

Rob had just spent a couple of days with Institute Director Prof Max Finlayson, a fellow member of the Ramsar Convention’s Scientific and Technical Review Panel. The two are scientific colleagues and are currently co-editing *(along with Dr Sally MacKenzie from the Wildfowl and Wetlands Trust)* a book on constructing wetlands for multiple benefits due to be published by Springer later this year. Rob and Max are also working on an on-line virtual encyclopaedia on wetlands.

Max is a lead editor with Prof Nick Davidson, Deputy Secretary-General of the Ramsar Convention Secretariat and Rob is co-editor of the volume on wetland management.

Rob, who is doing work for UNESCO on water and natural resource management in the Lake Chad Basin in Africa, was also in Australia to investigate parallels with the Murray Darling Basin and the lessons learnt that could be adapted to the Lake Chad Basin.

*About Rob McInnes (pic. Below)*

After studying geography and geology at the University of London, Rob worked in the oil and gas industry in Europe and North Africa for six years “until I got absolutely sick of what the oil industry was doing...one day I was sitting on a helipad about 400 metres from a wonderful Nature Reserve on the Dutch coast watching this slick of polluted water heading straight for the beach and decided to get out of the industry and retrain.”

So he then did his Masters in Environmental Management at the University of Stirling in Scotland, specialising in wetlands followed by a position as a researcher with the University of Exeter in the UK with Professor Ed Maltby. When Prof Maltby got a position with the University of London –Royal Holloway College as head of its Wetlands Ecosystem Research Group Rob followed and worked there for a number of years.

After that he worked as a senior principal wetland specialist for a private ecological consultancy doing a lot of practical work on wetland restoration, mitigation and constructed wetlands for water treatment. His next position, in 2001, was with the Wildfowl and Wetlands Trust, a NGO based at Slimbridge as managing director of its specialist environmental consultancy, which does wetland projects all over the world. After five years he then headed up the Trust’s Wetland Conservation Departments before leaving to work for another environmental consultancy prior to setting up his own company RM Wetlands & Environment two years ago “so I could have the freedom to pick and choose what I do.”

Since deciding to work for himself, Rob has been doing a lot of work with United Nations agencies such as UN Habitat, its human settlements program, working on urban biodiversity, urban wetlands, and ecosystem services.
"I’ve been developing a strategy on how the benefits of wetlands, especially in terms of biodiversity in urban environments to improve human well-being, which we are now taking forward to three pilot cities in West Africa, in Ghana, Senegal and Togo," says Rob. "That’s also in partnership with the Ramsar Convention.”

Rob is also doing some work with UNESCO on Lake Chad in Africa where he is pulling together information about the trans-boundary issues as a way of trying to manage potential future conflicts over water and natural resources in the Lake Chad Basin. "That ties back to this visit to Australia," says Rob. "There are huge parallels with managing a large watershed like the Murray-Darling with the lessons learnt that could be transferred to elsewhere in the world.”

While in Australia Rob checked out some of the water-sensitive urban design schemes in Melbourne “Again I think there are a lot of lessons learnt that could be transferred elsewhere in the world.”

More about Rob’s company at http://www.rmwe.co.uk/.

Tomomi Maekawa
Welcome to Tomomi Maekawa from Tokyo, Japan, a visiting student scholar studying Landcare in Australia. Tomomi is a PhD student from Tokyo Institute of Technology who is being mentored by Prof Allan Curtis. She arrived in Australia at the beginning of June and will be here for a year. She is based at CSU’s Albury-Wodonga campus.

Appointments
Former ILWS post-doc Dr Simon Watson took up his new position with La Trobe University in Melbourne in May where he will be continuing his research on the effects of spatial and temporal interactions in affecting ecological processes. However, his research will now have a greater focus on the role of fire in, rather than anthropogenic processes in driving these processes, particularly looking at Mallee ecosystems. While the position does contain a substantial research element, the major component of the position is working with post-graduate students and staff in the development of research projects where he will be providing advice on study design and data analysis.

Institute Events

Regional Centre of Expertise Murray-Darling
The first event to be hosted by the new Regional Centre of Expertise Murray-Darling (RCE-MD) was a meeting of environmental educators from across the Basin at CSUs Albury-Wodonga campus on April 11 & 12.

The RCE-MD is a consortium of key regional stakeholders within and across Murray-Darling communities that supports and promotes sustainable development through the integration of research, education and community engagement initiatives. Lead institutions are CSU, Wodonga TAFE and LaTrobe University.

Based in CSUs Institute for Land, Water and Society at Thurgoona, it is one of a number of Regional Centres of Expertise on Sustainable Development across the world designated by the United Nations University.

RCE-MD leader Dr John Rafferty said the event which was funded by the Murray Darling Basin Authority, was “a huge success.”

Over the two days 35 educators from primary schools, TAFE, catchment management authorities, state agencies and research institutes from NSW, ACT and Victoria explored education for sustainable development in the Murray Darling Basin.

Among the presenters was Dr Shelby Laird (ILWS) who spoke on ‘Natural Resources Management Education Ideas from North America; Dr Terry Hillman, Adjunct Professor at La Trobe University who spoke about the important role of knowledge brokers and embedding science expertise in management, and Neil Ward, Director of Indigenous Engagement with Murray Darling Basin Authority, who talked about engaging with Indigenous nations in the Basin.

“The group has now formed an association that will meet regularly and pursue a range of research and community engagement projects,” said Dr Rafferty. “The RCE-MD will host regular meetings across the MD Basin with sponsorship from the MDBA.”

(Below) The Murray Darling Basin Authority education unit, with Dr John Rafferty. (L to R) Cherie Shearer, Clair Bannerman, Dr John Rafferty, Will Inveen (Director Education) & Joanna Randall

*RCE-MD in collaboration with ILWS (members of the Environmental Justice and Governance for Social Change SRA) has also been successful in obtaining $90,000 funding from the Office of Environment and Heritage for a project “Our Place Riverina and Murray”.

The project is an OEH regional initiative in collaboration with the RCE-MD to help communities to protect their local natural environment and to live more sustainably.

Coming Up
Workshop on needs for conserving and managing important wetlands
(Photographs by Di Crowther, from the Victorian Department of Environment and Primary Industries)

A two-day workshop to discuss what information Australia needs to meet its international obligations for its inland and coastal wetlands covered by the Ramsar Convention on Wetlands has been hailed has “very forward-looking and very informative” according to international wetland expert Prof Nick Davidson.

The workshop, Adaptation policy and information needs for the conservation and management of nationally and internationally important wetlands, was hosted by the Institute in association with the National Climate Change Adaptation Research Facility (NCCARF) and the Society of Wetland Scientists (Oceania chapter). It was held at the Arthur Rylah Institute for Environmental Research in Melbourne April 16-17.

Its 25 participants included researchers, policy makers and wetland managers from most of Australia’s state government agencies, New Zealand, and representatives from the Murray-Darling Basin Association and the Australian Conservation Foundation.

The meeting was co-convened by Institute Director Prof Max Finlayson, NCCARF and the Society of Wetland Scientists (Oceania chapter). Prof Davidson, Deputy Secretary General of the Ramsar Convention Secretariat and Institute adjunct, was a key-note speaker.

Australia is a founding Contracting Party to the Ramsar Convention and over the past 40 years has designated a national network of 65 Wetlands of International Importance, or Ramsar Sites, covering over eight million hectares.

Prof Davidson said there were a number of important issues which were identified during the workshop. One of these, recognised for many years, is the need for good baseline wetland inventory.

“This would provide us with a basis to then work out how to handle the problems that wetlands face, which include the effects of an increasingly rapidly changing, and variable, climate,” said Prof Davidson. “If you don’t know where the wetlands are, or what they are, it is difficult to start working out how to plan to manage them most effectively.”

Another issue discussed at the workshop which he found interesting was how can Australia, a country which has long had a hugely variable wet/dry climate and with the increasing uncertainty and unpredictability of that climate, deal with some of its core commitments to the Ramsar Convention.

“When the text of the Convention was developed in the 1960s and 1970s, the issue of a warming climate was really not on the agenda,” said Prof Davidson. “In fact, much of the debate about climate at the time was exactly the opposite: about how quickly the next ice-age was going to kick in.”

There was a tendency to treat wetlands as static systems when instead they always have changed, and will continue to change.

“Maintaining the ecological character of a wetland is a core tenet of the Convention as a mechanism for delivering wise use of wetlands,” he said. “What is particularly challenging is determining what ecological character you should be trying to maintain because, if you go back to some historical baseline, that’s not what the wetland may be like in the future even under natural situations - let alone with the added affects a changing and increasingly variable climate.”

One of the discussions he found most helpful from the workshop was about trying to step away from establishing a single baseline ecological character state as the basis for setting management objectives to instead using an understanding of the trajectory of change, past, present and future, and to identify key features of a site which you may try to maintain, but with the expectation that the wetland will never have the same ecological character as it had in the past.

“There was also quite a lot of discussion about what are being called novel ecosystems, that is ecosystems which are emerging with different compositions of plants and animals to their past state, not only as a consequence of invasive species but also with changing compositions of native species,” said Prof Davidson.

Better communication

Another issue raised at the workshop was a need for better communication. “We are not that good at communicating in simple and understandable language to those that really need to be involved about the roles of wetlands in maintaining and delivering ‘ecosystem services’ - the many benefits that people get from wetlands,” said Prof Davidson.

“From a report Ramsar has recently commissioned on the economics of water and wetlands [The Economics of Ecosystems and Biodiversity for Water and Wetlands] we’ve realised that even wetland people have been under-recognising the value of wetlands. That value is huge on an area by area basis. One of the report’s findings is that both inland wetlands, like marshes and floodplains, and coastal wetlands, like mangroves and salt marshes, are often delivering orders of magnitude higher value per area than systems such as tropical forests. We need to get these kinds of messages out to local communities as well as to policy makers and water managers.”
Cases around the world have shown that maintaining and restoring wetlands and treating them as our natural infrastructure for water management was often more cost-effective than putting in more and more engineered structures and systems such as dams and water treatment plants. For example, floodplain wetlands could function as buffers to trap sediment from eroding catchments – so preventing the sediment getting into urban drinking water supplies, especially when there were big flood events.

“In terms of those very difficult decisions for water managers when at times there isn’t enough water to go around, with the increasing unpredictability of our weather making it even harder to make allocation decisions, we need to increasingly treat wetlands as the source of our water not just as competing for water with other uses - as they are an essential part of the water cycle and water process.”

Prof Davidson said South Africa has had an interesting trajectory of change in terms of its water policy, moving from a policy in the 1970s that any drop of water that reaches the sea is wasted, through wetlands and other ecosystems having just as much right to water as people, to in the 1990s the environment being the source of the water on which we depend.

“Water allocation stage”

“Australia has been moving in that direction and seems to be at the water allocation approach stage, but when it comes to the crunch no matter how much you agree to allocate water to the eco-systems as opposed to irrigation or drinking or whatever, if there isn’t enough water for people to drink that is where it will go,” said Prof Davidson. “So perhaps the whole approach of environmental flows and environmental water allocations is a bit of a cul-de-sac and is leading us in the wrong direction by only recognising that wetlands should have some water. Perhaps we need to turn around and say perhaps doing such water allocations is not necessarily the best natural solution for our future.”

He said he found explaining and talking about the approaches of the Ramsar Convention at the workshop and then looking at those approaches through the lens of the issues faced by one country was particularly helpful to take back to Ramsar since the messages will be just as relevant to many other countries as they are to Australia.

He described the bringing together of the scientists, policy makers and government departments for the workshop as very encouraging and something that probably doesn’t happen too often in other parts of the world.

“One approach suggested at the workshop was to use a “3As approach”, that is Avoid the problem, Adapt to maximise the future benefits from wetlands, or Abandon when there is nothing realistically that you can do to maintain a wetlands and its benefits to people.

“But what we don’t have yet is a toolkit to help decide which approach to take for particular systems,” said Prof Davidson. “That is something Ramsar’s Scientific and Technical Review Panel will be considering in relation to the outcomes and recommendations from the workshop.

“We really don’t yet know that much about how different specific wetlands are being, or will be, affected by climate change, as it is difficult to determine whether an observed change is as a consequence of a warming or variable climate or is a result of the many other things we are doing to them at the same time ... or, most likely, it is both.”
Regional Rail Revival Seminar

More than 105 people, including people from Victoria and Queensland, attended a public ‘Regional Rail Seminar” held at Blayney, NSW on Friday 10 May.

The seminar which was convened by Institute adjunct A/Prof Ian Gray, was organised by the Institute with assistance from the Lachlan Regional Transport Committee, Blayney Shire, and the Shires of Cowra, Weddin, Young and Harden.

“The seminar attracted many people who might seldom attend a university seminar, as well as people who have done so many times,” says Ian. “It brought together professionals and practitioners in rail and other industries, alongside people with responsibilities for government policy and research.”

Speakers were highly experienced professionals who discussed their ideas and solutions against a background of issues confronting sustainable regional transportation in New South Wales.

“These issues are being addressed in the course of an attempt to revive a rail freight service in the Central West of New South Wales involving local and state government and industry,” says Ian. “The process was initiated largely by rural local government and other local interests. That in itself is a significant development; one which has been recognised as potentially changing how government administers regional transportation.”

The speakers included Mr Ed Zsombor, Director Rail Services, Saskatchewan, Canada; Mr Dom Figliomeni CEO Port Kembla Port Corporation; Mr Bryan Nye, CEO Australasian Railway Association; Mr Frank Lander, Senior Policy Officer, Department of Transport Victoria; the mayors of Cowra and Blayney Shires; ILWS Adjunct Associate Professor Ian Gray and Cowra-based railway journalist and historian Mr Lawrence Ryan. The seminar was chaired by Mr Maurice Simpson, President of the Lachlan Regional Transport Committee.

Ian says since the seminar he has been asked to speak to local community organisations about the prospects for the revival of regional railway lines. “We are also working to help maintain contacts among participants in the seminar in order to ensure that people remain aware of the process of railway revival,” he says.

The audio transcripts and presentations of the speakers are available at http://www.csu.edu.au/research/ilws/research/SRAs/EnvironmentalJustice/EJGSC-RRR.htm

**Ed Zsombor**, a keynote speaker at the Regional Rail Revival seminar, has two messages for Australia when it comes to resurrecting our regional rail freight services.

They were:

- A need to simplify Government regulations for short line railways, and
- A commitment from the local region

Ed, who lives in the small town of Pilot Butte just outside Regina, the capital of Saskatchewan Province in Canada, has had a long association with railways in that country which started with working for Canadian Pacific Railway in three provinces from 1966 to 1974. He then took up an opportunity to set up a manufacturing plant to make track switch components at Thunder Bay in Ontario as well as run the company’s railway contracting and land development arms.

After two years with the company he went into transportation consulting working with consortiums studying transport in urban locations across Canada and on rail relocation projects as well as for the Province of Saskatchewan to help develop a ‘roadrailer’ (a kind of tractor unit able to use road and rail) and look after the quality control for the manufacture of 1000 grain hopper cars it was having made. He then worked for the city of Regina in a number of infrastructure roles one of which included a rail relocation project in the city.

“Then in 1997 Canada’s Federal Government enacted a new Transportation Act which forced the railway companies, Canadian National and Canadian Pacific, to follow a process for their low density branch lines that they wanted to abandon,” says Ed. “They had to put them up for sale. There was a period of time where they were offered for sale as a business deal, and if that period elapsed and there were no takers, then they had to offer it to the province and local governments at net salvage value. That’s when I became involved as the people of the Province believed there had to be some potential for saving these local, so-called ‘short line’ railways.”

The first of these short line railways was established in 1989 and was 25 miles long.

“Their first line was an opportunity to test the existing infrastructure lines and the new technology. It was a test period of time where they were offered for sale. If no takers, then they had to offer it to the province and local governments at net salvage value. That’s when I became involved as the people of the Province believed there had to be some potential for saving these local, so-called ‘short line’ railways.”

The seminar was highly experienced professionals who discussed their ideas and solutions against a background of issues confronting sustainable regional transportation in New South Wales.
simplify that somehow for the short lines. Personally I don’t think they are necessary for short lines. We don’t have any regulations, we have guidelines which are very flexible and conducive to innovation. The operators tell me how they are going to take care of safety with a safety management plan that they adhere to.”

The other thing that is important is local investment. “If there isn’t local investment there is no incentive for those people to support and protect their investment in the short line railway,” says Ed. “You have to find a champion whether it is a group or an individual, it doesn’t matter, that is prepared to have ‘buy in.'”

Profile

Dr Andrew Hall (SRA: Sustainable Water)

If you want to find out more about climate change modelling or just the influences on our climate in general, have a chat with ILWS member Dr Andrew Hall who is now based at the University’s Albury-Wodonga campus.

Andrew, a senior lecturer in remote sensing with the School of Environmental Sciences, has an interesting background. As a climatologist, one of the projects he has worked on was calculating the amount of water stored as snow for the hydro-electricity industry in New Zealand’s South Island. Another was on using remote sensing techniques combined with climate information to forecast yields for the grape industry.

Andrew, who grew up in the town of Spalding, in the south of Lincolnshire in England, migrated with his family to New Zealand when he was 18 in 1993 where he attended the University of Otago and did a Bachelor of Science majoring in geography. He then completed his Masters of Science in climatology at the beginning of 1999. His thesis, on the periodicity of rainfall for sub-regions of New Zealand, found some relationships between rainfall and large atmospheric oscillations such as the El Nino Southern Oscillation.

“There were negative or positive relationships of various levels of statistical significance depending on the region of New Zealand,” says Andrew. “We hypothesised that perhaps the differences were to do with the mountainous terrain and the latitudinal extent of New Zealand.”

After his Masters Andrew had various short term positions with the university including teaching, working in its accommodation offices and in research, mostly on snow modelling. He then got a full-time position as a viticulturist with a private wine company in New Zealand working on yield forecasting. Shortly after he started that job he was offered a PhD with the CRC for Viticulture, based the CSU’s Wagga Wagga campus which he took up, moving to Australia in 2000.

His PhD was in remote sensing, using the technology to quantify grapevine canopy size and density at a fine spatial scale and relating these data to fruit quality and yield.

“A lot of the work was related to object-based image analysis producing discreet metrics for individual grape-vines using high resolution imagery,” says Andrew. “We proved you could use high spatial resolution with colour-infrared imagery to estimate spatial variability in wine grape quality in vineyards.” Using this technique producers are able selectively manage different parts of the vineyard “so, for example, they might harvest one bit one week, then wait a week for the rest to ripen before harvesting which gives them a better overall grape quality”.

After completing his PhD in 2003 and a four month break Andrew took up a lecturing position with the then School of Science and Technology (now the School of Environmental Sciences) in 2004.

(more next page)
From 2008 to 2010 he was seconded to the Grape and Wine Research Development Corporation based at the National Wine Grape Industry Centre at Wagga where he worked on yield forecasting using remote sensing techniques and climate data. This work led to investigating potential climate change on the viticulture focussed climate data. Future growing conditions for grapevines were produced by modelling heat accumulation and consequent plant phenological stages under various climate change scenarios.

“The crucial ripening period temperature, which can be a major determinant of eventual wine quality and value, was found to warm significantly beyond just a general increase in temperature due to an accelerated phenology,” says Andrew. “Interesting geographic variation for the different wine producing regions of Australia were also found with inland regions and those regions currently considered cool being most affected by warming temperatures.”

Andrew returned to lecturing in 2011 and at the end of 2012 moved to a property at Wooragee in North East Victoria. He says a further diversification of his research interests began after his secondment finished and he started to do some work in habitat occupancy modelling with Dr Skye Wassens.

“We were looking at trying to determine the probability that frog species were present based on certain environmental characteristics and other covariates,” says Andrew.

**Current Research**

Currently Andrew, research-wise, is finishing off some work for the yield forecasting project, supervising PhD students and is involved in one of the Institute’s major projects, ‘Monitoring the ecological response of Commonwealth environmental water delivered in 2012-13 to the Murrumbidgee River.’ He is also working with Skye on a project for the Office of Environment & Heritage ‘Assessment of the status of frog communities in the Lower Murrumbidgee (2012-2013).’

The students he is supervising include Amelia Walcott, Steve Sass who is looking at frog occupancy in the south coast of NSW, Camilla Vote who was measuring water and carbon exchange fluxes and Adam Matthews who is working on a remote sensing project associated with viticulture.

For the monitoring projects Andrew’s skills are used “to bring together the large datasets, statistics and analysis.” “I like doing that kind of research work,” says Andrew. “I feel that the knowledge gained is more valuable than that from the research I was doing in viticulture. And because it is more useful it is an area I would like to get more involved in.

“Amelia’s project (described on page 4) on is indicative of the area I would like to get more into. She’s working in the Lachlan Catchment looking at where the significant wetland assets and the potential effects of climate change on water regimes and how that will affect the spatial distribution of viable wetlands for species conservation.”

Andrew says he is looking forward to working on any research projects that require expertise in spatial climate data, climate change scenarios modelling (especially related to water), habitat occupancy modelling (particularly projects that involve some kind of spatial aspect) and anything involving vegetation remote sensing.

**Post-graduates**

**PhD News**

Joanne Edney gave a paper titled: ‘Do we care about shipwrecks? Impacts and management of divers on underwater cultural heritage’ at the International Coastal, Island and Tropical Tourism conference at Kota Kinabalu, Sabah, Malaysia, April 22-24.

Michelle Oliver (a distance student who just happens to live in Byron Bay) attended the Economics of Happiness Conference, organised by the International Society for Ecology & Culture, held in Byron Bay, March 15-17.

**New PhD students**

Welcome to new PhD student Mr Jeleel Balyaminu who is being supervised by Dr Helen Masterman-Smith (Principal), and Dr John Rafferty and Dr Oliver Villar. Jeleel's working title is: "Natural Resource Endowment and Conflict in Nigeria".

Jennifer Sherry

Another student to join the ranks of the Institute’s international PhD students is Jennifer Sherry from the U.S. Jennifer, who began her PhD in March this year, is looking at, in general terms, the human aspects of planning for natural disasters with supervisors Prof Allan Curtis, Dr Shelby Laird and Dr Eric Toman (The Ohio State University).

Jennifer grew up in Ohio where she did her Bachelor in Environment Natural Resources and Masters Degree in Environmental Social Science at The Ohio State University. For her Masters, under the supervision of Dr Toman and Dr Robyn Wilson, she looked at how managers make decisions about mitigating for future bushfires.

“From the beginning of my studies I’ve been interested in emergency response planning for natural disasters and I ‘fell’ into the Masters program as I had met Eric as an undergraduate student,” says Jennifer who, with Eric, also helped lead two study abroad trips for Ohio State University students to Australia.

The trips focussed on Australian ecology and on how people interact with their environment. Through Eric, Jennifer found out that Prof Curtis was looking for another PhD student so she applied for, and got a CSU PhD scholarship.

“I haven’t determined yet exactly what I want to study,” says Jennifer. “I came here thinking I would study bushfire in Australia, especially ‘stay or go’ policies but I have been exploring other potential topics
related to other natural disasters such as floods. I’m in the process of indentifying something that is interesting to me that will also make a good PhD. If I do the bushfire research it is possible I will do some comparative work between Australia and the U.S.”

Buyani Thomy

New PhD student Buyani Thomy is researching in the environmental economics area, specifically a study to estimate the value of improved riverine health to urban communities along the Cooks and Georges River in Sydney, NSW.

Buyani is based at CSUs campus at Bathurst and is being supervised by Dr Rod Duncan and Prof Mark Morrison. Originally from Botswana where he began a Bachelor of Science at the University of Botswana, Buyani was the recipient of a Botswana Government scholarship which gave him the opportunity to study abroad in a country of his choice. He chose Australia and seven years ago came here to do a Bachelor of Agricultural and Resource Economics (Honours) at the University of New England. Armidale where he was awarded a University medal for highest achievement and excellence.

He then moved to Brisbane to work as a research economist for a private research and consulting company mostly evaluating projects undertaken by Research Development Corporations such as the Fisheries RDC and Grains RDC and the Department of Primary Industries-Victoria. At the same time he did a Master of Environment at Griffith University majoring in economics and policy and some private consultancy work (economic and agronomic analysis) for ACIAR for some of its Africa food security projects.

For his PhD on “Valuing the Benefits of Improved Urban River Health” Buyani will use a newly developed approach that combines hedonic price and travel cost methods to assess the amenity and recreational values of improving riverine health.

This new approach will be extended further to include renters and multiple measures of riverine health; which has not yet been done in Australia or elsewhere. There has been a lot of work done on rivers in Australia (including research by CSU). However most of that research is on rivers in rural and remote areas – where most of the biodiversity is, but not on rivers in urban areas - where most of the people are.

This project will help address this imbalance and also provide valuable information for analysts and policy makers in urban regions.

“I’ll be using economics to measure how much people value the recreation they get from the river as well as the natural amenities they get from the river,” says Buyani. “I’ll be looking at how much people spend to get to the rivers as well as looking at the impact of river health on property values close to the rivers.”

Buyani’s work is part of the new project Duncan, R & Morrison, M (2013-2015) The Value of River Health to the Residential Community of the Georges and Cook River Catchments which has received $30,000 from the Sydney CMA and the Canterbury and Fairfield Councils. Buyani has also received a top-scholarship fromCSIRO Flagship Postgraduate Top up Scholarship program.

Amelia Walcott

For new ILWS PhD student Amelia Walcott it was the opportunity to work as an under-graduate with Dr Skye Wassens out in the field at Yanga National Park near Balranald that helped her decide where her real passion lay. “I had always wanted to work with animals but I wasn’t entirely sure what I wanted to do,” says Amelia, who grew up on a farm at Bombala in NSW’s south-east.

Amelia, who did a Bachelor of Animal Science (Honours) with CSU at Wagga, realised in her third year of her under-graduate studies that her interest lay in conservation biology and environmental studies.

The fieldwork she did in 2009 with Skye and Dr Jennifer Spencer (OEH) in the Lowbidgee monitoring frog and fish populations in response to environmental flows reinforced that interest and Amelia went on to do her honours, with Skye and Dr Raf Freire, on frog breeding in rain fed wetlands. For that Amelia did broadscale surveys at 30 sites from Wagga to Coolamon to Hay in the Murrumbidgee catchment.

After completing her honours Amelia moved to Canberra where she got a job in the public service working in animal bio-security as an assessment officer. After two years in a job she was finding “very operational” when the opportunity for her to apply to do a PhD arose she took it.

“I really enjoyed my honours research so I never ruled out doing a PhD but I did want to take some time out from study to see what a ‘normal’ job would be like,” says Amelia who started her PhD in March this year. Her supervisors are Dr Andrew Hall (principal), Prof Max Finlayson and Dr Skye Wassens.

While it’s early days yet in terms of a final research topic, the working title of her research topic is ‘Identification and bio-assessment of wetlands in the Upper Lachlan Catchment using occupying frog communities as indicators of wetland health to enable modelling of habitat responses to potential future hydrologies.’

“It’s a great opportunity to learn something new and gain an understanding of something that will contribute to the natural resource knowledge on the Lachlan Catchment and will potentially assist in prioritising works and water delivery to the wetlands,” says Amelia.
Masters student
Earlier this year Michelle Smith submitted her Masters in Philosophy research degree on “Balancing conservation and development in protected areas: A case study from Laos.”

Michelle’s research was conducted while working for the Nakai Nam Theun Watershed Management and Protection Authority in central Laos over two years as an Australian volunteer. Her thesis explored the potential to achieve a balance between conservation and development within occupied protected areas, using an in-depth case study of an enclave village in Laos, Southeast Asia. Her research focused on biodiversity conservation and sustainable livelihood issues in one ethnic Brou village whose people have close historical ties to the land.

Her research showed that villagers had three main core values: ‘livelihood security’, ‘sense of place’ and ‘village solidarity’. These values included a desire to continue village improvements while protecting their local natural environment and village unity.

In 2006 the Australian Bureau of Statistics found that adequate health literacy was lower in rural versus urban areas and in 2008 a South Australian study found the same variation in health literacy.

“Our study builds on these by not just identifying levels of health literacy but also looking at information seeking behaviours as knowledge availability/seeking is seen as a key determinant in the development of adequate health literacy,” says Andrea. “Therefore our research question is: Is health literacy impacted by information seeking practices and are either influenced by rurality.”

The survey looks at common health issues, such as smoking for which the safety levels are well publicised as well as topics for which the safety levels may be less well known eg. drinking water sources.

The researchers are seeking the thoughts of people from across Australia who have access to the internet and encourage anyone who completes the survey to pass the link on. To complete the survey go to https://adobeformscentral.com/?f=MrralhzBXV6NhALHbj7Sg

Publications
Peers-reviewed Papers


Papers in a special issue of Hydrobiologia- ‘Wetlands and climate change: ecological outcomes and adaptation as shown by Australian case studies’ with Prof Max Finlayson, guest editor were:


(Above) A demonstration farm in Laos looking at various vegetable varieties

Project Update
Health Literacy & Water Survey
Dr Andrea Crampton and Dr Angela Ragusa are conducting an Australian Health Literacy & Water Survey which has been funded by ILWS.

According to US Department of Health & Human Services (2010) health literacy relates to “an individual’s capacity to seek, understand and utilise health information to make informed decisions about their own health.”

To complete the survey go to https://adobeformscentral.com/?f=MrralhzBXV6NhALHbj7Sg


Books


This 440 page book, which has been co-edited by Dr Paul Humphries, reviews our past and present understanding of the ecology of Australian freshwater fishes. It compares patterns and processes in Australia with those on other continents, discusses the local relevance of ecological models from the northern hemisphere and considers how best to manage our species and their habitats in the face of current and future threats. http://www.publish.csiro.au/nid/21/pid/6515.htm

Book Chapters


Conference Papers


Reports


New Grants

External grants

Paroissien, K., Rafferty, J., Masterman-Smith, H., Mitchell, A., Laird, S., Dunphy, J. & Dunlop, O. (2013-14) Our Pace- Riverina and Murray, in collaboration with the RCE-MD, OEH, $90,000

Curtis, A., & Rogers, M. (2013-14) Managing Multi-functional Landscapes at the Interface of Public Forests and Private Land, in collaboration with The Ohio State University, US Joint Fire Service Program, $60,000


Blackwell, J. & Krivokapic-Skoko, B. (2013-17) Farm Power and Conservation Agriculture for Sustainable Intensification, ACIAR, via CIMMY (International Maize and Wheat Improvement Centre), $544,000


Wassens, S. & Luck, G. (2012-13) Frog communities of the Mid and Lower Lachlan River, OEH, $14,000

Wassens, S. & Hall, A. ((2012-13) Assessment of the status of the Southern Bell Frogs in the Lower Murrumbidgee after major flooding from 2010-12, OEH, $20,000

Morrison, M. (2013-14) Age Care Workforce Reform- Building communities of practice around the prevention of functional decline, Carewest, $25,000