Sustainable Water SRA

**Program Leader A/Prof Robyn Watts**

Over the last two years this Strategic Area (formerly called Adaptive Management of Water Policy, Planning and River Operations) has undertaken a range of research projects primarily in the Murray-Darling Basin. The incorporation of what had been the emerging Sustainable Management of Wetlands in Agricultural Landscapes SRA into this SRA mid-2012 saw an increase in the number of Sustainable Water SRA members and also in the breadth of its research foci. In particular, Institute director Professor Max Finlayson has joined this SRA, bringing with him his expertise and knowledge of wetland management in both the national and international arenas.

Members of this SRA are involved in a number of significant projects which include:

**CSIRO Flagship Cluster project ‘Ecological responses to altered flow regimes’**

Since 2010 members of this SRA (A/Prof Robyn Watts, Prof Max Finlayson, Dr Skye Wassens, and Dr Keller Kopf) have been involved in a $3 million multi-disciplinary national research collaboration called the CSIRO Flagship Cluster Project ‘Ecological responses to altered flow regimes.’ The Cluster involves four sub-projects with ILWS members contributing to two sub-projects. They are:

- ‘Flow dependant ecological responses’ which is investigating the development of ecological models and innovative methods for monitoring and the assessment of environmental water; and
- ‘Assessing aquatic habitat condition and trend,’ which is assessing the current ecological condition in the Murray-Darling Basin.

The three year research cluster project is being undertaken in collaboration with CSIROs Water for a Healthy Country Flagship, Griffith University, University of NSW, Monash University, La Trobe University and the Arthur Rylah Institute.

By improving the knowledge and tools that underpin water resource planning for aquatic ecosystems, the Cluster is developing the science which will underpin improved environmental monitoring and modelling tools for the Murray-Darling Basin.

**Ecosystem responses to in-stream environmental watering in the Edward-Wakool system**

SRA members are undertaking a multi disciplinary collaborative project in the Edward-Wakool system to evaluate the ecosystem responses to environmental flows the Edward-Wakool system.
Institute researchers first began monitoring the Edward-Wakool system in the 2010/11 watering year for a project funded by the Institute and the Murray Catchment Management Authority investigating natural flow pulses which triggered blackwater events and the effectiveness of environmental water in providing refuge habitats. A CSU honors student also studied frog responses to in-channel flow pulses. The following year (2011/12), with $281,000 funding from the Commonwealth Environmental Water Office (CEWO), monitoring of environmental watering was further expanded with the Institute collaborating with the Murray CMA and Monash University to study a range of ecosystem responses and indicators. This project also received in-kind support from the CSIRO Flagship Cluster Collaboration project ‘Ecological responses to Altered Flow Regimes’.

For 2012/13 the monitoring of environmental watering in the Edward-Wakool system consolidating a range of assessment methods into the one ecosystem-based monitoring program, incorporating fish movement and population assessments undertaken by NSW DPI. The program, funded by CEWO ($910,000), is led by A/Prof Robyn Watts who heads a team of 19 people. Project partners are CSU, NSW DPI Fisheries, Murray CMA, Monash University, the Wakool River Association and the NSW Office of Environment and Heritage.

The knowledge from this project (and the one below) is helping water managers in Australia improve the delivery of environmental water in this system and will assist other environmental water programs in Australia and across the world.

**Monitoring of responses to environmental watering in the Murrumbidgee System**

Another multi-disciplinary collaborative project being undertaken by members of this SRA is the monitoring of ecosystem systems responses to environmental flows in the Murrumbidgee system.

The project’s leader Dr Skye Wassens first started working in this system in 2000 when she began research on frogs in the semi-arid parts of NSW, including the Lowbidgee, and helped develop an emergency watering strategy in 2007 to help save the Southern Bell Frog. Since then NSW OEH has funded further research identifying the relationships between the responses of fish, waterbirds and frogs following environmental flows and natural flood events.

In 2010/11 NSW OEH funded research to monitor the responses of the Southern Bell Frog and to assess the resilience of frog communities in the mid-Murrumbidgee following long periods of drought. In 2011/12 the CEWO provided $152,000 funding to continue and expand the monitoring in response to environmental watering. Further CEWO funding ($776,000) for 2012/13 has broadened the mid-Murrumbidgee project to include monitoring of the response to environmental watering in the Lowbidgee wetlands, as well as the Western Lakes, and the Murrumbidgee River from below Burranjuck and Blowering Dams to its end. Dr Wassens leads a team of about 14 people. Partners included CSU, NSW OEH, University of NSW, Murrumbidgee CMA and NSW DPI Fisheries.
Climate change mitigation

Another major project, almost complete, is ‘Identifying low risk climate change mitigation and adaptation in catchment management while avoiding unintended consequences’ (2012-2013) funded by the National Centre for Climate Change Adaptation Research Facility ($100,000). Principal Investigator is Professor Max Finlayson, with co-researcher Dr Jamie Pittock, from ANU, and ILWS post-doctoral research fellow Dr Anna Lukasiewicz.

This project focused on several catchments in the Murray-Darling Basin as examples for testing a method for more integrative climate change adaptation that increases resilience and avoids maladaptation. A ‘Climate Change Adaptation Catchment Assessment Framework’ (CCA CAF) was developed as a planning tool for regional management bodies in southern Australia to assess climate change adaptation. The framework is currently being tested and a user guide is being developed.

Developing Fish Friendly Design Criteria for Small Hydro Facilities

A new project for this SRA which started in 2012 was ‘Developing Fish Friendly Design Criteria for Small Hydro Facilities’. The project, with post-doc Dr Anna Navarro (who is based at the Narrandera Fisheries Centre) and ILWS researcher Wayne Robinson, is a two year project funded by the Australian Centre for Renewable Energy through DPI NSW (Fisheries) and Waratah Power ($144,000). One of the aims of the project is to come up with a design for small hydro power stations that can be built on small existing weirs throughout the Murray Darling Basin.

MBD Futures CRN

As part of CSU’s involvement in the Murray-Darling Basin Futures Collaborative Research Network (MDB futures)(2012-2015) led by the University of Canberra, ILWS researchers are involved in four projects that sit under two of the CRNs four priority areas.

Under the CRN’s “Environmental watering and allocation – understanding and optimising watering requirements, biodiversity, ecosystem services and productive water uses in the Murray-Darling Basin” theme:

- Wayne Robinson is working on a project called ‘Examination of the relationships between stream water flow and fish species and invertebrate taxa using hierarchical regression analyses’ as part of a larger project ‘Using an Evidence Based Approach in the Optimization of Water Allocation Decisions’

- Dr Mariagrazia Bellio, with principal investigator Prof Max Finlayson, is working on a sub-project of a larger project ‘Conserving Biodiversity’ titled “Analysis of Ramsar Site information in the Murray Darling Basin.”

Focus Farm Wetland study
The multi-disciplinary Focus Farm Wetland Study was a joint research project with the Graham Centre for Agricultural Innovation. This project was featured in the 2009-2010 report and completed in 2011. A project report is available here.

**International linkages**

Members of the SRA were/are also involved in research collaborations and projects overseas. These include A/Prof Robyn Watts, who, at the invite of Professor Xia, from Hohai University, Nanjing, visited China as a Visiting Professor in May 2011 where she assisted on a research project involving aquatic monitoring and assessment. CSU and the Institute have a formal alliance with Hohai University and in February 2011, Chinese student Lei Yinru (Ruby) began her PhD looking at climate change and migration on a CSU/Hohai University PhD Scholarship.

In 2011, as a follow-up to a previous visit by research collaborator and colleague Dr Hubert Keckeis from the University of Vienna in Australia, Dr Paul Humphries spent six weeks based at the University of Vienna collaborating on a project associated with larval fish dispersal in the Danube and other experimental work with Dr Keckeis and his students. The three year project ‘Modelling dispersal patterns of fish larvae in a large river’ has been financed by the Austrian Science Fund.

Since 2009 Dr Catherine Allan has collaborated with Professor Pier Paolo Roggero and Dr Giovanna Seddaiau from the University of Sassari, Sardinia, Italy. Their shared research focus is on applications of systems thinking via social learning. Systems thinking is also at the centre of Dr Allan’s collaboration (paper publication and grant applications) with Professor Ray Ison and Dr Kevin Collins from the Open University UK, and recent collaboration (paper) with researchers, including Professor Claudia Pahl-Wostl (Germany) and Jun Xia (China) from the Global Water Systems Project.

Institute director Professor Finlayson has continued his extensive involvement with the Ramsar Convention on Wetlands and work on wetlands. More details of Professor Finlayson’s international and national activities during 2011/12 are here.

**ACEAS**

Australian Centre for Ecological Analysis and Synthesis (ACEAS) is a virtual and physical Facility within the Terrestrial Ecosystem Research Network (TERN) for both disciplinary and inter-disciplinary integration, synthesis and modelling of ecosystem data to aid in the development of evidenced-based environmental management strategies and policy at regional, state and continental scales.

ILWS researchers are involved in four collaborative working groups funded by the (ACEAS) focusing on freshwater ecosystems. They are:

- ‘Where have all the fish gone, and can they come back?’ (2012-2014). Dr Paul Humphries, Dr Nicole McCasker and Dr Keller Kopf are among a group of ecologists with expertise in fish and floodplain ecology and NRM managers responsible for actions to restore native fish populations who are working to help restore native fish populations.
• ‘Adaptation pathways for aquatic plants under climate change: facilitating dispersal and management interventions’ (2012-2013) with Prof Max Finlayson, Principal Investigator, and Dr Daryl Nielsen (MDFRC). They are members of a team analysing how wetland plants can/could move in a changing landscape looking at such things distribution and life history traits, dispersal mechanisms, successional pathways and vulnerability to climate change.

• ‘Thresholds and regime shifts-Australian freshwater ecosystems’ (2011-2013) which involves Prof Finlayson.

• ‘Developing ecologically meaningful metrics to advance environmental flow ecology’ (2012) which involves A/Prof Robyn Watts.

Media

Members of this SRA have also been active in the media and in on-line forums in response to the Murray Darling Basin Plan. Prof Max Finlayson, Dr Paul Humphries and Dr Syke Wassens were among the 60 plus scientists who signed a joint statement issued April 13, 2012 commenting on the then draft Murray-Darling Basin Plan for lacking transparency and failing to consider climate change.

Members

Prof Max Finlayson, A/Prof Robyn Watts, Dr Catherine Allan, Dr Roderick Duncan, Dr Andrew Hall, Dr Jonathon Howard, Dr Julia Howitt, Dr Paul Humphries, Dr Shelby Laird, Dr Skye Wassens, Dr Alek Zander, Prof Kathleen Bowmer, Dr Anna Lukasiewicz, Dr Nicole McCasker, Dr Susanne Watkins and Dr Mariagrazia Bellio.

PhD Students

This SRA also has a large number of PhD and a Masters student working on relevant projects. They include:

Dr Sylvia Zukowski: ‘What information is required for sustainable recreational freshwater fishery regulations in Australia?’ Sylvia graduated in 2012 and her thesis has made a major contribution to development of new fishing regulations for the NSW Murray Crayfish recreational fishery.

Paul Amoateng : The changing spatial extent of water bodies and the implications for urban flooding. The case of Kumasi, Ghana

Carmen Amos: Frogs in the middle and lower Lachlan catchment and how biophysical factors impact their occupancy patterns

Adrian Clements: Ecological responses of aquatic vegetation communities to the water regime and water quality of inland ephemeral lakes (This project has received funding from NSW State Water and the Lachlan Catchment Management Authority)

James Dyer: The role of movement in explaining the distribution of riverine shrimp
Jamin Forbes: Population dynamics and implications for management of a Murray cod and golden perch fishery in south-eastern Australia

Damian Kelly: Historical Aboriginal fish traps and river function

Alexandra Knight: Benefits of environmental watering for the distribution of Sloanes's froglet (Crinia sloanei), the Common Eastern Froglet (Crinia sigifera), and the Plains Froglet (Crinia parinsignifera psrsignfera)

Stacey Kopf: Fish assemblages and instream habitat in lowland river anabranches

Saideepa Kumar: Establishing more acceptable and achievable environmental watering targets in a complex changing world. (This project has received funding from the National Centre for Groundwater Research and Training)

Lei Yinru (Ruby): Climate change and migration

Xioyoing Liu (Sha Sha): Ecological Characterisation and Scenario Setting for Lake Cowal (This project is funded by the Lake Cowal Foundation.)


Luisa Perez-Mujica: A system dynamics approach to assessing sustainability of tourism in wetlands

Christine Reid-Piko: Contemporary and palaeo-ecology of freshwater mussels

Steve Sass: Frog Communities of the NSW Far South Coast: Distribution, Habitat Occupancy and Climate Change

Jess Schoeman: Adaptive management and participation of local communities in wetland and water management in the Lachlan Valley

Kylie Singh: Water requirements of fresh water turtles in the Murray-Darling Basin and the responses to environmental flows.

Abbie Spiers: An exploration of community perceptions about wetland health in New Zealand

Amelia Walcott: Natural resources that support threatened species such as frogs in the wetlands in the Upper Lachlan catchment

Activities

There were a number of activities associated with this SRA during 2011/12. They included:

- A Climate Change Adaptations Options technical workshop held at the Lake Hume Resort, NSW, May 7 to 9, 2012 for a NCCARF funded project. It was attended by 24 people including scientific
experts, representatives from three Catchment Management Authorities (Goulburn Broken, Victoria and the Lachlan and Murray, NSW) involved in the project, the Murray Darling Basin Authority, and government agencies.

- During 2012, the Institute participated in the Murray-Darling Basin Seminar Series, a series which brings together managers, researchers, landholders, students and practitioners working in the Murray-Darling Basin on Basin-wide issues. The series is a collaboration between the MDFRC, La Trobe & Charles Sturt Universities, and the North East and Murray CMA's with the aim of sharing information, learning from others and to provide a regular opportunity for people to meet and discuss Basin issues. The Institute hosted four seminars during the year at the Albury-Wodonga campus. The seminar series will continue in 2013.

- On November 20, 2012 the Institute held a special morning tea to celebrate its success in attracting on-going funding from the Commonwealth Environmental Water Office (CEWO) for two projects to monitor and assess the ecosystem responses to environmental watering in the Edward-Wakool and Murrumbidgee river systems for the 2012-13 water year. Nearly 50 people, including representatives from the Commonwealth Environmental Water Office (CEWO) and various partner agencies, attended the event.

**Visitors**

There have been a number of visitors to the Institute as a result of connections to members of this SRA which during 2011/12 included:

- A colleague of Prof Finlayson, Dr Jan Pokorný, a plant physiologist and wetland ecologist from the Czech Republic, who visited in March 2011. Dr Pokorny, co-author of the book *Water for the Recovery of the Climate: A New Water Paradigm* ([www.waterparadigm.org](http://www.waterparadigm.org)) believes the critical role plants have in distributing solar energy and equalizing temperature extremes is being overlooked and under emphasised.

- In August 2011, the Institute organised and hosted a week-long visit for a group of 14 scientists, engineers, foresters and administrators from India who visiting Australia to investigate how it is addressing the sometimes conflicting uses for limited water resources. While here the group from Loktak in Manipur state (Loktak Development Authority) and Chilika in Orissa State (Chilika Development Authority) took part in a three day workshop at the Albury-Wodonga campus before a three day field trip to visit natural and artificial wetlands in the Murray-Darling Basin. The visit was under the auspices of Wetlands International-South Asia, a global non-profit organisation dedicated to the conservation of wetlands world-wide. A follow-up from this visit is the project ‘Strengthening livelihood security and adapting to climate uncertainties in Chilika Lagoon, India’ with researchers Dr Mariagrazia Bellio and Prof Max Finlayson.

- Professor Cao Lei, Executive Director of the Multidisciplinary Centre for Eco-Environmental Science, University of Science and Technology of China in cooperation with the Chinese Academy of Science, spent three months in Australia in 2011 as a visiting researcher, dividing her time between Charles Sturt University and Deakin University. She made a second visit in
2012 as a recipient of an AusAid Australian Leadership Award Fellowship. Professor Lei is involved in a major project studying waterbirds in the Yangtze floodplain, which has also involved Institute Director Professor Max Finlayson, Dr Mariagrazia Bellio and Dr Daryl Nielsen from the Murray Darling Freshwater Research Centre.

**On-going projects**

Two projects as part of Murray-Darling Basin Futures CRN (2012-2015)

- **Examination of the relationships between stream water flow and fish species and invertebrate taxa using hierarchical regression analyses.** Robinson, W., CSU ($40,000) & CRN ($30,651)

- **Conserving biodiversity: Analysis of Ramsar site information in the Murray-Darling Basin.** Bellio, M. & Finlayson, M., ($80,000) in kind from CSU

**Assessment of post-flood recovery of frog populations in the Lachlan catchment**. Wassens, S., & Luck, G. (2012-2013) OEH. $13,964

**Assessment of the status of frog communities in the Lower Murrumbidgee.** Wassens, S. & Hall, A (2012-2013). OEH, $19,960


**Investigation into the Socio-ecological System of the Murray Catchment.** Murray Catchment Management Authority. Howard, J. (2012)

**Developing Fish Friendly Design Criteria for Small Hydro Facilities.** Finlayson, M. & Robinson, W. (2012-2014) Australian Centre for Renewable Energy through DPI NSW (Fisheries), $144,000

**Monitoring the ecological response of Commonwealth environmental water delivered in 2012-13 to the Edward-Wakool river system.** SEWPAC, Watts, R., Wassens, S. & Howitt, J. (2012-2013) Partners Department of Primary Industries – NSW Fisheries, Murray Catchment Management Authority, Monash University, Wakool River Association and NSW Office of Environment and Heritage. $910,935 Read more

**Monitoring the ecological response of Commonwealth environmental water delivered in 2012-13 to the Murrumbidgee River.** SEWPAC, Wassens, S., Hall, A., & Watts, R. (2012-2013) Partners Department of Primary Industries – NSW Fisheries, Murrumbidgee Catchment Management Authority, NSW Office of Environment and Heritage and University of NSW. $776,222 Read more

**Adaptation pathways for aquatic plants under climate change: facilitating dispersal and management interventions.** Australian Centre for Ecological Analysis and Synthesis (ACEAS) Finlayson, M. Nielsen, D. (2012-2013)
Where have all the fish gone, and can they come back? Australian Centre for Ecological Analysis and Synthesis (ACEAS). Humphries, P., McCasker, N., and Kopf, K. (2012-2014)


Developing ecologically meaningful metrics to advance environmental flow ecology? Australian Centre for Ecological Analysis and Synthesis (ACEAS), A/Prof Robyn Watts

Strengthening livelihood security and adapting to climate uncertainties in Chilika Lagoon, India Wetlands International – South Asia (WISA) in partnership with Chilika Development Authority. Finlayson, M., Bellio, M. (2012-2015)

Ecological responses of aquatic vegetation to the environmental water regime developed for Lake Brewster, Finlayson, M., Nielsen, D., Clements, A. Lachlan CMA, State Water & CSU. (2012-2015)

Ecological Characterisation and Scenario Setting for Lake Cowal - PhD Scholarship, Finlayson, M. (2012-2015) Lake Cowal Foundation $90,000

Barmah-Millewa midden fish study Living Murray Program of the Murray-Darling Basin Authority. Humphries, P., and the Yorta Yorta Nation (2010-2012) [Summary Sheet PDF]

Modelling dispersal patterns of fish larvae in a large river. Project team: Hubert Keckeis (University of Vienna), Michael Tritthart, Hubert Habersack (University of Natural Resources and Life Sciences) and Paul Humphries (2011-13), Austrian Science Fund


Completed Projects


Identifying low risk climate change mitigation and adaptation in catchment management while avoiding unintended consequences NCCARF. Finlayson, M. & Pittock, J. (2012 to January 2013)

Focus Farm Wetland Study. Murrumbidgee CMA, Caring For Our Country & NSW Government. Allan, C., Duncan, R., Dehaan, R., Finlayson, M., Morrison, M., Wassens, S., Wilson, A (2010-2011) (This is a joint ILWS and EH Graham Centre project)


Identification of hydrological and habitat requirements to maintain viable Southern Bell Frog (Litoria raniformis) populations in the Lowbidgee floodplain (Phase 2), Department of Environment and Climate Change. S Wassens, A Wilson. (2010-2011)

Vulnerability Assessment of the Impacts of Climate Change and Sea Level Rise on Sydney Olympic Park Wetlands, Finlayson, M., Spiers, A., Paul, S. Sydney Olympic Park Authority/CSU. (2011) Sydney Olympic Park Authority, $10,000

How is social justice embedded in Australian water governance institutions? ILWS PhD scholarship A. Lukasiewicz. (2008-2012)


Climate Change Adaptation in the Coorong, Murray Mouth and Lakes Alexandrina and Albert NCCARF. In conjunction with ANU. Finlayson, M., Gross C., (ANU) Pittock, J., (ANU). (2010-2011) [Summary Sheet PDF]

Identification of hydrological and habitat requirements to maintain viable Southern Bell Frog (Litoria raniformis) populations in the Lowbidgee floodplain (Phase 2), Department of Environment and Climate Change. S Wassens, A Wilson. (2010-2011)


Assessment of fish habitat and fish populations in the Old Man Creek/Beavers Creek anabranch of the Murrumbidgee River Funded by Water for Rivers. Watts, R. (2007-2011)