



Cooperative Research Centre  
for Freshwater Ecology

Annual Report 2000 – 2001



COOPERATIVE RESEARCH CENTRE FOR  
**FRESHWATER ECOLOGY**

Established under the Australian Government's  
Cooperative Research Centre Program



COOPERATIVE RESEARCH CENTRE FOR  
**FRESHWATER ECOLOGY**

## **Vision**

*The Cooperative Research Centre for Freshwater Ecology exists to improve the condition of Australia's inland waters.*

## **Mission**

*The Cooperative Research Centre for Freshwater Ecology provides ecological understanding to improve and protect Australia's inland waters by collaborative research, education, resource management, policy advice and community liaison.*

## **Objectives**

*To deliver high quality scientific research that contributes to the ecological understanding of aquatic ecosystems and enables predictions to be made as to how those systems might change.*

*To develop and test ecological theory through the research program.*

*To provide the ecological knowledge and principles to underpin management decisions and actions and to address key management issues facing Australia's water industry.*

*To increase the capacity of Australia's water industry to predict ecological consequences of management actions.*

*To produce ecological assessment methods and tools to assist water managers in measuring the performance of their actions.*

*To contribute an ecological perspective to policy debates within the water industry.*

*To maintain international linkages to contribute our work internationally and to ensure our science is at the best possible standard.*

*To provide ongoing professional education to build ecological understanding and capacity within the water industry.*

*To provide high quality postgraduate education and experiences that equip graduates with skills and knowledge appropriate to industry needs.*

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for Freshwater Ecology**

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**Annual Report 2000 – 2001**



*The Cooperative Research Centre for Freshwater Ecology is a collaborative venture between:*

ACTEW Corporation

CSIRO Land and Water

Department of Land and Water Conservation, NSW

Department of Natural Resources and Environment, Victoria

Environment ACT

Environment Protection Authority, NSW

Environment Protection Authority, Victoria

Goulburn-Murray Rural Water Authority

Griffith University

La Trobe University

Lower Murray Water

Melbourne Water

Monash University

Murray-Darling Basin Commission

Natural Resources and Mines, Queensland

Sunraysia Rural Water Authority

Sydney Catchment Authority

University of Canberra

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*The CRC for Freshwater Ecology wishes Dr Terry Hillman well on his retirement. Terry has made an enormous contribution to the CRC over the last eight years. His research over the last 27 years has helped reveal the immense value of billabongs to the health of river systems. While Terry has officially retired, his interest in freshwater ecology and the close association between the CRC and Terry will continue for many years to come.*

*Photo: B Bachman*

***Wetlands in the Murray-Darling Basin that are of international importance & listed under the Ramsar Convention***

State	No	Wetland	Area in ha
SA	1	Coorong and Lakes Alexandrina and Albert	140 500
	2	Riverland, including Chowilla Floodplain System	30 600
Vic	3	Hattah-Kulkyne Lakes	1 018
	4	Lake Albacutya	10 700
	5	Kerang Lakes	9 172
	6	Gunbower Forest	19 450
	7	Barmah Forest	28 500
NSW	8	Macquarie Marshes Nature Reserve	18 200
ACT	9	Ginini Flats, Namadgi National Park	125
Qld	10	Currawinya Lakes National Park	151 300

***Important wetlands of 5 000 ha or more in extent (excluding the Ramsar sites)***

State	No	Name, Location	Area in ha	
NSW	11	Lake Goran, Liverpool Plains	6 000	
	12	Lower Gwydir Wetlands, Lower Gwydir River and Gingham Watercourse	102 120	
	13	Menindee Lakes, Lower Darling River, near Menindee	45 000	
	14	Narran Lakes, Terminal drainage of Narran River	10 000	
	15	Talyawalka Anabranh & Teryawynia Creek, Darling River between Wilcannia and Menindee	H / variable	
	16	Paroo Overflow, Paroo-Warrego Riverine Plains	720 000	
	17	Yantabulla Swamp, Paroo-Warrego Riverine Plains	37 200	
	18	Darling Anabranh Lakes, Darling River Plains on Great Anabranh	269 000	
	19	Lowbidgee Floodplain, Murrumbidgee River between Maude and Balranald	200 000	
	20	Lake Cowal-Wilbertoy Wetlands, Lachlan River Floodplain between Forbes & West Wyalong	29 000	
	21	Booligal Wetlands, Floodplains of Lachlan River distributaries	5 000	
	22	Great Cumbung Swamp, Lachlan River Floodplain near Oxley	50 000	
	23	Lachlan Swamp, Mid Lachlan River	6 600	
	24	Lake Brewster, Lachlan River Floodplain	6 114	
	25	Koondrook and Perricoota forests, River Murray, between Moama and Barham	31 150	
	26	Millewa Forest, River Murray, between Tocumwal and Barmah	33 636	
	27	Weraï Forest, along Edward and Niemur rivers	11 234	
	28	Lake George, Between Canberra and Goulburn	15 000	
	Vic	29	Lake Hindmarsh, North-west of Jeparit	15 600
		30	Lake Tyrrell, North-west of Sea Lake	20 860
		31	Lindsay Island, near Mildura	15 000
		32	Wallpolla Island, near Mildura	9 200
		33	Lake Hume, Near Albury-Wodonga	18 465
		34	Lake Dartmouth, on Mitta Mitta River	5 990
		35	Lower Goulburn River Floodplain, below Goulburn Weir	13 000

Source: ANCA 1996.







*Dr John Langford  
Chairman*

Over the past year, the CRC for Freshwater Ecology has planned and commenced implementation of a research portfolio that strategically targets both short and long-term issues facing land and water managers.

The CRC consulted extensively with researchers and managers to develop its research portfolio, guided by the conviction that if truly multi-disciplinary and collaborative research is to be undertaken to achieve real benefits for the environment, researchers and managers must be involved in the planning of research projects.

In order to continue the involvement of land and water managers, Program Advisory Committees (PACs) which include industry representatives, have been established for each research program; further ensuring that the CRC's research is relevant to the water industry.

The CRC's research projects vary from large, integrated, three to six year projects focusing on the scientific questions that underpin the issues facing the water industry, to short term 1-6 month projects addressing immediate needs and knowledge gaps.

Twelve large, multi-disciplinary projects currently form the backbone of the CRC's research portfolio. These projects use expertise from across the CRC to focus on problems at an appropriate field scale and are producing some exciting initial results. Further details about these research projects and staff can be found in the Research Chapter, page 17.

The quality of the CRC's research was confirmed in an outstanding report from the First Stage of the Second Year Review. Staff are already working towards the Second Stage of the Second Year Review, to be held in September 2001.

As Chairman of the Board, I have the pleasure of congratulating Professor Peter Cullen and Ian Lawrence for their impressive double win in the 2001 Banksia Awards.

Peter was honoured with the Prime Minister's most prestigious award for services to the environment, the Prime Minister's 'Environmentalism of the Year Award'. This Award recognises Peter's outstanding contribution to improving the management of Australia's water resources.

As founding Director of the CRC for Freshwater Ecology, Peter has driven the development of new models for knowledge generation and exchange. He has made an enormous contribution to the knowledge base upon which we as a society make decisions about the management of our natural resources.

Ian Lawrence was awarded the Banksia Environmental Foundation Award for "Outstanding Individual Achievement" in recognition of his contribution towards improving Australia's sustainable future.

I would like to thank Peter Cullen, the management team, staff and students for their commitment to the CRC and the immense contribution they make to the success of the CRC.

Special thanks must go to Terry Hillman who retired in July 2001. Terry has been Director of the MDFRC for the last 8 years and made an enormous contribution to the CRC. Terry's research over the last 27 years has helped to reveal the value of billabongs to the health of river systems. On behalf of the Board, I wish him all the best in his retirement.

Finally, I greatly appreciate the cooperative spirit of the Board members. Leadership starts at the top, and the cooperation of the Board members is an excellent example for the whole CRC.

***Dr John Langford  
Chairman of the Board***



Prof Peter Cullen  
Chief Executive

It has been an exciting year for the CRC for Freshwater Ecology as we have completed the planning phase and started work on the new research projects. We have an exciting portfolio of research projects that we believe will make a difference to the management of Australian water resources.

The Centre completed the first stage of its Second Year Review with an outstanding report.

*"The CRCFE's research performance to Year 2 is impressive..."*

*"The CEO and key researchers are the agents for these major changes. Foremost, they are excellent scientists, recognised nationally and internationally as generating quality scientific knowledge, and prepared to lead integrated teams tackling big scale ecological issues. Additionally, they are contributing to innovative knowledge exchange processes to get the new and existing knowledge used for management and policy, and are providing the required leadership to facilitate the changes in research culture the CRCFE is striving to achieve."*

*"In general the research management is very thorough and effective."*

Preparation is now underway for the second stage review which takes place in September 2001.

During the year the Prime Minister announced the "National Action Plan on Salinity and Water Quality" with a budget of \$1.4 billion. The CRC was heavily involved with the development of this Plan.

I assist the Government by serving on a variety of Committees. I have been asked by the Lake Eyre Ministerial Forum to chair the new Scientific Advisory Panel on Lake Eyre, and I continue to work on the State of the Environment Committee and the Natural Heritage Trust Advisory Committee. These committees provide one of the many opportunities we take to transfer the knowledge gained through the CRC to the Government and the agencies who can use this knowledge to fulfil their functions.

The Government released its response to the Innovation Summit and the Chief Scientist's report with a major injection of funds to the CRC program, and a number of other important initiatives that will provide a much better funding environment for basic research. This confidence in the ability of the CRC program to provide an important bridge between the providers and the users of knowledge is welcomed.

The success of the CRC program continues to attract international attention. The CRC for Freshwater Ecology has been asked to assist the World Bank with knowledge about environmental flows below major new dams, and to start developing this linkage I attended a meeting in Washington with Bank staff and some consultants.

The CRC continues to work closely with our partners to deliver our knowledge in useful forms to help their operations. We have worked with the Murray-Darling Basin Commission to develop an approach that will provide a Sustainable Rivers Audit for the Basin, and we expect to see that implemented in the following year. We have assisted Environment Australia with an Assessment of the Ecological Outcomes of the COAG Water Reforms.

The CRC assisted the Olympic Coordinating Authority with plant growth problems in the Olympic Rowing Course at Penrith and were delighted to see the course functioned so well during the Olympic competition.

The delivery of our knowledge is the responsibility of our Knowledge Exchange team. Professor Gary Jones has joined the University of Canberra as Director of Knowledge

Exchange and Education, and Amanda Kotlash is working as a knowledge broker based in the Sydney Catchment Authority. Michelle Bald has joined the team as a knowledge broker at Mildura.

The CRC continues to be a vibrant and productive organisation, committed to making a difference. This comes about because of the energy, enthusiasm and talent of the staff and students who have a commitment to collaborative research and to delivering research that can be used. The goodwill of so many people is critical to the CRC's success.

Special thanks must go to our Board and in particular our Chairman, Dr John Langford. Dr Langford has not only led the Board with distinction, but provided much wise counsel to me as Chief Executive.

***Professor Peter Cullen***  
***Chief Executive***



*Staff of the CRCFE testing the water and collecting invertebrates to assess the health of Paddys River, ACT.  
Photos: A Tatnell*



The management of the Cooperative Research Centre for Freshwater Ecology is designed to maximise the strengths of its member organisations. It does this by facilitating collaboration between staff across sites and research programs, and emphasising education, communication and knowledge exchange.

## 1.1 Membership of the CRC for Freshwater Ecology

The Cooperative Research Centre for Freshwater Ecology (CRCFE) was formally established in July 1993 under the Commonwealth Government's CRC Program. In 1999, the CRC successfully applied for a further seven years of funding. It is an unincorporated joint venture between:

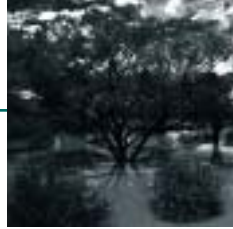
- ACT Government
- ACTEW Corporation
- CSIRO Land and Water
- Department of Land and Water Conservation, New South Wales
- Department of Natural Resources and Environment, Victoria
- Environment Protection Authority, New South Wales
- Environment Protection Authority, Victoria
- Goulburn-Murray Rural Water Authority
- Griffith University
- La Trobe University
- Lower Murray Water
- Melbourne Water
- Monash University
- Murray-Darling Basin Commission
- Natural Resources and Mines, Queensland
- Sydney Catchment Authority
- Sunraysia Rural Water Authority
- University of Canberra

In September 2000, the Board voted to formally accept the University of Adelaide as a Party of the CRCFE.

## 1.2 The Board

The CRCFE is governed by a Board comprising of the following members at June 30, 2001:

- Dr Colin Adrian, Executive Director, Environment ACT
- Mr Don Blackmore, Chief Executive, Murray-Darling Basin Commission
- Mr Bruce Cooper, Director, Ecosystem Management Branch, Department of Land and Water Conservation, NSW
- Professor Allan Cripps, Dean of Applied Science, University of Canberra
- Professor Peter Cullen, Chief Executive of the CRC for Freshwater Ecology and Professor of Resource and Environmental Science, University of Canberra
- Professor Peter Darvall, Deputy Vice Chancellor, Research and Development, Monash University
- Mr Ron Dennis, Independent Board member
- Dr Jane Doolan, Waterways Unit, Department of Natural Resources and Environment, VIC
- Professor Bill Hogarth, Dean of Environmental Sciences, Griffith University
- Dr John Langford, Executive Director, Water Services Association of Australia (Chairman of the Board)
- Professor Nancy Millis, University of Melbourne (Independent Board member)
- Mr Chris Moran, Chief, CSIRO Land and Water
- Mr Paul Shanahan, General Manager, Catchment Protection, Sydney Catchment Authority
- Mr Tom Vanderbyl, Manager, Water Resource Planning, Natural Resources and Mines, Queensland
- Mr Ross Young, General Manager, Waterways and Drainage, Melbourne Water



**Table 1.1**  
**Attendance at Board**  
**Meetings**

	14 September 2000	1 March 2001	30 May 2001
Dr John Langford	●	●	●
Prof Peter Cullen	●	●	
Dr Colin Adrian			
Ms Elizabeth Fowler		●	●
Mr Gary Coston	●		
Mr Don Blackmore		●	●
Mr Greg Claydon	●		
Mr Tom Vanderbyl		●	●
Mr Bruce Cooper	●	●	●
Prof Allan Cripps	●	●	●
Prof Peter Darvall			
Prof Grahame Coleman	●		
Prof Robert Norris			●
Mr Ron Dennis	●	●	
Dr Jane Doolan	●	●	●
Dr Graham Harris			
Dr Chris Moran	●	●	●
Prof Bill Hogarth	●	●	
Mr Dennis Lincoln			●
Prof Nancy Millis	●	●	
Mr Jeff Wright			
Mr Paul Shanahan	●		●
Mr Ross Young			
Mr Grant Wilson		●	●
Mr Kevin Wood	●		

## 1.3 Organisational Structure

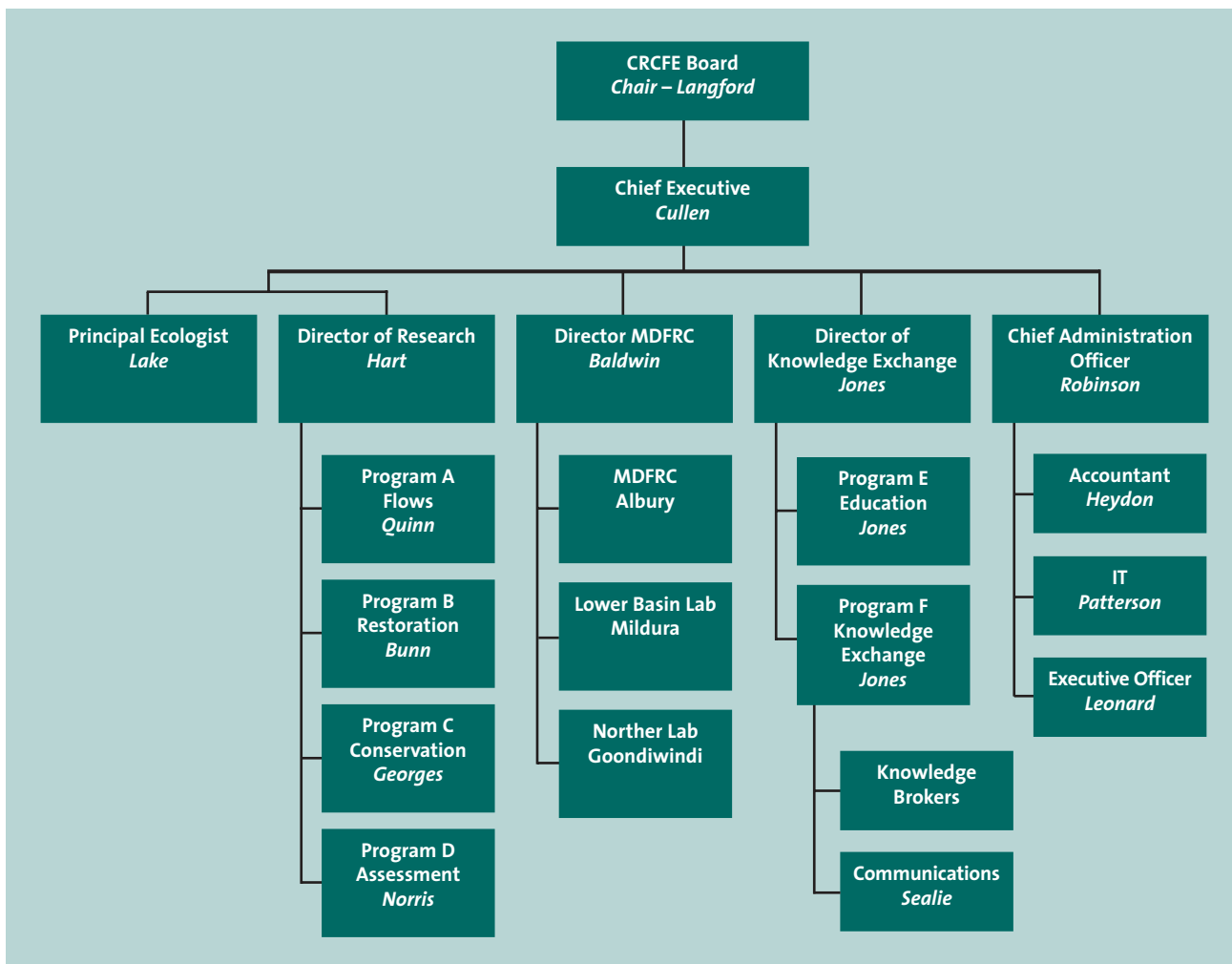
The Chief Executive, Professor Peter Cullen, carries executive responsibility for managing the Centre within the policy framework established by the Board. Three deputies support him – Professor Barry Hart is responsible for coordinating and implementing the research program. Dr Terry Hillman is responsible for managing the three regional laboratories: the Murray-Darling Freshwater Research Centre at Albury, the Lower Basin Laboratory at Mildura and the Northern Laboratory at Goondiwindi. Professor Gary Jones is responsible for the Knowledge Exchange and Education Programs.

The Chief Executive, Directors and Chief Administration Officer form the CRCFE's Executive Committee.

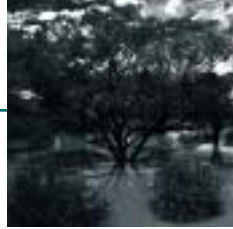
Directors of the CRCFE,  
Prof Barry Hart (left), Dr Terry Hillman  
(centre) and Prof Gary Jones  
Photos: CRCFE



Figure 1.1  
Organisational Structure







#### 1.4 The Centre's Programs

The Centre's six programs consist of four research programs and an Education and Knowledge Exchange program:

- A Flow-related Ecological Processes
- B Restoration Ecology
- C Conservation Ecology
- D Water Quality and Ecological Assessment
- E Education
- F Knowledge Exchange

#### 1.5 Program Advisory Committees

Program Advisory Committees (PACs) have been established for each research program to strengthen the links between industry needs and the Centre's research programs. The four PACs have met and reported to the Board:

##### Program A Advisory Committee, Flow Related Ecological Processes

Gerry Quinn	CRCFE Program Leader
Jane Doolan	DNRE
Tony Paull	SCA
Greg Raisin/Paul Wettin	DLWC
Brian Wilkinson	Environment ACT

##### Program B Advisory Committee, Restoration Ecology

Stuart Bunn	CRCFE Program Leader
Peter Donnelly	Environment ACT
Jane Doolan	DNRE
Noel Kesby	DLWC
Kate Lenertz	SCA
Scott Seymour	MW

##### Program C Advisory Committee, Conservation Ecology

Arthur Georges	CRCFE Program Leader
Neal Forster	DLWC
Mary Knowles	SCA
Bill Logan	Environment ACT
Julia Reed	DNRE

##### Program D Advisory Committee, Water Quality and Ecological Assessment

Richard Norris	CRCFE Program Leader
Bruce Cooper	DLWC
Amir Deen	SCA
Lisa Dixon	EPA Vic
Bob Neil	Environment ACT
Peter Thompson	DNR



Charles Robinson,  
Chief Administrator of the CRCFE

## 1.6 Second Year Review

The CRCFE underwent a Second Year Review in 2001. The first stage of this Review was held at the Water Studies Centre, Monash University, Melbourne on 10 and 11 May 2001. The Review Panel consisted of:

Ian Rae (Chair)  
Pierre Horwitz  
Jenny Davis  
Barbara Bowles (Centre Visitor)

The CRCFE received a very favourable report. The report stated that “The CRCFE’s research performance to Year 2 is impressive”. The First Stage of the Second Year Review provided some useful pointers to make the CRCFE even more focussed and relevant to the aims of the CRC for Freshwater Ecology. Stage 2 of the Second Year Review will be held on 27 and 28 September 2001.

# 2

## RESEARCH PROGRAM



## 2.1 Research Overview

The CRCFE's research portfolio seeks to generate new knowledge and combine this with the existing knowledge base to address the short and longer term issues facing land and water managers. To address these issues, the portfolio contains a range of projects varying from large, integrated three to six year projects looking at scientific questions underpinning the issues facing our industry, to short term 6 month projects addressing immediate needs and knowledge gaps.

Nine large, multi-disciplinary projects currently form the backbone of the CRC's research portfolio. These projects use expertise from across the CRC to focus on problems at an appropriate field scale and are already producing some exciting initial results. With over 70 projects in total, the CRC is well positioned to make a real difference to sustainable water management in Australia. A complete list of projects is included at the end of this chapter.

The research is managed through the four research programs

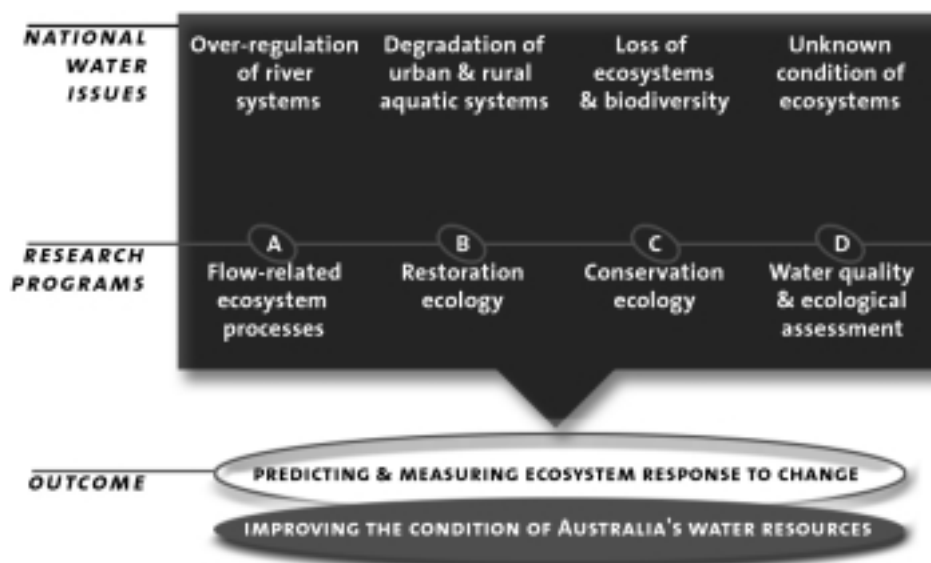
**Program A** – Flow-Related Ecological Processes (Program Leader: Dr Gerry Quinn)

**Program B** – Restoration Ecology (Program Leader: Professor Stuart Bunn)

**Program C** – Conservation Ecology (Program Leader: Associate Professor Arthur Georges)

**Program D** – Water Quality and Ecological Assessment (Program Leader: Associate Professor Richard Norris)

**Figure 2.1**  
Links Between  
Research Programs and  
National Water Issues



The CRC research portfolio addresses five key national drivers:

- The over-regulation of our river systems, and the pressure for development of presently unregulated water resources;
- The serious degradation of many of our urban and rural aquatic systems and the lack of knowledge on how to rehabilitate these;
- The loss of ecosystems and biodiversity;
- The lack of detailed information about the condition (or health) of Australia's aquatic ecosystems;
- The lack of fundamental scientific understanding of the functioning of Australian inland aquatic systems, and how human actions impact upon biological communities and ecosystem processes.



All research projects undertaken within the CRC undergo a rigorous review process to ensure excellent quality science which is relevant and of benefit to our partners. To reinforce this, we have established a quality assurance manual which documents the review process that all research projects must undergo. This has three levels:

- internal review of the science (by management committee);
- external review of the science (by peers); and
- review of management relevance (by Program Advisory Committees).

## 2.2 Program Advisory Committees

The CRC consulted extensively with researchers and managers to develop its research portfolio, guided by the conviction that if truly multi-disciplinary and collaborative research is to be undertaken to achieve real benefits for the environment, researchers and managers must be involved in the planning of research projects.

In order to continue the involvement of land and water managers, Program Advisory Committees (PACs) which include industry representatives, have been established for each research program; further ensuring that the CRC's research is relevant to the water industry.

The PACs meet at least once per year and report on progress to the Board.

## 2.3 Program A – Flow-Related Ecological Processes

### ***Program Leader: Dr Gerry Quinn***

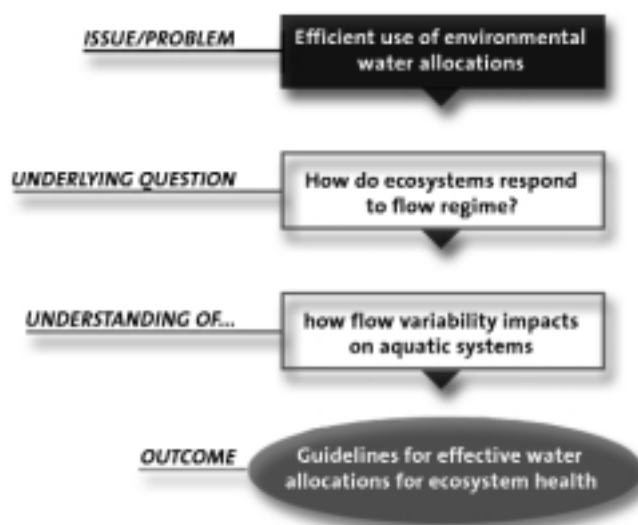
Australia's rivers and wetlands occupy a remarkably diverse range of geographic and climatic conditions, including the coastal fringe and inland, summer and winter rainfall, and temperate and arid zone systems. While these categories allow broad classification of flow regimes, the flow patterns in many of these systems are amongst the most unpredictable in the world. Regulation has resulted in many changes to these spatial and temporal patterns of flow. Total flow in most river systems has been reduced, the seasonal pattern of flow has often been reversed with water stored during the wetter months and released during the drier months for irrigation use, and much of the hydrological variability caused by extreme events (e.g. high flows) has been removed. Our understanding of the effects of regulation on river ecosystems is limited. Nonetheless, we predict marked changes in habitat structure and availability, poorer links between the main river channel and its floodplain and ecological changes at a number of levels: altered recruitment to plant and animal populations, changes in biodiversity and food web structure and loss of productivity.

This program is investigating how flow affects ecological processes in rivers and their floodplains, and through its two themes will address both basic ecological issues (Theme A1) and shorter-term management needs (Theme A2).



*Dr Gerry Quinn  
Program Leader*

## Program Issues and Outcomes



## Program Objectives

- Determine the sensitivity of aquatic ecosystems to flow regulation and water abstraction.
- Determine how options for flow management will affect Australian aquatic ecosystems.
- Develop tools for assessing the success of environmental flow allocations.

## THEME A1 – ROLE OF FLOW IN DETERMINING NATURAL ECOLOGICAL PROCESSES IN RIVERS AND STREAMS

- *We will examine selected ecological processes in river channels and their floodplains and wetlands, and based on the 'flood-pulse' hypothesis, specifically consider the interactions and transfer of materials between these landscape components.*
- *We aim to quantify links between key attributes of flow (particularly floods, but also droughts), representative biota and key ecological processes in rivers and their floodplains to develop predictive capacity in assessing flow regime modifications.*

## PROJECT A200 – THE EFFECT OF FLOW ON LOWLAND RIVER PRODUCTIVITY

**Project leader:** Dr Ben Gawne

**Project Team:** Dr Darren Baldwin, Dr Bruce Chessman, Ms Helen Gigney, Mr John Hawking, Dr Paul Humphries, Mr Ian Lawrence, Mr Zygmunt Lorenz, Dr Daryl Nielsen, Dr Rod Oliver, Dr Gavin Rees, Dr Russ Shiel, Mr Garth Watson, Dr David Williams

**Timeframe:** 1/10/2000 - 30/6/2003

**Funding:** CRCFE \$295,998, MDFRC \$1,171,000, Inkind \$532,700



### **Aim**

The primary objective of the project is the development of a broadly applicable conceptual model of lowland river ecosystems that will describe the relationship between flow and riverine ecology. The model will improve managers' ability to predict the outcome of flow changes and to design flows to maintain riverine productivity.

### **Progress**

The project started in early 2001 with the purchase of equipment and an inception meeting in Albury. The inception meeting decided that the project would be undertaken at Barmah in the Murray R., Peachelba in the Ovens and Benalla in the Broken River. We have since undertaken a trial field trip to evaluate the proposed methods in the Ovens. We have also undertaken sampling at all our sites under base flow conditions. Sampling trips to sample increasing flow and high flow events are planned for the spring of 2001. Recruitment of a technician to work on an associated AFFA fish diets project is underway.

*Lowland rivers are complex and productive ecosystems. The Murray River winding its way through the Barmah-Millewa Forest.*  
Photo: D Eastburn



## **PROJECT A708 – THE EFFECT OF WATER REGIME ON WETLAND ECOLOGY**

**Project Leader:** Dr Margaret Brock

**Project Team:** Michael Healey, Ken Harris, Meredith Royal, Laurie O'Donnell, Katharine Crossle, Sue Botting

### **Aim**

This ongoing project is examining how wetland communities develop under different water regimes in a set of experimental wetlands. In particular the longer term aim is to examine how sustainable wetland communities develop under different water regimes.

### **Progress**

The University of New England's (UNE) Experimental Wetlands are 16 wetlands designed as a research, teaching and extension facility. They allow manipulation of the timing, frequency, and duration of the presence of water by raising and lowering water levels independent in each wetland. Five water regimes are replicated: spring flood x4 ; autumn flood x4 ; spring and autumn flood x4 ; permanently flooded x2 ; mimic of natural regime in local wetlands x2. This experimental tool is being used to assess the effect of water regime on wetland ecology.

Phase 1 of this project (completed in 2000) was funded by the Wetlands R&D Program (Environment Australia and Land and Water Resources Research and Development Corporation LWRRDC with Department of Land and Water, DLWC, as a partner) through a grant to Margaret Brock at UNE. The final report on this phase has been accepted and some management outcomes delivered. Further data analysis and delivery is needed to maximise use of the data collected.

Phase 2 of this project is a DLWC project and an Associated Project A708 with the CRC for Freshwater Ecology.

In 2000-2001 data collection on plant community development from seed banks, seed bank development and on frog community use of different water regimes continued.

In 2000-2001 the final report for the LWRRDC funded project was produced together with two booklets on wetland restoration. Papers on the project were presented in a symposium at the INTECOL Wetlands Conference in Quebec, International Limnology Conference in Melbourne and at the Drought Symposium in Albury.

### PROJECT A712 – IMPORTANCE OF FLOOD FLOWS TO PRODUCTIVITY OF DRYLAND RIVERS AND THEIR FLOODPLAINS

**Project Leader:** Prof Stuart Bunn

**Project Team:** Mr Frank Walker (QNRM), A/Prof Peter Davies (UWA), Fiona Balcombe, Steve Balcombe, Dr James Udy, Michelle Winning

#### **Aim**

The aim of this project is to determine the importance of aquatic production on floodplains of dryland rivers to both aquatic and terrestrial food webs and to estimate the overall importance of floodplain inundation for landscape-scale productivity.

#### **Progress**

The first phase of this project was completed in September 2000 and the Milestone Report accepted by Environment Australia. This outlined the preliminary findings of our coverage of the March 2000 flood event on the Cooper Creek system. Specific highlights included: measurement of benthic and pelagic algal production on the inundated floodplains after only a few

*Floods transform the Cooper River, triggering an explosion of growth and production.*  
Photo: R Ashdown







days, as well as the presence of N-fixing algae; collection of 10 species of fish on the floodplain (larvae, juveniles and adults) with an estimated biomass of 1.3 tonnes km<sup>2</sup> (NB – the flood covered approx 8,000 km<sup>2</sup>); collection and analysis of aquatic invertebrates and fish for stable isotope analysis. This together with fish diet data confirm the importance of aquatic food sources (rather than terrestrial sources from the floodplain). In October 2000, we held our first face-to-face meeting with our Project Advisory Committee and presented a poster summary of our work at the launch of the Lake Eyre Basin strategy in Birdsville. We have recently purchased seven geographically rectified Landsat TM images over 3 dates during the flood of 2000, and will use these to quantify the extent and duration of inundation. The second year of funding for the project has recently been approved under the Environmental Flows Initiative.

#### **PROJECT A714 – THE OCCURRENCE AND SIGNIFICANCE OF PHOTOSYNTHETIC BACTERIA IN FRESHWATER SYSTEMS**

**Project Leaders:** Dr Gavin Rees, Dr Roger Croome

**Project Team:** Ms Deborah Gribben, Mr Tony Presely, Dr Bob Seviour

##### **Aim**

To examine the extent of photosynthetic bacteria in Murray-Darling billabongs, characterise them physiologically/taxonomically, and assesses their significance within carbon and nutrient cycling in wetland systems.

##### **Progress**

The second year of this project comprised event-specific sampling to further categorise the partitioning of the habitat and contribution to the ecosystem by photosynthetic bacteria, and laboratory - based determination and investigation of the primary bacterial autotrophs. The field sampling has identified a major and unexpected contribution of Bacteriochlorophyll *d* containing organisms, and the laboratory work has progressed to discussions of molecular probe development with Dr Bob Seviour at the Biotechnology Centre, LTU Bendigo. Outputs included an Honours thesis (D. Gribben) and a paper submitted to Aquatic Microbial Ecology.

#### **THEME A2 – FLOW MANIPULATION IN REGULATED LOWLAND RIVERS**

- We will build upon the experience gained from the current Campaspe Environmental Flows project by continuing long-term flow manipulation experiments in winter rainfall rivers and extending these studies to include summer rainfall regulated rivers in northern NSW and southern Queensland. There is considerable scope to interact with the environmental flow allocation processes occurring in Victoria, NSW and Queensland.
- We will quantify relationships between different water release regimes and effects on target species or communities chosen to represent potential 'response' groups. Initially, these groups will be key biota (eg. fish, invertebrates, riparian and floodplain vegetation), but this will be extended to include ecological processes (eg. fluxes of carbon and nutrients, nutrient spiralling) and food web dynamics.

## PROJECT A100 – CAMPASPE FLOW MANIPULATION

**Project Leader:** Dr Paul Humphries

**Project Team:** Dr Jane Grouns, Mr Robert Cook, Mr Luciano Serafini, Mr Adam Richardson, Prof Sam Lake, Dr Gerry Quinn, Mr Graeme Hannan, Mr Frank McKinley

**Timeframe:** 1/7/2000 - 30/6/2001 in the first instance

**Funding:** CRCFE \$187,600 MDFRC \$10,000 Inkind \$47,500 Other \$148,310

### **Aim**

The Campaspe Flow Manipulation Project (CFMP) is an ecosystem-scale long-term environmental flows experiment which aims to assess the effectiveness of a 'translucent dam' approach to environmental flow allocation.

### **Progress**

As of the 1<sup>st</sup> May 2001 the experimental flow release began in the Campaspe River. This means that the experiment is now finally in the 'after' phase of the project. We now have six years of adult and larval fish data and four and a half years of macroinvertebrate data from the Campaspe and Broken Rivers, which represents the 'before' component of the project. Several publications based on results from the 'before' phase have recently been accepted and several more are in preparation. Our results indicate that the larval fish and macroinvertebrate faunas of the heavily regulated Campaspe River are consistently different from the less regulated Broken River. In addition, there are considerable differences among the sections of the Campaspe River, each of which experiences a unique flow regime. We conclude that the summer irrigation releases from Lake Eppalock on the Campaspe River have had a marked effect on the conditions experienced by macroinvertebrates and fish. In the case of shrimp and fish larvae, it is likely that regulation has meant that only the tolerant, opportunistic species thrive. We will soon be in a position to determine the impact on the fish and macroinvertebrates of the experimental flow release, which occurs during the non-irrigation season, relative to the impact of the summer irrigation releases.



*Regulation of the Campaspe River favours tolerant, opportunistic species of fish, like this Flat-headed gudgeon, Philypnodon grandiceps.*  
Photo: B Gawne



## PROJECT A702 – RIVERINE FLOODPLAIN INTERACTIONS DURING PERIODS OF HIGH FLOW

**Project Leader:** Dr Terry Hillman

**Project Team:** Prof Alistair Robertson, Dr Adriene Burns, Ms Helen Gigney, Mr Garth Watson, Dr Daryl Nielsen, Ms Trish Bowen, Mr Nigel Anthony

### **Aim**

The project investigates the response of different levels of the riverine food web to connections between the main channel of the Murrumbidgee River and floodplain billabongs.

### **Progress**

After several years of drought and an extremely short floodplain connection in 1998, heavy rain in the catchment produced elevated flows in the Murrumbidgee River in August 2000. These flows were almost sufficient to provide a reasonable period of connection to the selected floodplain billabongs. Rapid action by the Murrumbidgee River Management Committee permitted the release of an environmental contingency allocation (38 500 ML) which extended the peak flow over five days taking the total period of connection to four weeks. This was accompanied by an intensive sampling program in the billabongs, connecting channels, and associated reaches of the river producing several thousand samples, most of which have now been analysed.

We are now piecing together a detailed history of a high-flow event in terms of nutrients, carbon, bacteria, and zooplankton, concentrating on the stimulating effect of inundation and the interchange between river and billabong. The data appear to be indicating that inundation of billabongs produces a rapid response ranging from almost instantaneous in the case of nutrients and dissolved carbon to 10-20 days for zooplankton. More rigorous analysis of our data set will indicate the size of this response and its significance in the ecological processes of the river ecosystem. The final report will go to Land and Water Australia in early July 2001. Two manuscripts have been prepared and another three will be finalised during the year.

## PROJECT A703 – MEASURING THE EFFECTIVENESS OF ENVIRONMENTAL WATER ALLOCATIONS

**Project Leader:** Dr Gerry Quinn

**Project Team:** Dr Michael Reid, Dr Terry Hillman

### **Aim**

To develop and trial monitoring programs to detect ecological responses in floodplain wetlands to environmental water allocations (EWA).

### **Progress**

This project established a monitoring program to assess the ecological responses in wetlands in the Barmah-Millewa Forest to environmental water allocations. The design was an MBACI (Multiple Before-After-Control-Impact), with four control wetlands not normally receiving water under planned EWAs and five “impact” wetlands receiving water. The distinction between the two types of wetlands was on the basis of flood threshold measurements. Water quality, macrophytes and macroinvertebrates were used as indicators of ecological responses and recorded twice per year for two years. Although there were natural high flow events during this period, there were no EWAs so these are “before” data. There were differences between control and impact wetlands for both macrophytes and macroinvertebrates, although the latter was confounded by a specific flooding event. The project made specific recommendations about future sampling designs, choice of indicators and levels of taxonomic resolution.

### PROJECT A709 – ENVIRONMENTAL FLOW REQUIREMENTS FOR AUSTRALIAN ARID ZONE RIVERS

**Project Leader:** Mr Julian Reid

**Project Team:** Mr Michael Good, Dr Jim Puckridge, Dr Fran Sheldon, A/Prof Keith Walker, Mr Justin Costelloe, Graeme Tomlinson, Dr Russ Sheil, Ms Janet Pritchard, Ms Vanessa Bailey, Mr Phil Bourke

#### **Aim**

To test the predictions of Dry/Wet and the IMAGHYD methodology in a two year multidisciplinary sampling program in arid and semi-arid rivers of the Lake Eyre Basin. This will extend the geographic scope of the DRY/WET predictions, as well as the predictive power to other parts of the biological community. From these results a general model will be developed (ARIDFLO) for environmental responses to flow for Australian arid zone rivers and a methodology for determining these responses.

#### **Progress**

ARIDFLO makes steady progress with fulfilling in a two-year time frame for its ambitious objectives.

Four field surveys across five broad reaches in three river systems in Queensland and South Australia have been successfully completed as planned. Some results are spectacular, although analyses and modelling are still in their infancy. Aerial surveys of waterbirds along with follow-up groundwork have resulted in the discovery of major, mixed-species breeding colonies hitherto unreported (several in excess of 10,000 pairs, with 10+ species involved); in all, 50 species of waterbird have been documented breeding. Striking changes in fish assemblage composition and diversity along salinity gradients, both across reaches and within reaches through time, have been found. Also through the collaboration of the Australian National University, the study of fish otoliths is providing ARIDFLO with a long retrospective window on fish breeding, growth and condition variability in response to inter-annual variation in the timing and magnitude of floods. Some community indices for the macroinvertebrate and zooplankton assemblages show similar responses to those for fish.



ARIDFLO team sampling channels of the Diamantina River at Goody Waterhole, SA.  
Photo: J Reid, CSIRO



The paucity of hydrologic data in the Lake Eyre Basin has been addressed by the installation of 18 water level loggers in 13 waterbodies over the three river reaches in South Australia. These water level data provide essential information on depth variations in water bodies during periods of no flow, on the timing of flow events at points downstream of existing gauging stations, and on previously ungauged rivers. In conjunction with remote sensing of flooding and drying patterns, IMAGHYD is allowing us to model the hydrologic regimes of these poorly gauged and ungauged arid zone rivers. Discharge data from existing and modelled hydrographs are currently being generated and incorporated into biological response models, at a variety of scales depending on the taxon and particular response (ie: the preliminary formulation of the ARIDFLO models).

### SUMMARY OF PROGRAM A OUTCOMES

Program outcomes (From Schedule)	3 year milestones (From Schedule)	Progress at year 2
Better understanding of the link between flows, ecological processes and biodiversity in a range of river types	Improved conceptual and empirical understanding of the role of flow (floods and droughts) as a disturbance affecting ecological processes in rivers and streams	<ul style="list-style-type: none"> <li>• Successful international symposium on the ecological effects of drought (Albury, Feb 2001). Proceedings to be published in <i>Freshwater Biology</i>.</li> <li>• Final report on Lowland River project emphasises the importance of phytoplankton and microbial loop in lowland river productivity. Results suggest that Flood Pulse Concept may over-emphasise importance of floods as source of organic material to lowland rivers.</li> <li>• Project on effects of flow on productivity, decomposition and trophic links in lowland rivers commenced.</li> <li>• Greatly improved understanding of links between flow and fish recruitment from Campaspe Flow Manipulation Project.</li> </ul>
New tools that will lead to improved recommendations for, and evaluations of, environmental water allocations	Ecological characterisation of flow regimes in rivers in Eastern Australia including both winter and summer rainfall systems	<ul style="list-style-type: none"> <li>• Proposal for funding of research project on characterising flow regimes completed and submitted - awaiting decision.</li> <li>• User-friendly version of software for calculating a range of flow parameters from flow gauge data. Current beta-testing by CRCFE and CRCC.</li> <li>• Focus on assessment of environmental flows (and other restoration efforts) at workshop on design and analysis of ecosystem experiments (Monash, Dec 2000).</li> </ul>
Ability to predict the sensitivity of aquatic ecosystems to varying levels of flow regulation (or water abstraction) from models relating biotic patterns and ecological processes with flow attributes	<p>Assessment and development of designs for:</p> <p>monitoring the effects of environmental water allocations, (environmental flows) to rivers floodplains and wetlands, and</p> <p>experimentally testing, at realistic spatial and temporal scales, the causal links between attributes of flow regimes and specific ecological processes</p>	<ul style="list-style-type: none"> <li>• Modified flow regime for Campaspe Flow Manipulation project will commence in 2001. Before-manipulation data set on fish and macroinvertebrates extensive with numerous publications.</li> <li>• Scoping report on research priorities for Narran Lakes and associated floodplain completed. Consultancy awarded from MDBC to collate and synthesis available hydrological and ecological data for Narran Lakes. Other research proposals being developed.</li> </ul>
Develop and promote the adoption of flow restoration recommendations that could lead to measurable ecological benefits in degraded rivers	Development of interim flow restoration guidelines for lowland rivers that will lead to measurable ecological benefits in the main channel, the floodplain and associated wetlands	<ul style="list-style-type: none"> <li>• Project on environmental flows and ecosystem response in the Cotter River, ACT, commenced. Focus on links between habitat, fish and their food resources.</li> <li>• Part of project developing statewide guidelines for environmental flow rules for unregulated rivers in Victoria.</li> </ul>

## 2.4 Program B – Restoration Ecology



Prof Stuart Bunn  
Program Leader

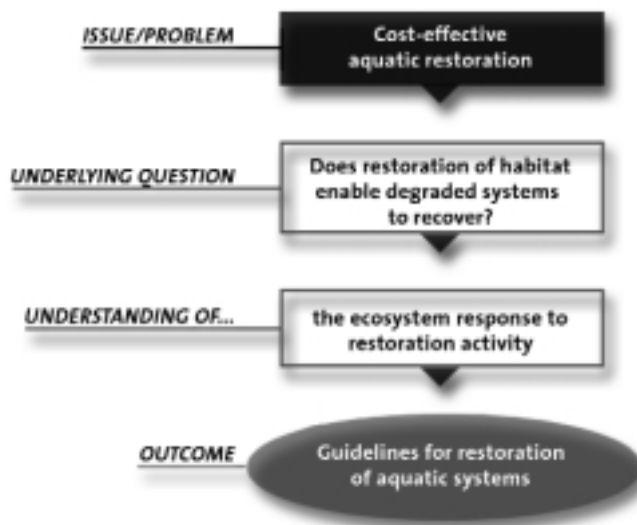
### **Program Leader: Professor Stuart Bunn**

Many of our streams, rivers and wetlands are in a degraded state and millions of dollars are spent each year on restoration. Unfortunately, little of the past restoration effort has been underpinned by a strong scientific base, and few attempts have been made to measure environmental benefits.

The CRC for Freshwater Ecology has a vital role to play in providing the essential ecological knowledge that is needed to underpin and guide practical restoration measures. The core research objective of this Program is to understand the ecological processes that will facilitate the recovery of disturbed stream and river ecosystems.

With this knowledge, we can ensure that future restoration projects are undertaken in ways that maximise the environmental benefits achieved for the money spent. We plan to assist this process through the development of guidelines for rehabilitation of streams, rivers and floodplain wetlands in both rural and urban settings, which include protocols for the assessment of recovery potential. We will also develop a suite of tools to monitor the success of restoration and link our efforts to demonstration sites to showcase ecologically sound rehabilitation methods. Where possible, we will undertake these activities in active collaboration with the CRC for Catchment Hydrology (CRCCH).

### **Program Issues and Outcomes**



### **Program Objectives**

- To understand the processes that will facilitate recovery of disturbed systems, and determine the resilience of restored systems to subsequent disturbances.
- To develop innovative approaches to waterway restoration which integrate across conventional disciplines to maximise environmental outcomes.
- To establish several case studies with relevant management groups as adaptive stream rehabilitation experiments.
- To facilitate the integration of river restoration practice into total catchment management.



To achieve these broad objectives, the *Restoration Ecology Program* has been organised around three broad research themes:

- Physical habitat restoration.
- Mechanisms of colonisation and recruitment.
- Indicators of success of restoration strategies.

#### THEME B1 - PHYSICAL HABITAT RESTORATION

A key assumption of most river and riparian restoration activities is that if you rebuild or recreate habitat then organisms will return and ecological condition will improve. This implies that recovery of degraded streams and rivers is largely constrained by the availability of suitable habitat.

- We will use rigorous scientific experiments to determine whether restoring habitat structure will lead to increased biodiversity and improved ecosystem function: e.g. Is it necessary to rehabilitate both the channel and the riparian zone? How much habitat needs to be restored and are there 'priority' sections?
- We plan to link our research with a small number of large-scale demonstration sites aimed at showing practical, cost-effective and ecologically sound rehabilitation methods. These will include urban and rural settings, in both summer and winter rainfall regions.

#### PROJECT B200 – RESTORATION ECOLOGY IN DEGRADED RURAL STREAMS: THE GRANITE CREEKS PROJECT, NE VICTORIA (JOINT CRCFE/CRCCH)

**Project Leader:** Prof Sam Lake

**Project Team:** Ms Alena Glaister, Dr Nick Bond, Dr Ian Rutherford, Dr Barbara Downes, A/Prof B. J. Finlayson, A/Prof R. Keller, J. Lin, N. Marsh, J. Olley, Mr Tarmo Raadik, Mr Leon Metzeling

**Timeframe:** 1/7/2000 - 30/6/2003

**Funding:** CRCFE \$388,040 Inkind \$267,000 Other \$261,000

##### **Aim**

Implement a specific rehabilitation method in the sand-impacted sections of rural streams and to evaluate the hydraulic, geomorphological and ecological effects of the habitat augmentation procedure.

##### **Progress**

All of the project milestones for 2000-2001 have been met.

The project is now at the stage that after the collection of hydrological, geomorphological and biological before-intervention data at the 18 test sites (9 per creek), the timber structures have now been installed.

In each of the lengthy sections of Castle and Creightons Creeks affected by the sand slugs, 3 control sites, 3 sites receiving 1 sleeper structures and 3 sites receiving the 4 sleeper structures were randomly selected. All the 18 control and test sites were chosen by September 2000 and all were characterised, geomorphologically and hydrologically by March 2001 by the project team members from the CRC for Catchment Hydrology. Before-intervention macroinvertebrate samples from both natural logs and from the sand substrate were taken at the test sites in late winter and spring 2000.

*The Granite Creeks Project is evaluating the effects of installing sleepers on sand-impacted sections of rural streams.  
Photo: N Bond, CRCFE*



The structures were designed by CRC for Catchment Hydrology colleagues and negotiations with landowners for permission to place the structures in the creeks on their land were successfully completed by March 2001.

The structures made from red gum railway sleepers were very efficiently built and assembled by staff of the Goulburn-Broken Catchment Management Authority and they were successfully installed between May 8 and May 22, 2001.

Work from the project has resulted in four conference presentations, a CRCFE Report (Technical Report 7/2000) and one refereed paper (in Ecological Restoration and Management).

This project is closely linked with the Associated Project B706 “Restoration Ecology of Fish Assemblages in degraded Rural Streams: The Granite Creeks Project” that is lead by Dr N Bond and supported by an AFFA Grant.

### **PROJECT B704 – RIVER REHABILITATION THROUGH RESNAGGING**

**Project leader:** Mr Simon Nicol

**Project Team:** Mr John Koehn, Mr Jason Lieschke, Mr Jarod Lyon, Mr Tim O'Brien

#### **Aim**

To identify and develop design criteria, measurable rehabilitation objectives for resnagging and success criteria for reintroducing snag habitat to a large lowland river and then to apply these to a number of sites to test the general application and success of this approach.

#### **Progress**

Design criteria were developed for reintroducing large woody debris into lowland rivers and experimentally tested at 14 sites in the Murray River. Three hundred pieces of woody debris were placed to test the response from the fish fauna to large woody debris densities and position in the river channel. The response from the fish fauna was surveyed in June 2001, with analysis still to be undertaken. This analysis will be used to determine whether the





measurable rehabilitation objectives and success criteria for reintroducing snag habitat were appropriate. The final product of the project will be a model for major resnagging of lowland rivers. This will include a cost/benefit analysis of resnagging, and criteria for prioritising areas for resnagging. Both are currently in draft form.

#### **PROJECT B705 – EXPERIMENTAL ASSESSMENT OF PHYSICAL HABITAT IN URBAN STREAMS: LIMITATIONS TO RECRUITMENT**

**Project leader:** Dr Chris Walsh

**Project Team:** Mr Edward Tsyrlin, Ms Kristy Brooke

##### **Aim**

To assess the effect of placing artificial rock-riffles in physically degraded urban streams on benthic macroinvertebrate community abundance and composition before and up to five years after placement.

##### **Progress**

Five years after their placement in six small streams with highly urbanised catchments, the riffles have retained their structural integrity. In some streams a dense stand of macrophytes has grown in and upstream of the riffles. Quantitative macroinvertebrate samples were taken in these six (and three control) streams 4 and 6 months before, and 7, 10, 43 and 58 months after placement. 10 months after placement some changes in community composition were evident in the riffles, but the assemblages remained species-poor, typical of degraded urban streams. Sample processing is near completion, with analysis and reporting to be complete in 2001.

*Brushy Creek at Croyden, Melbourne, before, during and after riffle replacement.  
Photos: C Walsh, CRCFE*



## THEME B2 – MECHANISMS OF RECOLONISATION AND RECRUITMENT

A key assumption of most river rehabilitation projects is that, if you re-create or restore aquatic or riparian habitats, then aquatic organisms will return (the so-called field of dreams hypothesis “If you build it, they will come...”). Successful stream and river restoration will depend, however, not only on the availability of habitat suitable for aquatic organisms to survive and reproduce, but also on the ability of organisms to reach the new habitat via dispersal. Physical restoration of stream habitats will be pointless if ecological recovery is constrained by the ability of aquatic plants and animals to recolonise disturbed sites. To be able to predict how quickly disturbed systems will recover, we need to know how aquatic organisms disperse (i.e. what mechanisms do they use) and how far can they move.

We will determine the major mechanisms of recruitment and recolonisation of biota to restored streams or reaches: e.g. What are the major constraints to recovery – are there in-stream barriers to dispersal? What are the rates of recolonisation and how quickly will restored habitats recover?

Projects will focus on the dispersal capability of a range of aquatic species in disturbed and reference catchments. This will include studies of restored sites to determine mechanisms of dispersal and the rate of recolonisation, and identify potential barriers and other constraints to recovery.

## PROJECT B703 – THE ROLE OF DISPERSAL AND RECRUITMENT IN STRUCTURING STREAM INVERTEBRATE POPULATIONS

**Project Leader:** A/Prof Jane Hughes

**Project Team:** Prof Stuart Bunn, Mia Hillyer, Dr Richard Marchant

### **Aim**

To determine whether recruitment is the result of only a few matings and in-stream movement is limited, by sampling streams where species have synchronous larval development and mass emergence of adults, and where in-stream movement (by drift) is thought to be high.

### **Progress**

Sampling for species with asynchronous development has been completed. We have analysed one species (a baetid mayfly), using nuclear and mitochondrial markers. Our hypothesis of recruitment being the result of a limited number of matings was supported in this species. An additional species from SE Qld, a stone-cased caddisfly, is also being analysed using nuclear and mitochondrial markers. The nuclear analysis has been completed and also supports the idea of limited recruitment. The mtDNA work is still to be done. Samples of a caddis and a baetid mayfly have been collected from an area with synchronous emergence times (Victoria). The caddis has been analysed for mtDNA, but had little nuclear (allozyme) variation. In addition, the presence of multiple species, recognised only after genetic analysis, made analysis problematic. Caddis have been resampled and will be analysed in the next few months, along with the Victorian baetids.

## THEME B3 – INDICATORS OF SUCCESS OF RESTORATION STRATEGIES

Most restoration projects are undertaken with the broad goal of improving “health” or “condition”, and success can only be measured in terms of both biodiversity and key ecosystem processes. The CRCFE has an important role to play in the development of practical and cost-



effective indicators of success of restoration activities. Much of the proposed work aimed at developing and testing new methods for ecological assessment of the success of restoration will be undertaken in Program D. For example, a detailed biophysical monitoring program is now in place to assess the success (or otherwise) of the small-scale riparian restoration experiments underway as part of the SEQ Regional Water Quality Management Strategy (D721). This is being undertaken in direct collaboration with CRCCH (Project 6.4).

However, an important question to be addressed in the *Restoration Ecology Program* is whether it is possible to restore key ecosystem processes (e.g. primary production, nutrient cycling) without completely restoring all elements of the biological communities.

We will identify biological indicators to evaluate the success of particular restoration strategies, for streams, rivers and floodplain wetlands.

An important aspect of this is to determine the relationship between commonly measured patterns (e.g. biodiversity or species composition) and important ecosystem level processes (e.g. carbon and nutrient fluxes).

#### PROJECT B220 – PROCESSES AND PATTERNS: RESTORATION, BIODIVERSITY AND ECOLOGICAL FUNCTIONS

**Project Leader:** Dr Darren Baldwin

**Project Team:** Dr Gavin Rees, Dr Rod Oliver, Dr Chris Walsh, Ms Alison Mitchell, Ms Helen Gigney, Mr Zygmunt Lorenz, Mr Garth Watson

**Timeframe:** 1/10/2000 - 30/6/2003

**Funding:** CRCFE \$199,050 MDFRC \$812,500 Inkind \$177,500

##### **Aim**

To determine whether or not river reaches with different in-stream habitat have different microbial and micro-algal community structure. These differences in community structure will be investigated to see if they equate to differences in the way a limiting nutrient (N) is processed.

##### **Progress**

The project, which commenced on 1 March 2001, will be based on the headwaters of Illalong Creek, near Yass. The first part of the project has been devoted to method development. We are currently optimising a molecular method to determine microbial diversity (terminal restriction fragment length polymorphism) for our samples. We have also developed a simple and robust technique to sample and study aquatic biofilms. Planning for the first major field trip, to be held at the end of July, is well under way.



*Moving snags into the Murray River. Initial results from the Resnagging Project (Project B704) suggest that re-introducing snags helps increase the number of native fish in the area. Photo: J Koehn, CRCFE*

## SUMMARY OF PROGRAM B OUTCOMES

Program outcomes (From Schedule)	3 year milestones (From Schedule)	Progress at year 2
<p>An improved understanding of the constraints to recovery of disturbed aquatic ecosystems and the processes that can facilitate rehabilitation can be quantified in ecological terms</p>	<p>Development and validation of innovative and practical monitoring tools so that the success of rehabilitation of streams and rivers</p>	<ul style="list-style-type: none"> <li>• Sampling techniques developed and tested for monitoring recovery of LWD habitats in degraded lowland streams. Experimental study commenced on the effects of LWD restoration in sand impacted streams.</li> <li>• Design and testing of a monitoring program for riparian rehabilitation in SE Qld as part of the SEQ Regional Water Quality Management Strategy.</li> <li>• Population genetic tools used to estimate dispersal capability of common stream invertebrates in SE Qld streams. Sampling of selected taxa in Victorian streams commenced. Core project developed with a focus on NSW coastal catchments.</li> <li>• Observed lack of recolonisation of benthic invertebrates on constructed riffle habitats in an urban stream after four years indicates that other factors may constrain recovery .</li> <li>• Two projects from CRCFE Mkl completed on understanding of nutrient cycling and ecosystem processes in streams, and how these relate to overall stream health.</li> <li>• A new project has commenced looking at the links between biodiversity and ecosystem processes, and the factors that may constrain recovery of processes</li> </ul>
<p>To ensure that public funds invested in restoration of degraded ecosystems result in the maximum environmental benefit possible This will be achieved by:</p> <ul style="list-style-type: none"> <li>• Developing guidelines for rehabilitation of streams, rivers and floodplain wetlands in both rural and urban settings, based on sound ecological principles</li> <li>• Establishing demonstration sites to showcase ecologically-sensitive rehabilitation methods</li> </ul>	<p>Initiate demonstration sites aimed at showcasing practical, cost-effective and ecologically sound methods for the rehabilitation of rivers and wetlands</p> <p>Contribute to the development of "best management practice" for the cost-effective and ecologically sound rehabilitation of rivers and wetlands</p>	<ul style="list-style-type: none"> <li>• Selection of study sites for riparian rehabilitation in SE Qld as part of the SEQ Regional Water Quality Management Strategy.</li> <li>• Recommendations for riparian land management written into the Draft SEQ Regional Water Quality Management Strategy.</li> <li>• Contribution to the production of technical guidelines on Riparian Management (with CRCCH &amp; LWRRDC).</li> <li>• LWD demonstration project underway on the Murray</li> <li>• Development of R&amp;D proposal for Phase 2 of the L&amp;W Riparian Lands Program - recently approved. This has obvious links with several projects in Program B and several CRCFE partners.</li> <li>• Two working groups established to investigate current best practice in restoring both flows and habitats in Australian rivers.</li> </ul>



*Female green and golden bell frog, Litoria aurea. The Litoria aurea population at Captains Flat is the only population known to survive in the Southern Tablelands. Photo: D Hunter, CRCFE*



## 2.5 Research Program C – Conservation Ecology



Assoc Prof Arthur Georges  
Program Leader

### **Program Leader: Associate Professor Arthur Georges**

Biodiversity is important to our culture in terms of economic value that can be gained from the biota via materials and medicines, the ecological sustainability of human societies, and the rich and varied opportunities in recreation and tourism.

Loss of biodiversity is perhaps our most serious environmental problem. Whether we look at wetlands or salt marshes, mangroves or bushland, inland rivers or estuaries, the same story emerges. Degradation of habitat, the major source of biodiversity loss, is continuing at an alarming rate.

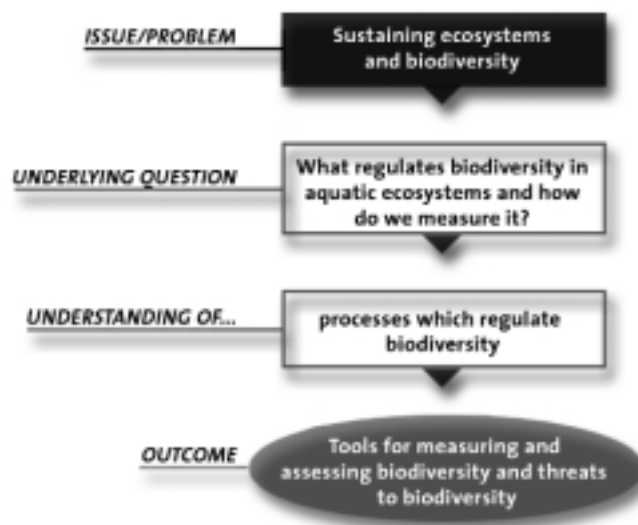
Conservation biology is a crisis discipline. Decisions regarding appropriate responses often need to be made on a time-scale of the immediate to the very near future. It demands an adaptive approach, where intervention and research, including monitoring and evaluation, go hand in hand to achieve improved conservation outcomes.

Negotiating a path to an effective solution may require input from a range of government bodies, non-government agencies, community groups and private land-holders whose activities influence biodiversity, positively or negatively. While we would argue that there is an important and arguably central role for science in biodiversity conservation, the contribution of science is not always clear, being moderated by a range of socio-economic factors. Without a prudent use of the best available knowledge and scientific decision-making frameworks, well-intentioned and expensive management often is ineffective or even counterproductive. On the other hand, science is not the sole contributor to solutions of environmental problems.

Any contribution of science to biodiversity conservation in freshwater ecosystems must include not only research, but mechanisms for ensuring the results of research are injected into the decision-making process in a timely fashion and in a form readily assimilated by managers and policy makers.

The CRC for Freshwater Ecology, by virtue of its strong industry linkages and its multi-disciplinary research capacity and knowledge base, is uniquely placed to provide leadership in research and its application to maintaining or restoring biodiversity values in a range of freshwater ecosystems.

### **Program Issues and Outcome**



## **Program Objectives**

- To assess biodiversity and its distribution in freshwater ecosystems, and to gain insights into processes that regulate levels of biodiversity at various scales in space and time.
- To identify threats to biodiversity, to measure their impacts on biodiversity, and to undertake research leading to a greater understanding of the mechanisms by which they act.
- To develop responses to these human-induced pressures, to monitor the outcomes of those responses, and to evaluate the effectiveness of the responses.

To achieve these objectives, the Conservation Ecology Program has been organised around the following research themes:

- Biodiversity assessment and regulation,
- Conserving Biodiversity.

## **THEME C1 – BIODIVERSITY ASSESSMENT AND REGULATION**

We will address the questions: What do we have left — what of our natural freshwater biodiversity remains relatively intact, how do we measure it, and how is it distributed across the landscape? How does the system work — what are the factors that regulate biodiversity in natural and modified ecosystems?

### **PROJECT C200 - DRYLAND RIVER REFUGIA**

**Project leader:** Professor Stuart Bunn

**Project Team:** Dr Yahya Abawi, Prof Angela Arthington, Michael Arthur, Stephen Balcombe, Dr Darren Baldwin, Chris Bartlett, Dr Margaret Brock, Dr Satish Choy, Louisa Davis, Dr Christy Fellows, Dr Nancy Fitzsimmons, A/Prof Arthur Georges, A/Prof Jane Hughes, Mr David Moffat, Dr Heather Proctor, Dr Jim Puckridge, Dr Russ Shiel, Dr Fran Sheldon, A/Prof Martin Thoms, A/Prof Keith Walker, Dr D Williams, Mr Glen Wilson, Michelle Winning

**Students:** Gio Carini (PhD), Heather McGinnes (PhD), Elvio Medeiros (PhD) and Ben Cook (Hons)

**Timeframe:** 1/10/2000 - 30/6/2003

**Funding:** CRCFE \$705,975 MDFRC \$51,000 Inkind \$1,152,000

#### **Aim**

To determine the importance of water holes as refugia for aquatic organisms in dryland river catchments and to identify the biophysical processes that sustain biodiversity and ecosystem health in these refugia.



### **Progress**

Staff have been appointed to each of the part-time and full-time positions at Canberra and Griffith Universities. Field sites have been selected in the Cooper Creek catchment and most have been selected in the Warrego River catchment. Site selection (particularly of undisturbed waterholes) within the Condamine-Balonne system is also underway. The proposed sampling design for the major field assessment of biodiversity was presented at the CRCFE Ecosystem Experiment Workshop in Melbourne in December 2000. Some of the difficulties in separating potential disturbance gradients (e.g. from water resource development) from geographic and climatic gradients were highlighted and discussed. A project information sheet has been prepared, and a detailed knowledge exchange plan is planned as part of the Program level activity. An initial field trip to the Cooper Creek catchment was undertaken in April 2001. This was a major undertaking, involving 18 staff and postgraduate students. Fifteen waterholes were intensively surveyed and sampled across four locations within the catchment. Initial sampling of sites in the Warrego catchment is planned for September 2001. Several invertebrate and fish species have already been screened for assessment of genetic diversity and Ben Cook recently received a first class Honours for his work in this area.

## **PROJECT C709 – ENDANGERED SPECIES SURVIVAL DECISION TOOL**

**Project Leader:** Mr Simon Nicol

**Project Team:** Mr John Koehn, Mr Charles Todd, Mr Andrew Bearlin, Dr Sabine Schreiber

### **Aim**

To develop a PC/Windows driven generic software tool to quantify the predicted risk of decline or likelihood of increase in native freshwater fish in the Murray Darling Basin.

### **Progress**

A second prototype of this software was finished in January 2001. This prototype is currently being tested against a number of Murray-Darling fish species. Help files for this software are currently being finalised, prior to the software being sent to an invited test panel for review. The test panel consists of professional working in both risk management and resource management of freshwater ecosystems in the Murray-Darling Basin. The software provides a fully interactive exploration of population dynamics in the PC/Windows environment. The software is due for completion in December 2001. All milestones have been achieved.

## **THEME C2 – CONSERVING BIODIVERSITY**

We will address the question: What can we do — how can we identify key threatening processes, manage their impacts, protect biodiversity values in natural and partially degraded systems, and conserve threatened species and communities?

## **PROJECT C210 - ADAPTIVE MANAGEMENT IN RESTORATION ECOLOGY**

**Project Leader:** Dr John Koehn

**Project Team:** Dr Simon Nicol, Dr John Harris, Dr Charles Todd, Mr Andrew Bearlin.

**Timeframe:** 1/1/2001 - 31/12/2001

**Funding:** CRCFE \$44,940 Inkind \$38,000

## Aim

To develop and apply an adaptive management approach to undertake fish conservation in the context of restoration ecology.

## Progress

The project has involved a review of literature on adaptive management in aquatic systems and explores how it can be applied to native fish management in the Murray-Darling Basin. The reintroduction of threatened fish is being used as an example. A dynamic population model for the threatened trout cod has been developed to which includes feed-back loops for evaluating reintroduction strategies. The literature review is due for completion in August 2001. The findings from this review and the modelling will provide the basis for a project plan for an adaptive management experiment. A workshop on adaptive management and its application to fish conservation and restoration ecology is planned for the later half of 2001.

*The Adaptive Management project has developed a dynamic population model for the threatened Trout cod.  
Photo: G Schmida*



## SUMMARY OF PROGRAM C OUTCOMES

Program outcomes (From Schedule)	3 year milestones (From Schedule)	Progress at year 2
New knowledge on the distribution, life history and conservation ecology of threatened freshwater biota	Organisation of a national forum on conservation of biodiversity in freshwater ecosystems, bringing together the range of perspectives from science and management	<ul style="list-style-type: none"> <li>Fenner Conference on the Environment to be hosted by the Australian Academy of Science and the CRCFE in July 2001.</li> </ul>
Principles and recommendations for assessing the biodiversity values of freshwater systems	Design of experimental protocols for testing hypotheses on the processes that regulate biodiversity in natural and modified freshwater ecosystems	<ul style="list-style-type: none"> <li>Key outcome of Dryland Refugium Project, especially with regard to the role of connectivity.</li> <li>Key outcome of associated project on sustainable management of on-farm biodiversity in the rice growing industry.</li> <li>Scoping study on biodiversity regulation in streams.</li> </ul>
Advice on the likely impacts of various human-induced disturbances on biodiversity in freshwater ecosystems and the spatial scales over which they are likely to be affected	Develop principles for the assessment of biodiversity in freshwater ecosystems	<ul style="list-style-type: none"> <li>Key outcome of associated project on sustainable management of on-farm biodiversity in the rice growing industry.</li> <li>Workshops on biodiversity assessment in freshwaters conducted for the Sydney Catchment Authority.</li> <li>Contract research project on assessment of the fish, macro-invertebrate and riparian biodiversity in the Sydney Catchments.</li> </ul>





## 2.6 Program D – Water Quality and Ecological Assessment



Assoc Prof Richard Norris  
Program Leader

### **Program Leader: Associate Professor Richard Norris**

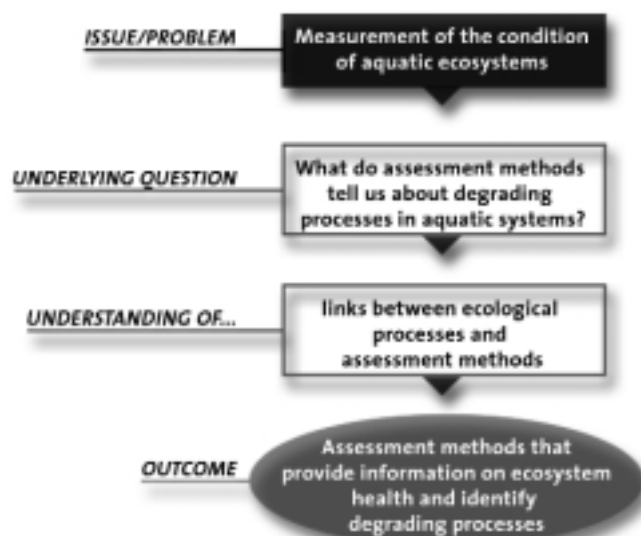
Recognition of the importance of aquatic biota coupled with biological assessment requirements in the new ANZECC guidelines has resulted in a move among Australian river management agencies towards more ecologically based management. To this end biological techniques that can be rapidly employed to assess the effectiveness of the management process have been adopted, in particular those using AUSRIVAS under the National River Health Program (NRHP).

There is a need for biological assessment of water quality approaches that: provided a rapid turn around of data for use in management; present the resulting information in an easily interpretable form; standardise the methods of measurement and data presentation; are applicable on a regional basis; respond in known ways to natural variability; can be implemented with designs that meet statistical needs such as avoiding spatial and temporal auto-correlation; can be easily incorporated into a monitoring program (rather than just assessment); and that can predict expected communities or processes so that degree of impact can be assessed and targets set for rehabilitation.

Some of these needs have been met in CRCFE Mkl and the NRHP, but others still require testing. Additional to the above needs, new issues are emerging. These include the protection of biodiversity; river restoration; environmental flows; habitat assessment; and those resulting from the application of the new methods such as reference site selection and variability in AUSRIVAS model outputs.

The CRCFE believes that biological assessment is fundamental to determining the state and direction of change in freshwaters. Further, that more confidence can be placed on interpretations if the ecological features closely related to the assessment methods are understood. Research in the area of ecological assessment is closely linked with knowledge exchange and the boundaries between the two are often unclear. For this reason, some closely related activities have been included against the milestones.

### **Program Issues and Outcome**



*Taking water samples to assess biota at Vanity's Crossing, ACT before a fishway is installed.  
Photo: A Tatnell*



### **Program Objectives**

Program D has five primary objectives around which the three program themes are arranged:

- To determine the ecological response of rivers and related wetlands to stressors.
- To develop and test ecological risk assessment procedures for application to freshwater systems.
- To develop the ecological basis for determining reference conditions against which comparisons to determine damage or change are often made.
- To determine the effectiveness of various bioassessment approaches to provide information on the condition of the aquatic communities and ecosystem processes.
- To determine the relationships between ecological features and processes and outputs from bioassessment methods.

### **THEME D1 – ECOLOGICAL RESPONSE TO DAMAGING AGENTS**

It is becoming increasingly recognised by the community and water agencies that effective management of the effects of human activities on the environment requires an understanding of the ecological effects of such activities. Damaging agents result from many sources including agricultural development and urbanisation. The variety of possible causes of damage to streams requires a concomitant range of studies. Generalisation of ecological responses and methods of detection is an overall goal in such work.

### **PROJECT D210 – URBANISATION AND THE ECOLOGICAL FUNCTION OF STREAMS (JOINT CRCFE/CRCCH)**

**Project Leader:** Dr Chris Walsh

**Project Team:** Dr Mike Grace, Dr Sophie Bourguès, Dr Simon Roberts, Tim Fletcher, Dr Peter Breen, Dr Gavin Rees, Dr Peter Newell, Dr Darren Baldwin, Dr John Beardall, Dr Tony Wong, Prof Barry Hart, A/Prof Jim Peterson, Ms Carleen Mitchell, Mr Simon Heislars, Ms Pua Tai Sim.



**Timeframe:** 1/10/2000 – 30/6/2003

**Funding:** CRCFE \$564,475 MDFRC \$67,500 Inkind \$607,500 CRCCH \$700,000

**Aim**

This project will assess the effects of urban land use on nitrogen transport and processing in streams, and relate these effects to more commonly used indicators of stream health, such as community composition.

**Progress**

The initial phase of this project has been devoted to the development of methods and finalisation of study design. A spatial database quantifying catchment imperviousness and drainage connection for the study area has been developed and will be used to select sites for the main phase of the project. Preliminary determinations were conducted at two sites: a 10 km<sup>2</sup> heavily urbanised subcatchment (Mullum Mullum Creek) and a 14 km<sup>2</sup> undeveloped forested catchment (McRae Creek). Temporal variation in nutrient spiralling length, and spatial variation within and between habitat types in chlorophyll concentration have been determined at both sites. Developmental work has also been conducted on estimation of whole-stream photosynthesis and respiration, and of nutrient concentration gradients in pore-water in the sediments. This work will be used to determine appropriate sampling regimes for the main phase. The dominance of hyporheic flows in less disturbed streams in the study area has discounted the use of benthic chambers for determination of sediment-water nutrient fluxes, and methods for the use of ex-situ cores are being developed. A Membrane-Inlet Mass Spectrometer has been purchased and set up for determination of denitrification rates.

*Part of the Project D210 team at Mullum Mullum Creek, Victoria*



## PROJECT D715 – ALGAL AVAILABILITY OF PHOSPHORUS DISCHARGED FROM DIFFERENT CATCHMENT SOURCES

**Project Leader:** Dr Rod Oliver

**Project Team:** Dr Ian Webster, Mr Shane Perryman, Ms Helen Gigney, Mr Zygmunt Lorenz

### **Aim**

To determine the bioavailability of phosphorus from different sources and to develop a sediment transport model that predicts the impact of the form of phosphorus on downstream algal blooms.

### **Progress**

This project was completed and a final report accepted by Land and Water Australia.

Reducing phosphorus enrichment of waterways is an important strategy for limiting the size of algal blooms, but it is important to correctly target the major contributors, especially as some sources are more amenable to regulation than others. Usually, the major phosphorus sources are identified from their relative contribution to the total phosphorus load. This approach assumes that the phosphorus from different sources is equally important in stimulating algal blooms, but this is not always the case. In this project, the different forms of phosphorus contributed to the Goulburn River by three major source types (an irrigation return drain, a sewage treatment plant and an upland dryland catchment) were assessed. Measurements were used to determine if the total phosphorus load from each source was indicative of its contribution to the supply of algal available phosphorus. In addition, samples were taken at distances downstream of each source to investigate whether phosphorus was transported along the river away from the source or stored within the local river sediments. These measurements were also used to assess the extent of transformation between forms. It was found that, despite a two-fold variation in the supply of total phosphorus from the three sites, they all contributed a similar amount of available phosphorus to the river. In all cases the majority of the available form was as 0.2 µm filterable reactive phosphorus. The composition of the phosphorus loads changed in response to run-off and flow events but differently for each of the sources. Downstream concentrations of phosphorus over the 20km long reaches remained surprisingly constant. A phosphorus speciation and transport model was developed and demonstrated the buffering of nutrient concentrations by the bottom sediments. This model also demonstrated the extent of phosphorus supply from the bottom sediments due to desorption processes. A diagenesis model was used to estimate nutrient release based on measurements of pore water nutrient concentrations in the sediments. Maximum rates downstream of the STP inflow were sufficient to increase river concentrations up to 7 µgP/L in a day. Rates at other sites were low. These differences between sites have important implications for targeting and managing phosphorus sources to rivers.

## PROJECT D717 – NATIONAL LAND AND WATER AUDIT

**Project Leader:** A/Prof Richard Norris

**Project Team:** A/Prof Martin Thoms, Dr Peter Liston, Dr Fiona Dyer, Mr Simon Linke, Ms Nerida Davies, in conjunction with CSIRO Land and Water (Dr Ian Prosser and Dr Bill Young)

### **Aim**

To provide an Australia wide assessment on the aggregate impact of land uses on river condition, and to recommend priorities for remedial works, protection and management.



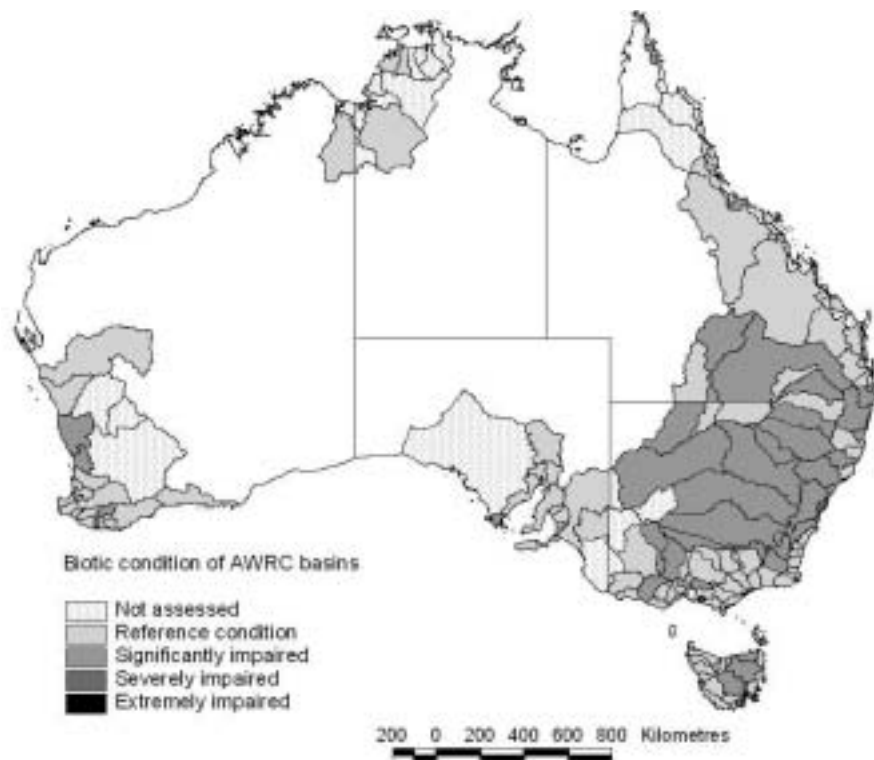
### Progress

This is a large project undertaken in collaboration with CSIRO Land and Water and is funded by the Natural Heritage Trust. The project recognises that national natural resource management requires information measured at a concomitant scale. Such information is required to assist managers assess and develop policy, decide on investments, evaluate program and policy performance and direct resource management, particularly by Government. Thus, large-scale auditing that focuses on the information needs of the Commonwealth and State Governments is needed. However, it is recognised that Local Government, rural industries, community groups, and various other government and non-government organisations will also benefit. Rivers need to be in good condition to provide the ecological goods and services that are fundamental to sustaining most of the uses to which they are put.

The Assessment of River Condition is an integration of a number of related elements of riverine condition, all of which affect, or are influenced by, ecological condition. The method is structured in a way that recognises the links between catchments, riverine habitats and aquatic biota, and in a way that allows the use of surrogates where available information is insufficient for assessments of particular elements. The ARC comprises two types of information on streams; status or condition as measured by the biota, and driving or impacting processes as assessed by habitat and catchment measures. There are five basic indices: one for biotic condition (Aquatic Biota Index), one for catchment condition (Catchment Disturbance Index) and three for habitat condition – Water Quality Index, Hydrology Index and Physical Habitat Index (incorporating channel geomorphology, riparian catchment and connectivity).

A final report has been submitted, reviewed by the states and NL&WRA office and is undergoing final editorial changes. The project has required the development of some innovative methods that have been applied at the national scale. An automated method has been developed for determining stream reaches using a digital elevation model and stream power characteristics. National databases have been created for each of the indices. Innovative methods combining spot data, remote sensed data and process and empirical models have been developed to create the indices for reporting at the reach scale nationally in a Geographic Information System.

*Map of the ecological condition of Australian river basins based on the aquatic invertebrate fauna. Ecological conditions at approximately 6000 sites were determined using the AUSRIVAS model. Over half the area assessed had biota rated as significantly impaired.*



## PROJECT D721 – SOUTH EAST QUEENSLAND REGIONAL WATER QUALITY MANAGEMENT STRATEGY – (SEQRWQMS): DEVELOPMENT OF AN ECOSYSTEM HEALTH MONITORING PROGRAM (TASK DIBM3) AND EVALUATION OF RIPARIAN REHABILITATION (RR3)

### TASK DIBM3 - DEVELOPMENT OF AN ECOSYSTEM HEALTH MONITORING PROGRAM (EHMP) FOR RIVERS AND STREAMS IN SOUTH EAST QUEENSLAND (SEQ)

### TASK RR3 - EVALUATING THE BENEFITS OF RIPARIAN REHABILITATION ON STREAM HEALTH

**Project Leaders:** Prof Stuart Bunn, Dr Andrew Storey

**Project Team:** Prof Stuart Bunn, Dr Andrew Storey, Mr Michael Smith, Dr James Udy, Ms Joanne Clapcott, Prof Angela Arthington, Mr Mark Kennard, Mr Nick Marsh, Dr Satish Choy, Mr Chris Marshall, Dr Bronwyn Harch, Dr William Venables, Dr Peter Davies, A/Prof Richard Norris, Ms Christina Dwyer

#### **Aims**

##### *Task DIBM3:*

This project will produce a generic, coordinated EHMP for freshwaters of SEQ that is able to measure and report on current and future changes in water quality and ecological condition. In addition, relevant regional water quality (vis ecosystem health) guidelines have been developed.

##### *Task RR3:*

This project will utilise a range of water quality (vis ecosystem health) indicators to assess the ecological condition of a number of small streams that have been subjected to riparian rehabilitation. Data are being collected before and after rehabilitation.

#### **Progress**

##### *Task DIBM3:*

The DIBM3 team started with a list of over 50 potential water quality (vis ecosystem health) indicators and through a rigorous, objective approach reduced this list to 15 indicators which were recommended for the EHMP. The centrepiece of the study was a major field trial that saw more than 20 indicators trialed at 53 sites across a gradient of disturbance. All indicators were applied at the same sites at the same time and an analytical protocol was employed to ensure results were directly comparable. The 15 recommended indicators fall into five

Researchers electrofishing in a south east Queensland stream to collect data on fish communities. Three fish indices are being used along with 12 other physical, chemical and biological indicators, to produce an Ecosystem Health Monitoring Program for the freshwaters of south east Queensland.  
Photo: A Arthington, CCISR, Griffith University





categories (see conceptual model) and include indicators of ecosystem processes ( $GPP_{R_{24}}$ ), biological patterns (fish, invertebrates) and some physico-chemical indicators (Diel DO, pH). Regional water quality guidelines have been developed for all indicators. The EHMP has been designed so that community groups, government departments and other institutions can work in a combined manner to report on the health of SEQ's freshwater ecosystems. The final report was submitted to the SEQ Regional Water Quality Strategy Office in July 2001 and is currently being reviewed.

*Task RR3:*

The focus of this task has been on Echidna Creek, a small demonstration catchment near Nambour on the Sunshine Coast. Pre-rehabilitation sampling has been performed at several sites on Echidna Creek and on a number of positive and negative control sites. Positive controls have healthy riparian vegetation whereas negative controls have no vegetation. On-the-ground works (i.e. fencing and tree planting) were completed towards the end of summer. The final report will be compiled by December 2001 and post-rehabilitation sampling will occur over the coming years to monitor long-term trends.

**PROJECT D722 – NUTRIENT CYCLING, PRIMARY PRODUCTION AND AQUATIC FOOD WEBS IN COASTAL RIVER SYSTEMS: IMPLICATIONS FOR EUTROPHICATION MANAGEMENT**

**Project leader:** Prof Stuart Bunn

**Project Team:** Dr James Udy, Dr H.M. Hunter, Dr W. Dennison, Dr W.A. Poplawski, Ms A Schmidt, Mr. M. Bartkow

**Aim**

The project will improve our understanding of impacts of catchment land use on downstream ecosystems and contribute to effective strategies for eutrophication management

**Progress**

This study has completed six field trips to investigate in-stream processes at 23 sites representing all the major landuse types in SE Qld. The key findings to date include:

- Nitrogen is the primary limiting nutrient for algal growth in freshwater streams of SE Qld.
- Denitrification is able to remove between 6 and 20% of the nitrogen that is delivered from diffuse sources in the sub-catchments of SE Qld.
- The rates for sediment nutrient flux were of a similar magnitude to the denitrification rates. However, in contrast to denitrification, sediment nutrient flux results in nutrients moving both into and out of the sediments. As a result, nutrient flux from the sediment is important on a local scale, but had only a small effect on catchment wide nutrient budgets.
- When the riparian canopy provided less than 70% shade to the stream, factors other than light availability determined the rates of algal production.
- Stable isotope analysis at natural abundance levels suggests that benthic algae provides the predominant source of organic carbon for in-stream fauna.

### PROJECT D723 – PREDICTING THE ECOLOGICAL CONSEQUENCES OF INCREASING SALINITY ON WETLAND SUSTAINABILITY

**Project Leaders:** Dr Margaret Brock and Dr Daryl Nielsen

**Project Team:** Michael Healey, Ken Harris, Irene Jarosinski

#### **Aim**

To determine how salinity and hydrology individually and in combination select plant and invertebrate communities from the “seed-bank”. This will allow protocols to be developed that predict how future changes in salinity will influence wetland sustainability and if modifications to hydrological management can ameliorate those effects.

#### **Progress**

In the 2000-2001 year this project has set up its experimental facility, conducted pilot trials and has collected its first data set and planned the second year of the project.

Our preliminary analysis of the first year’s data suggests that increasing salinity reduces the number of plant and zooplankton taxa emerging and surviving. Loss of these taxa will impinge on other processes that occur in wetlands. Continued investigation of these processes under a range of salinities, with sediments from a range of wetlands will further our potential to provide information that will allow development of protocols for management of salinity in a variety of wetlands.



*Daryl Nielson checks the progress of some salinity samples for Project D723.  
Photo: J Biro*

Within the next six months we will be able to use this preliminary data set to define our next set of experiments. These experiments will investigate emergence of biota from (1) A wider range of wetlands, (2) Intermediate salinities, (3) Continued examination of the interaction between salinity and hydrology, and (4) Continued examination of the sub-lethal effects of salinity on recruitment and reproduction.

Within Phase 1 we will deliver our understanding of how increasing salinity influences the composition of wetland communities from dormant eggs and seed banks. This information can be used as an indicator of change in aquatic ecosystems as a consequence of increasing salinity.

Subject to funding we intend to examine Phase 2: “How sustainable are the components and processes in wetland communities under increasing salt”, and Phase 3: “Can the aquatic communities of salt affected wetlands be rehabilitated by transplanting “seed and egg banks” selected for under saline conditions.” This should allow us to provide protocols and information that will aid in setting targets for salinity levels in wetlands in a variety of catchments, and provide tools for rehabilitation of wetlands under a variety of salinity levels within five years.





## THEME D2 – INNOVATIVE BIOASSESSMENT METHODS

Maintenance of 'river health' has become an important objective for river managers. This has led to a demand for standardised methods that accurately represent ecological condition. Many such methods have been developed recently but comparison and extensive testing has lacked the rigour and tradition of longer established physical and chemical methods. Thus, a need for better understanding of the strengths and weaknesses of such methods has been demonstrated.

Adequate assessment of ecosystem health also requires a range of methods that measure features of structure and function that are specific to particular problems or that clarify inter-relationships between various environmental features.

### PROJECT D200 – ASSESSMENT AND DELIVERY OF METHODS FOR DETERMINING RIVER HEALTH

**Project Leader:** A/Prof Richard Norris

**Project Team:** A/Prof Martin Thoms, Dr Peter Liston, Ms Sue Nichols, Mr Ian Lawrence, Mr Greg Keen, Mr Mark Lintermans, Prof Angela Arthington, Mr Mark Kennard, Prof Stuart Bunn, Dr Ross Hyne, Dr Bruce Chessman, Dr Satish Choy, Mr Glen Wilson, Mr Tim O'Brien, Mr Leon Metzeling, Dr Peter Newall, Mr Wayne Robinson, Mr Ian Prosser

**Timeframe:** 1/7/2000 - 30/6/2003

**Funding:** CRCFE \$632,700 Inkind \$926,000 Other \$90,000

#### **Aims**

To develop and test cost-effective approaches for assessing aquatic ecosystems using ecological information (physical, chemical and biological), through understanding processes and links between components and using this to develop appropriate guidelines for ecosystem protection.

#### **Progress**

##### *1. Method testing and comparison*

Different biological assessment methods (using fish, macroinvertebrates, macrophytes, diatoms and various functional measures) will be used to sample from selected sites along impact gradients (salinity, alien fish and habitat simplification). The first sampling run was completed by June 2001. Macroinvertebrates, macrophytes and diatoms were sampled from 90 sites along salinity gradients in selected areas of Victoria, NSW, ACT and QLD to compare the various biological assessment methods.



*Dedicated CRC staff member, Dan Mawer, livepicking invertebrates as part of Project D2000 to compare various biological assessment methods.*

### 2. *Development of new methods*

**A** *The Habitat Assessment Approach* requires construction of a predictive model(s) based on the habitat requirements of native fish. The models will predict habitat features that should occur at a site within the catchment and thus provide a valuable tool to manage the survival, breeding and passage requirements of fish populations. Murray Cod, Catfish, Murray Cod, Trout Cod, Australian Bass, Macquarie Perch, Two Spined Blackfish, Rainbow Fish, Purple Spotted Gudgeon, and Smelt were the fish chosen for the focus of the habitat assessment project. These species represent a range of fish types and cover a range of habitat requirements.

The initial task, now completed, has been to develop conceptual models, identify the habitat requirements of the selected fish species, and determine which are the limiting or most important features for the various life stages. These habitat preferences can now be translated into geomorphic terms and other variables that can be predicted from larger scale catchment features. Data existing in several databases Australia wide will be used together with new data to create and test the models.

**B** *The Reference Condition Approach* has been established as an efficient way of providing site-specific assessments. However, there is considerable debate over on what the reference condition should be based and how this affects assessment outcomes. Some argue for pre-European conditions, while others consider that since post-European land uses are not going to be removed from developed catchments, the adoption of best management practices should define the reference condition.

To date, good management practices for urban streams have been identified, and sites within the ACT that have met these criteria were sampled in autumn 2001. Additionally, a number of impacted sites and 'least disturbed' reference sites were also sampled. Predictive models based on the good-management-practice reference sites will be constructed following sorting and identification of the macroinvertebrate samples.

### 3. *Knowledge exchange*

A workshop was held in March 2001 to ensure that the design of research undertaken in this project is responsive to Partner information needs. Partner organisations and other water resource managers were invited to participate. Topics of discussion included principles guiding the selection of assessment methods appropriate to the information needs, information transfer tools to be provided by the project and the arrangement for ongoing review and development of knowledge exchange components. Check the CRC web site for a workshop summary.

## PROJECT D720 – SUPPORT AND COMPLETION OF AUSTRALIA WIDE ASSESSMENT OF RIVER HEALTH MODELS

**Project Leader:** A/Prof Richard Norris

**Project Team:** Ms Julie Coysh, Ms Nerida Davies, Ms Sue Nichols

### **Aim**

This project was designed to enable a second iteration of all the state/territory AUSRIVAS models to allow the incorporation on improvements in data quality and reference sites.

### **Progress**

The project was contracted to Environment Australia in two phases. The first phase producing final models for the ACT, Victoria and Tasmania has been completed, the models made available on the AUSRIVAS Website. Phase II of the project has recently been approved and final models are being produced for Western Australia, Queensland, Northern Territory and New South Wales.



### THEME D3 – ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment is a relatively new technique that holds promise as a quantitative method for assessing the level of risk posed by multiple stressors to the health of our aquatic ecosystems (multiple species). This new research area is being actively developed by the Water Studies Centre and the CRCFE.

#### PROJECT D220 – DEVELOPMENT OF A CATCHMENT-BASED ECOLOGICAL RISK ASSESSMENT FRAMEWORK FOR AQUATIC SYSTEMS.

**Project leader:** Dr Mike Grace

**Project Team:** Dr Peter Breen, Ms Monika Muschal, Dr Ross Hyne, Ms Therese Manning, A/Prof Mark Burgman, Mr David Tiller, Mr Charles Todd, Prof Barry Hart, Dr Chris Marshall

**Timeframe:** 1/7/2000 - 30/6/2001

**Funding:** CRCFE \$111,340 Inkind \$137,000

#### **Aim**

This project has three main objectives:

- To develop a generic, catchment-based ERA framework for assessing the ecological effects of multiple stressors. Throughout the development of the framework, there will be an initial focus on pesticides, a sub-project based at the Northern Laboratory at Goondiwindi. Concurrent development of a pesticide ERA will be used as a practical example of the application of this framework.
- To develop a core group of skilled ERA professionals in the CRCFE and also to enhance the general awareness of the ERA process in partner organisations.
- To develop a detailed ERA project proposal for continuation into phase II of the project and will develop from the knowledge and experience gained in this first year.

#### **Progress**

This one year project has been completed in accordance with the designated milestones, with only the final report still pending. Two, week-long workshops focussing on developing ERA expertise within the CRCFE and partner organisations have been undertaken under the tutelage of Assoc. Prof. Mark Burgman. These have dramatically improved the level of ERA awareness as well as introducing techniques required for quantitative risk assessment. The workshops also discussed the major inadequacies of existing ERA methods (including implicit subjectivity, bias, lack of 'bounds' on estimates, lack of transparency) and methods for avoiding/overcoming these deficiencies, all within the context of Australian ecosystems. A stakeholder workshop was held in Goondiwindi, providing the initial stage for a catchment-based ERA on the Macintyre River. This Macintyre ERA is being used synergistically in development of the CRCFE's "catchment-based ERA framework". Further development and application of this framework is one of the key objectives in phase II of this project. The detailed project proposal for phase II also includes aligning ERA research and application with particular environmental issues of concern to the CRCFE and its partners, including eutrophication, pesticides, salinity, suspended solids/sedimentation and environmental flows.

## SUMMARY OF PROGRAM D OUTCOMES

Program outcomes (From Schedule)	3 year milestones (From Schedule)	Progress at year 2
Improved scientific knowledge on the ecological effects of damaging agents (including nutrients and pesticides) in Australian freshwater systems	Development of priority areas for research in ecological response to agents that damage freshwater ecosystems	<ul style="list-style-type: none"> <li>• Effects of pesticides from cotton growing demonstrated in NSW rivers.</li> <li>• Nitrogen found to be the primary limiting nutrient in SE Qld. NO<sub>3</sub> &amp; OC important for controlling denitrification and rates are insufficient to deal with current loads. Shading from the riparian zone important for controlling stream productivity.</li> <li>• Scoping study on 'Macroinvertebrate Biomarkers: links to toxicosis and changes in populations or communities' now complete.</li> <li>• Urban rivers project now collated data on imperviousness and drainage connection to rivers. Methods and study design for assessing denitrification, nutrient spiralling and stream metabolism now finalised.</li> <li>• National Land and Water Resources Audit has incorporated an understanding of the relationships between catchment activities, habitat, water quality, changes to flow and the biota to provide an assessment of river condition. Data collation is complete, most data analysis is complete, final analysis, summary statistics and reporting is underway.</li> </ul>
Improved and robust bioassessment methods that provide information on ecosystem health and assist in identifying the degrading processes (including habitat modification)	Integration of AUSRIVAS with other techniques for assessment of river condition	<ul style="list-style-type: none"> <li>• Scoping study 'Dirty water models' completed and draft paper prepared for submission.</li> <li>• SEQRWQMS methods comparison and study design now complete and accepted by councils with new management structure.</li> <li>• Biological assessment has become an important component of the Victorian State Environmental Protection Policies, Index of stream condition, Qld Water Allocation Management Plans.</li> <li>• Workshops held on design for comparison of methods, habitat assessment and information needs of partners for integration of biological methods into monitoring programs.</li> <li>• National State of the Environment Report summary of the First National Assessment of River Health with site assessments, basin summaries and state agency comments has been completed and submitted to Environment Australia.</li> <li>• Final report on Physical and chemical methods for assessment of river condition has been accepted by Environment Australia.</li> <li>• Study design for a Sustainable Rivers Audit in the Murray Darling Basin is nearing completion. This has involved the integration of physical, chemical and biological methods in an overall framework and interfaced with state agencies' current assessment programs.</li> <li>• A pilot study is commencing to establish the requirements for a long-term biodiversity assessment program for the Sydney Catchment Authority. The project includes assessment of fish, riparian vegetation and macroinvertebrates. The design has been done in collaboration with the SCA.</li> </ul>
New ecological risk assessment procedures and associated tools for use by water industries	Bring in expertise in ecological risk assessment (biota and processes with inputs to ecological risk assessment over a range of scales up to catchment level)	<ul style="list-style-type: none"> <li>• Leader in Environmental Risk Assessment, Dr Mark Burgman brought in to assist in leading workshops on ERA.</li> <li>• Community groups engaged in ERA.</li> <li>• CRCFE staff developing expertise in ERA through a series of workshops.</li> <li>• CRCFE playing major role in the developing and applying ecological risk assessment approaches (e.g. new Australian and New Zealand water quality guidelines, NPIRD Project).</li> </ul>



## 2.7 List of Research Projects

(i) The letter in front is the Program Code A – D. Our research programs are assigned letters A, B, C and D (see below).

(ii) The hierarchy of the numbering system (which runs across programs) is:

- 100s Continuing projects from CRCFE Mk1
- 200s Core projects from CRCFE MkII Phase 1
- 600s Special investigations (scoping studies, consultancies)
- 700s Associated research projects
- 800s Postgraduate projects

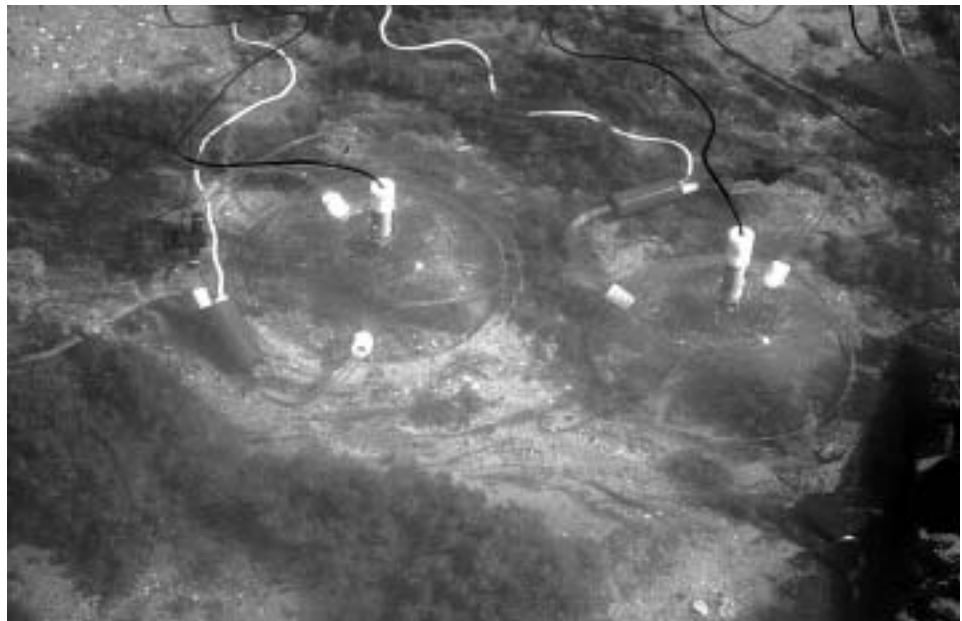
Consulting projects are usually run through program F, as are some contract research projects, and will normally carry an F600s number.

\* Recently approved projects

### **Program A: Flow-related Ecological Processes**

- A100 Campaspe flow manipulation
  
- A200 The effect of flow on lowland river productivity
- A210 Environmental flows and ecosystem response in the Cotter River \*
  
- A702 Billabong river interactions during high-flow in the mid Murray
- A703 Measuring the effectiveness of environmental water allocations
- A708 The effect of water regime on wetland ecology
- A709 Environmental flow requirements for Australian arid zone rivers
- A710 Modelling dry-season flows and predicting the impact of extraction on a flagship species
- A711 Habitat fragmentation and environmental flows in the Condamine River
- A712 Importance of flood flows to productivity of dryland rivers and their floodplains
- A713 Floodplain inundation and fish dynamics
- A714 The occurrence and significance of photosynthetic bacteria in freshwater ecosystems

*Metabolism domes, one of the tools being used in Project D722 to improve our understanding of the impacts of land use on downstream ecosystems.  
Photo: CCISR, Griffith University*



- A801 Identification and characterisation of larval fish nursery habitats in floodplain rivers of the Murray Darling Basin
- A802 Relationships between lowland river fish and snag habitats
- A803 Photochemistry of aquatic substances
- A804 Impact of flow regulation on carbon and nutrient cycles of floodplain wetlands of the Murray River
- A806 Factors affecting growth of larval fish in the MDB
- A807 Fish habitat in giant rush stands: littoral zone interactions in a floodplain billabong river
- A808 Distribution and abundance of three species of carp gudgeons in the Broken River, Victoria
- A809 Flow related responses of floodplain vegetation in variable inland catchments
- A810 The influence of water regime upon the floristic composition of Lower Murray wetlands
- A813 Zooplanktivory by fishes in rivers of the lower MDB

### **Program B: Restoration Ecology**

- B200 Restoration Ecology in degraded rural streams: the Granite Creeks Project, NE Victoria
- B220 Processes and Patterns: Restoration, Biodiversity and Ecological Functions
- B230 Connectivity and Dispersal \*
  
- B701 Storage, production and transfer of carbon and nutrients in the Condamine-Balonne River system
- B703 The role of dispersal and recruitment in structuring stream invertebrate populations
- B704 River rehabilitation through resnagging
- B705 Experimental assessment of physical habitat in urban streams: limitations to recruitment



*Assessing the biota moving in and out of the reach at Vanity's Crossing, ACT before a fishway is installed.  
Photo: A Tatnell*



- B706 Restoration ecology of fish assemblages in degraded rural streams: The Granite Creeks project \*
- B707 Rehabilitating submerged macrophytes enhances survival of larval and juvenile fish \*
  
- B801 Impact of carp on macrophytes and water quality. - Driver
- B802 Biochemical cycling of nutrients in a sand slug stream (Creightons Creek Vic)
- B803 Dispersal of aquatic insects and the implications for river conservation in southern Africa
- B804 Colonisation of macroinvertebrates following reintroduction of vegetation in a degraded rural stream
- B805 The influence of coarse woody debris on habitat quality for invertebrate fauna in red gum forest
- B806 The productivity and community structure of periphyton in relation to grazer guilds
- B807 Riparian vegetation distribution, disturbance and regeneration in the SE Murray-Darling Basin
- B808 The ecology of large woody debris in Australian lowland rivers

**Program C: Conservation Ecology**

- C200 Dryland River Refugia
- C210 Adaptive Management in Restoration Ecology
- C220 Conservation Biology and Systematics of the Mountain Galaxias \*
  
- C702 Systematics of the Australian mayflies (Ephemeroptera) of the Family Baetidae and Family Caenidae
- C704 Conservation and evolution of freshwater crayfish
- C709 Endangered species survival decision tool
- C710 Long-term monitoring of the littoral fauna of Lake Pedder
- C711 Sustainable management of on-farm biodiversity in the rice growing industry: vertebrate wildlife resources \*
- C712 The ecological distribution and abundance of Green and Golden Bell frogs on the Molonglo River floodplain \*
  
- C802 Temperature dependant sex determination in turtles
- C.03 Assessing biodiversity in temporary and perennial wetlands
- C805 Taxonomy of two stonefly genera Leptoperla and Riedoperla
- C806 Taxonomy of freshwater invertebrates (Ephemeroptera)
- C808 Fish distribution on the Ovens floodplain: relationships between oxygen, temperature and pH
- C809 Habitat heterogeneity and carbon dynamics in semi-arid floodplain river systems
- C810 Factors affecting biota in temporary freshwater ponds

**Program D: Water Quality and Ecological Assessment**

- D200 Assessment and delivery of methods for determining river health
- D210 Urbanisation and the Ecological Function of Streams
- D220 Development of a Catchment-based Ecological Risk Assessment Framework for Aquatic Systems

- D715 Algal availability of phosphorus discharged from different catchment sources
- D717 National Land and Water Audit
- D720 Support and completion of Australia wide assessment of river health models
- D721 SEQRWQMS
- D722 Nutrient cycling, primary production and aquatic food webs in coastal river systems: implications for Eutrophication management
- D723 Predicting the ecological consequences of increasing salinity on wetland sustainability
- D724 Tooma River Study \*
  
- D802 Algae and bacteria in nutrient cycling
- D804 Nutrient dynamics in LaTrobe River catchment: P spiralling in response to lotic ecosystem disturbance
- D805 In situ testing of water quality
- D806 Compositional patterns of lotic benthic macroinvertebrates
- D807 Rapid assessment protocols for using diatoms as water quality indicators
- D811 Characterisation of colloid-sized particles using FFF techniques
- D814 Development of a predictive model for algal growth in Cairn Curran Reservoir
- D817 Population dynamics and physiology of phytoplankton
- D818 Scales of spatial correlation in macroinvertebrate community structure
- D819 A Reference Condition for River Protection Based on Good Management Practices
- D820 A quantitative basis for the use of fish as indicators of river condition
- D821 Determining the health of the Lachlan River
- D822 Toxicity of pesticide mixtures and sediment binding of pesticides in storm runoff water from cotton fields
- D823 Characterisation of aquatic particles and cells using Thin Channel Fractionation methods

The CRC is working to preserve native fish, such as this Mountain Galaxias, *Galaxias olidus*.  
Photo: N Armstrong









Prof Gary Jones  
Program Leader

## **Program Leader: Professor Gary Jones**

### **Highlights**

- Provided First National Assessment of River Condition, through the National Land and Water Resources Audit, as a basis for large scale decision making about improving river condition across Australia.
- Developed a framework for a clear, comprehensive annual review of the condition of the Basin's river systems – the Sustainable Rivers Audit – for the Murray-Darling Basin Commission.
- Provided high level briefings on river health and related water issues to the Prime Minister, and Federal Ministers for the Environment; Agriculture, Fisheries & Forestry; and Science, Resources & Industry.
- Reviewed progress made toward the definition, measurement and reporting of Ecologically Sustainable Development as it is applied to Queensland's water resources in a 2 day workshop with Queensland Department of Natural Resources and Mines (QDNRM).
- Worked with CRC for Freshwater Ecology partners over three workshops to establish and plan monitoring needs for chemical, physical and biological stressors of aquatic systems.
- Organised and facilitated the Dalby Condamine-Balonne Community River Health Forum on behalf of partner QNRM.
- Initiated a three day workshop on "Knowledge Seeking Strategies of NRM Professionals". Involved Stakeholders.
- Two new Knowledge Brokers joined the KE Team – Amanda Kotlash (based at Sydney Catchment Authority) and Michelle Bald (Lower Basin Laboratory, Mildura)
- Gave over 90 presentations and talks to a wide range of people and organisations.
- Published 94 refereed journal articles, 13 book chapters, 10 identification guides and 59 conference papers.
- Produced 130 media hits through over 65 media outlets (10 TV, 42 radio, 67 newspaper and 11 magazine stories).

### **3.1 Cooperative Linkages**

The CRC for Freshwater Ecology (CRCFE) recognises that collaboration is fundamental to achieving its outcomes and has established strong links:

- Across CRCFE sites and disciplines;
- With its 19 member organisations;
- With researchers and outside the CRCFE;
- With the four other water-related CRCs in the Water Forum – CRC for Catchment Hydrology; CRC for Water Quality and Treatment; CRC for Waste Management and Pollution Control; CRC for Coastal Zone, Estuary and Waterway Management;
- With natural resource managers, government officials and community groups; and
- With the water industry.

A range of knowledge exchange strategies are used to forge these cooperative links including: jointly planned research projects, face to face problem solving workshops, joint research and consulting submissions, participation on expert panels and committees; joint planning meetings; knowledge brokering, staff exchanges; joint publications and newsletters.



### 3.1.1 INTERNAL LINKAGES

The CRCFE works to ensure that cooperation occurs between its four research programs and across its different sites. Internal structures and activities are in place to facilitate this internal cooperation:

Activity	Function	2000 - 2001
Board Meetings	Set CRCFE policy and direction. Ensure that activities meet the Centre's stated objectives	Met three times in the year
Executive Meetings	Chief Executive, Deputy Directors and Chief Administrator. Review progress of the CRCFE against objectives and outcomes. Provide implementation plans on new initiatives as determined by the Board	Fortnightly
Management Committee	Executive, Program Leaders and Chief Ecologist. To develop proposals to present to the Board for approval	Every two months
Program Meetings	Coordinate the implementation of each research program, review progress	
Annual Staff Meeting	Sharing and updating of information	Albury, November
Postgraduate Workshop	Student presentations of research, and discussion on key education issues	Albury, November
Database Sharing	Most CRCFE sites are connected with each other electronically. Lotus Notes, a projects management system, facilitates reporting and collaboration	Ongoing
Seminar Series	New national CRC Water Forum seminar series currently being developed in Brisbane, Sydney, Melbourne and Canberra. Commencing November, 2001	Variable
Watershed	Internal and external newsletter, reports on Centre's research. Readership of 3,000	6 times per year
CRCFE News	Electronic internal newsletter	Weekly

### Sharing of facilities

The Centre's research portfolio emphasises cross-project and cross-site links. As a result, a number of projects share field sites and equipment. Staff and students have access to the following facilities across research sites:

- Experimental billabongs – Albury
- Chemistry laboratories – Albury, Canberra, Melbourne, Brisbane, Mildura
- Curated flora and fauna collections – Canberra, Albury



*The D2 project team met during the CRC's Annual General Meeting.  
Photo: L Sealie, CRCFE*

## 3.1.2 PARTNER SUPPORT

### 3.1.2.1 ACTEW Corporation

- Effluent Quality from Distributed Treatment Plants Risk Assessment: Provision of health risk assessment (Monash Medical School) (I Lawrence)
- Design of Cotter River environmental flow monitoring program (I Lawrence)
- Risk assessment for distributed treatment plants for ACTEW (I Lawrence)
- Advice on study design and monitoring for environmental flows in the Cotter River. (R Norris, G Quinn, J Whittington, I Lawrence)
- Distributed Treatment Plant Risk Assessment consultancy, (B Maher, R Norris, P Cottingham, I Lawrence)
- Advice regarding the environmental health of ACT's waterways and on issues associated with the setting of ACT's Cap (J Whittington, I Lawrence)

### 3.1.2.2 CSIRO Land and Water

- Development of R&D priorities for nitrogen in freshwaters (S Bunn, J Udy and C Fellows)
- Co-organised Fifth International Conference on Toxic Cyanobacteria
- Reference panel assessment of CRCCH/CSIRO projects on sediment transport effects on physical habitat and fish habitat rehabilitation (R Norris)
- Input to Biodiversity Sector meeting (R Shiel, J Hawking)
- Development of Phase 2 of LWA Riparian Lands Program (S Bunn and I Prosser)

### 3.1.2.3 Department of Land and Water Conservation (NSW)

- Provided advice on use of draw-downs in carp control (G Wilson)
- Input to 2<sup>nd</sup> Cross Border meeting (T Hillman)
- Participated in MLDCRC Targeted Environmental Releases Working Group (T Hillman)
- Input to Murray Unregulated River Management Committee (J Whittington)
- Collaboration on stable isotope analysis of biofilms, through DLWC's "*Integrated Monitoring of Environmental Flows Methods Manual*" (S Bunn, B Chessman, D Westhorpe)
- Collaboration on jointly supervised PhD project on Floodplain vegetation (A809) (S Bunn and M Brock)
- Field trip to Walgett and the Narran Lakes Nature Reserve to scope potential research projects (MDFRC, DLWC and CRCFE staff)
- Member of Snowy River Benchmarking project Scientific Steering Committee (S Lake)
- Catchment Targets of the Murray Catchment Plan meeting (T Hillman, M Copland)
- Chairman of Expert Panel, Agribusiness Taskforce (T Hillman)
- Member, Algal Coordinating Committee (B Gawne)
- Advice and publications provided on Bony Bream management (I Ellis, B Ebner)
- Provided advice on carbon dynamics-Ecosystem Processes & Biodiversity Unit (S Bunn)
- Advice provided to the Warragamba Catchment Joint Planning Group (JPG), on setting appropriate catchment management targets for aquatic health in the catchment (A Kotlash)

### 3.1.2.4 Department of Natural Resources and Mines (Qld)

- Organised River Health Community Forum in Dalby Qld, 16th May. Forum report published and distributed (L Sealie, G Jones)
- Discussions on stream habitat assessment (S Bunn, S Boon)
- Input to Water Resources Plans: Pioneer Water Resource Plan, Technical Reports for publication
- Discussions on WAMP communication needs (G Jones)
- Developing collaboration opportunities for Northern Laboratory (G Wilson, B Hart, S Bunn, A Arthington G Claydon, T Vanderbyl and S Choy)



Satish Choy and participants at the River Health Forum, Dalby.  
Photo: R McIntyre, QDNR&M



- Collaborative fish research projects in Murray-Darling Basin (G Wilson, A Arthington and D Moffatt) and Northern Laboratory research priorities (G Wilson, T Hogan, Director General of QDNR, J Voller)
- Input to Burnett PDL Workshop (A Arthington)
- Member Benchmarking Steering committee (A Arthington)
- Carried out Obi Obi Creek Surveys (A Arthington)
- Advised on Burnett WAMP, Pioneer WAMP, Logan River Basin (A Arthington)
- Input to biomonitoring for the Condamine-Balonne (S Bunn)
- Proposed implementation of an ecosystem health monitoring program for SEQ streams and rivers

#### **3.1.2.5 Department of Natural Resources and Environment (Vic)**

- Provided advice on use of draw-downs in carp control (G Wilson)
- Developing linkages with Victorian CMAs (B Hart, J Doolan and J Riddiford)
- Bulk entitlements meeting with Bill Hansen (B Hart)
- Report on 'quantifying nutrient-algae relationships' from workshop Aug 2000 (B Hart and P Cottingham)
- Development of project brief seeking the formation of expert panels to assess flow requirements in the Broken River and Ovens River, Victoria (P Cottingham)
- Scientific Panel on environmental flows in Ovens River (P Cottingham, T Hillman, G Hannan, J Koehn, L Metzeling J Roberts and I Rutherford)
- Scientific Panel on environmental flows in Broken River (P Cottingham, T Hillman, P Humphries, G Hannan, L Metzelaing, J Roberts and M Stewardson)
- Scoping study to identify needs of river rehabilitation for lower Thomson and Macalister rivers (B Hart, P Cottingham, T Raadik, G Quinn and J Barton)
- Scientific Reference Panel for the Victorian River Health Strategy (S Lake and B Hart)
- Sustainable Streamflow Regime and Development Limits Project Working Group (S Lake)
- Working Group on project – State-Wide Guidelines for the Determination of Environmental Water Requirements in Victoria. (S Lake)
- Advice to DNRE on the split of flow released from Cowwarr Weir to the Thomson River and Rainbow Creek (P Cottingham, B Hart and P Humphries)
- Participated in the Victorian River Health Strategy - proposed Instream Habitat issues workshop, Melbourne on 14 July (T Hillman)
- Provided water quality data for preparation of Olinda and Stringybark Creeks stream-flow management report (C Walsh)
- Exploring potential research on nitrogen cycling in riparian zones (S Bunn)

## 3.1.2.6 Environment ACT

- Advice on ACT & SE Region State of the Environment Report (Water) to Environment Commissioner (I Lawrence)
- Member of the Sullivans Creek Catchment Technical Advisory Committee (I Lawrence)
- Advice and support to Sullivans Creek Catchment Group on demonstration wetlands (I Lawrence)
- Advice to ACT Planning & Land Management Division on integrated urban land & water management principles and practices in relation to new sub-divisions (I Lawrence)
- Development of a Sustainability Index (Water) for urban residential development, for ACT Planning & Land Management (I Lawrence)
- Supported Planning Initiatives Workshops (I Lawrence)
- Input to OECD Renaissance Project re urban water management initiatives (I Lawrence)
- Input to Review for the ACT Water Audit Report (I Lawrence)
- Development meeting for the Cotter Environmental Flows Research project (J Whittington, I Lawrence, R Norris)

*A release of water from Bendora Dam provides environmental flows for the Cotter River.  
Photo: S Nichols. CRCFE*



## 3.1.2.7 Environment Protection Authority (Vic)

- Assisted in organising the EnviroInx Catchments to Coast Forum (P Cottingham)
- Presentation on role and activities of the CRCFE (B Hart)
- Attended Board meeting (B Hart)
- Input to Board planning meeting (B Hart)
- Member, Science Advisory Committee (B Hart)
- Input to Community Consultation Forum (B Hart)
- Organised workshop to examine approaches to calculating nutrient loads discharged from the Macalister Irrigation District, report prepared (B Hart, P Cottingham)
- Assistance to Mr Rob Goudey on the analysis of rotenone applications to streams
- Met with EPA Vic and DNRE to discuss Victorian River Health Strategy (B Hart)



### **3.1.2.8 Environment Protection Authority (NSW)**

- Provided advice on use of draw-downs in carp control (G Wilson)
- Discussions with new knowledge broker (A Kotlash)
- Advice to D Winfield Queanbeyan Office on biogeochemical framework underpinning catchment management planning (I Lawrence)
- Joint development of SCA Biodiversity project through two problem solving workshops
- Assisted in identification of dead fish for EPA Wentworth (I Ellis)
- Advice provided to the Warragamba Catchment Joint Planning Group (JPG), on setting appropriate catchment management targets for aquatic health in the catchment (A Kotlash)

### **3.1.2.9 Goulburn-Murray Rural Water Authority**

- Scoping study for ecological risk assessment completed, to be adopted by Land and Water Australian in National Program for Irrigation Research and Development (P Cottingham, P Breen, R Beckett, M Grace and B Hart)
- Lake Mokoan Restoration Strategy Workshop (T Hillman and R Oliver)
- Collaborated in seeking funds from National Program Irrigation R&D funds to scope approaches to ecological risk assessment of the Goulburn Irrigation Area (B Hart, P Breen, P Cottingham)

### **3.1.2.10 Griffith University**

- Discussions on CRCFE education program needs (Jones/Heck)
- New PhD project for Griffith University student established at Northern Laboratory (G Wilson, A Arthington and E Medeiros)

### **3.1.2.11 La Trobe University**

- Member, University Council (T Hillman)
- Provided Chairman – La Trobe University Albury Wodonga Campus Regional Advisory Board (T Hillman)
- On-going ecological education development with Graduate Diploma students (M Copland)

### **3.1.2.12 Lower Murray Water**

- Provided advice on management of Blue-Green Algae to Board (B Gawne)
- Provided advice on *Typha* management (B Gawne)
- Member, Cardross Task Group, Mallee Catchment Authority (B Gawne)
- Input to Wetlands Operational Plan Project, Mallee Catchment Authority (B Gawne)

### **3.1.2.13 Melbourne Water**

- Yan Yean Reservoir management joint problem solving workshop (P Breen, P Cottingham, B Hart, G Jones, I Lawrence, R Oliver)
- Provided advice on management of blue-green alga *Planktolyngbya* in the Quiet Lakes (Patterson Lakes) (P Cottingham, R Oliver and G Jones)
- Assisted with organisation, and attendance at the Yarra Forum, July 2000, December 2000 and June 2001 (P Cottingham, P Breen, C Walsh and B Hart)
- Supplied information on approaches to sampling zooplankton (P Cottingham, D Nielson)
- Provided identification of zooplankton collected from three urban lakes (D Nielson)
- Contributed to a report defining best options for management programs in Maribyrnong River Catchment (C Walsh)
- Produced and maintained a bibliography of Yarra catchment research on the WWW (<http://www.wsc.monash.edu.au/urbanwater/yarrabibliog.html>) (C Walsh)

### **3.1.2.14 Monash University**

- Input to Environmental management post graduate course (P Cottingham and L Soste)
- Developing potential links between L&WA Riparian Lands (Phase 2) and the Granite Creeks Project (S Lake, S Bunn)
- Provided CRCFE publications (L Sealie)

### **3.1.2.15 Murray Darling Basin Commission**

- Development of Sustainable Rivers Audit, including several task group meetings (J Whittington, R Norris, J Coysh, M Thoms, P Liston, I Lawrence, B Gawne)
- Briefed MDBC on SRA Draft Final Report (J Whittington)
- Input to MDBC Biological Monitoring Working Group technical meeting (T Hillman)
- Member, Riverine Issues Working Group meeting (T Hillman)
- Attended and participated in MDBC Forum April, 2001 (J Whittington, P Cullen, B Hart, B Gawne, G Wilson, G Jones, R Norris, T Hillman)
- Provided CRCFE publications (L Sealie)
- Coordinating new Murray River Environmental Flows & WQ Objectives Expert Reference Panel (G Jones, T Hillman, K Walker, A Arthington, J Whittington, S Cartwright, T Jacobs)
- Environmental flows working group for Murray River met with Trevor Jacobs (P Cullen, J Whittington, I Lawrence, P Liston)
- River Health presentation to MDBC Community Advisory Committee (B Gawne)
- Meeting to develop MDB Communications and Basin Link Network (G Jones, L Sealie and L Kirk)
- Member, Advisory Group on Hume-Yarrawonga Waterway Management (T Hillman)
- Murray River Expert Panel, Stage 2 of Assessment of Environmental Flows, report to MDB Ministerial Council (T Hillman, G Jones, M Thoms, J Koehn)
- Presentation to combined meeting of two Project Boards of the MDBC: The Environmental Flows Management and Water Quality Objectives for the River Murray Project Board, together with members of the Floodplain Management Strategy Project Board (T Hillman)
- Input to River Health Strategic Scientific Panel (B Hart)

### **3.1.2.16 Sunraysia Rural Water Authority**

- Provided updates on Lower Basin Laboratory research and developments (B Gawne)

### **3.1.2.17 Sydney Catchment Authority**

- New knowledge broker, Amanda Kotlash established at SCA Penrith
- Member, SCA Expert Advisory Panel (G Jones)
- Met with SCA management to clarify the major ecological knowledge needs (P Cullen and A Georges)
- Advice provided to SCA Executive on development of Knowledge Strategy (P Cullen, G Jones)
- Two Joint problem solving workshops to advise on assessment and management of biodiversity issues in the Sydney water supply catchments (A Georges, P Cullen, J Harris, J Hughes, S Lake, R Butcher, P Cottingham, A Kotlash, G Jones)
- Designing and conducting pilot biodiversity assessment, and designing long-term biodiversity monitoring program (A Kotlash, R Norris, T Raadik, D Williams, A Arthington, J Harris, E Turak, G Jones)
- Assisted Education and Media Officer to prepare presentation on importance of industry and university partnerships and knowledge management (A Kotlash)
- Coordinated a consultancy to design a performance monitoring program to assess the effect of environmental flow releases from Woronora Dam (T Hillman, R Norris, M Thoms, G Quinn, J Frankenberg, J Harris and P Sloane, P Cottingham)





*Ms Amanda Kotlash, a newly appointed CRCFE Knowledge Broker based at the Sydney Catchment Authority.*

- Provided further assistance in development of Woronora River Environmental Flows (A Kotlash, J Harris)
- Input to SCA Catchment Land and Water Management Plan meeting (G Jones)
- Advice provided to the Warragamba Catchment Joint Planning Group (JPG), on setting appropriate catchment management targets for aquatic health in the catchment (A Kotlash)
- Assisted in developing a communications strategy for its Science and Research Branch (A Kotlash)
- Provided assistance and advice means to obtain relevant information regarding a number of areas of aquatic ecology e.g. zooplankton research, biofilm monitoring, impacts of infrastructure on ecological systems (A Kotlash)
- Organised joint planning workshop on developing a new CRCFE research project – the Connectivity and Dispersal Project (J Hughes, S Bunn, A Kotlash)
- Assisted with in development of SCA's web site, which will feed back to the CRCFE's continuing web development (A Kotlash)

### **3.1.2.18 University of Canberra**

- Met with Public Relations Manager to develop joint publicity strategies (L Sealie)
- Joint planning meeting with Northern Laboratory staff to develop student research project (Thoms, Wilson)
- Providing information materials for University of Canberra promotion

### **3.1.3 EXTERNAL SUPPORT**

Support (advice, publications, etc) was provided to the following non-partner universities, governments departments, agencies, and funding bodies:

Wodonga City Council, Victorian Farmers Federation, University of NSW, Sydney Water, South East Queensland Water, SA Government, Queensland Health, Qld Department of Primary Industries, Pine Rivers Shire Council, Olympic Coordination Committee, Department of Agriculture, WA, Fisheries R&D Corp, Department of Agriculture, NSW, Australian Cotton Growers Research Association, EPA Qld, Cotton Australia, Banksia Foundation, Border Rivers Food and Fibre, ACT Parks, ABARE, ACT Government, Univ. of W.A., Univ. of New England, Rivers Consortium, L&W Australia, Pine Rivers City Council, NSW National Parks and Wildlife, Land and Water Australia, Inland Rivers Network, Greening Australia, Goondiwindi Town Council, Envirolinx, DWR (S.A.), Commissioner for the Environment ACT, Charles Sturt University, CALM (W.A.), Brisbane City Council, Australian National University, SA Water Corporation Board, NSW Fisheries, Gosford Wyong Shire, Gippsland Water, Brisbane City Council, Kilcoy Council.

### **Professional organisations**

Support provided to:

Australian Science Festival, Federation of Australian Science and Technological Associations (FASTS), Academy of Technological Sciences, Academy of Science, Australian Water Association, Australian Society for Limnology (ASL), Queensland Environmental Law Association, Australian Institute of Engineers, Water Services Association.

## Consultants

Support provided to:

Cardno MBK, WSL Consultants, Willing and Partners, Connell-Wagner Pty Ltd, Sinclair, Knight Mertz

## Environment Australia

- Advice provided to Federal Minister for the Environment, Senator Hill
- Participation in development of National State of the Environment Report – AUSRIVAS First National Assessment River Health data
- Advice provided to Parliamentary Secretary, Sharman Stone on salinity impacts and management
- Advice and consultancy regarding NCC COAG Water Reform Jurisdictional Assessment
- Completed AUSRIVAS Phase 1 models, AUSRIVAS Physical - Chemical Assessment module, AUSRIVAS 'New Method' Project d
- Contributed to the final meeting of the National River Health Program – Urban Sub Program, Canberra
- Working with EA staff on development of Murray River Environmental Flow and Water Quality Project (with MDBC)

## Water Research Foundation of Australia

- Contributed to the publication “Freshwater Biodiversity, Protecting Freshwater Ecosystems in the Face of Infrastructure Development.”

## Australian Institute of Urban Studies and various Melbourne metropolitan councils

- Presented information to the steering committee of the “Environmental Indicators for Metropolitan Melbourne Bulletin”, and contributed data to the bulletin

### 3.1.4 COOPERATION WITH OTHER CRC'S

The CRCFE seeks opportunities for collaborative projects and activities with other CRCs. It is an active member of the CRC Program community. Many CRCFE staff members liaise with their counterparts in other CRCs and joint research, consulting and educational activities are undertaken. The Chief Executive, Director Knowledge Exchange & Education, Business Manager and Communications Manager, are part of an active network of information sharing with other CRCs on relevant areas of operation.

#### *The CRC Association*

- CRC Communicator workshop was held. Lynne Sealie, Communications Manager gave a presentation. Chief Executive, Peter Cullen made a keynote presentation.
- Assistance in the form of publications and images were provided.
- Two executive members attended the CRC Association Annual Conference in May.



### The CRC Water Forum

The Water Forum is comprised of the CRCFE, the CRC for Water Quality and Treatment, the CRC for Catchment Hydrology, the CRC for Waste Management and Pollution Control, and the CRC for Coastal Zone, Estuary and Waterway Management.

- CRCFE has joint research activities with the CRCCH (see research section) and a number of other activities coordinated through the CRC Water Forum. These include joint displays at conferences, joint seminar series (in planning), and joint conference symposia.
- The CRC Water Forum are hosting a half day workshop at the start of the 2001 River Symposium (part of the River Festival) with the theme “Source to Sea”.
- Planning is under way to run a collaborative seminar series in Brisbane, Melbourne, Sydney and Canberra. The new Water Forum seminar series will commence in October.



*The Water Forum Brochure, a joint publication produced by the Water Forum CRCs*

### Cooperation with other CRCs included the following:

CRC	Activity
Catchment Hydrology	<ul style="list-style-type: none"> <li>• Planning joint Pond &amp; Wetland Design Guidelines</li> <li>• Review of Water Sensitive Road design Technical report</li> <li>• Presentation to CRCCH, CRES/ANU Workshop on Modelling</li> <li>• Meetings with Director and Program Leaders</li> <li>• Meeting with Communications Manager to discuss Knowledge Exchange strategies</li> <li>• Contributed to CRCCH communication and adoption evaluation</li> <li>• Discussions with M Stewardson furthering links between CRCFE Program A and CRCCH</li> </ul>
Sustainable Rice Production	<ul style="list-style-type: none"> <li>• Presentation made to Sustainable Rice Production meeting</li> <li>• Address to Sustainable Rice workshop dinner</li> </ul>
Catchment Hydrology & Coastal Zone, Estuary and Waterway Management	<ul style="list-style-type: none"> <li>• Collaboration on joint project (CRCFE D722)</li> </ul>
Cotton	<ul style="list-style-type: none"> <li>• Meeting with the chair of the board to discuss the Northern Laboratory and its research priorities</li> <li>• Meeting with CRC Cotton and the Cotton Research Development Corporation to discuss areas of potential research collaboration</li> </ul>

## 3.1.5 INTERNATIONAL COLLABORATIONS

The CRCs international strategy has four components:

### *Quality Assurance for our Research*

The CRCFE ensures its research and education is world-class through peer reviewed publications in international journals, presentations at, and organisation of, international conferences, and through international collaborations with selected institutions and researchers.

International collaborative research projects and conference organisation:

Links	Activity	Contact
USA NSF and EPA.	Research on the 'Development and Testing of a Decision Support System for River Rehabilitation' Waters and Waterways	R Norris
Institute of Ecosystems Studies, New York, USA	Gene Likens working with CRCFE staff to review Narran Lakes scoping report	Several
University of Capetown, South Africa	Development of Environmental Flows methodologies with Dr Jackie King	A Arthington
US Forestry Service, Portland, USA	Design of research projects to address large scale environmental issues	P Cullen
South African Water Research Commission	Developing methods for fish based assessment of the condition of South African rivers	M Kennard, A Arthington
Universitas Jember, Indonesia	Collaborative research project on impacts to an upland stream in East Java, Indonesia	C Walsh, M Grace
International Conference on Environmental Flows – Fourth Ecohydraulics Conference. Cape Town, South Africa, 2002	Members on International Advisory Committee	A Arthington, M Thoms
International River Symposium 2000	Program Chairs and Co-organiser	S Bunn
Fifth International Conference on Toxic Cyanobacteria	Joint organisers (CSIRO, UC and Griffith University)	G Jones

### *Helping Australia meet its international obligations*

CRC activities inform and support the United Nations Convention on Biological Diversity, and the RAMSAR Convention on Wetlands of International Importance. The CRC is investigating the impacts of water resource development on the ecology of the Narran Lakes, a RAMSAR listed wetland. This project will also consider how such wetlands might be characterised in terms of health or ecological condition, and how Australia can best meet its reporting obligations under the RAMSAR Convention. CRCFE staff are also working with the MDBC to develop improved flooding regimes for the protection of the five River Murray RAMSAR wetland sites; Barmah-Millewa, Gunbower-Perricoota, Hattah-Kulkyne, Chowilla and The Coorong.

Staff are also invited to represent Australia in their discipline area on international committees, and to participate in international scientific planning processes being coordinated by groups such as the United Nations. During the past year staff have worked with the following:

- United Nations Secretariat on the Convention on Biological Diversity Montreal, Canada
- Scientific Committee for Water Research, International Council for Science
- International Ecology Institute
- International Water Academy



#### *Ensuring international best practice is used in Australia's water industry*

The CRCFE seeks to assist our partner government agencies and the Australian water industry with the development and implementation of best international practice in waterway management. The CRCFE will organise and sponsor the 9th International River Regulation Symposium. This symposium, to be held in 2003, will provide opportunities for international and Australian water industry and government representatives to exchange the latest information about best practice in river management.

#### *Raising Australia's profile with major international organisations.*

Chief Executive, Peter Cullen, was recently invited to join the World Bank's working group on environmental flows. For the World Bank's annual Water Week, the Bank brought many of its staff and advisers involved with water developments to Washington to review strategic directions and to share information. At Water Week, Peter presented a seminar on the Murray-Darling Basin Commission as a model and also discussed the expertise available within the CRCFE. Peter will continue to advise the World Bank on strategic issues in the area of environmental flows, and the CRC will collaborate with World Bank partners on appropriate international projects. As a first step, the CRC is developing guidelines and policy for consultancies with the World Bank.

### **International Visitors**

CRCFE staff have organised meetings and visits with international visitors from the following organisations:

Mekong River Commission; Official delegation Hangzhou Province; China, Urban Affairs Division, OECD; University of Kentucky; University of Wisconsin; Duke University; University of Minnesota; Arizona State University; University of Oklahoma; University of New Orleans; Colorado State University; University of Birmingham; Japanese Ministry of Land, Infrastructure and Transport; Embassy of Japan, Canberra; World Wildlife Foundation, Malaysia; Institute of Ecosystem Studies, New York; Prince of Songkla University, Thailand; Institute of Water Research, Rhodes University, South Africa; Tohoku University, Japan;

## **3.2 Specialist Advice**

### **3.2.1 POLITICAL BRIEFINGS**

Cabinet briefing on the need for Commonwealth involvement in NRM. Subsequent to this, Peter Cullen assisted a small task force to develop an action plan (P Cullen).

Discussions on water issues with Senator John Woodley during a visit to the Northern Laboratory at Goondiwindi (G Wilson).

Science Meets Parliament presentations and discussions with Federal MPs (various).

SA Premier John Olsen visited the MDFRC and was briefed on the activities of the centre. Premier Olsen presented the centre with a plaque in recognition of the Centre's contribution to the health of the Murray river.

### **3.2.2 COMMITTEE MEMBERSHIP**

One effective way of making the Centre's expertise available is by staff serving on Government and community committees.

CRCFE staff are chairing the following committees:

- Federation of Australian Scientific and Technological Societies (National)
- ACT Environment Advisory Committee
- National River Health Program Advisory Committee (Environment Australia)
- ACT State Assessment Panel, National Heritage Trust (ACT Government)
- ACT Nature Conservation and Namadgi Sub-committee (ACT Government)
- Victorian Environmental Water Quality Management Committee
- La Trobe University Regional Board
- Canberra Region State of the Environment Reporting Committee (ACT Government)

CRCFE staff are members of the following committees and boards:

- ACT Environmental Advisory Committee
- ACT Flora and Fauna Committee (ACT Government)
- ACT Science and Technology Council (ACT Government)
- Advisory Committee, Northern Laboratory (MDFRC)
- Advisory Committee, Wonga Wetlands Community Advisory Committee (Albury City Council)
- Advisory Group on Hume to Yarrawonga Waterway Management (MDBC)
- Albury-Wodonga Regional Parklands Board
- Community Advisory Committee (Murray-Darling Basin Council)
- Critical Review Committee for Sydney Water harbour waste-water planning project and overflow abatement program (Sydney Water)
- Earthwatch, (International)
- Editorial Board, Ecological Management and Restoration (International)
- Editorial Board, Journal of Marine and Freshwater Research
- River Symposium (International)
- Gippsland Water Technical Advisory Group (Gippsland Water)
- Gungahlin Development Authority

*Rivers are recharged with a massive dose of organic material after floodplains are inundated during floods. The Macintyre River shown here is one of the rivers being investigated from the CRC's new Northern Laboratory.*  
Photo: G Wilson





- Johnstone Centre Advisory Board (CSU)
- La Trobe University Council for the coming triennium
- Lake Eyre Catchment Management Coordinating Group (P Cullen)
- Land and Water Australia, Member of Communications Committee, Program Management Committee, Remnant Vegetation Program, and Rivers Policy Group
- Landcare Australia Limited
- Melbourne Water Resources Strategy Committee (Victorian Government)
- Murray Corridor Floodplain Rehabilitation Consultative Committee, (DNRM)
- Murray Unregulated River Management Committee (J Whittington)
- Murray-Lower Darling Community Reference Committee (NSW Government)
- National Executive of the Murray Darling Association (MDA)
- National River Health Program: Scientific and Technical Advisory Committee
- Natural Heritage Advisory Committee (Environment Australia)
- North East Catchment Management Authority (CMA)
- NSW Murray Unregulated River Management Committee (NSW Government)
- NSW Threatened Species Scientific Committee
- Off Allocation Water Value Subgroup, MLDCRC (NSW Government)
- Office of the Commissioner of the Environment, Biodiversity Reference Group
- Olympic Coordination Committee (NSW Government)
- River Health Strategy Scientific Committee (DNRE)
- School Committee, Australian Environmental Studies (Griffith University)
- Scientific Advisory Committee, Parks Victoria (Victorian Government)
- Scientific Committee for Water Research (International Council for Science)
- SEQ Region Water Quality Monitoring Study Committee (SEQ Water)
- State Technical Advisory Committee (STAC) for DLWC's IMEF
- Steering committee for FishRehab project (AFFA)
- Steering committee, 'Water quality management in the Border Rivers catchment' project (Border Rivers CMA)
- Steering committee, Reducing delays to fish spawning migrations at barriers with fishways' (QLD DPI)
- Sullivans Creek Catchment Technical Advisory Committee (ACT Government)
- Technical Steering Committee of the Snowy River Benchmarking and Flow Response Monitoring Project (DLWC)
- Victorian Catchment Management Council (B Hart)
- Victorian Environment Protection Authority (Victorian Government)
- Victorian Nutrient Management Strategy Implementation Committee (Victorian Government)
- Water and Riverine Management Committee (Border Rivers CMA)
- Wetland Care Australia
- World Wide Fund for Nature (WWF) Scientific Advisory Committee
- World Wide Fund for Nature (WWF) Trustee
- Yarra Forum (Melbourne Water)

### 3.2.3 SUPPORT FOR EXPERT ADVISORY PANELS

An approach developed by the CRC is the use of expert panels to provide expertise and make recommendations on water issues, especially environmental flow allocations. Staff have participated in a number of such panels over the year. These include:

- Expert Panel for Southeast Queensland Regional Water Quality Management Strategy (SEQ Regional Water)
- ACTEW Expert Panel on Trade Waste (ACTEW)

- Expert Assessment Panel Funding Applications for Fish Rehabilitation Program (AFFA)
- Expert Panel on Strategies for the Implementation, Management and Monitoring of Environmental Flows in the Gosford/Wyong Shires (Gosford/Wyong City Council)
- Expert Panel on the “Health of the Murrumbidgee River (DLWC and the Murrumbidgee Agribusiness Forum
- Federal State of Environment Report 2001, Expert Reference Panel (Environment Australia)
- Landscape and Open Space Expert Advisory Panel (Olympic Coordinating Authority)
- Murray River Expert Panel, Stage 2 of Assessment of Environmental Flows, to report to MDB Ministerial Council (MDBC)
- Review of the Environmental Flow Regime for the Broken Basin and the Ovens Basin
- River Murray Scientific Panel (DNRE)
- River Murray Scientific Panel on Environmental Flows ( MDBC)
- SCA Expert Reference Panel (SCA)
- Scientific Advisory Panel (Victorian EPA)
- Scientific Advisory Panel, Environmental Flow Monitoring Committee (DLWC)
- Scientific Expert Advisor, to the River Monitoring Committee (Lower Clarence County Council, NSW)
- Scientific Expert Panel for Southeast Queensland Regional Water Quality Management Strategy (SEQ Regional Water)
- Scientific Panel, Victorian River Health Strategy
- Snowy Scientific Reference Panel (East Gippsland CMA)
- Technical Advisory Panel for Condamine-Balonne and Border Rivers WAMP
- Technical Advisory Panel on Environmental Flows in the Fitzroy Basin (DNRM)
- Technical Advisory Panels for the Logan, Burnett and Pioneer Basin WAMPs (DNRM)
- Technical Group for the Bulk Water Entitlement Project for Victoria’s Wimmera-Mallee system
- Technical Advisory Group to the Victorian Stormwater Advisory Committee

*The Condamine-Balonne River. CRC staff on the Technical Advisory Panel provide scientific advice to assist the development of the Condamine-Balonne Water Allocation Management Plan.  
Photo: QDNR&M*







### 3.2.4 CONFERENCES/WORKSHOPS SUPPORTED BY THE CRC

Title	Function	Client
Knowledge Seeking Strategies Workshop	To explore the circumstances in which individuals seek knowledge and approaches to knowledge exchange	CRCFE & Land and Water Australia
Joint Problem Solving Workshop	To review the progress made toward the definition, measurement and reporting of Ecological Sustainable Development as it is applied to Queensland's water resources	CRCFE & DNRM
AusRivas Workshops	Interaction of all state agencies involved with AusRivas for training and accreditation - review of physical and chemical assessment of Aus Rivas	
Risk Assessment Workshop	Reservoir management Risk Assessment Workshop	SEQ Water
Workshops	Several SRA Planning and discussion Workshops	CRCFE
Project Workshop	Workshop for B3 Connectivity and Dispersal project	SCA/Griffith University/CRCFE
Research Workshop	Understanding Large-scale Ecological Studies and their Importance for Freshwater Resource Management	CRCFE
Ethics in Science workshop	Workshop on ethical issues	CRCFE
Conference	SIL, XXVIII International Congress	
Workshop	13th Taxonomic Workshop	CRCFE/MDFRC
Symposium	The Role of Drought in Aquatic Ecosystems Symposium, Albury	CRCFE/MDFRC
Joint Problem Solving Workshop	Assessment and management of biodiversity issues in the Sydney water supply catchments	CRCFE / SCA
Workshop	Nutrient Algae relationship	DNRE & CRCFE
Workshop	Nutrient loads from the Macalister Irrigation District	
Yarra Forum	Provided an opportunity for all organisations undertaking research or with management responsibility to share experiences and coordinate activities	
Workshop	The Australian Society for Fish Biology Inc. Annual Workshop and Conference	CRCFE & NSW Fisheries
Workshop	CRCA Communicators Workshop	CRCFE / CRCA

### 3.2.5 SMALL TO MEDIUM ENTERPRISES

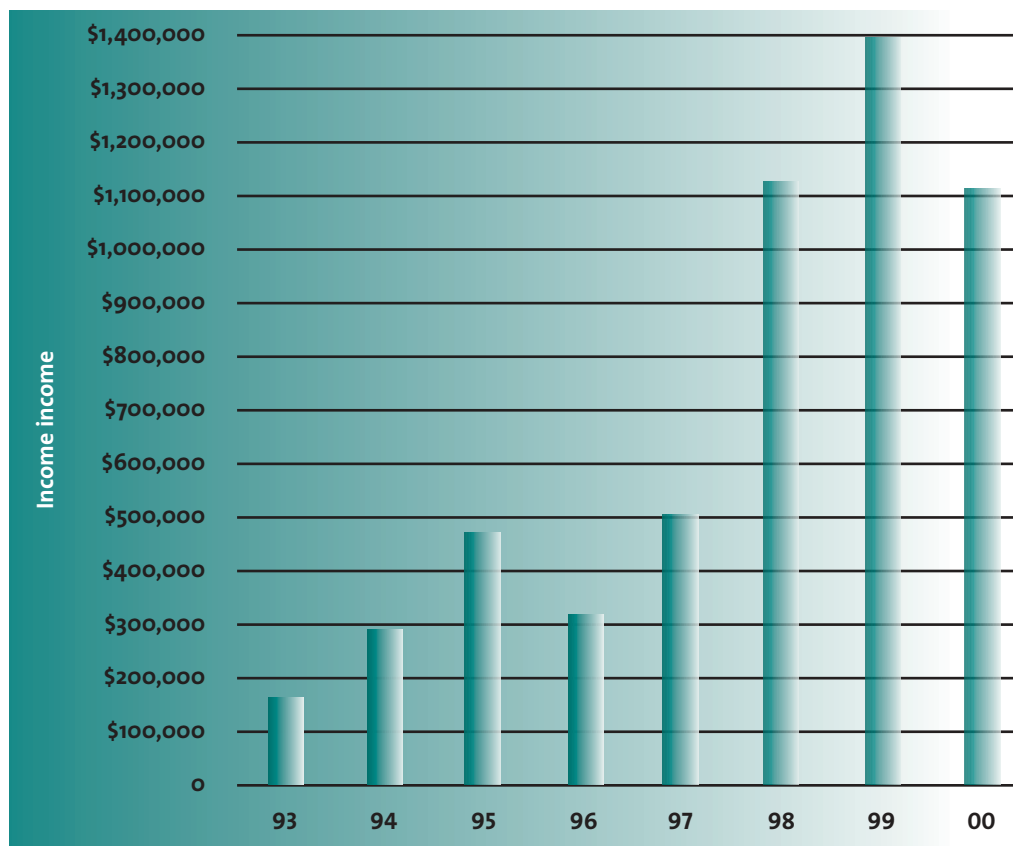
For the CRCFE, target SMEs are smaller water organisations, consultants and Catchment Management Authorities/Boards. We are addressing their needs in a number of ways:

- Input at the state wide coordination level (Victorian Catchment Management Council)
- Joint investigations (Anabranche flow requirements – Mallee CMA)
- Project steering committees (Mallee CMA, Murray-Lower Darling CMB)
- Adoption of pollution control pond design guidelines (SKM)

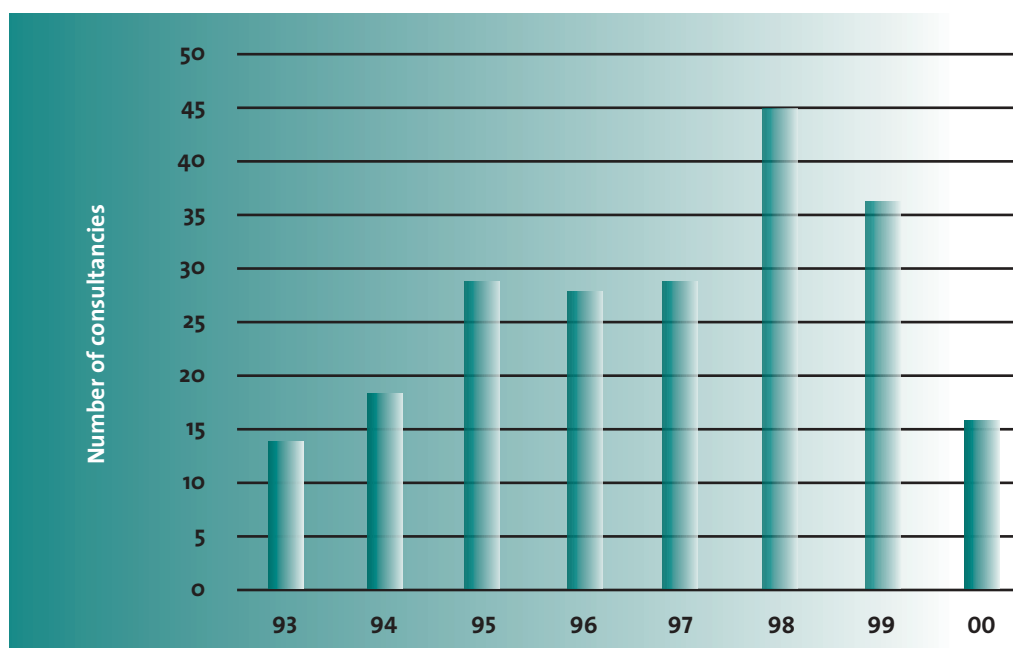
## 3.2.6 CONSULTING ACTIVITIES

Consulting work continued as a significant knowledge exchange activity for the Centre. The trend of accepting fewer, more strategic, projects in recent years was continued in 2000/01 (Figures 1 and 2). The strategy of accepting fewer projects had little relatively little impact on the income derived from consulting.

**Figure 3.1**  
Annual income received from consulting projects



**Figure 3.2**  
Number of consultancies undertaken annually





The projects undertaken during 2000/01 are listed below:

**Consulting projects undertaken during 2000/01**

Project	Client
Review of NSW Fisheries Tallowa Dam assessment	SCA
Scope of the Sustainable Rivers Audit	MDBC
Wimmera, Avoca Environmental Flow Assessment	DNRE
Thomson-Macalister Stressed Rivers Scoping Study	DNRE
ERA of Goulburn Irrigation Region	NPIRD
Ovens River Scientific Panel	DNRE
Sustainable Rivers Audit	MDBC
Technical Advice on Algae Assessment to SCA	SCA
NRHP Urban Sub-program Final Report	WSAA
Assessment of Toxic Pollution and Remediation in the Tooma River	DLWC
SCA Biodiversity Research Program	SCA
Independent Assessment of the Environmental Achievements of the COAG Water Reforms	EA
Dalby River Health Forum	Qld NRE
Deflation Lake Ecology Study	MDBC
Broken River Scientific Panel	DNRE
Sustainable Diversion Limits Assessment	SKM
Environmental Flows & Quality Objectives for the River Murray Project Expert Reference Panel	MDBC

*Speakers at the Dalby River Health Forum.  
Photo: R McIntyre, NR&M, Qld*



## 3.3 Scientific Publications

### 3.3.1 OVERVIEW

Publications are a critical part of the Centre's knowledge generation and exchange – they are an important avenue for informing organisations and the community about the Centre's work and findings. As well as putting considerable resources into distributing its publications widely, the Centre responds to many requests for its publications and makes most of its publications freely available on its website. During 1990-2000 the CRCFE produced:

- 13 Chapters in books;
- 94 Refereed journal articles;
- 9 Articles in non-refereed journals;
- 10 Identification guides and books;
- 59 Conference papers and proceedings;
- 60 Consultancies and technical reports.

For a detailed list of these scientific publications, please refer to Appendix A, page 95.

For information on general publications, including brochures, newsletters and media coverage, see section 3.5, Communications, page 75.



*Publications are an important avenue for the CRC to inform water managers, the science community and the wider community about its work.  
Photo: A Tatnell*

## 3.4 Conferences, Workshops and Presentations

CRC staff and students actively participate in workshops, conferences and meetings as a way of influencing and educating the scientific community, the water industry and the wider community.

Workshops attended by CRC staff and students include the:

- Victorian Catchment Management Council
- Catchment Management Conference
- Towards a Sustainable Australia Workshop
- Melbourne Water – Yan Yean Reservoir Management Workshop
- Lake Mokoan Restoration Strategy Workshop
- SEQ Reservoir Management Risk Assessment Workshop
- North Central Catchment Management Authority, Gunbower Environmental Water Requirements Workshop
- Inland Rivers Workshop



- Murrumbidgee 2000 workshop on habitat assessment in the Murrumbidgee River
- Victorian River Health Strategy - proposed Instream Habitat issues workshop
- Strategic planning workshop for Inland Rivers Network

Funding support was given to CRC staff to attend the following conferences

- 49<sup>th</sup> North American Benthological Society Conference
- 8<sup>th</sup> International Paleolimnology Symposium, Canada
- Australian Society for Limnology, Darwin
- INTECOL Wetlands Conference, Quebec, Canada
- International Association of Hydrological Sciences, Waterloo, Canada
- International River Symposium
- International Symposium on Regulated Streams, Toulouse, France
- National Waterwatch Conference
- Societas Internationalis Limnologiae XXV11
- The Role of Drought in Aquatic Ecosystems Symposium
- Wood in World Conference, Oregon, USA.

In addition to published Conference Papers and Proceedings listed in Appendix A, page 95, CRC staff and students delivered over 81 presentations and lectures to a wide range of audiences, including natural resources managers, scientists, tertiary science students, politicians, policy-makers, corporate managers, catchment management groups and the wider community. For a detailed list of these conferences, workshops and presentations, please see Appendix B, page 107.

### 3.5 Communications 3.5.1 KNOWLEDGE MANAGEMENT AND THE WEB

The CRC is updating its Information Management System (IMS) to provide better information management and improved reporting capabilities. The improved IMS will include databases for a number of communications functions such as publications inventories, distribution lists, CRC policies and procedures. The web site is also being enhanced and integrated with the IMS.

#### 3.5.2 GENERAL PUBLICATIONS (ALSO SEE SCIENTIFIC PUBLICATIONS, SECTION 3.3)

##### **Newsletters**

- 6 issues of the CRC's newsletter, WaterShed, were produced. (L Sealie, L Regan)
- 1 issue of the Lower Basin Laboratory's (Mildura) newsletter, Lower Basin Links, was produced. (L Sealie)
- 50 issues of the CRC's internal email newsletter, CRCFE News, were produced. (L Sealie)
- 11 issues of Ripples (8-2000 to 17-2000) were compiled and distributed.

##### **General Information Brochures**

- Understanding our WaterWays. (L Sealie)
- Snags: A Valuable but Scarce Resource. This brochure has been in such high demand that it has been reprinted. (L Sealie, J Whittington, P Cottingham)

##### **Other Publications & Resources**

- Compiled small, relevant collection of high quality photos from researchers, NRM organisations and photographers for publications and media work. (L Sealie)
- Know Your Beasties – A flip guide to some aquatic invertebrates for use by Waterwatch in the upcoming Aquatic Invertebrate Snapshot Survey. Photographs and editorial by John Hawking.
- Whistling Frog and Murray Cod publicity cards. (L Sealie)

## 3.5.3 OTHER INFORMATION SERVICES

The success of the CRC's communications partly depends on informing partner and non-partner organisations and people about the CRC's work. This is a critical part of our outreach activities to the community. Everyday examples of information services include: providing text, pictures and copyright information to a partner organisation, distributing new publications to our partners, making technical reports and newsletters freely available to people via the website, displaying our publications at a community workshop and sending reports to international research and government centres.

### *Summary*

- Provided information, publications and images to partners on more than 2,000 occasions.
- Provided information, publications and images to more than 3,040 non-partner government, industry, community organisations and the general public.

## 3.5.4 MEDIA

### *Media coverage*

It was a busy year for the CRC with media activities – the CRC's work was covered by a variety of mass media outlets as well as industry and community email newsletters. One media highlight was the coverage of Peter Cullen winning the Prime Minister's "Environmentalist of the Year Award" and Ian Lawrence winning the Banksia Environmental Foundation Award for "Outstanding Individual Achievement" for their outstanding contribution to the environment. These awards prompted coverage by national, regional, government and industry media.

The CRC's involvement in 'The Australian' newspaper's 'Save the Murray' campaign reached many thousands of readers. Another highlight was the ABC TV Four Corners program 'Water Pressure'. An after show, on-line forum for the general public received 920 responses, one of the busiest ABC forums ever.

A total of 130 media hits (10 TV, 42 radio, 67 newspaper and 11 magazine stories)

### *Media releases*

- 5 media releases and 1 media alert to 58 media outlets
- 1 community service announcement to 49 media outlets

## 3.5.5 PUBLIC AWARENESS AND PROMOTION

- CRC's involvement with National Science Week:
  - Live frog display in central shopping centre, Canberra;
  - Invertebrate display in the 'Rivers of Life' workshop;
  - Information on the CRC was also on display at the 'Amazing World of Science' as part of the University of Canberra exhibition.
- Information display on the Water Forum, including CRC for Freshwater Ecology, for the River Symposium, Brisbane.
- Information display on the Water Forum, including CRC for Freshwater Ecology, at Partners' Meeting of CRC for Freshwater Ecology, Melbourne.
- Information display on the CRC for Open Day at University of Canberra.

# 4

## EDUCATION AND TRAINING



## 4.1 Postgraduate Education

### **Program Leader: Professor Gary Jones**

The overarching objective of the CRCFE Education Program is to stimulate a broader education and training experience for its students. Particularly, in graduate programs through initiatives such as the active involvement of researchers from outside the higher education system, and to enhance the employment prospects of students through involvement in our user oriented research programs. Its specific objectives include:

- Provision of postgraduate education that produces ecologists and aquatic scientists with high level research skills that are sought after to work in the water industry.
- Contribution to undergraduate education programs to ensure graduates have sound ecological knowledge and an appreciation of its application to water management, and that graduates are aware of opportunities and employable within the water industry.
- Assisting community groups to understand water related issues and help equip them to take an active role in land and water management.
- Building community awareness of water ecology and related environmental issues through a program of public and school-based education.

The program seeks to meet the water industries' human resource training need for well-rounded graduates who have the academic, as well as the field, communication and technological expertise to contribute to the workplace. We have five educational target groups: postgraduate; undergraduate; post-professional; schools; community; with postgraduate training being our primary focus.

### **Postgraduate Scholarships**

One CRCFE full postgraduate scholarship was awarded to Stephen Mackay (Griffith Univ). Top Up scholarships were awarded to Carol Conway (Univ Canberra), John Foster (Univ Canberra), Susan Gehrig (Adelaide Univ), David Hunter (Univ Canberra), Slobodanka Stojkovic-Tadic (Monash Univ), Benjamin Smith (Adelaide Univ).

### **Postgraduate Student Workshop**

This was held in conjunction with the CRCFE Annual meeting. The format of the workshop was presented as a poster session with some informal discussion. 15 CRCFE students presented posters to the CRCFE research staff who then provided feedback on their development. Staff and students also took the opportunity to discuss emerging postgraduate education issues in a group format.

### **Project Management Course**

Nine CRC students attended this course. The course covered many aspects of project management, including identifying features of successful projects and reasons why a project might fail. Stakeholder analysis,



*CRC postgraduate students gain high level research skills and are well equipped to work in the water industry.  
Photo: A Tatnell*





project manager skills, writing project proposals, project justification and cost/benefit analysis, project planning, communication, monitoring and review, MS Project and team building were among other topics covered.

A Project Management and Induction course will be run for 2001 entry students in September 2001.

### Other Training Courses

Claudette Kellar (Monash University) was given support to attend the Wetlands Ecology Course, Grampians Retreat, Victoria.

### Postgraduate Completions

Postgraduate students who have completed their studies this year are:

Damian Green (PhD)	University of Canberra
Bailen Chen (PhD)	Monash University
Jennifer Driessen (PhD)	Monash University
Joanne Clapcott (MSc)	Griffith University
David Hunter (MSc)	University of Canberra

### Conference/Workshop Attendance

The CRCFE supported students to travel to and present papers and posters at the following national and international conferences and workshops:

- Symposium on the Role of Drought in Aquatic Ecosystems, MDFRC, Albury
- Ethics workshop, Monash University, Victoria
- INTECOL conference, Quebec City, Canada
- World in Wood Conference, Oregon, USA
- Societas Internationalis Limnologiae, XXVIII Congress, Monash University
- Australian Society for Fish Biology, Albury, NSW
- Australian Society for Limnology

*Alison King (third from left) a CRC PhD student, received an honourable mention in this year's Young Water Scientist of the Year Award. Alison's PhD is entitled "The importance of in-channel and floodplain environments for fish recruitment in lowland rivers".*



## Young Water Scientist of the Year Finalist

Ms Alison King was selected to represent the CRCFE at the Young Water Scientist of the Year Award, and received an honourable mention from the judges. Alison's PhD is titled "The importance of in-channel and floodplain environments for fish recruitment in lowland rivers".

## 4.2 Undergraduate Education

Undergraduate teaching takes place at Monash University, University of Canberra, Latrobe University and Griffith University and other CRC sites, or at the request of other institutions.

The following undergraduate freshwater ecology and water science related units are offered at university partners as part of an associated degree. These often encourage students to further their studies by MSc or PhD in the water field within the CRCFE. Students are exposed to CRCFE research and researchers as much as possible, especially during their final year.

- Griffith University: BSc in Ecology and Conservation Biology; BSc Environmental Science; Aquatic Ecology unit; Field Ecology
- University of Canberra: BSc Resource and Environment – Water Science unit
- Monash University: Units offered in the BSc degree, Freshwater Ecology unit; Aquatic Chemistry
- La Trobe University: BSc in Environmental Management and Ecology also an honours degree; Graduate Diploma in Environmental Management
- Adelaide University: BSc, BEnvSci and BA degrees.



*CRC researcher, Sue Nichols, helping a Water Science student to complete a habitat sheet in the field.  
Photo: A Tatnell*



### Summer Research Scholarships and Work Experience

\$30,000 was distributed for 16 summer scholarships distribution among the sites. These were allocated as follows:

Monash University 3, University of Canberra 4, Griffith University 3, MDFRC/La Trobe University (Wodonga/Albury) 3, University of Adelaide 1, MDFRC (Mildura) 1, MDFRC (Goondiwindi) 1.

The scholarships are offered for 8-10 weeks, with students submitting a final research report.

Work experience for students was arranged at the following organisations:

ACTEW  
ACT Government  
NSW Fisheries

### Honours Supervision

Wherever possible, honours research topics are chosen by CRCFE staff to align with CRCFE objectives and CRCFE project research being carried out in a researcher's laboratory. The current distribution of CRCFE related honours projects is:

- Griffith University 2 students
- University of Canberra 6 students
- La Trobe University 3 students
- Monash University 5 students
- Adelaide University 9 students

### International Education

Prof Barry Hart (Monash University) delivered lectures at the Institute of Technology, Indonesia, Surabaya, Indonesia

## 4.3 School Education

The CRCFE is involved in school education at a number of levels, including:

- Presentations at science exhibitions and Teachers' Association conferences.
- Presentations, class lessons and field work for specific schools.
- Curriculum development and teacher training (including the Diploma of Education at La Trobe University).
- Development of gifted students/high achievers extension program.
- Work experience and career advice.
- "Albury Easter School", "Mildura Riverine School" and "Upper Murray School" (in conjunction with Rotary).

Our schools program is coordinated by Mike Copland, MDFRC Albury. Mike's position was funded this year by the Murray Darling Basin Commission.

Learning outcomes for school students include:

- the excitement of science and some appreciation of techniques,
- the relevance and importance of science to environmental problems,
- an understanding of aquatic ecosystems, and
- possible career path direction.

## School Curriculum Materials

Mike assisted local NSW HSC chemistry teachers by preparing classes and a half day excursion “package” to cover aspects of the “new” course, especially Urban Water. This was developed in conjunction with the Albury City Council (filtration works and sewerage plant). This has been trialed at a local high school and will now be offered to other secondary schools in the district.

## **Rotary Murray-Darling School of Freshwater Research**

The sixth “Easter School” held at the MDFRC involved observing and sampling the Kiewa River from its source in the Bogong High Plains to its entry into the Murray. This year there were 34 participants from as far afield as Adelaide and Nambucca heads. Working with mentors from La Trobe University, Wodonga a report was compiled to try and bring together all the factors along the Kiewa River which they felt contributed to its living and non-living characteristics. The “Easter School” continues to encourage and motivate students to stay within the science “web”. Advice from students who attended the first “Summer/Easter Schools” who are now at university confirms that this has been achieved.

## **The Rotary Camp on River Health**

The MDFRC Lower Basin Laboratory (Ben Gawne, Michelle Bald) and Rotary District 9520 hosted the 3<sup>rd</sup> annual “Health of the River System” forum at Lake Cullulleraine. Fifty-one year 9 and 10 students from three states explored how river health affects our lives, concentrating on solutions to the problems confronting our rivers and wetlands. The social and economic importance of river systems were explored via a ‘role play’ game of water allocation in a hypothetical catchment. Mentors and project leaders recruited from MDFRC, Rotary, Lower Murray Water, Murray Wetlands Working Group, the Mallee CMA and the Coomealla Anglers Club.

*Two year 9 and 10 students immersed in the moment in Lake Cullulleraine for the Rotary Camp on River Health.  
Photo: M Bald*





### **Demonstrations to School Groups**

Primary and secondary school students continue to be made aware of a variety of environmental issues that effect their communities. Interest in possible careers in the water industry is also developed. Students from La Trobe's Post Graduate Diploma continue to be involved in this program. Some examples of the involvement this year included:

- Classes and field trips on the biodiversity and water quality of billabongs (Wodonga and Shepparton High Schools).
- A two hour "Ecological Walk", part of an on-going project to follow the changes in the creek adjoining the school over the year. This project also involves the participation of the La Trobe Graduate Dip. Ed. Student. (St Monica's Primary School).
- A field trip to investigate "Changes in an Ecosystem". (A case study involving the changes brought about by a Landcare group established in 1987). (Catholic College Wodonga VCE Biology 25 students).
- The staff at the Lower Basin Laboratory continues to support the local school community with information and publications. They have also given tours and presentations of the centre to groups and individuals.

## **4.4 Community Education**

The CRCFE was actively involved in assisting regional councils and associations with their community education programs and projects. Workshops, presentation and forums were organised at the request of various organisations. In 1999-2000, these organisations included:

North Central Catchment Management Authority, National Capital Authority, Land and Water Australia, Waterwatch, Victorian Catchment Management Council, SA River Murray Catchment Board, North East Catchment Management Authority, Border Rivers Catchment Management Association, Goondiwindi, Barwon-Darling River Management Committee, Biggara Water Users Group, Parklands Albury Wodonga, Victorian Catchment Management Committee, Earthwatch, Murray Lower Darling Community Reference Committee

Some examples of our community education involvement were:

- Dalby River Health Community Forum (see section 3.1 Cooperative Links)
- Preparation of an Education Program to complement the installation of three gross Pollutant traps (NSW EPA, Albury City Council)
- Advice to the Lower Clarence River County Council on the review of programs to monitor the effects of implementing environmental flows
- Representation on the Wodonga Wetlands Management Committee, Albury City Council
- Reviewing of a report on water quality, and contributed to steering committee meeting for the water quality project, Border Rivers CMA Goondiwindi
- Talk on Northern Laboratory and its research priorities and activities, Lion Club Goondiwindi
- Representation on the "River Interpretation Centre" committee, Wodonga City Council
- Catchment Management Plan: Implementation of demonstration wetlands and design of a mosquito survey, Sullivans Creek Catchment Group
- Consolidated preparation work for the "Science Trails Through the Community" project being managed by Trish Bowen (project funded by DEET Victoria)
- Involvement in the National Science Week, providing live displays, workshops and information on the centre's research and education

## Public Presentations

- Presentation on the 'Granite Creeks Restoration Project' given to a public meeting organised by Granite Creeks and Molka-Miepoll Landcare Groups (S Lake).
- 'Sustainable water use in urban landscape design', presentation, Hume Region, Parks & Leisure Association.
- Presentation on 'Lessons from the NHT and the Way Forward', Tumburumba Landcare Group.
- Principal Guest Speaker at the Continuing Education Centre (Albury Wodonga) Inc AGM. Talk given on 'Environmental Education'.
- Presentation on 'Integrated Urban Land & Water Management' to Kingston Foreshore development Authority.

## Community Training

John Hawking (MDFRC) continues to develop valuable training links with the National and State Waterwatch Program. John and colleagues organised three training days to train coordinators and monitors in invertebrate sampling, sorting and identification skills. A field guide was produced with support from the CRCFE.

*Audience at the Dalby River Health Forum.  
Photo: R McIntyre, QDNR&M*





The achievements of the Cooperative Research Centre for Freshwater Ecology are largely due to the hard work and commitment of its staff. The Centre's culture of working collaboratively and aiming for excellence has created an organisation where quality, vitality and goodwill are the norm.

## 5.1 Specified Personnel

The specified personnel from Schedule 5 of the Commonwealth Agreement have not changed during the year and are as follows:

Prof Peter Cullen	University of Canberra	CEO	100%
Prof Barry Hart	Monash University	Director (Research)	85%
Dr Terry Hillman	MDFRC	Director (Regional Laboratories)	100%
Prof Sam Lake	Monash University	Chief Ecologist	75%
Prof Stuart Bunn	Griffith University	Program Leader	60%
A/Prof Richard Norris	University of Canberra	Program Leader	75%
A/Prof Arthur Georges	University of Canberra	Program Leader	75%
Dr Gerry Quinn	Monash University	Program Leader	75%

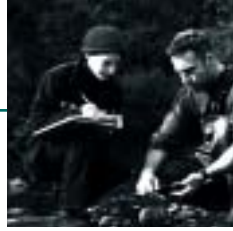
## 5.2 Staff Contributed by Partners

Staff contributed to the CRCFE are detailed in the 2000/2001 Financial and Staffing Report.

## 5.3 Staff Commencing and Staff Leaving

Staff Commencing Name	Position	Location
Stephen Balcombe	Research Assistant	Griffith University
Michelle Bald	Knowledge Broker	MDFRC-Lower basin lab
Kelly Barr	Administration Assistant	University of Canberra
Chris Bartlett	Research Assistant	Griffith University
Kristy Brooke	Research Assistant	Monash University
Jo Clapcott	Research Assistant	Griffith University
Ben Cook	Research Assistant	Griffith University
Frances D'Souza	Research Assistant	Griffith University
Christy Fellows	Research Assistant	Griffith University
Simon Hieslers	Research Assistant	Monash University
Gary Jones	Director of Knowledge Exchange/Education	University of Canberra
Amanda Kotlash	Knowledge Broker	University of Canberra
Chester Merrick	Research Assistant	MDFRC – Albury
Carleen Mitchell	Research Assistant	Monash University
Fran Sheldon	Research Assistant	Griffith University
Charles Robinson	Chief Administration Officer	University of Canberra
Pua Tai Sim	Research Assistant	Monash University
Edward Tsyrlin	Research Assistant	Monash University
Staff Leaving Name	Position	Location
Simon Hieslers	Research Assistant	Monash University
David Rischbieth	Business Manager	University of Canberra
Melanie Saxinger	Administration Assistant	University of Canberra
Michelle Winning	Research Assistant	Griffith University





## 5.4 Staff Development

### Information Technology

Mike Paterson attended Web Design course.

Lynne Sealie attended Photoshop 6 course.

### CSIRO/BHERT Leadership of Research and Development Teams

John Whittington (University of Canberra), Gerry Quinn (Monash) and Chris Walsh (Melbourne Water) have all completed or are on course with the BHERT/CSIRO Achievement Through Teams: Leadership in Innovation course.

### First Aid Training

Claire Townsend completed a Senior First Aid course.

### Four Wheel Drive Course

Alison Mitchell, Judy Frankenberg, John Hawking, Julia Howitt, Rob Cook, Melanie Pearson, Adam Richardson and Rod Oliver completed the Four Wheel Drive Course.

### Waders Course, North Albury Pool

John Pengelly, Shane Perryman, Helen Gigney, Garth Watson, Zygmunt Lorenz, Chester Merrick, Darren Baldwin, Gavin Rees, John Hawking, Adam Richardson, Luciano Serafini, Paul Humphries, Daryl Nielsen and Rob Cook completed the Waders Course.

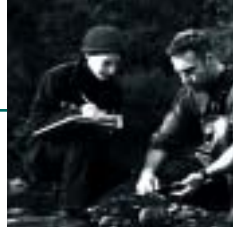
## 5.5 Awards

- Professor Peter Cullen was awarded the Prime Minister's Environmentalist of the Year Award 2001, for his outstanding contribution to the management of Australia's water resources.
- Ian Lawrence received the Banksia award, 2001, for Outstanding Individual Achievement. The award recognises Ian's contribution to urban water research and planning.
- Alison King was awarded an honourable mention in the Young Scientist of the Year Award for her research on fish nursery habitats in floodplain rivers.
- Sam Lake was awarded the North American Benthological Society 'Award of excellence' for his contribution to Benthic Science.
- Debbie Heck and John Fein were presented with the Griffith University teaching team award. They received the award for outstanding teaching in the areas of environmental education and science communication.
- Richard Norris received the Chairman's award for his outstanding contribution to biological assessment of water quality and implementation at the national level.
- Sarah Cartwright was awarded the University of Canberra Medal for her completion of the Bachelor of Applied Science with First Class Honours in Water Science. Sarah's honours research, which was supervised by Martin Thoms, focussed on floodplain ecosystem functioning through detailed investigations of zooplankton emergence in response to various hydrological conditions present on Australian floodplains. The results of her work, in combination with other studies in the region, will have a significant influence on floodplain management in south-east Queensland.
- Vic Hughes was awarded the John Lake award for the best poster presentation by an honours student, at the annual Australian Society for Fish Biology meeting. Vic studied the influence of geomorphology on the distribution of snags in part of the Murray River.

## 5.6 Grants Held by CRCFE Researchers

Researcher	Organisation	Project	Funding source	Period	Total funding
Bunn/Davies/Walker	Griffith University/ University of WA/QDNR	Importance of Flood Flows to Productivity of Dryland Rivers and their Floodplains	EA	Jan 00 - Dec 01	\$275,000
Bunn/Smith	Griffith University	Development of integrated baseline monitoring program	SEQRWQMS	Jan 00 - Mar 01	\$250,000
Bunn/Udy/Hunter	Griffith University/QDNR	Nutrient cycling, primary production and aquatic food webs in coastal river systems: implications for eutrophication management	ARC – SPIRT & SEQRWQMS	Jan 99 - Dec 02	\$419,000
Copland	MDFRC	Waterlines: Studies in irrigation in the basin	NRMS	Sep97 - Aug00	\$245,000
Croome	La Trobe	Occurrence and significance of photosynthetic bacteria in freshwater systems	ARC	Jul 99 - Jun 02	\$12,000
Georges	University of Canberra	Environmental Flows Initiative: Daly River flows and impacts on a flagship species	EA NHT	Jan 00 - Jul 01	
Glaister	Monash University	Study of elmid fauna of South Australia	Sir Mark Mitchell Research Foundation	Feb 00 - Dec 00	\$1,330
Harris		Fish Stocking in the Murray-Darling Basin	EA NHT	Feb 00 - Jan 01	\$25,000
Harris		Floodplain inundation and fish dynamics	EA NHT	May 00 - Feb 01	\$20,000
Hughes/Bunn	Griffith University	Importance of dispersal and recruitment in stream invertebrate populations	Australian Research Council	Jan 99 - Dec 02	\$110,000
Hughes/Bunn	Griffith University	The role and dispersal and recruitment in structuring stream invertebrate populations	ARC	1999 - 2001	\$114,000
Hyne	NSW EPA	Relationship between pesticides in passive samplers to riverwater concentrations and macroinvertebrate populations	Cotton RDC		\$402,000
Koehn	DNRE	Endangered species survival decision tool	EA NHT	Oct 98 - Dec 01	\$142,500
Lake	Monash University	Restoration ecology of fish assemblages in degraded rural streams	AFFA	2000 - 2003	\$196,000
Lake/Humphries	Monash University /MDFRC	Environmental flows on the Campaspe river	LWRRDC	Jul 96 - Jun 01	\$696,000
Nicol	DNRE	River rehabilitation through resnagging	EA NHT	Oct 96 - Dec 01	\$390,000
Norris	University of Canberra	AUSRIVAS training and accreditation	EA NHT NRHP	Feb 00 - Oct 00	\$59,000
Norris	Uni of Canberra	AUSRIVAS Mapping Module	LWRRDC	Feb 99 - Jan 01	
Norris	Uni of Canberra	AUSRIVAS Software Enhancement	EA	Dec 99 - Jan 00 Phase 1	
Quinn	Monash University	Measuring the effectiveness of environmental water allocations phase II	DNRE	Jul 98 - Jun 00	
Thoms	University of Canberra	Storage, production and transfer of nutrients and carbon in lowland floodplain river systems: Condamine/Balonne	EA/QDNR	Jul 97 - Jun 00	\$312,000
Thoms	University of Canberra	AUSRIVAS physical and chemical assessment module	EA NHT NRHP	Jan 00 - Jan 01	\$130,000
Thoms	University of Canberra	Habitat fragmentation and environmental flows, Condamine Balonne River	ARC	1999 - 2001	\$183,000

## 5.7 New Grants Held by CRCFE Researchers



Researcher	Organisation	Project	Funding source	Period	Total funding
Harris		Review of NSW Fisheries Tallowa Dam assessment	SCA		\$3,360
Whittington	University of Canberra	Scope of the Sustainable Rivers Audit	MDBC		\$27,312
Raadik	DNRE	Wimmera, Avoca environmental flow assessment	DNRE		\$19,820
Cottingham	Melbourne Water	Thomson-Macalister stressed rivers scoping study	DNRE		\$31,922
Cottingham	Melbourne Water	ERA of Goulburn irrigation	NPIRD		\$21,890
Cottingham	Melbourne Water	Ovens Scientific Panel	DNRE		\$58,333
Whittington	University of Canberra	Sustainable Rivers Audit	MDBC		\$185,000
Oliver	MDFRC	Technical advice to SCA	SCA		\$25,000
Cottingham	Melbourne Water	NRHP urban sub-program final report	WSAA		\$6,900
Harris		Assessment of toxic pollution and remediation in the Tooma River			\$125,700
Jones	University of Canberra	SCA Biodiversity Research	SCA		
Jones	University of Canberra	Independent Assessment of the Environmental Achievements of the COAG Water Reforms	EA		\$89,000
Jones	University of Canberra	Dalby Workshop	Qld NRE		\$27,000
Gawne	MDFRC	Deflation Lake Ecology Study	MDBC		\$400,000
Cottingham	Melbourne Water	Broken River Scientific Panel	DNRE		\$80,276
Jones	University of Canberra	Environmental Flows & Water Quality Objectives for the River Murray Project - Expert Reference Panel	MDBC		\$180,000
Hart	Monash University	Sustainable Diversion Limits Assessment	SKM		\$15,090

## 5.8 Major Renovations and Purchases

A Residual Gas Analyser (RGA 200 - SRS) was purchased for project D210. The instrument is located at the Water Studies Centre, Monash University (\$18,000).

This instrument allows high precision measurements of dissolved gases in water samples and will be used to determine denitrification activity and community metabolism for sediments sampled in streams with different level of urbanisation around Melbourne.

## 5.9 Financial Matters

The financial pages for the CRCFE for the year 2000/2001 are in the Financial and Staffing Report. The accounts of the CRCFE were audited by Day Nielson in accordance with Commonwealth requirements.



*Ian Lawrence, recipient of the 2001 Banksia Award for outstanding Individual Achievement.  
Photo: A Redman, University of Canberra*



*Sarah Cartwright, a CRCFE student, received the University of Canberra Medal for her Bachelor of Applied Science with First Class Honours.  
Photo: L Sealie*



## 6.1 Cooperative Arrangements

### 6.1.1 ACTIVITIES OF THE CENTRE SEEN BY STAKEHOLDERS AS MAKING A DIFFERENCE TO WATER MANAGEMENT

- Provided First National Assessment of River Condition, through the NLWRA, as a basis for large scale decision making about improving river condition across Australia
- Developed a framework which will provide for a comprehensive annual review of the condition of the Basin's waterways – the Sustainable Rivers Audit – for the Murray-Darling Basin Commission
- Reviewed progress made toward the definition, measurement and reporting of Ecologically Sustainable Development as it is applied to Queensland's water resources in a 2 day workshop with QDNR
- Provided scientific input and oversight to several riverine environmental flows assessment expert panels
- Provided expert advice that helped resolve Lake Burley Griffin bacterial contamination 'crisis'

### 6.1.2 MOST RESEARCH UNDERTAKEN IN LARGE MULTI-DISCIPLINARY PROJECTS MANAGED IN AN INTEGRATED WAY

Twelve large, multi-disciplinary projects currently form the backbone of the CRC's research portfolio. These projects use expertise from across the CRC to focus on problems at an appropriate field scale.

The CRC's research portfolio is guided by a conviction that if truly multi-disciplinary and collaborative research is to be undertaken, the researchers and managers must be involved from the start in developing the projects. We continue to invest in leadership training to help staff work in these integrated projects.

### 6.1.3 MAINTAINING A STRONG PARTNER BASE

The partner base has been strengthened with the inclusion of the University of Adelaide and discussions are underway with another prospective partner.

## 6.2 Research and Researchers

### 6.2.1 RESEARCH PORTFOLIO APPROPRIATE TO SHORT AND LONGER TERM ISSUES FOR THE WATER INDUSTRY

Our research portfolio targets both short and long-term issues facing the water industry. As such we have a range of projects varying from large, integrated three to six year projects looking at scientific questions underpinning the issues facing our industry, to short term 1-6 month projects addressing immediate needs and knowledge gaps. The portfolio also contains a mix of high to medium risk projects.

We believe that most benefit will be gained if research projects are developed as collaborative partnerships between researchers and managers.

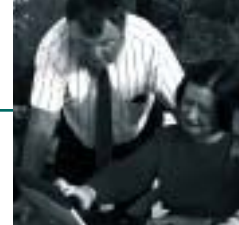
To ensure the relevance of our projects for the water industry, Program Advisory Committees (PACs) have been established for each research program to formalise the involvement of industry staff in research planning and activities. The PACs meet at least once per year and report on progress to the Board.

### 6.2.2 RESEARCH IS OF AN EXCELLENT STANDARD AND IS PUBLISHED IN REFEREED LITERATURE.

- All research projects undertaken within the CRC undergo a rigorous review process to ensure excellent quality science which is relevant and of benefit to our partners. To reinforce this, we have established a quality assurance manual which documents the review process that all research projects must undergo. This has three levels:
  - internal review of the science (by management committee);
  - external review of the science (by peers); and
  - review of management relevance (by PACs).

All research projects must be approved the CRC for Freshwater Ecology Board.

- One way the CRC ensures its research world-class is through international collaborations with selected institutions and researchers. These linkages enrich the research



generated by both parties and benefit the broader water science community in Australia as CRC researchers share their knowledge.

- 94 articles in refereed journals during the year.

#### **6.2.3 EFFECTIVE PROJECT MANAGEMENT WITH REGULAR REPORTING TO BOARD.**

The CRCFE Project Management System tracks the achievement of milestones for individual projects. Reasons for missed milestones are provided by the Project Leader and these form part of the Exceptions Report to the Board.

### **6.3 Education and Training**

#### **6.3.1 NUMBER OF POSTGRADUATE STUDENTS ENROLLED AND WORKING WITH THE CRC AND DEGREES CONFERRED**

The CRCFE has 41 PhD and 1 Masters student.  
90 students approved as Associated Project students.  
One full and six top-up postgraduate scholarships awarded.

#### **6.3.2 INVOLVEMENT OF NON-UNIVERSITY STAFF IN TEACHING POSTGRADUATE COURSES AND RESEARCH SUPERVISION**

1 postgraduate student is co-supervised by non-university staff.

#### **6.3.3 SHORT COURSES AND WORKSHOPS DEVELOPED AND PRESENTED**

Organised seventeen research planning, joint problem solving or communications workshop. See Knowledge Exchange section for details.

### **6.4 Applications of Research**

#### **6.4.1 ADOPTION OF RESEARCH BY PARTNERS.**

- River health assessment methods (SCA, MDBC, NR&M, DNRE, DLWC, EPAs)
- Integrated urban land and water management (ACT Government)
- Urban stream rehabilitation (ACT Government)
- Biodiversity assessment methods (SCA)
- Environmental flows assessment and setting (MDBC, DNRE, SCA, NR&M)
- Taxonomic guides (DNRE, NRM, DLWC, EPAs)

#### **6.4.2 ADVICE AND CONSULTANCIES PROVIDED TO INDUSTRY PARTNERS AND OTHERS AND**

#### **6.4.3 APPLIED RESEARCH, INVESTIGATION AND CONSULTING CONTRACTS WITH NON-PARTICIPATING AGENCIES**

Completed sixteen contract consultancies generating income of \$1.1 million (See Knowledge Exchange for details).

#### **6.4.4 PRODUCTION OF TECHNICAL PUBLICATIONS APPROPRIATE FOR END-USERS AND DEVELOP OTHER VEHICLES FOR REACHING THESE GROUPS**

Twelve technical reports were produced for end-users. To broaden the access to these publications, most technical reports are available in PDF format on the CRC website. A number of less technical brochures on research findings are also produced for end users.

The CRC uses a variety of communication strategies to reach end users, including seminars, workshops, conferences, consultative and business meetings, international visits, committees and training sessions.

#### **6.4.5 CENTRE STAFF INVOLVEMENT IN GOVERNMENT AND OTHER ADVISORY BODIES**

CRCFE staff chair 8 committees and serve as members on 52 Committees and 23 Expert Panels.

CRCFE staff are serving as Chair on the following committees:

- Federation of Australian Scientific and Technological Societies (National),
- ACT Environment Advisory Committee,
- National River Health Program Advisory Committee (Environment Australia),

- ACT State Assessment Panel, National Heritage Trust (ACT Government),
- ACT Nature Conservation and Namadgi Sub-committee (ACT Government),
- Victorian Environmental Water Quality Management Committee (B Hart),
- La Trobe University Regional Board,
- Canberra Region State of the Environment Reporting Committee (ACT Government).

## 6.4.6 MEDIA EXPOSURE BY CENTRE

The CRC's work was covered by a variety of mass media outlets as well as industry and community email newsletters. One media highlight was the coverage of Peter Cullen winning the Prime Minister's "Environmentalist of the Year Award" and Ian Lawrence winning the Banksia Environmental Foundation Award for "Outstanding Individual Achievement" for their outstanding contribution to the environment. These awards prompted coverage by national, regional, government and industry media.

The CRC's involvement in 'The Australian' newspaper's 'Save the Murray' campaign reached many thousands of readers. Another highlight was the ABC TV Four Corners program 'Water Pressure'. An after show, on-line forum for the general public received 920 responses, one of the busiest ABC forums ever.

Generated 130 media hits, including 42 radio and 10 TV interviews, plus 67 newspaper and 11 magazine articles through over 65 media outlets.

## 6.5 Management and Budget

### 6.5.1 EFFECTIVENESS OF BOARD IN SETTING RESEARCH DIRECTIONS AND PROVIDING OVERALL POLICIES FOR THE CENTRE

The Board has been very involved with developing the current research portfolio and with setting other policies.

### 6.5.2 REPORTING PROGRESS TO THE BOARD AND TO THE COMMONWEALTH

The CRCFE Board receive financial information on a quarterly basis and research progress reports at each Board meeting.

The Commonwealth are advised of the financial position of the CRC each quarter.

### 6.5.3 ACCURATE MONITORING OF AGREED PERFORMANCE INDICATORS

The CRCFE has a project management system in place, which tracks the completion of milestones for the research component. The other performance indicators are monitored through the CRCFE Information Management System.

### 6.5.4 DELIVER INDUCTION PROGRAM SO THAT ALL NEW ENTRANTS TO THE CENTRE HAVE AN UNDERSTANDING OF THE ORGANISATION, ITS OPERATIONS AND RESOURCES

Induction program carried out as part of project management course for new students and staff. Postgraduate student manual outlines funding opportunities, applications other administrative procedures.

### 6.5.5 PROVIDE APPROPRIATE STAFF DEVELOPMENT OPPORTUNITIES WITHIN THE CENTRE

Staff are targeted for managerial development and training through the CSIRO-Melbourne University BHERT management course. Staff attending this course in 1999-2000 were John Whittington and Gerry Quinn.

15 staff attended CRCFE organised and funded course in Large Scale Ecological Processes.

11 staff attended CRCFE convened course on Ethics in Scientific research.

### 6.5.6 SIGNIFICANTLY INCREASE REVENUES FROM OUTSIDE SOURCES DURING THE LIFE OF THE CENTRE

Completed sixteen contract consultancies generating income of \$1.1 million.



- **APPENDIX A – SCIENTIFIC PUBLICATIONS**



## A1.1 Chapters in Books

- Arthington, A.H., Brizga, S.O., Choy, S.C., Kennard, M.J., Mackay, S.J., McCosker, R.O., Ruffini, J.L., Zalucki, J.M. June 2000. "Environmental Flow Requirements of the Brisbane River Downstream from Wivenhoe Dam". EQWC Ltd/CCISR.
- Brock, M.A. and Jarman, P.J. 2000. Wetland use and conservation in the agricultural environment: managing processes for the components. pp 258-268 in Craig, J.L., Saunders, D.A. & Mitchell, N. (editors) *Nature Conservation 5: Conservation in Production Environments: Managing the Matrix*. Surrey Beatty & Sons, Chipping Norton, Australia.
- Gehrke, P.C. 2001. The Paroo River. In Young, W.J. (ed.). *Rivers as Ecological Systems: The Murray-Darling Basin*. Murray-Darling Basin Commission, Canberra. Pp. 119- 131.
- Hawkins, C.P. and Norris, R. 2000. Effects of taxonomic resolution and use of subsets of the fauna on the performance of RIVPACS-type models. In: *Assessing the biological quality of freshwaters: RIVPACS and similar techniques*. Edited by J F Wright, D W Sutcliffe & M T Furse. Freshwater Biological Association, Ambleside.
- Lintermans, M. 2001. Chapter 5: Australian Capital Territory. Pp 22-33. In: Environment Australia, *A Directory of Important Wetlands in Australia, Third Edition*. Environment Australia, Canberra.
- Oliver, R.L., Ganf G.G., 2001. Freshwater Blooms. In: Whitton, B.A. and Potts, M. (eds) *The Ecology of Cyanobacteria: Their diversity in time and space*. Kluwer Academic Publishers.
- Palmer, M.A., Lake, P.S. 2000. Invertebrates, Freshwater Overview. In: Levin, S.A. (eds) Academic Press, San Diego. *Encyclopaedia of Biodiversity* Vol 3: pp 531-542.
- Proff, N.L., Angermeier, P.L., Cooper, S.D., Lake, P.S., Fausch, K.D., Winemiller, K.O., Mertes, L.A.K., Oswood, M.W., Reynolds, J., Rahel, F.J. 2001. Global change and stream fish diversity. Pp 315-349 In: Chapin, F.S. Sala, O.E., Huber-Sannwald, R. (eds) *Scenarios of future biodiversity*. Springer-Verlag, New York.
- Schiller, C.B. and Harris, J.H. 2001. Native and alien fish. In Young, W.J. (ed.). *Rivers as Ecological Systems: The Murray-Darling Basin*. Murray-Darling Basin Commission, Canberra. Pp 229- 258.
- Young, W.J., Schiller, C.B., Harris, J.H., Roberts, J. and Hillman, T.J. 2001. River flow processes, habitats and river life. In Young, W.J. (ed.). *Rivers as Ecological Systems: The Murray-Darling Basin*. Murray-Darling Basin Commission, Canberra. Pp 45-99.
- Young, W.J., Schiller, C.B., Roberts, J. and Hillman, T.J. 2001. The rivers of the basin and how they work. In Young, W.J. (ed.). *Rivers as Ecological Systems: The Murray-Darling Basin*. Murray-Darling Basin Commission, Canberra. Pp 3-43.

## A1.2 Refereed Journal Articles

- Baker, P.D., Brookes, J.D., Burch, M.D., Ganf, G.G. 2000. Advection, growth and nutrient status of phytoplankton populations in the lower River Murray, South Australia. *Regul River* 16: (4) pp 327-344.
- Balcombe, S.R., Closs, G.P. 2000. Variation in Carp gudgeon (*Hypseleotris spp.*) catch rate in dense macrophytes. *Journal of Freshwater Ecology* 15 (3): pp 389-395.
- Baldwin, D.S., Mitchell, A.M. Rees, G. 2000. The effects of *in situ* drying on sediment-P interactions in sediments from an old wetland. *Hydrobiologia*, 431: pp 3-12.
- Baldwin D.S., Mitchell, A.M. 2000. Effects of Drying and Reflooding on the Sediment/Soil Nutrient-Dynamics of Lowland River Floodplain Systems -A Synthesis. *Reg. Rivers: Res. Mgmt*, 16: pp 457-467.
- Baldwin, D.S., Coleman, L., Beattie, J., Jones, D. 2001. Hydrolysis of an Organophosphate Ester by Manganese Dioxide. *Environmental Science and Technology*. 35: pp 713- 716.
- Beckett, R. 2001. Fate and toxicity of endosulfan in Namoi River water and bottom sediment. *J. Environ. Qual.* 30: pp 750-759.
- Bowles, K.C., Apte, S.C., Maher, W.A., Kawai, M. and Smith, R. Bioaccumulation and Biomagnification of mercury in Lake Murray, Papua New Guinea. *J. Fish. Aquatic Sci.*
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- **APPENDIX B – PRESENTATIONS AND LECTURES**



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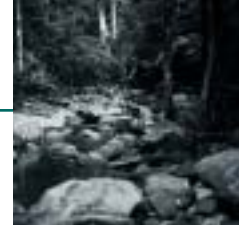
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- Neilson, D., Shiel, R., Green, J.D. 2001. Are Successional Patterns IN Billabongs The Same? XXV111 SIL Congress, 4-10 February 2001.
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- Sealie, L. 2000. Made a presentation to the CRC Communicators' Workshop on Effective Communications in CRCs.
- Sim, P.T., Peterson, J.A., Chandra, S. 2000. Farm dam distribution change in the Woori Yallock catchment 1976-1996. Poster presentation, OZRI 2000 conference, Melbourne, October 23-25.
- Thoms, M. Sheldon, F. 2001. A Framework for Restoring the Lateral Connectivity of a Large Dryland River: The Barwon Darling, Australia. XXV111 SIL Congress, 4-10 February 2001.
- Thoms, M., Foster, J.M. 2001. The influence of large scale geomorphology on floodplains sedimentation processes. XXV111 SIL Congress, 4-10 February 2001.
- Treadwell, S. 2001. Photosynthetic Characteristics of Biofilm Growing on Large Woody Debris in an Australian Lowland River System. XXV111 SIL Congress, 4-10 February 2001.
- Tsyrlin, E., Campbell, I. 2001. Recolonisation Pattern of Macroinvertebrates on Submerged Wood in the Acheron River. XXV111 SIL Congress, 4-10 February 2001.
- Walsh, C.J. 2000. A look at the city from the stream: why limnologists should care more about urbanisation. ASL Victorian Branch Seminar, Melbourne, August 24.
- Walsh, C.J. 2000. Biological assessment of urban impacts to streams: some new approaches. River Basin Management Society, Waterway Management Seminar. University of Ballarat, Ballarat, Victoria, August 2.
- Walsh, C.J., Sharpe, A.K., Breen, P.F., Sonneman, J.A. 2001. Linking the effects of urbanisation to stream macroinvertebrates a heuristic model of urban constraints on species traits. XXV111 SIL Congress, 4-10 February 2001.
- Williams, D.G., Bowen, P.M., Frankenberg, J. 2001. Magnitude and Seasonality of Carbon Inputs to the Murray River from Riparian and Emergent Vegetation. XXV111 SIL Congress, 4-10 February 2001.
- Wilson, G.G., Gawne, B. & McCarthy, B. 2001. Development of experimental design and monitoring for a weir draw down trial to determine the nature of ecological benefits – Riverine Project R13. Poster presented at the MDBC 2001 Strategic Investigation and Education Forum, Canberra.



- **APPENDIX C – STUDENTS IN THE CRCFE**



Name	Commenced	University	Supervisor	Topic	Funding	Graduate Employment
<b>Masters Continuing</b>						
CURMI, Tim	1/3/99	La Trobe	Suter (La Trobe)	The Health of the Lachlan River	NHT	
DAVIS, Nicole	6/3/96	University of Canberra	Apte (CSIRO) Maher (UC) Wade (ACTEW)	The fate of ammonia and the effects on the river system	ACTEW	
HUNTER, David	1/7/96	University of Canberra	Osborne Georges (UC)	Life history of declining and non declining frogs in the Southern highlands of NSW	Self Funded	
<b>Masters Completed</b>						
CLAPCOTT, Joanne	7/99	Griffith University	Bunn (GU)	Examining the contribution of C4 plants to the aquatic food webs of lowland subtropical Queensland streams	AP	
<b>PhD Commencing</b>						
CONWAY, Carol	7/3/01	University of Canberra	Maher (UC)	Reactivity of organic carbon under anaerobic conditions and its role in sediment nutrient dynamic	APA + CRCFE Top up	
SMITH, Ben	1/4/01	Adelaide University	Walker (Adelaide)	Observations on the early life history of carp, <i>Cyprinus carpio</i> : fecundity, spawning and tolerance of eggs to salinity and dehydration Biosphere.	APA + CRCFE Top up	
GEHRIG, Susan	1/5/01	Adelaide University	Walker (Adelaide)	The ecology of Riparian Willows on the River Murray	APA + CRCFE Top up	
FOSTER, John	16/7/01	University of Canberra	Thoms (UC)	Inland river floodplains: the role of sediment and nutrient exchanges	APA + CRCFE Top up	
HUNTER, David	2/7/01	University of Canberra	Osborne (UC)	Life history of declining and non declining frogs in the Southern highlands of NSW.	APA + CRCFE	
KELLEHER, Adrian	1/7/00	Biological Science Monash	Quinn (Monash) Humphries (MDFRC)	Distribution and abundance of three species of carp gudgeons in the Broken River, Victoria	CRCFE	
KENNARD, Mark	1/3/00	Griffith University	Arthington Pussey (Griffith)	A quantitative basis for the use of fish as indicators of river condition	AP	
MACKAY, Stephen	1/8/01	Griffith University	Arthington Mosisch (Griffith)	Flow requirements of aquatic macrophytes in south-east Queensland streams	CRCFE	
STOJKOVIC-TADIC, Slobodanka	1/2/01	Monash	Beardall	Interactions between nutrient status and UVB in microalgae	APA + Top up	
RYAN, David	1/3/00	Melbourne	Downes (Melbourne) Lake (Monash)	Colonisation of macroinvertebrates following the reintroduction of vegetation in a degraded Victorian stream	AP	



Name	Commenced	University	Supervisor	Topic	Funding	Graduate Employment
<b>Masters Continuing</b>						
NICOL, Jason	25/7/01	Adelaide	Walker Ganf (Adelaide) Gawne (UC)	Ecology and Management of deflation Basin Lakes	MDBC Associated Project	
WISHART, Marcus	1/3/98	Griffith	Hughes Bunn Davies (Griffith)	Dispersal of aquatic insects and the implications for river conservation in southern Africa	Associated Project	
<b>PhD Continuing</b>						
BALLINGER, Andrea	24/2/00	Biological Sciences, Monash	MacNally (Monash) Lake (Monash)	Invertebrate biodiversity of coarse woody debris on floodplains	MDBC CRCFE Top Up	
CAPON, Samantha	1/2/00	Griffith University	Bunn (CU), Brock (DLWC)	Flow related response of vegetation in arid inland floodplains	LWRRDC	
BALCOMBE, Stephen	27/8/95	La Trobe	Lawler (La Trobe) Humphries (MDFRC) Closs (Otago)	Spatial and temporal habitat use in billabongs by small fish assemblages.	La Trobe Scholarship (expired)	
BROWN, Glen	1/6/98	University of Canberra	Norris/Maher (UC)	Relationships between nutrients, algae and invertebrates in the Thredbo River.	Kosciuszko Thredbo Top up (expired)	DNR - QLD
BUTCHER, Rhonda	28/3/96	Biological Sciences, Monash	Lake (Monash) Marchant (Museum of Victoria)	Conservation assessment of Victorian wetlands using invertebrates.	APA + CRCFE Top up (expired)	
CROOK, David	1/3/98	Charles Sturt University	Humphries (MDFRC)	Habitat use and movement of golden perch and carp in a lowland river.	CSU + CRCFE Top up	
DOODY, Sean	20/2/96	University of Canberra	Georges Osborne (UC)	Effects of nest site selection and fluctuating temperatures of <i>Carettochelys insculpta</i> .	CRCFE Scholarship (expired)	
DRIVER, Patrick	27/2/95	University of Canberra	Harris (NSW Fisheries) Norris (UC) Closs (Otago)	Impact of carp on macrophytes and water quality	CRCFE scholarship (expired)	DLWC -
EBNER, Brendan	3/3/97	La Trobe	Suter (La Trobe) Gawne (MDFRC)	Introphic interactions between zooplankton and fish	La Trobe (expired) Scholarship	
EVANS, Lisa	24/7/95	University of Canberra	Williams Thoms (UC)	Riparian vegetation development and disturbance along the Upper Murray and Murrumbidgee rivers.	APA CRCFE Top Up (expired)	
FINLAY, Kyla	1/8/96	Biological Sciences, Monash	Campbell (Monash)	Taxonomy of freshwater invertebrates (Ephemeroptera).	CRCFE Scholarship (expired)	

Name	Commenced	University	Supervisor	Topic	Funding	Graduate Employment
FRANCIS, Cathy	3/3/97	University of Canberra	Thoms Gawne(UC)	The effects of flow regulation on carbon and nutrient cycle in temporary wetlands of the Murray River.	APA CRCFE Top up	
FRASER, Ian	4/10/96	Water Studies Centre, Monash	Hart (Monash) Barling(SKM)	Development of a predictive model for algal growth in Cairn Curran Reservoir.	Goulburn Murray-Water	
HOWITT, Julia	29/3/99	Monash	Baldwin Rees(MDFRC)	Photochemistry of Aquatic Substances.	APA, CRCFE top up	
KELLAR, Claudet	1/3/00	Monash	Quinn (Monash) Lake (Monash)	Community Dynamics in temporary pools	CRCFE	
KING, Alison	30/3/98	Biological Sciences, Monash	Lake (Monash) Humphries (MDFRC)	Identification and quantification of the nursery habitats of Murray Darling freshwater fish larvae.	CRCFE Scholarship	
LLOYD, Natalie	21/8/95	Biological Sciences, Monash	Campbell MacNally (Monash)	Scales of spatial correlation in macroinvertebrate community structure.	CRCFE Scholarship (expired)	
MCNEIL, Dale	4/3/96	La Trobe	Lawler (La Trobe) Hillman (MDFRC) Closs (Otago) Gehrke (NSW Fisheries)	Fish, zooplankton and algae dynamics in Murray River billabongs.	APA + CRCFE top up (expired)	
MCKENNY, Claire	24/1/00	Griffith University	Bunn Proctor (GU)	The relationship between ecosystem processes and community structure in south east Queensland rivers	AP	
OSWALD, Louisa	20/11/95	University of Canberra	Norris / Maher (UC)	In situ toxicity testing of water quality.	APA CRCFE Top up (expired)	
PETERSON, Kylie	3/3/97	University of Canberra	Kearney Thoms (UC) Humphries (MDFRC)	Age, growth and survival of larval fish in the Murray-Darling Basin.	APA CRCFE Top Up (expired)	EA
SIEBENTRITT, Mark	1/99	University of Adelaide	Walker (Adelaide) Ganf (Adelaide)	Effects of water regime on wetland plants.	Bookmark Biosphere Trust + CRCFE Top-up	
SONNERMAN, Jason	1/7/97	Water Studies Centre, Monash	Kershaw (Monash) Breen (Melb Water)	The development of rapid bioassessment protocol for the use of diatoms as water quality indicators.	APA +CRCFE Top Up	WSC-Monash
TREADWELL, Simon	2/9/96	Biological Sciences, Monash	Lake MacNally Campbell (Monash)	Role of snags in carbon dynamics in lowland rivers.	CRCFE Scholarship (expired)	
SELLENS, Claire	1/5/00	University of Canberra	Norris (UC)	Defining the reference condition: implications for biological assessment	CRCFE	



Name	Commenced	University	Supervisor	Topic	Funding	Graduate Employment
WATTS, Kellie	19/06/00	Monash	Hart/Grace (Monash)	Biogeochemistry of nutrients in a sand slug stream, Creightons Creek, Victoria	APA + CRCFE Top up	
<b>PhD Submitted</b>						
ASSEMI, Shoelah	19/1/95	Water Studies Centre, Monash	Beckett Hart (Monash)	Characterisation of humic substances and its role in phosphorus speciation in natural waters.	CRCFE Top Up (expired)	
BEATTIE, Gillian	31/3/96	Water Studies Centre, Monash	Hart/Beardall (Monash)	The role of algae and bacteria in nutrient cycling in lowland rivers.	Monash CRCFE top up (expired)	
GRIGGS, Jackie	4/1/95	La Trobe	Croome (La Trobe) Shiel (MDFRC)	Taxonomy, biogeography and ecology of Chydoridae in Australia.	ABRS+ CRCFE top up (expired)	Tasmania's HECS
JENKINS, Kim	16/3/98	University of New England	Boulton Brock (UNE)	Flood frequency and community dynamics of invertebrates emerging from reflooded sediments of dry lakes in south-western NSW.	Menindee Project Scholarship (expired)	
PARSONS, Melissa	12/9/95	University of Canberra	Norris/Thoms (UC)	Compositional patterns of lotic benthic macroinvertebrates: Relationship to habitat and the scale of measurement.	APA + CRCFE Top up (expired)	
<b>PhD Completed</b>						
GREEN, Damian	15/9/95	University of Canberra	Harris Oliver (MDFRC) Cullen (UC)	Population dynamics and physiology of phytoplankton in an artificially perturbed reservoir.	CRCFE scholarship	Murray Wetlands working group
CHEN, Bailin	20/1/97	Monash	Beckett (Monash)	Development of field flow fractionation methods.	APA	Research fellow at Uni of Tennessee
DRIESSEN, Jennifer	1/3/95	Monash	Hart (Monash)	Carbon and nutrient cycling in lowland rivers	CRCFE scholarship (expired)	
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ABRS	Australian Bureau of Resource Science
ACRLGS	Australian Centre for Regional and Local Government Studies
ACTEW	ACT Electricity and Water
ANZECC	Australia and New Zealand Environmental
APA	Australia Postgraduate Awards
ARC	Australian Research Council
ASL	Australian Society for Limnology
AUSRIVAS	Australian River Assessment Scheme
AWQC (SA Water)	Australian Water Quality Centre
AWT	Australian Water Technologies
AWWA	Australian Water and Wastewater Association
CALM WA	Conservation and Land Management, Western Australia
CIT	Canberra Institute of Technology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
BHERT	Business and Higher Education Round Table
CSU	Charles Sturt University
CRC-WMPC	CRC for Waste Management and Pollution Control
DISR	Department of Industry, Science and Resources
DLWC	Department of Land and Water Conservation
EA	Environment Australia
EPA NSW	Environment Protection Authority, NSW
EPA Vic	Environment Protection Authority, Victoria
ERISS	Environmental Research Institute of the Supervising Scientist
FASTS	Federation of Australian Science and Technological Societies
FRDC	Fisheries Research Development Corporation
FRP	Filterable reactive phosphorus
GHD	Guthrie, Haskins and Daley (consultants)
IMEF	Integrated Monitoring of Environmental Flows
LBL	Lower Basin Laboratory
LWRRDC	Land and Water Resources Research and Development Corporation
MDBC	Murray-Darling Basin Commission
MDFRC	Murray-Darling Freshwater Research Centre
MDFRC, LBL	Murray-Darling Freshwater Research Centre Lower Basin Laboratory
MW	Melbourne Water
MRHI	Monitoring River Health Initiative
NATA	The National Association of Testing Laboratories
NRHP	National River Health Program
DNRM	Department of Natural Resources and Mines, Queensland
NRMS	Natural Resource Management Strategy
NSWFRI	NSW Fisheries Research Institute
QDNR	Queensland Department of Natural Resources
RIVPACS	River Invertebrate Prediction and Classification Scheme
SKM	Sinclair Knight Merz
SoE	State of the Environment
SRA	Sustainable Rivers Audit
TCM	Total Catchment Management
TISA	Taylor Integrated Sampler
UC	University of Canberra
UWRAA	Urban Water Research Association of Australia
UNE	University of New England
UWS	University of Western Sydney
WAMP	Water Allocation Management Plan
WSAA	Water Services Association of Australia
WSC	Water Studies Centre, Monash University



