



Established and supported under the Australian Government's Cooperative Research Centres Programme

COOPERATIVE RESEARCH CENTRE FOR

FRESHWATER ECOLOGY

ANNUAL REPORT 2002-03



CRC 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 understanding of the ecology of aquatic ecosystems. With in-depth understanding, it is possible to predict how aquatic ecosystems react to different scenarios.

To develop and test ecological theory, through our research program.

To provide knowledge of the principles of ecology, so they can underpin management decisions and actions and address key management issues facing Australia's water industry.

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

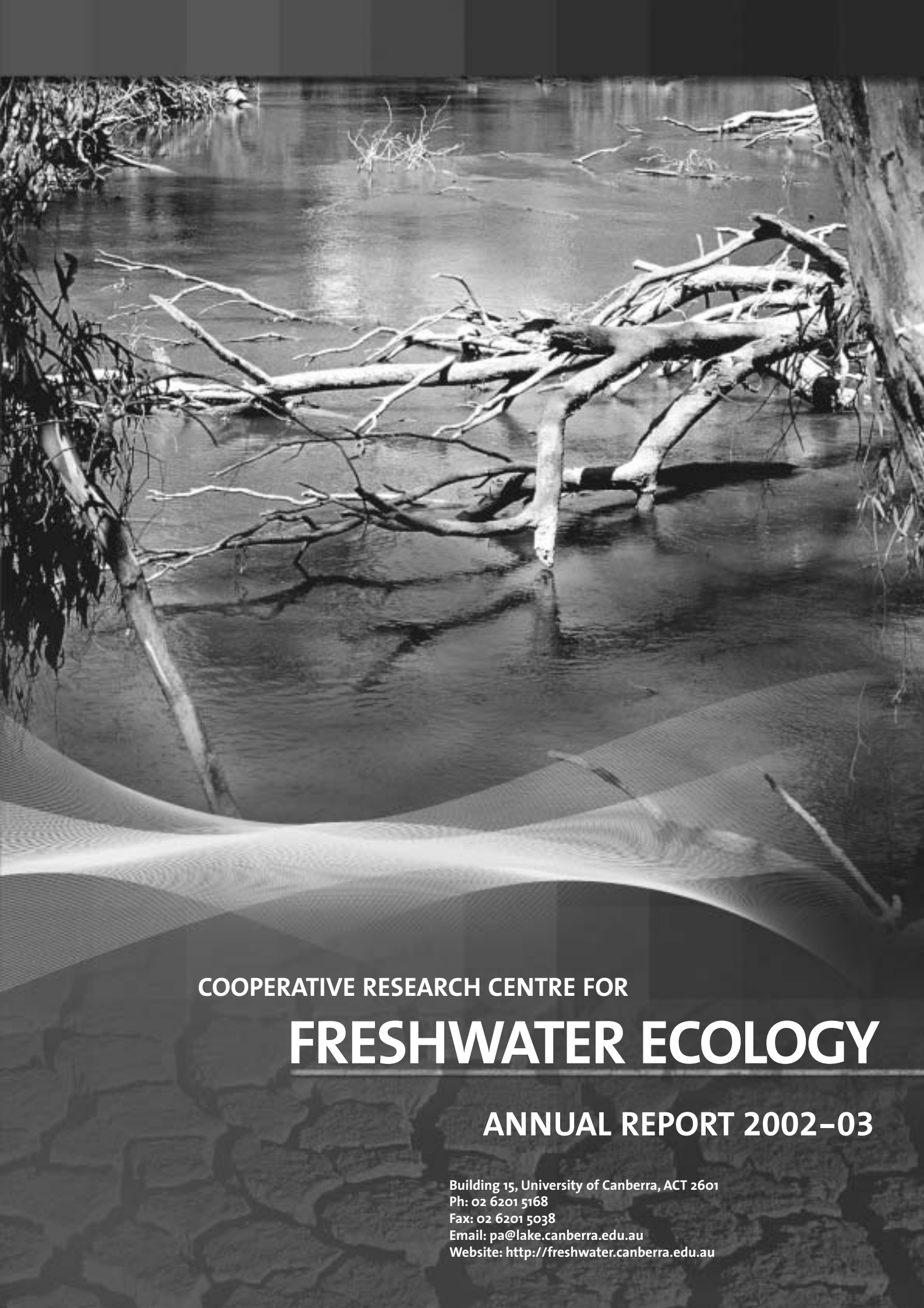
To produce methods and tools for assessing ecological conditions, to assist water managers to measure the effects of their actions.

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

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

To provide ongoing professional education to build up a capacity within the water industry to understand ecological issues.

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



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THE COOPERATIVE RESEARCH CENTRE FOR FRESHWATER ECOLOGY IS A COLLABORATIVE VENTURE BETWEEN:

ACTEW Corporation
CSIRO Land and Water
Department of Infrastructure, Planning and Natural Resources, NSW
Department of Natural Resources and Mines, Queensland
Department of Sustainability 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
Sunraysia Rural Water Authority
Sydney Catchment Authority
University of Adelaide
University of Canberra

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ISSN 1327 1342

Compiled by Ann Milligan

Design and Layout by Graphic Ark Pty Ltd

Printed by Goanna Print

Contents

<i>Vision, Mission, Objectives</i>	inside front cover
<i>Foreword by Dr John Langford, Board Chair</i>	4
<i>Chief Executive's report</i>	5
1 <i>Structure, management and cooperative linkages</i>	7
Cooperative linkages	9
2 <i>Research</i>	11
Program A: Flow-related ecosystem processes	11
Program B: Restoration ecology	15
Program C: Conservation ecology	18
Program D: Water quality and ecological assessment	20
List of research projects	24
3 <i>Education and training</i>	26
Postgraduate students and projects active at June 2003	30
4 <i>Knowledge exchange — Helping end-users to apply CRCFE research</i>	32
Highlights	32
Partner organisations	33
Consultancies	38
Non partner organisations	39
Research users overseas	42
5 <i>Staffing and administration</i>	44
6 <i>Publications</i>	45
7 <i>Presentations and publicity</i>	50
8 <i>Awards and grants</i>	55
9 <i>Performance indicators</i>	58
<i>Acronyms</i>	inside back cover

Foreword

The year 2002–2003 has been unique in the history of water use in Australia. Against a background of extreme drought across the country, water availability and management have become topics of national interest. The newspapers, particularly, have carried numerous articles and letters dealing with water rights, real and perceived, environmental flows and water restrictions.

It has been a year in which wise leadership was needed to guide water policy, and a year in which the CRC for Freshwater Ecology (CRCFE) has been able to provide significant advice to policy-makers, based on its large and growing knowledge-base.

With its new Chief Executive, Professor Gary Jones, at the helm the CRCFE has had a shift in emphasis during 2002–2003. From being a leader in the conservation of river environments it has now become a leader that *also* acknowledges the importance of the human communities that use our rivers and river environments.

Little can be achieved in the push for long-term sustainable water resources unless there is cooperation between these user groups and scientists, managers and policy makers.

Within the CRCFE, Gary has encouraged staff to develop three main foci: landscape-scale (and multi-user) thinking; advice not advocacy; and the importance of win-win outcomes. These three foci are

evident in the new portfolio of research projects that the program leaders and advisory committees have developed during the year. For example, existing studies on single rivers are now being linked together and expanded to landscape scale. The similarities and differences between rivers like these will now guide the CRCFE as it develops principles for managing *types* of rivers and riverine landscapes.

The new portfolio consists of ten multidisciplinary core projects. Between them they aim to establish clearly the benefits of environmental flows. Several projects will advance our understanding of the effects on ecology and sustainability when structures and processes break the natural continuity of flow and water quality between tributaries and main streams. Two projects are investigating effects of salinity, and

ways of predicting the spread of invasive species into our freshwater environments. The management of urban water ecology is continuing to be examined. Finally, the CRCFE's AUSRIVAS methods and models are being compared to other biological means of rapidly assessing water quality.

The Narran Lakes project (in partnership with, and funded by, the Murray-Darling Basin Commission), investigating freshwater ecology in the Narran Lakes on the Lower Balonne Floodplain, is a significant addition to the CRCFE's new research portfolio. The project is an excellent example of applying landscape-scale thinking, advice not advocacy, and win-win outcomes all at once, and it is to be hoped that its final results will point the way to sustainability and cooperation as other river resources, particularly in northern Australia, are developed in the future.

The CRCFE is entering the last three years of its second term. However, scientists, water managers and policy makers would agree that much work remains to be done in studies of freshwater ecology, particularly at the landscape and whole-of-basin scales that are often beyond the scope of state water agencies. Cooperative research in this field, across state borders, really began when the CRCFE was set up in 1993, and developed strongly under the leadership of Professor Peter Cullen. Now the drive of Gary Jones is supporting the CRCFE staff as they maintain and increase the relevance of the CRCFE's work to communities and policy-makers. I would like to thank Gary and the program leaders for their enormous commitment to the present CRCFE and its partners, and for their vision of the scale of achievements that are possible and necessary.

Finally, I thank the members of the Board and the program advisory committees, as well as the staff of the CRCFE, for their hard work and generosity of spirit throughout the year.

DR JOHN LANGFORD
Chairman of the Board



Chief Executive's Report

Over the life of the current CRC for Freshwater Ecology (CRCFE) we have developed an integrated strategy of high quality research focused on the management of Australia's inland river systems and innovative knowledge synthesis and exchange. The success of this integrated strategy has seen the CRCFE front and centre in several major public policy and decision processes during 2002–2003.

Our scientists and knowledge brokers have worked together under immense public and political scrutiny on a draft interim scientific report on the Living Murray environmental flows process. The draft report is expected to be delivered on schedule, for review by a panel of international scientists and then consideration by the Ministerial Council in November 2003.

This summer saw the nation's water resources severely stressed by drought. In the ACT, CRCFE scientists provided vital advice to the ACT Government which enabled an agreement to be reached on an appropriate environmental flows regime below the Territory's major water-supply dams. This allowed revisions to the short-term water security predictions for the Territory at a time when severe measures were being contemplated.

In Victoria, the CRCFE's scientists worked closely with the Department of Sustainability & Environment on the development of the Sustainable Diversions Limits agreement that helped water management in unregulated and ungauged streams across the State.

In the CRCFE, we continue to produce innovative research to support major environmental outcomes. CRCFE scientist Dr Chris Walsh (Monash University), with collaborators from the CRC for Catchment Hydrology, has for the first time provided clear evidence for links between hydraulic connectivity (via the stormwater drainage system) and stream condition in urban catchments. This finding has the potential to revolutionise ecologically sustainable urban planning and development. Chris was the recipient of the 2002 CRCFE Chairman's Award.

It was a good year for awards for CRCFE staff. In August, Debbie Heck, leader of our education program, was part of a Griffith University team that won the Australian Museum's Allen Strom Eureka Prize for environmental education. Then Associate Professor Bill Maher of University of Canberra won the rarely awarded Royal Australian Chemical Institute's Analytical Chemistry

Medal — it is only the sixth time it has been awarded. Associate Professor Martin Thoms (University of Canberra) won the prize for Innovation in Geomorphology at the Binghampton Geomorphology Symposium in Pennsylvania. Dr Darren Baldwin was awarded the Macquarie University School of Law Prize for International Environmental Law (2003). The team from the Arthur Rylah Institute (Victoria) who resnagged a section of the River Murray won the DNRE's David Ashton Biodiversity and Ecosystem award. Centenary Medals were awarded to Professor Barry Hart and Professor Peter Cullen as well as two senior members of our Board — Dr John Langford and Mr Don Blackmore — for services to Australian society. At the University of Canberra, Dr Nancy FitzSimmons and Associate Professor Bill Maher were awarded Vice Chancellor's Distinction Awards for 2003. And several CRCFE postgraduate students won awards for excellence in presentations at conferences during the year.

We have continued to expand our role of capacity building and value adding in the education of Australia's future water researchers and water resources professionals. In addition to our on-going training of all postgraduate students in project management, communications and media skills, we have undertaken new speciality training in topics such as GIS applications in freshwater ecology. Also this year, all new postgraduate students have adopted an 'industry mentor' from one of our partner agencies. The industry mentor will help foster an understanding of the demands of water resources management and an appreciation of the environment in which Australia's water managers operate. Our aim is to produce a more mature early career scientist with a better understanding of the role of an environmental scientist in 21st century society. We believe this is an important and innovative initiative that will pay dividends for our graduates and industry partners in the coming years.

After broad consultation amongst our staff and partners, and external peer review, we have embarked on our Phase 2 research project portfolio, which will take us through to the end of the current CRCFE in 2006. Key strategic drivers for the research portfolio are: increasing our ability to predict ecological outcomes of management actions; development of a landscape approach to ecological research and management; and searching for quantitative relationships between environmental

factors and ecological condition. Building capacity in ecological prediction & decision systems, and landscape ecology & management will be important aspects of a CRCFE rebid which we are expecting to develop during the coming year.

For me, our growing and effective influence on public policy outcomes is a key measure of the benefits of a healthy and functional CRC. Investment in a CRC is not just an investment in high quality research and knowledge. An effective CRC has a cross-organisation knowledge management strategy that allows it to put its knowledge assets to effective use. Our scientific networks and knowledge exchange methods provide a mechanism for rapid review and synthesis of available knowledge that often may be spread across many scientists in different states and territories. This enables timely delivery of answers to many of the tough environmental management questions being posed by government or regional managers.

However, we certainly cannot be complacent or rest on our laurels. My aim is to stimulate the continuing evolution of a new level of scientific maturity — one that values scientific teams and embraces a culture of 'problem solving' — not just 'problem defining'. I will be encouraging all our staff to accept this challenge.

It has been an interesting year for many reasons. I thank Professor Peter Cullen for his encouragement and support. I'd like to give advance thanks to the team, led by Associate Professor Martin Thoms, which has organised the 'Ninth International Conference on River Research and Applications' on behalf of the CRCFE. The conference begins on the first weekend of July 2003, at Albury, NSW, with delegates attending from 24 countries including Australia. It should be a great success. And finally, sincere thanks to all the staff of the CRCFE, for your friendly, willing attitudes and impressive teamwork throughout 2002–2003.

PROFESSOR GARY JONES

Chief Executive



Chapter 1 ~ Structure, Management & Cooperative Linkages

STRUCTURE AND MANAGEMENT

MEMBERSHIP OF THE CRCFE

The Cooperative Research Centre for Freshwater Ecology (CRCFE) was formally established in July 1993 under the Commonwealth Government's CRC Programme.

In 1999, the CRC successfully applied for a further seven years of funding. The CRCFE is an unincorporated joint venture between 19 partners or core participants:

- ACT Government
- ACTEW Corporation
- CSIRO Land and Water
- Department of Land and Water Conservation, New South Wales (DLWC)*
- Department of Natural Resources and Mines, Queensland (QNRM)
- Department of Natural Resources and Environment, Victoria (DNRE)*
- Environment Protection Authority, New South Wales (EPA NSW)
- Environment Protection Authority, Victoria (EPA VIC)
- Goulburn-Murray Rural Water Authority
- Griffith University
- La Trobe University
- Lower Murray Water
- Melbourne Water
- Monash University
- Murray-Darling Basin Commission (MDBC)
- Sydney Catchment Authority
- Sunraysia Rural Water Authority
- University of Adelaide
- University of Canberra

**During 2002–2003, the environment aspects and staff of the DNRE (Victoria) became part of the new Department of Sustainability and Environment (DSE). In New South Wales, the DLWC became part of the Department of Infrastructure, Planning and Natural Resources (DIPNR).*

CRCFE BOARD

The CRCFE is governed by a Board comprising the following members at 30 June 2003:

- Dr John Langford — Executive Director, Water Services Association of Australia (Independent Chair)
- Mr Don Blackmore — Chief Executive, MDBC
- Mr Bruce Cooper — Director Ecosystem Management Branch, DIPNR
- Dr Maxine Cooper — Executive Director, Environment ACT
- Dr Jane Doolan — Waterways Unit, DSE

Dr Ruth Foxwell — Health, Science and Design, University of Canberra (replacing Prof. Mohamed Khadra)

Prof. Nancy Millis — Independent Board member

Dr Kathleen Bowmer — CSIRO Land & Water (replacing Dr Chris Moran)

Prof. Robert Norris — Dean, Faculty of Science, Monash University

Prof. Roy Rickson — Dean Environmental Sciences, Griffith University (replacing Prof. Bill Hogarth)

Mr Barrie Turner — Manager Environment and Planning Division, Sydney Catchment Authority (replacing Mr Paul Shanahan)

Mr Tom Vanderbyl — Manager Water Resources Planning, QNRM

Mr Grant Wilson — General Manager Waterways and Drainage, Melbourne Water

(Mr Ron Dennis, Independent Board member, resigned in March 2003)

The Board meets on a quarterly basis.

BOARD COMMITTEES

The Finance Committee and the Research Committee continued to operate during 2002–2003. The Finance Committee oversees the CRCFE's finances and makes recommendations to the Board. The Finance Committee meets on a quarterly basis. The Research Committee oversees the research undertaken, provides input into the new research program development (Phase 2 was developed during the year) and advises the Board. Phase 2 research is due to commence in July 2003.

Finance Committee

Dr John Langford — Chair

Mr Grant Wilson

Dr Ruth Foxwell (replacing Mr Ron Dennis)

Mr Charles Robinson (CRCFE Chief Administrative Officer)

Prof. Gary Jones (Chief Executive)

Research Committee

Prof. Nancy Millis — Chair

Mr Tom Vanderbyl

Dr Jane Doolan

Mr Bruce Cooper

Prof. Sam Lake (CRCFE Chief Ecologist)

Prof. Gary Jones (Chief Executive)

ORGANISATIONAL STRUCTURE

The Chief Executive, Professor Gary Jones (University of Canberra), carries executive responsibility for managing the CRC for Freshwater Ecology (CRCFE) within the policy framework established by the Board.

He is supported by the **Senior Management Team**, which consists of nine people (see fig. 1):

- Chief Ecologist, Professor Sam Lake (Monash University)
- the Director of the Murray-Darling Freshwater Research Centre, Dr Ben Gawne (MDFRC, CSIRO Land & Water)
- the leaders of the four research programs and the education program
- the Director of Knowledge Exchange, Associate Professor Ralph Ogden (University of Canberra)
- the Chief Administrative Officer, Mr Charles Robinson.

Figure 1: Organisational Structure



The research staff of the CRCFE are almost all provided by the five university partners (Adelaide, Canberra, Griffith, La Trobe, Monash) at labs in Adelaide, Albury, Brisbane, Goondiwindi and Melbourne. Other research staff are provided by CSIRO Land & Water through the Murray-Darling Freshwater Research Centre laboratories at Albury and Mildura, and state water agencies at Armidale and Goondiwindi. Staff and students at these laboratories work within any or several of the four research programs, according to expertise. See chapter 2 for details of the research programs.

- Research Program A — ecological processes that are influenced by river flows — is led by Assoc. Professor Gerry Quinn (Monash University, Melbourne).
- Research Program B — ecology of river (and wetland) restoration — is led by Professor Stuart Bunn (Griffith University, Brisbane).
- Research Program C — conservation ecology and aquatic biodiversity — is led by Dr Margaret Brock (DIPNR, Armidale).
- Research Program D — assessment of water quality and river condition — is led by Assoc. Professor Richard Norris (University of Canberra).

The education and training program (Program E) is led by Debbie Heck (Griffith University).

Knowledge exchange (Director: Assoc. Professor Ralph Ogden) is undertaken by a dedicated team of staff, as well as by several of the researchers themselves. See Chapter 3 for more details.

PROGRAM ADVISORY COMMITTEES

Program Advisory Committees (PACs), one for each research program, strengthen the links between industry needs and the CRCFE's research programs. The PACs have met in the year to help determine the phase 2 research portfolio for the CRCFE and to review the current research portfolio.

Program A Advisory Committee, Flow Related Ecosystem Processes

- Jane Doolan DSE
- Gerry Quinn (Program Leader)
- Tony Paull Sydney Catchment Authority
- Tom Vanderbyl QNRM
- Paul Wettin DIPNR



COOPERATIVE LINKAGES

COOPERATIVE LINKAGES WITHIN THE CRCFE

The CRCFE is a cooperative assemblage of 19 research and management institutions, as listed above. In this cooperative working environment, it is easy to forget that research in freshwater ecology, and communication between water professionals, were different before the CRCFE was set up. It is very important that the cooperative linkages between the CRCFE's core participants are maintained in good condition, and developed further where possible.

Several mechanisms operate to build mutual trust between the groups, across sites and disciplines.

- i) The strongest mechanism is the cross-institutional collaboration between the staff. The CRCFE's research teams work across disciplines and organisations. Program and project meetings and field-work offer opportunities for face-to-face interaction among team members from different institutions and states, reinforcing email and phone contact.
- ii) The cross-institutional collaboration is both led and reinforced by the new senior management team structure, which brings together representatives from five of the research sites, eight times per year.
- iii) Important cooperative linkages are also maintained at Board level, with four meetings per year plus committee and other interactions between meetings. The Board comprises senior representatives of the core participants that make the largest financial contributions to the CRCFE.
- iv) The Program Advisory Committees (PACs) — largely comprising representatives of CRCFE partner water agencies and authorities — stimulate cooperation among agencies and authorities and the research programs. Their interaction ensures that the CRCFE's research is relevant to the water industry. The PACs meet face-to-face at least once per year and report their progress to the Board. Their members are listed above.

Program B Advisory Committee, Restoration Ecology

John Amprimo QNRM
 Stuart Bunn (Program Leader)
 Peter Donnelly Environment ACT
 Kate Lenertz Sydney Catchment Authority
 Tony Roper DIPNR
 Scott Seymour Melbourne Water
 Wayne Tennant Goulburn-Broken CMA

Program C Advisory Committee, Conservation Ecology

Sally Boon QNRM
 Margaret Brock (Program Leader)
 Martin Krogh Sydney Catchment Authority
 Neal Foster DIPNR
 Julia Reed DSE
 David Shorthouse Environment ACT

Program D Advisory Committee, Water Quality and Ecological Assessment

Gary Bickford MDBC
 Brian Bycroft QNRM
 Bruce Cooper DIPNR
 Amir Deen Sydney Catchment Authority
 Lisa Dixon EPA Victoria
 Peter Donnelly Environment ACT
 Richard Norris (Program Leader)

- v) The CRCFE's knowledge exchange (KE) team also aims to help the development of trust between groups. The KE team members interact with the CRCFE partners, stakeholders and staff. They synthesise the knowledge of freshwater ecology that is being accumulated, and communicate it to our stakeholders, and they listen to the community and the water industry and learn from them for the benefit of CRCFE researchers.
- vi) All CRCFE staff receive an internal emailed newsletter once each fortnight, reporting on matters of relevance and interest. All members of staff are also sent copies of *Watershed*, the CRCFE's flagship newsletter/magazine. It describes recent research and happenings, and is written for a general audience. All staff can access the staff-only section of the CRCFE's web site.
- vii) Finally, the Annual General Meeting, a busy two and a half day meeting at a country venue, brings together staff and students from all CRCFE sites and programs who may otherwise know each other only by name. Likewise, the postgraduate students from all sites meet and share experiences and problems, at least once per year, usually during the AGM.

COOPERATIVE LINKAGES BEYOND THE CRCFE

Beyond the CRCFE, links have been established or are being developed with:

- policy-makers, natural resource managers, government officials from non-partner organisations ;
- community groups, and some parliamentarians;
- non-partner members of the water industry, particularly small-to-medium size enterprises (see chapter 4);
- the four other water-related CRCs in the Water Forum: the CRC for Catchment Hydrology; the CRC for Water Quality and Treatment; the CRC for Waste Management and Pollution Control; and the CRC for Coastal Zone, Estuary and Waterway Management; this collaboration operates at both a project level and in giving policy advice;
- some representatives of the media; and
- non-partner research institutions overseas and water agencies overseas.

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 Australia's river and catchment managers. The portfolio contains a mixture of large, longer-term, integrated field and laboratory projects addressing strategic priorities, and short-term projects addressing immediate needs and knowledge gaps.

Large multi-disciplinary projects form the core of the CRCFE's research portfolio. The nine core projects that have been the focus of the last few years are now being written up and replaced by ten new core projects. The core projects use expertise from across the CRCFE to focus on problems at a range of geographic and time scales, combining field, laboratory and 'desk-top' research and development. With over 98 projects in total (including postgraduate projects), the CRCFE is well positioned to make a real difference to sustainable water management in Australia. Projects are listed at the ends of this chapter and Chapter 3.

The CRCFE research portfolio addresses five key national issues:

- the over-regulation of river systems, and the pressure for development of presently unregulated water resources;
- the serious degradation of many urban and rural aquatic systems and the lack of knowledge about how to rehabilitate them;
- 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 affect biological communities and ecosystem processes.

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

- continual internal review of the science (by senior management team);
- external review of the science (by national and international peers), both at the initial proposal stage, and at the end of the project; and
- review of management relevance (by Program Advisory Committees).

The Program Advisory Committee system has been described in the previous chapter.

PROGRAM PROGRESS

Program A — Flow-related ecosystem processes

Program Leader: Associate Professor Gerry Quinn

Deputy Program Leader: Associate Professor Martin Thoms

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 their 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: for example, 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 it is addressing both basic ecological issues (Theme A1) and shorter-term management needs (Theme A2).

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 are examining selected ecological processes in river channels and their floodplains and wetlands, and, based on the 'flood-pulse' hypothesis, specifically considering 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.

Theme A2 — Flow manipulation in regulated lowland rivers

We are building 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 are quantifying relationships between different water release regimes and effects on target species or communities chosen to represent potential 'response' groups. Initially, these groups were key biota (e.g. fish, invertebrates, riparian and floodplain vegetation), but the study has been extended to include ecological processes (e.g. fluxes of carbon and nutrients, nutrient spiralling) and food web dynamics.

PROGRAM SUMMARY

This research program continues to advance our understanding of the role of flow in the ecology of river systems in Australia, such as the Murray, Ovens, Campaspe, Broken, Cotter, Goodradigbee and Cudgegong. Research is indicating that in-channel productivity may be a much more important factor driving lowland river ecosystems than previously thought. We have identified key biotic indicators for detecting ecological responses to modified flow regimes. We have quantified crucial habitat for threatened fish in gravel bed streams in relation to environmental flow releases. We have also continued to characterise flow regimes for summer- and winter-rainfall rivers, and to survey the literature to link ecological changes to modifications in flow regimes.

Several new initiatives began in 2002–2003 to directly address program milestones.

- 1) The CRCFE received \$1.6 million funding from MDBIC, to investigate the effects of changing flow regimes on the ecology of the Narran Lakes ecosystem. Although the start of this project was delayed, it has now got under way, in April 2003, led by Martin Thoms and Gerry Quinn.
- 2) A new project (Ecological sustainability of modified environmental flows in ACT rivers during the drought 2002–2003), related to project A210, is being funded by ActewAGL in collaboration with Ecowise Environmental. Richard Norris is managing the project, with Martin Thoms, Fiona Dyer and Heath Chester. The study design enables the project to differentiate between the effects of low flows and the effects of recent bushfires. Sediments and macroinvertebrates are being sampled regularly. Flow-type data at a range of time-scales and geographic-scales are being used to model the links between flow-type variability (hydraulic habitat) and flow regime. The January bushfires cleared the sampling sites used for the earlier geomorphic mapping, and so surveying is now being completed in more detail than was previously possible.
- 3) Following an assessment (for DLWC/DIPNR) of the effects of water transfers on the Cudgegong River, by Martin Thoms and Richard Norris, data have been collected to examine the geomorphological, chemical and biological effects of flow modifications on the river.
- 4) A new associated project (Monitoring ecological effectiveness of environmental flows in the Wimmera and Glenelg Rivers) is developing a monitoring design to assess ecological responses to environmental flows in the Wimmera and Glenelg Rivers. The literature review is now complete, and the final monitoring design should be complete by December 2003.
- 5) A related project (Targeted water management strategies for ecologically sustainable agriculture industries) is part of the Victorian DSE's Ecologically Sustainable Agriculture Initiative. The project is investigating appropriate methods for monitoring environmental flow provisions in unregulated streams.

These two projects will also feed into a CRCFE workshop in December 2003 to develop generic guidelines for monitoring environmental flows.

Two new projects are about to begin as part of the 2003–2006 research portfolio.

Project A240 (Quantifying flow–habitat–biota relationships in riverine ecosystems) aims to describe how environmental flows can best be allocated to maximise ecological value within the channels of Australian rivers. The project is examining the Cotter River, a high-energy upland river, the Broken River, a ‘medium’ energy tributary of the River Murray, and the River Murray itself, a low-energy highly regulated lowland system. The project is examining the way changing hydraulic habitat conditions affect stream metabolism, key fish species, macrophytes, and macro- and micro-invertebrates.

Project A250 (Development of flow–ecological response models) is taking on the scientific challenge of statistically relating changes in flow to responses of river biota. The team is drawing upon published and grey literature and CRCFE experience in hydrology, fluvial geomorphology and ecology to generate hypotheses relating flow variation to biological and ecological responses. It will then test the hypotheses, using existing data sets, and produce models relating to fish, invertebrates and ecological processes (production, decomposition) in eastern Australian rivers. The models will later be integrated into the Modelling Toolkit built by the CRC for Catchment Hydrology, for use by managers of catchment land-use and managers of environmental flows.

PROGRAM HIGHLIGHTS

Each of the program’s initial core research projects has made major achievements in 2002–2003.

Project A100 (Campaspe Flow Manipulation Experiment) has found that altered in-channel flows appear to have had a detrimental impact on habitats, such as backwaters, that are critical for the maintenance and recruitment of fish and shrimp species. The team has manipulated the conditions in backwaters (offshoots of the river which in natural conditions are shallow with zero flow and rich in microbenthos, and important rearing habitats) and has monitored the resulting flow and nutrients and the responses of fish and shrimp recruitment and macroinvertebrates.

Sampling of other MDB rivers is now testing the hypothesis (generated from Campaspe Project) that one species of atyid shrimp occurs only in unregulated reaches of lowland rivers. The production of a guide to fish larvae of the MDB is almost complete.

Project A200 (The effect of flow on lowland river productivity) was reviewed in July 2002 by Dr John Whittington (CRCFE and Chair), Prof Alistar Robertson (Charles Sturt University, Wagga Wagga), Assoc. Prof. Keith Walker (University of Adelaide) and Prof. Jim Thorp (University of Kansas). The Ovens, Murray and Broken Rivers have been sampled (during a rising hydrograph on the Ovens and Murray), refocusing the sampling effort in line with the recommendations of the review. There was no flooding in this financial year. A final report from the fish component has been submitted to DAFF (Dept of Agriculture, Fisheries and Forestry), and the entire project team is now completing a presentation for the NISORS conference (July 2003) and nine papers for publication.

Project A210 (Environmental flows and ecosystem response in gravel-bed streams) ended at June 2003. During 2002–2003, project staff worked closely with ActewAGL, ACTEW Corporation and Environment ACT, which are responsible for the water supply to the ACT, discussing and advising on environmental flows in the Cotter River. The project has characterised the hydrology of the Cotter River in ACT, and the physical structure of the river at low flow below the water supply dam ‘Bendora’. Spatial patterns of types of flow and streambed structure, as well as macroinvertebrates, have been mapped. Hydraulic preference curves have been developed for two-spined blackfish. The responses of invertebrates to dams, and the responses of periphyton and benthic invertebrates to modified flow, have been studied by two Honours students.

SUMMARY OF PROGRAM A OUTCOMES

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
Better understanding of the link between flows, ecological processes and biodiversity in a range of river types	<p><i>3 year</i> Improved conceptual and empirical understanding of the role of flow (floods and droughts) as a disturbance affecting ecological processes in rivers and streams</p> <p><i>5-7 year</i> Improved understanding of the links and exchange of biotic and abiotic materials, including organic matter and nutrients, between river channels and their floodplains.</p>	<ul style="list-style-type: none"> • A200 conducted field trips in August and September 2002 and successfully sampled a rising hydrograph in the Ovens and Murray Rivers. The Broken River has remained constant over this time. These sampling trips enabled the team to refocus the sampling effort in line with the recommendations of the panel that reviewed the project in July 2002. There was no flooding in this financial year. • Results from the fish component of the project were presented at the Australian Society of Limnology conference, and also submitted to DAFF in a final report. Nine papers are being written for refereed journals, and results are also being reported in a presentation at NISORS in July 2003. • A major conclusion from Project A100 is that altered in-channel flows appear to have had a detrimental impact on habitats critical for the maintenance and recruitment of fish and shrimp species. In particular, backwaters (offshoots of the river, which are shallow, have zero flow and are rich in microbenthos) are important rearing habitats.
New tools that will lead to improved recommendations for, and evaluations of, environmental water allocations	<p><i>3 year</i> Ecological characterisation of flow regimes in rivers in Eastern Australia including both winter and summer rainfall systems</p>	<ul style="list-style-type: none"> • Two papers on the hydrological characterisation of the Cotter River (Project A210: Environmental Flows and Ecosystem Response in Gravel-bed Streams) are currently being prepared/published. The first, on the use of the flow statistics and the method of analysis, is currently in press. The second, which outlines the model and addresses the exact changes on the Cotter, is being prepared. A report on the hydrological analyses is also being prepared. • Flow types and physical structure in the Cotter River at low flow between Bendora and Cotter have been mapped and eight geomorphic units have been identified. • The Project A100 team has established small-scale manipulations to destroy and create 'backwater' habitat and monitor the responses of various biotic components, especially fish and shrimp recruitment. Preliminary analyses suggest that larval and juvenile carp and rainbow fish use created backwaters. Destroyed backwaters displace fish larvae and are not sites of recruitment.
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><i>3 year</i> Assessment and development of designs for: monitoring the effects of environmental water allocations, (environmental flows) to rivers floodplains and wetlands, and experimentally testing, at realistic spatial and temporal scales, the causal links between attributes of flow regimes and specific ecological processes</p> <p><i>5-7 year</i> Implementation and analysis of (i) monitoring designs for assessing the effects of environmental water allocations to rivers, floodplains and wetlands, and (ii) multi-scale experiments testing the causal links between attributes of flow regimes and specific ecological processes</p>	<ul style="list-style-type: none"> • A project examining the effects of changing flow regimes and wetting and drying cycles on the Narran Lakes, a large terminal wetland system and Ramsar site in northern NSW, has been funded by the MDBIC and commenced in April 2003. • An associated project is developing a monitoring program to test ecological responses to environmental flows in the Wimmera and Glenelg Rivers in Victoria. A literature review guided the development of the final monitoring design, to be completed by December 2003. • A related workshop is developing monitoring guidelines for environmental flow provisions in rivers. • Project A100 is producing a paper on the persistence of macroinvertebrates, based on four years of Campaspe River sampling. • A key to larval fish is almost complete.

SUMMARY OF PROGRAM A OUTCOMES, *continued*

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
Develop and promote the adoption of flow restoration recommendations that could lead to measurable ecological benefits in degraded rivers	<p><i>3 year</i> 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</p> <p><i>5–7 year</i> Quantifying the benefits of environmental flows on key biota and ecological processes in winter- and summer-rainfall regulated rivers</p>	<ul style="list-style-type: none"> • Sampling of a range of MDB rivers is testing the hypothesis (generated from Campaspe Project) that one species of atyid shrimp occurs only in unregulated reaches of lowland rivers. • In Project A210 (Environmental Flows and Ecosystem Response in Gravel-bed Streams), all sampling and identification of invertebrates is complete, as is the detailed flow typing. Appropriate analyses are being developed. • The program staff are contributing, in a range of ways, to the Scientific Reference Panel work on environmental flows for the Living Murray initiative. • Two Honours projects have examined (i) the effects of dams on invertebrate colonisation and (ii) the responses of periphyton and the benthic invertebrate community to flow modification. • Hydraulic preference curves have been developed for two-spined blackfish. • A new associated project is studying the effects of a modified low flow environmental flow release during drought on the Cotter River, ACT. This project was complicated by the January bushfires, but the study design used in the initial project included balanced sites on the Goodradigbee River and its tributaries. Therefore, the effects of low flows can be differentiated from those of fire. The project commenced in February and a preliminary report was sent to Actew Corporation on 7 April.

Program B — Restoration ecology

Program Leader: Professor Stuart Bunn

PROGRAM OBJECTIVES

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 based on strong science, 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 guide practical restoration measures.

The core research objective of Program B is *to understand the ecological processes that will facilitate the recovery of disturbed stream and river ecosystems.*

The program has four broad 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.

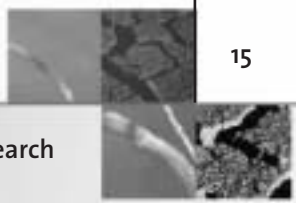
To achieve these objectives, the Restoration Ecology Program has been organised around three broad research themes:

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.

Theme B2 — Mechanisms of recolonisation and recruitment

Successful stream and river restoration will not only depend on the availability of suitable habitat for aquatic organisms to survive, 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 they use) and how far they can move.



Theme B3 — Indicators of success of restoration strategies

Much of the work aimed at developing and testing new methods for ecological assessment of the success of restoration is being undertaken in Program D. 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.

PROGRAM SUMMARY

Research in the Core projects (B200, B220 and B230) is now complete and the projects are being written up. Of the Associated projects, several are still underway and have contributed to the broader Program objectives. All Associated projects have met their milestones.

Two proposals have been developed for Phase 2 of the research program, building on work undertaken in Phase 1. On completion, the proposed projects will ensure that agreed program milestones are met. Project A250 will also be an important contributor to the Program B milestones; it has been designed to bring together aspects of flow and habitat restoration.

Project B240 (Ecological responses and adaptive stream rehabilitation: Application to degraded rural streams) aims to measure factors that constrain the effectiveness of rehabilitation work, focusing on both biodiversity (as in B200) and important ecosystem processes (e.g. production and nutrient cycling). The project is an expansion of B200, in which stream reaches are being partially rehabilitated with added habitat (large woody structures). The project team will also measure microbial diversity and selected biochemical processes in the stream, to see if they are limiting the macroinvertebrate recolonisation of the habitat. This work will build on research undertaken in B220.

Project B250 (Managing fragmentation and connectivity in river systems) aims to identify the distributions of representative species and populations of river organisms, among reaches, tributaries and streams, under natural conditions. The team intends to predict the groups of species most likely to be disadvantaged when aquatic populations become further fragmented by human activities. Ultimately it should be possible to recommend management strategies for lessening the potential effects of fragmentation in susceptible species. This project will build on the work undertaken in Projects B230 and C200.

PROGRAM HIGHLIGHTS

All Core Projects within the Program are progressing well:

Project B200 (Restoration Ecology in Degraded Rural Streams: the Granite Creeks Project): In spite of the low flow conditions in Euroa (as a consequence of the current drought) the wooden structures acted as predicted by creating scour holes. Since installation the structures have been colonised by algae (suggesting a shift towards in-stream production) and macroinvertebrates. Associated project B706 indicated that native fish (particularly mountain galaxiids and river blackfish) showed a positive response to the structures. The prolonged drought in the region has also highlighted the importance of remnant pools as refugia for aquatic organisms in this system.

Project B220 (Processes and Patterns: Restoration, Biodiversity and Ecological Functions): The third field trip to collect baseline data for the project was completed in mid-July 2002, and the samples have been processed. The final field-trip occurred in Feb. 2003. The ¹⁵N dosing experiment took place in December 2002. Discussion with Jon Olley (CSIRO Land and Water) cleared the way for one of the weir pools created by the installation of the Open Air Laboratory to be used for the addition experiment. The results of the preliminary experiments looking at the acute impacts of salinisation on anaerobic biogeochemistry and microbial community structure were presented to the steering committee for the associated project D723 (Salinity in Wetlands) and to the ASL congress in WA in September 2002.

Project B230 (Connectivity and Dispersal) Genetic analysis of shrimp, crayfish, caddisflies, mayflies, waterpennies and dobsonflies shows that populations of shrimp and crayfish are very fragmented, even on very small spatial scales, indicating very limited dispersal between streams, even within the same subcatchment. The insect species all showed very high levels of connectivity, both within and between catchments, indicating flight is the major dispersal mechanism. In addition, for all the groups examined, there was extensive cryptic diversity: i.e. species that were morphologically similar, but genetically divergent and non-interbreeding. High relief (topographic) can restrict dispersal.

SUMMARY OF PROGRAM B OUTCOMES

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
<p>An improved understanding of the constraints to recovery of disturbed aquatic ecosystems and the processes that can facilitate rehabilitation</p>	<p><i>3 year</i> Development and validation of innovative and practical monitoring tools so that the success of rehabilitation of streams and rivers can be quantified in ecological terms</p> <p><i>5-7 year</i> Identify important factors that constrain ecological recovery of degraded aquatic ecosystems and guide rehabilitation strategies to overcome such constraints</p>	<ul style="list-style-type: none"> The core projects B200, B220 and B230 have all met their Milestones and are being written up. Project B200 was favourably reviewed in November 2002. Several key journal papers have already been produced from this work. Work undertaken in B230 (and other associated projects) has highlighted the fragmented nature of populations of many aquatic species. This implies that dispersal within and between catchments may not be as extensive as previously thought and has major implications for the likely recovery of disturbed systems. A re-snagging experiment in the lower Murray (B704) has shown that return of wood to lowland rivers can have a very positive effect on rehabilitation of fish populations, such as Murray Cod and Trout Cod. This project has been extended. Experimental addition of rock riffles in urban streams (B705) has shown that rehabilitation of habitat alone may not always guarantee return of stream benthic communities, and other factors (such as water quality or dispersal) may constrain recovery. A final report on this project has been completed.
<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"> developing guidelines for rehabilitation of streams, rivers and floodplain wetlands in both rural and urban settings, based on sound ecological principles establishing demonstration sites to showcase ecologically-sensitive rehabilitation methods 	<p><i>3 year</i> 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> <p><i>5-7 year</i> Promote and assist with adoption of monitoring tools and protocols into restoration programs undertaken by stakeholders.</p> <p>Promote and assist with the adoption of best practice methods for rehabilitation of river and wetlands by stakeholders</p>	<ul style="list-style-type: none"> Work on riparian influences on stream temperature (B708) has continued in Echidna Creek, in association with the CRCCH restoration project (6.4), led by Nick Marsh. A report on the development of stream temperature models by Dr Kit Rutherford (NIWA, NZ) has been submitted to L&WA. This work is being expanded to include streams in other regions of Australia. The review on managing wood in streams, coordinated by Peter Cottingham and myself, has been finalised and was published by L&WA as a Technical update to the 1999 Riparian Management Guidelines. This was a joint activity with CRCCH and drew on outcomes from B200 and several Associated projects.



Program C — Conservation ecology

Program Leader: Dr Margaret Brock

Deputy Program Leader: Professor Jane Hughes

Biodiversity is important to our culture for the economic value that can be gained from the biota via materials and medicines, the ecological sustainability of human societies, and rich and varied opportunities in recreation and tourism. Loss of biodiversity continues to be one of our most serious environmental concerns. Whether we look at wetlands or salt marshes, mangroves or bushland, inland rivers or estuaries, the same story emerges. Degradation of habitat, the major cause of biodiversity loss, is continuing at an alarming rate.

Definition of threats to biodiversity is the first step in conservation of freshwater biota and ecosystems. Decisions regarding appropriate responses often need to be made on a time-scale of the immediate to the very near future. An adaptive approach is appropriate, where intervention and research, including monitoring and evaluation, go hand in hand to achieve improved conservation outcomes. The principles of conservation ecology need to be better understood, to guide decisions for restoration and abatement of threats.

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 in applying research to maintain or restore biodiversity values in a range of freshwater ecosystems.



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.

This program is addressing these objectives through research organised around two themes: Biodiversity Assessment and Regulation (Theme C1) and Conserving Biodiversity (Theme C2).

Theme C1 — Biodiversity assessment and regulation

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?

Theme C2 — Conserving biodiversity

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?

PROGRAM SUMMARY

Projects in Program C are making good progress or complete. Information from the projects and about biodiversity in general is being presented in various forums: as newsletters and fact sheets, reports, scientific papers, seminars, conference papers, a special journal issue of *Aquatic Ecosystem Health & Management*, on a web site, and via the NSW Scientific Committee for the Threatened Species Conservation Act.

In particular, studies on effects of increased salinity are finding reduced species richness and abundance and an interaction of hydrology and salinity. Invertebrates, phytoplankton, zooplankton, aquatic plant seed banks, algae, fish, geomorphology and turtles are being measured. Electrofisher efficiency trials have determined detection rates possible during monitoring of fish biodiversity. Taxonomic studies are underway on mountain galaxiids. New species of freshwater crayfish have been found in collections made in 2002. The NSW trout cod recovery plan is complete. Studies of the

sustainable management of on-farm biodiversity in the rice-growing industry (effectively complete) are contributing to our knowledge of the relationship between this farming system and biodiversity at farm and regional scales. The shoreline fauna of Lake Pedder is being examined, as are the factors affecting biota in temporary freshwater ponds, and the ecology of the green and golden bell frog *Litoria aurea* (Anura: Hylkidae) in southern NSW. Connectivity and fragmentation, via flooding and drying, as well as carbon sources, and the resulting biodiversity of anabranch channels and waterholes are being studied in semi-arid and arid river systems.

For the new research portfolio, three new projects have been developed. Project C240 will determine salinity effects on ecosystem function resilience and diversity; Project C250 will examine the role of refugia (such as waterholes) in maintaining biodiversity in dryland rivers, and the biodiversity dynamics of waterbodies at a landscape scale; and Project C260 aims to predict the spread of invasive aquatic biota. The projects have been developed in consultation with the Program Advisory Committee.

PROGRAM HIGHLIGHTS

Our core projects made strong contributions to our objectives and themes during 2002–2003.

Project C200 (Dryland River Refugia) completed collection and analysis of data on invertebrates, stable isotopes, phytoplankton, algae, fish, geomorphology and turtles. Progress reports were delivered as part of the Project Review on 30 October 2002. The project is being written up, and a second newsletter is being produced for stakeholders.

Project C210 (Adaptive Management in Restoration Ecology) has been liaising with stakeholders, and developing the NSW trout cod recovery plan, as well as running electrofisher trials to determine detection rates possible during monitoring of fish biodiversity.

Project C220 (Conservation Ecology and Systematics of the Mountain Galaxias) has completed the fieldwork collecting specimens, and is engaged in biochemical studies of galaxiid taxonomy.

SUMMARY OF PROGRAM C OUTCOMES

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
New knowledge on the distribution, life history and conservation ecology of threatened freshwater biota	<p><i>3 year</i> Organisation of a national forum on conservation of biodiversity in freshwater ecosystems, bringing together the range of perspectives from science and management</p> <p><i>5–7 year</i> Significant contribution to understanding of biodiversity, its regulation in natural and disturbed systems, its measurement and its distribution within the Australian freshwater landscape.</p> <p>Decision-making tools for biodiversity conservation, provided in a form that can be readily used by managers.</p>	<ul style="list-style-type: none"> The second Dryland River Refugia Newsletter is in production, following positive feedback on the first newsletter last year. A special issue of <i>Aquatic Ecosystem Health & Management</i> (March 2003, vol 6(1)), called 'Freshwater Biodiversity in Australia', comprises eight selected papers capturing highlights of the Fenner Conference of winter 2001 ('Biodiversity Conservation in Freshwaters') run by the CRCFE. Topics discussed include conservation of the platypus; freshwater molluscs in habitats ranging from mound springs to rivers; wetland plants and wetlands; subsurface waters; and rivers. The papers also discuss impacts of water resource development; whether assessment criteria for terrestrial biodiversity can be applied to freshwater systems; and challenges to the conservation of freshwater biodiversity. Studies of the sustainable management of on-farm biodiversity in the rice-growing industry are contributing to our knowledge of the relationship between this farming system and biodiversity at farm and regional scales.

SUMMARY OF PROGRAM C OUTCOMES, *continued*

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
Principles and recommendations for assessing the biodiversity values of freshwater systems	<p><i>3 year</i> Design of experimental protocols for testing hypotheses on the processes that regulate biodiversity in natural and modified freshwater ecosystems</p> <p><i>5–7 year</i> Principles and recommendations for assessing the biodiversity values of freshwater systems and recommendations for management options</p> <p>Leadership in taxonomic research in targeted areas and provision of a range of taxonomic services to industry and research</p>	<ul style="list-style-type: none"> • In C200 (Dryland refugia), data on invertebrates, stable isotopes, phytoplankton, algae, fish, geomorphological measurements and turtles have been analysed and posted on an intranet database. Progress reports were delivered as part of the Project Review on 30 October 2002. The project is being written up. • In Project C210 (Adaptive management in restoration ecology), electrofisher efficiency trials have determined detection rates possible during monitoring. The final project completion date is delayed by 3 months to 1 October 2003. • In Project C220, stage 1 (planning and logistics) and stage 2 (specimen collection and fieldwork) are complete. The project was reviewed in December 2002. • An allozyme overview study is in progress, at the Evolutionary Biology Unit, South Australian Museum. A morphological study is underway (morphometric and meristic analysis of galaxiid populations), at the Arthur Rylah Institute and Museum of Victoria. A mitochondrial DNA study is being organised for later in 2003.
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	<p><i>3 year</i> Develop principles for the assessment of biodiversity in freshwater ecosystems</p> <p><i>5–7 year</i> Direct involvement in policy and decision-making through established government processes for implementing policy on biodiversity and threatened species conservation</p>	<ul style="list-style-type: none"> • Project C210 has engaged in stakeholder consultation. • The NSW trout cod recovery plan is now complete.

Program D — Water quality and ecological assessment

Program Leader: Associate Professor Richard Norris

Deputy Program Leader: Dr Chris Walsh

As Australian river-management agencies move towards more ecologically based management, biological assessment methods are becoming increasingly important for measuring the effectiveness of management processes. The CRCFE has been pivotal in the development and adoption of rapid biological assessment techniques, particularly AUSRIVAS under the National River Health Program.

Effective biological assessment methods should provide a rapid collection and analysis of data for management use on a regional basis. The methods should assess the degree of impact and present this in an easily interpretable form, using standardised methods

of measurement and data presentation. Models underlying the assessment should respond in known ways to natural variability and be implemented with designs that meet statistical assumptions such as the need for independence of treatments being compared.

Furthermore, for research managers to choose the most effective restoration and conservation strategies, ecological assessment should include assessment of degrading processes and an understanding of causal links between the damaging agents and observed ecological condition.

Some of these requirements have been met in current and previous CRCFE projects, but further testing and development are required. There is a pressing need to complete further work if ecological assessment and monitoring are to be effectively implemented. Projects within Program D are addressing these needs.

PROGRAM OBJECTIVES

- To determine the ecological responses of rivers and related wetlands to stressors.
- To develop and test ecological risk assessment (ERA) 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 in providing 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

Rivers and related wetlands generally demonstrate an ecological response to damaging agents, both physical and chemical. We are determining the responses to nutrient cycles, particularly of nitrogen and phosphorus, and to pesticides and herbicides, land-use, habitat degradation and flow regulation, in a range of winter- and summer-rainfall river systems.

Theme D2 — Innovative bioassessment methods

We are making a comparative assessment of the effectiveness and relative costs of various bioassessment methods. Are they robust to geographic changes in environmental variables, and are some methods better than others for particular situations? Can we identify relationships between ecological patterns and processes that may influence the regional distributions and abundances of organisms and habitats?

Theme D3 — Ecological risk assessment

We are developing and testing ecological risk assessment procedures for use particularly where several human-induced disturbances are operating in combination. The focus is on defining damaging agents in the Australian context and combining them in ERA models.

PROGRAM SUMMARY

All core projects are on schedule, and progressing well. Associated projects are complete or on schedule. The program is organising the Symposium on Urbanisation and Stream Ecology to be held at University of Melbourne, 8–10 Dec 2003. Six international invited speakers are confirmed to attend. Richard Norris attended, as a nominated Australian representative, a United Nations Expert meeting on Indicators of Biological Diversity including indicators for Rapid Assessment of Inland Water Ecosystems, Montreal, Canada, 10–12 February 2003. Program staff working on the ecological risk assessment of irrigation schemes (D726) have conducted a workshop with teams working on two related studies in the Fitzroy (Queensland) and Ord catchments. Organisations represented at the meeting were Central Queensland University, University of Western Australia, Edith Cowan University, Melbourne University, NPIRD, Goulburn-Murray Water and Goulburn-Broken CMA. With an eye to the future, the program team has consolidated the macroinvertebrate data collected by Melbourne Water since 1994 (over 1800 samples from 468 sites) into a taxonomically and systematically consistent database, which will greatly enhance the utility of these data both for Melbourne Water and for proposed CRCFE projects.

The Program Advisory Committee has guided the program on two projects for the new research portfolio, one of which has been approved so far. Project D250 (Predicting ecological condition of streams in response to urban stormwater management), will develop predictive models of ecological condition in urban catchments. It will do that by assessing the assemblages of macroinvertebrates (visible insect larvae and crustaceans) and microscopic diatoms, and relating them to the area of impervious surfaces in the catchment and the extent of stormwater drainage connection. The resultant models will be incorporated into existing stormwater management decision support software developed by the CRC for Catchment Hydrology.

PROGRAM HIGHLIGHTS

All core projects are on schedule, and progressing well.

Project D200 (assessment and delivery of methods for determining river health) is comparing the performance of several biological assessment methods in saline and sedimented situations. The study design has used gradients that include sites from southern Queensland, NSW, ACT and Victoria. The broad spatial scale has enabled general findings to be made, rather than findings specific to a particular area. Methods tested have used macroinvertebrates, diatoms, macrophytes and stream metabolism. The project has highlighted the difficulties of defining gradients that are unconfounded by things other than the issue of primary interest. This is a problem because most of the biological methods are designed to assess the combined effects of human activities. Preliminary data analysis suggests that several of the methods tested respond to the gradients being tested. It has also been shown that some methods have strong latitudinal gradients that



should be accounted for before the data can be interpreted. Prediction of local fish habitat features using larger-scale catchment characteristics, using a high quality data set from south-east Queensland, has proved successful. This approach may now be applicable for predicting features of fish habitat that may be missing from sites disturbed by human activities. Several papers from this work are now almost complete.

Project D210 (Urbanisation and the ecological function of streams)

has completed its last round of fieldwork, labwork and analyses. The project has found stormwater drainage connection to be a strong predictor of stream ecological condition, even at very low levels of catchment urbanisation. Two special sessions consisting of six papers presented findings from the project at the 2002 ASL congress (as well as a seventh paper reporting on an Associated student project by S. Stojkovic-Tadic). Eight papers are being written from this project, and there will potentially be a similar number of papers from associated student projects. Preparations for the Symposium on Urbanisation and Stream Ecology, run by this project, are going well. Discussions have continued with Melbourne Water and Brisbane City Council on methods for creating GIS layers required for the proposed project D250.

Project D220 (Development of a catchment-based ecological risk assessment framework for aquatic systems)

has two major ongoing components: a decision support system and two case studies. The final report on the DSS has been submitted. For the case study modelling the risk of algal blooms in Lake Yarrunga with the Sydney Catchment Authority, a conceptual model has been developed and data mining has extracted useful information to populate the quantitative algal model. The quantitative model is now under development. For the second case study, a review of the STREAMS decision support system with Melbourne Water, a workshop called 'Introduction to Quantitative Modelling' was held at Monash University in June 2003. The team has begun reviewing the components of the Index of Stream Condition as criteria for establishing stream improvement plans. Publications from this work are almost complete.

SUMMARY OF PROGRAM D OUTCOMES

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
Improved scientific knowledge on the ecological effects of damaging agents (including nutrients and pesticides) in Australian freshwater systems	<p><i>3 year</i> Development of priority areas for research in ecological response to agents that damage freshwater ecosystems</p> <p><i>5–7 year</i> Understanding of cause and effect links between ecological features and processes and methods of assessment</p>	<ul style="list-style-type: none"> The new catchment-scale indicator of urban stormwater impacts, 'drainage connection', has been confirmed as a strong predictor of degradation of in-stream community composition and of several ecological processes along an urban–rural gradient, even at low urbanisation. Biological assessment methods have been compared in saline and sedimented situations along gradients that include sites from southern Queensland, NSW, ACT and Victoria. Quantitative habitat assessment methods have been refined with the re-programming of an existing model to handle continuous data. In the methods comparison section of D200, sampling, data collection, identification of diatoms and sample processing are complete. Data analysis is in progress. The fish habitat assessment component of D200 has focused on using a high quality data set provided by Griffith University to trial the habitat modelling approach before it is extended to other regions with poorer data. Categorising the data from the perspective of the fish species being targeted has helped deal with variability of habitat data spatially, temporally and between samplers.
Improved and robust bioassessment methods that provide information on ecosystem health and assist in identifying the degrading processes (including habitat modification)	<p><i>3 year</i> Integration of AUSRIVAS with other techniques for assessment of river condition</p> <p><i>5–7 year</i> Understanding the effects of natural variability on bioassessment methods</p> <p>Evaluation of bioassessment techniques in an experimental process</p>	<ul style="list-style-type: none"> Richard Norris represented Australia at a United Nations Expert meeting on Indicators of Biological Diversity including indicators for Rapid Assessment of Inland Water Ecosystems, Montreal, Canada, 10–12 February 2003. A paper was presented at the 2002 ASL congress by Wayne Robinson on assessment using diatoms. Richard Norris has given presentations on the National Water Resources Audit and the Snapshot of the Rivers of the Murray-Darling Basin to several North American universities, and has completed a draft of the jointly-authored book 'Bioassessment of Freshwater Ecosystems Using the Reference Condition Approach'. Organisation of the Symposium on Urbanisation and Stream Ecology to be held at University of Melbourne 8–10 Dec 2003 is well advanced. Six international invited speakers are confirmed to attend. Program staff provided advice to ActewAGL and ACT government on the effects of fires in the ACT region. Richard Norris attended a national Monitoring and Evaluation Working Group meeting in Adelaide on indicators for national and regional monitoring. A workshop on the National River Health Program followed where the issue of AUSRIVAS website support was debated. Data collected on the effects of fires in ACT region.

SUMMARY OF PROGRAM D OUTCOMES, *continued*

Program outcomes (From Schedule)	Milestones (From Schedule)	Progress at year 4
New ecological risk assessment procedures and associated tools for use by water industries	<p>3 year Inclusion of expertise in ecological risk assessment (biota and processes with inputs to ecological risk assessment over a range of scales up to catchment level)</p> <p>5–7 year Integration of bioassessment methods into agency assessment programs.</p>	<ul style="list-style-type: none"> Reviewed Melbourne Water's Waterway Management Strategy, and then gave two well-received one-day workshops with Melbourne Water staff on revising their current risk assessment framework for waterway management. As part of associated project D726, on ecological risk assessment of irrigation schemes in the Goulburn-Broken catchment, CRCFE staff conducted a workshop with teams working on two related studies in the Fitzroy and Ord catchments. Organisations represented at the meeting were Central Queensland University, University of Western Australia, Edith Cowan University, Melbourne University, NPIRD, Goulburn-Murray Water and Goulburn-Broken CMA.

LIST OF RESEARCH PROJECTS, 2002–2003

PROGRAM A: FLOW-RELATED ECOLOGICAL PROCESSES

Core projects

- A.100: Environmental flows in regulated rivers (Humphries)
- A.200: The effects of flow on lowland river productivity
- A.210: Environmental flows and ecosystem response in gravel-bed streams

Associated projects

- A.302: Water quality monitoring of Thredbo
- A.303: Impacts of resorts in Kosciuszko National Park
- A.304: Cotter River low flows
- A.305: Keepit Dam augmentation effects
- A.604: Narran scoping study
- A.605: Narran research development
- A.708: The effect of water regime on wetland ecology (Brock)
- A.710: Modelling dry-season flows and predicting the impact of extraction on a flagship species (Georges)
- A.711: Habitat fragmentation and environmental flows, Condamine-Balonne river (Thoms)
- A.712: Importance of flood flows to productivity of dryland rivers and their floodplains (Bunn)
- A.714: The occurrence and significance of photosynthetic bacteria in freshwater ecosystems (Croome)
- A.716: Fish habitat protection in the Darling and Paroo Rivers
- A.717: The character and flow criteria for wetlands along the Barwon-Darling River
- A.718: Monitoring ecological effectiveness of environmental flows in the Wimmera and Glenelg Rivers

- A.801: Identification and characterisation of larval fish nursery habitats in floodplain rivers of the Murray-Darling Basin (King)
- A.803: Photochemistry of aquatic substances (Howitt) PhD
- A.804: Impact of flow regulation on carbon and nutrient cycles of floodplain wetlands of the Murray (Francis) PhD
- A.809: Flow related responses of floodplain vegetation in variable inland catchments (Capon) PhD
- A.810: The influence of water regime upon the floristic composition of Lower Murray wetlands (Siebentritt) PhD
- A.813: Introphic interactions between zooplankton and fish (Ebner) PhD

PROGRAM B: RESTORATION ECOLOGY

Core projects

- B.200: Restoration ecology of degraded rural streams (Lake)
- B.220: Processes and patterns (Baldwin)
- B.230: Connectivity and dispersal

Associated projects

- B.703: The role of dispersal and recruitment in structuring stream invertebrate populations (J Hughes)
- B.704: River rehabilitation through resnagging (Nicol)
- B.706: Restoration ecology of fish assemblages in degraded rural streams: the Granite Creeks project
- B.708: National Riparian Lands Program — In-stream ecological issues

- B.802: Biogeochemistry of nutrients in a sand slugged stream (Vanderkruk) PhD
- B.803: Dispersal of aquatic insects and the implications for river conservation in Southern Africa (Wishart) PhD
- B.805: The influence of coarse woody debris on habitat quality for invertebrate fauna in red gum forest (Ballinger) PhD
- B.806: The productivity and community structure of periphyton in relation to grazer guilds (McKenny) PhD
- B.807: Riparian vegetation distribution, disturbance and regeneration in the SE MDB (Evans) PhD

PROGRAM C: CONSERVATION ECOLOGY

Core projects

- C.200: Dryland river refugia (Bunn)
- C.210: Adaptive fish management (Koehn)
- C.220: Conservation ecology and systematics of the mountain galaxias

Associated projects

- C.300: Narran integrated project
- C.702: Illustrated key to the nymphs of the Aust. Ephemeropteran Baetidae & Caenidae (Suter)
- C.704: Conservation and evolution of freshwater crayfish
- C.710: Long term monitoring of the littoral fauna of Lake Pedder (Lake)
- C.711: Sustainable management of on-farm biodiversity in the rice growing industry: vertebrate wildlife resources
- C.712: The ecology, distribution and abundance of green and golden bell frogs on the Molonglo River floodplain between Queanbeyan and Captains Flat
- C.803: Biodiversity in temporary & perennial wetlands (Butcher) PhD
- C.808: Fish distribution on the Ovens floodplain: relationships between oxygen, temperature and pH (McNeil) PhD
- C.809: Connectivity and fragmentation of floodplain–river exchanges in a semi-arid anabranching floodplain river system (McGinness) PhD
- C.810: Community dynamics in temporary pools (Kellar) PhD

PROGRAM D: WATER QUALITY AND ECOLOGICAL ASSESSMENT

Core projects

- D.200: Assessment and delivery of methods for determining river health (Norris)
- D.210: Urbanisation and ecological functioning of streams (Walsh)
- D.220: Development of an ecological risk assessment framework (Grace)

Associated projects

- D.604: 'Dirty water' models. Predicting community composition for streams in disturbed landscapes (Walsh)
- D.706: AUSRIVAS modelling projects (Norris)
- D.717: Land & Water Audit (Norris)
- D.718: Relationship between pesticides and in passive samplers to riverwater concentrations and macroinvertebrate populations
- D.720: Support and completion of Australia wide assessment of river health models (Norris)
- D.721: SEQRWQMS (Bunn)
- D.722: Nutrient cycling, primary production and aquatic food webs in coastal river systems: implications for eutrophication management (Bunn)
- D.723: Predicting the ecological consequences of increasing salinity on wetland sustainability (Brock)
- D.724: Tooma River study
- D.725: Robust procedures for measuring metal speciation and bioavailability
- D.726: Ecological risk assessment of irrigation schemes
- D.727: Suspended particulate matter
- D.819: Defining the reference condition: implications for biological assessment (Sellens) PhD
- D.820: A quantitative basis for the use of fish as indicators of river condition (Kennard) PhD
- D.821: The health of the Lachlan River (Curmi) MSc



Chapter 3 ~ Education & Training

Program Leader: Debbie Heck

Deputy Program Leader: Associate Professor Bill Maher

The overarching objective of the CRCFE Education Program is to stimulate a broader education and training experience for its students, particularly in graduate programs. This is achieved through initiatives such as the active involvement of researchers from outside the higher education system, and by enhancing the employment prospects of students through involvement in our user-oriented research programs. The program's specific objectives include:

- provision of postgraduate education that produces ecologists and aquatic scientists with high-level research skills that are sought after for 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 are 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 industry's human resources training need for well-rounded graduates who have the academic expertise, as well as the field, communication and technological skills to contribute to the workplace. We have five educational target groups: postgraduate; undergraduate; professional; school; community. Postgraduate training is our primary focus.

PROGRAM OBJECTIVES

- Provide **postgraduate** education and professional experience that produces ecologists and related scientists with high level research skills who are sought after to work in the water industries.
- Contribute to the continuing development of **professionals** working in the water industry through continuing education programs that update their knowledge and skill base.

- Contribute to **undergraduate** education programs such that graduates gain a sound ecological knowledge and an appreciation of its application to water management issues.
- Raise student awareness of employment opportunities within the water industry.
- Assist **community groups** to understand water-related issues, and help equip them to take an active role in land and water management.
- Build community awareness of water ecology and related environmental issues through a program of **public and school-based** education.



SUMMARY OF PROGRESS

Milestones (From Schedule)	Progress at year 4
<p><i>3 year</i> Identification of the education needs of the water industries</p> <p>A program developed for professional training of postgraduates and staff and a workshop and seminar program developed for professional education for the water industries.</p> <p><i>5-7 year</i> Able to demonstrate a range of education options targeted to the needs of the water industries.</p> <p>A wider professional learning experience offered to a wide variety of students and professionals through successful Centre programs.</p>	<ul style="list-style-type: none"> • A water-science statistics course, delivered on-line, is now available at University of Canberra. This particular project is very specific to environmental statistics and is offered at a postgraduate level to water industry staff, students and researchers. • An online course has been developed to teach AUSRIVAS methods to all interested people, including industry staff, from July 2003. • Media skills courses are offered on an as-needs basis for small groups of senior staff. • Workshops are running for staff and students, through 2003 and 2004, on GIS, PhD project management, presentation and media skills, statistics, and project management for consultancies.
<p><i>3 year</i> Arrangements in place for cross-institution supervision of students and contribution to tertiary teaching programs including professional practice for students in partner organisations.</p> <p>A group of high quality PhD candidates attracted to the Centre.</p> <p><i>5-7 year</i> Demonstrated publication and communication record amongst CRC postgraduate students.</p> <p>Curriculum materials developed including written and electronic teaching resources that can be widely used by undergraduate students.</p>	<ul style="list-style-type: none"> • 51 PhD students and 1 Masters students were enrolled in the CRCFE at end of June 2003. • To receive CRCFE top-up scholarships, students must have mentors in industry, with whom they interact at least four times each year. • Current PhD students have had 11 papers published or accepted for publication during the year. • 11 PhD students have given conference presentations during the year. • Michael Hammer arranged a publicity program for the pygmy perch, including sale of chocolates in that shape for Easter and Christmas. • Alison Mitchell and Neil Sims won awards for best oral presentations, at BIOGEMON 2002 and the IAHS Symposium respectively. • Heather McGinness won best poster paper at the IAHS Symposium in Alice Springs. • Lisa Evans's paper at 41st ASL Congress gained a special mention. • Claire Sellens spoke at the CRCA conference in May about her experiences as a PhD student with the CRCFE. • Claire Sellens features in a series of videos called <i>Wild Rivers</i>, for release later in 2003 or 2004. • Sam Capon was a finalist in the Young Water Scientist of the Year award for 2003.

PROFESSIONAL DEVELOPMENT

In response to requests for specific professional development courses, the following workshops were arranged for staff and students for early 2003, and announced in early December.

- Introduction to Arc Geographic Information Systems (Adelaide, Canberra, Melbourne and Brisbane).
- PhD project management (Brisbane)
- Presentation and media skills (Brisbane)

At the Presentation and Media Skills course, students and staff of CRCFE worked with Jenni Metcalf and Toss Gascoigne (media professionals) on presentation skills during the day. Participants each made three presentations during the day and then watched themselves on videotape, so they could review their development. In the evening session, representatives from both television and radio answered student questions about getting the watery issues into the media. This was followed by an opportunity to be interviewed by one of the media representatives.



Students new to CRCFE were invited to attend a workshop on PhD project management. The aim was to help them develop clear plans for their PhD programs of study and to identify milestones for their projects, for use in the CRCFE project management system. During the one and a half days, participants explored Gantt charts, critical pathways, lessons from other CRCFE PhD students, risk management, the difference between tasks and milestones, and budget preparation. Students were introduced to the CRCFE as an organisation, and were able to ask questions.

POSTGRADUATE EDUCATION

During 2002–2003, the CRCFE had 51 PhD students and 1 MSc student enrolled. Of the PhD students, nine had submitted their theses by end of June 2003, and two were part-time.

Nine students were recommended for top-up scholarships starting on 1 June 2003: Kane Aldridge, Bonnie Atkinson, Cassandra Bryce, Simon Linke, Sarina Loo, Timothy Page, David Reid, Aaron Troy and Susan Watkins. The scholarships are strictly limited to three years, and to receive them the students must have a water-industry mentor with whom they meet on a regular basis at least four times per year. Seventeen other students also held top-up scholarships in 2002–2003, seven held full scholarships and six were working on Associated projects.

Students within the postgraduate education program with the CRCFE had a one-day meeting prior to the annual general meeting in November 2002. The students reviewed their professional development needs and were able to explore other issues in relation to their research work with the CRCFE.

Sam Capon (Griffith University) reached the finals of the Young Water Scientist of the Year competition, run for the Water Forum CRCs, and made an excellent presentation at the AWA Conference in Perth (April 2003). She was also the CRCFE nominee for the CRCA conference postgraduate award.

PhD progress

These students' PhD theses were being examined, at the end of June 2003:

- Kylie Peterson, 'Environmental impacts on spawning and survival of fish larvae and juveniles in an upland river system of the Murray-Darling Basin' (University of Canberra).
- Marcus Wishart, 'Dispersal of aquatic insects and the implications for river conservation in southern Africa' (Griffith University)
- Simon Treadwell, 'The ecology of large woody debris in Australian lowland rivers' (Monash University)
- Lisa Evans, 'The influence of fluvial geomorphology on riparian vegetation in upland river valleys: south eastern Australia. (University of Canberra)
- Patrick Driver, 'Interactions between the age-structure of common carp (*Cyprinus carpio*, L.) populations and their habitat at catchment and experimental scales' (University of Canberra)
- Julia Howitt, 'Photochemical degradation of aquatic dissolved organic matter: the role of suspended iron oxides' (Monash University)
- Piyapong Chotipuntu, 'Aspects of sub-lethal salinity on the early life stages of an Australian native freshwater fish, Murray cod (*Maccullochella peelii Mitchell 1838*) (Monash University)
- Sam Capon 'Flow related response of vegetation in arid inland floodplains' (Griffith University)
- Rhonda Butcher 'Biodiversity in temporary and permanent freshwater wetlands in the West Wimmera, Victoria' (Monash University).

Four PhD students graduated during 2002–2003:

- Alison King, 'Identification and characterisation of larval fish-nursery habitats in floodplain rivers of the Murray-Darling Basin' (La Trobe University)
- Stephen Balcombe, 'Fish habitat in giant rush stands: littoral zone interactions in a floodplain billabong river' (La Trobe University)
- David Crook, 'Habitat use and movement of golden perch and carp in lowland river' (Charles Sturt University)
- Alison Mitchell, 'Anaerobic nutrient cycles in freshwater sediments' (Charles Sturt University)

Conference/workshop attendance and travel

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

- Society of Wetland Scientists Conference
- Biochemistry Workshop
- BIOGEOMON 2002
- Institute of Ecosystem Studies Conference
- Fluvial Sedimentary System Conference
- World Congress on Aquatic Protected Areas 2002
- 41st Annual ASL Congress
- Ecological Society of Australia 2002 Conference
- Ozwater Conference
- CRC Association Conference

Sam Capon has been awarded \$3000 from the CRCFE for travel to Sweden to work with Professor Christer Nilsson of Umea for three months from August to October 2003.

UNDERGRADUATE EDUCATION

Undergraduate teaching takes place at Monash University, University of Canberra, La Trobe University and Griffith University, University of Adelaide and at 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 Ecology and Conservation Biology; BSc Environmental Science; Aquatic Ecology unit; Field Ecology
- La Trobe University: BSc in Environmental Management and Ecology; also an honours degree; Graduate Diploma in Environmental Management
- Monash University: units offered in the BSc degree, Freshwater Ecology unit; Aquatic Chemistry
- University of Adelaide: B Sci and B Environmental Science
- University of Canberra: BSc Resource and Environmental Science.

Summer research scholarships and work experience

Summer scholarships were undertaken in November 2002 through to February 2003 by talented undergraduate students. They worked on short projects lasting 8–10 weeks under the supervision of CRCFE staff at the various institutions. The scholarships were provided to: Griffith University (3), University of Canberra (3), Monash (3), Mildura Lab (1), Albury Lab (1).

SCHOOL AND COMMUNITY EDUCATION

The Easter schools were run again in autumn 2003, promoting water issues to people in years 9 and 10. PhD students from within the CRCFE assisted with the camps to demonstrate that water science is an exciting area of study. One of them, Ben Smith (U. Adelaide) said:

‘I thought the camp was fantastic! The kids were extremely bright, and very enthusiastic about River Murray and general water-related issues. The daily activities were fun and educational (even for the mentors!) and the final performances given by each student group included knowledge gained during the activities — proving their effectiveness.’

The highly successful Rotary Murray-Darling School of Freshwater Research ran for its eighth year in April 2003. The School brings the best Year 11 students living in or near the Murray-Darling Basin, together with leading scientists, to increase the students’ understanding and appreciation of freshwater ecology, conservation, and the environment.

At the University of Canberra, three separate groups of high school and college students were introduced to the physical, chemical and biological characteristics of the Cotter River. Students collected water quality and physical habitat data and macroinvertebrates during one-day excursions in November. After mornings spent at the river, sampling and collecting, the students returned to the laboratory and were shown how to analyse their data and identify their catches, and some interesting adaptations the macroinvertebrates have for living in their aquatic habitat. Student reactions ranged from interest to excited enthusiasm.

POSTGRADUATE STUDENTS ACTIVE AT JUNE 2003

Name and expected degree	Project title	Supervisor and institution	Source(s) of funds
Aldridge, Kane PhD	Structure and function of Mediterranean creeks along a rural-urban gradient: influence on phosphorus dynamics	George Ganf, Justin Brookes, University of Adelaide	CRCFE Top-up scholarship from 1 June 2003
Atkinson, Bonnie PhD	Ecosystem function responses to stream rehabilitation in the Granite Creeks	Barry Hart, Mike Grace, Monash University; Wayne Tennant, GBCMA (industry)	CRCFE Top-up scholarship from 1 June 2003
Ballinger, Andrea PhD	Invertebrate biodiversity of coarse woody debris on floodplains	Sam Lake, Monash University	MDBC CRCFE Top-up
Barrett, Melissa PhD	Distributions and implication of C ₃ , C ₄ , CAM/SAM Species in Murray-Darling Basin	Keith Walker, George Ganf, Adelaide University	APA + CRCFE Top-up
Bowen, Trish PhD	Flow effects on cycling of carbon from lowland river macrophytes	David Williams, University of Canberra	LWA + CRCFE Associated Project Student
Boys, Craig PhD	Habitat use by riverine fish communities in semi-arid regions during low-flow	Martin Thoms, University of Canberra	CRCFE full scholarship
Bryce, Cassandra PhD	The ecology and systematics of the Australian Eustheniidae (Insecta:Plecoptera) and the implications of climate change on their conservation status	Phil Suter, La Trobe University; John Hawking, MDFRC	CRCFE Top-up scholarship from 1 June 2003
Carini, Giovannella PhD	The role of flooding in the maintenance of genetic diversity in four floodplain invertebrates	Jane Hughes, Griffith University	Griffith and CRCFE Associated Project
Conway, Carol PhD	Reactivity of organic carbon under anaerobic conditions and its role in sediment nutrient dynamics	Bill Maher, University of Canberra	APA + CRCFE Top-up
Cook, Ben PhD	Recovery and recruitment of aquatic fauna in rehabilitated streams in south-eastern Australia	Jane Hughes, Griffith University	APA + CRCFE Top-up
Davis, Nicole PhD	Fate and environmental effects of ammonia	Bill Maher, University of Canberra	Funding expired
Ebner, Brendan PhD	Introphic interactions between zooplankton and fish.	Phil Suter, La Trobe University; Ben Gawne, MDFRC	La Trobe (expired) Scholarship
Francis, Cathy PhD	The effects of flow regulation on carbon and nutrient cycles in temporary wetlands of the Murray River	Martin Thoms, University of Canberra; Ben Gawne, MDFRC	APA + CRCFE Top-up
Gehrig, Susan PhD	The ecology of riparian willows on the River Murray	Keith Walker, University of Adelaide	APA + CRCFE Top-up
George, Amy PhD	Population dynamics and recruitment of eucalypts on the lower Murray floodplain	Keith Walker, University of Adelaide	Adelaide + CRCFE Associated Project
Hammer, Michael PhD	Setting a framework for conservation: molecular systematics and conservation biology of small fishes of the Murray-Darling Basin	Keith Walker, University of Adelaide	APA + CRCFE Top-up
Harbott, Ernestine PhD	Use of enzyme activity for characterising organic carbon in Australian freshwater streams	Barry Hart, Mike Grace, Monash University	APA + CRCFE Top-up
Hughes, Victor PhD	Hydraulic habitat of inland rivers: the role of large woody debris	Martin Thoms, University of Canberra	APA + CRCFE Top-up
Hunter, David PhD	Life history of declining and non-declining frogs in the Southern Highlands of NSW	Will Osborne, University of Canberra	APA + CRCFE
Kellar, Claudette PhD	Community dynamics in temporary pools	Gerry Quinn, Monash University	CRCFE
Kennard, Mark PhD, part-time	A quantitative basis for the use of fish as indicators of river condition	Angela Arthington, Griffith University	Associated Project
Linke, Simon PhD	New approaches in biodiversity assessment for conservation purposes	Richard Norris, University of Canberra	CRCFE Top-up scholarship from 1 June 2003

POSTGRADUATE STUDENTS ACTIVE AT JUNE 2003

Name and expected degree	Project title	Supervisor and institution	Source(s) of funds
Loo, Sarina PhD	Intercontinental analysis and modelling of invasive species	Ralph Mac Nally, Sam Lake, Dennis O'Dowd, Monash University	CRCFE Top-up scholarship from 1 June 2003
Mackay, Stephen PhD	Flow requirements of aquatic macrophytes in south-east Queensland streams	Angela Arthington, Griffith University	CRCFE
McGinness, Heather PhD	Connectivity and fragmentation of floodplain-river exchanges in a semi-arid, anabranching floodplain river system	Martin Thoms, University of Canberra	APA + CRCFE Top-up
McKenny, Claire PhD	The relationship between ecosystem processes and community structure in south east Queensland rivers	Stuart Bunn, Heather Proctor, Griffith University	PhD Scholarship from Griffith University, plus CRCFE top-up scholarship, extended by six months to July 2003
McNeil, Dale PhD, part-time	Fish, zooplankton and algae dynamics in Murray River billabongs	Susan Lawler, La Trobe University	APA + Top-up expired
Medeiros, Elvio PhD	Variation on diet composition of fish in dryland refugia	Angela Arthington, Griffith University	International Scholarship and Associated Project
Nicol, Jason PhD	Ecology and management of arid deflation basin lakes	George Ganf, University of Adelaide	MDBC Associated Project
Oswald, Louisa PhD	<i>In situ</i> toxicity testing of water quality	Richard Norris, Bill Maher, University of Canberra	APA + CRCFE Top-up expired
Page, Timothy PhD	Historical biogeography of the sand barrier islands of Moreton Bay as revealed by molecular phylogeography of obligate freshwater species	Jane Hughes, Stuart Bunn, Griffith University	CRCFE Top-up scholarship from 1 June 2003
Perryman, Shane PhD	Nitrogen cycling and bacterial bio-diversity in urban Australian streams	Barry Hart, Mike Grace, Monash University	CRCFE Full scholarship
Price, Amina PhD	Influence of hydrology on the recruitment of native fishes to Narran Lakes, NW NSW	Martin Thoms, University of Canberra	CRCFE Full scholarship
Reid, David PhD	Effects of riparian zone degradation and restoration on ecological processes in freshwater streams	Gerry Quinn, Sam Lake, Monash University; Mentor from DSE and CMA to be arranged	CRCFE Top-up scholarship from 1 June 2003
Sellens, Claire PhD	Defining the reference condition: implications for biological assessment	Richard Norris, University of Canberra	CRCFE
Sharma, Suman PhD	Genetic structure of aquatic fauna in coastal streams in SE Qld: Evidence for past drainage changes	Jane Hughes, Griffith University	CRCFE Full Scholarship
Siebentritt, Mark PhD	Effects of water regime on wetland plants University of Adelaide	David Walker, George Ganf,	Bookmark Biosphere Trust + CRCFE Top-up
Smith, Ben PhD	Spawning and early life dynamics of carp in the lower Murray River, South Australia.	Keith Walker, University of Adelaide	APA + CRCFE Top-up
Stojkovic-Tadic, Slobodanka PhD	Interaction between phosphorus limitation and UVBR regulating the physiology of algae in freshwater biofilms	John Beardall, Monash University	APA + CRCFE Top-up
Troy, Aaron PhD	Quantification of ecological benefits associated with wetland rehabilitation along the Murray River Floodplain	Phil Suter, La Trobe University; Terry Hillman; Keith Ward, DSE and NECMA (industry)	CRCFE Top-up scholarship from 1 June 2003
Vanderkruk, Kellie PhD	Biogeochemistry of nutrients in a sand slug stream, Creightons Creek, Victoria	Barry Hart, Mike Grace, Monash University	APA + CRCFE Top-up
Watkins, Susan PhD	Effects of flooding and drying cycles on ecological processes in river floodplain systems	Gerry Quinn, Monash University; Ben Gawne MDFRC	CRCFE Top-up scholarship from 1 June 2003
Curmi, Tim MSc, part-time	The health of the Lachlan River	Phil Suter, La Trobe University	NHT

Chapter 4 ~ Knowledge Exchange

HELPING END-USERS TO APPLY CRCFE RESEARCH

Knowledge is fundamental to the effective management of natural resources. The CRCFE sees the generation and exchange of knowledge as its core business. We focus heavily on knowledge exchange with, and assistance to, our partners and also the community. We seek to ensure that our research meets the short- and long-term knowledge needs of the partners and that new knowledge is applied by our partner management agencies and by others, as stated in the CRCFE's Commonwealth Agreement (1999).

STRATEGY FOR USING AND APPLYING THE RESEARCH OUTPUTS OF THE CRCFE

KNOWLEDGE EXCHANGE

The CRCFE delivers knowledge exchange both through the activities of its scientists and more particularly via a team of staff dedicated to the task of knowledge brokering. Our knowledge brokers and scientists focus continually on linking the partners and water managers in the community — those that want ecological information — with those that can provide it. We listen to the needs, often management-related, of our stakeholders; that is, end-users in government, industry and the community and in other scientific groups and management agencies. We then assemble and review the available information and skills within the CRCFE and beyond, and synthesise these to produce the desired product, be it a consultancy, a workshop or conference, a project team, a publication, a briefing or meeting, or software or other communication materials. We also seek feedback from stakeholders to determine if their knowledge needs have been met and what their new knowledge needs might be. This focus on gaining information from stakeholders distinguishes knowledge exchange from the range of activities normally implied in 'technology transfer'. Although most of the interaction is between CRCFE staff and partner organisations (core participants), the table below shows that many other groups also seek advice and information.

The knowledge exchange team at June 2003 consists of Associate Professor Ralph Ogden (appointed during 2002–2003, at University of Canberra), knowledge brokers in Melbourne (Peter Cottingham), Sydney (Amanda Kotlash), Mildura (Michelle Bald & Sylvia Zukowski), Goondiwindi (Glenn Wilson) and Albury-Wodonga (John Hawking) and Canberra (Anthony Scott & Bronwyn Rennie), backed up by the communications group (Ann Milligan & Bronwyn Rennie) in Canberra.

The regional placement of most of the team makes it easier for the brokers to cooperate with and build linkages among the far-flung partners and other stakeholders of this CRC.

OTHER LINKS WITH END USERS

CRCFE staff also engage in the usual activities for disseminating scientific information: seminars, conferences, journal papers, technical reports. CRCFE research is publicised in *Watershed*, the newsletter/magazine of the CRCFE, and from there the media may take up the story. However, the media increasingly call our staff first, apparently recognising us as a source of interesting and useful information about freshwater matters. Publications, presentations and media are listed in Chapters 6 and 7.

The CRCFE continues to build linkages with SMEs (small-to-medium size enterprises); SMEs such as Sunraysia Rural Water Authority and Lower Murray Water are among our core participants. The CRCFE is currently pursuing cooperative interaction with the Cotton RDC, Cotton Australia, the Rice Growers Association, and others. These SMEs operate at the interface between freshwater ecology and how it is affected by land use, and it is important to the CRCFE that together we achieve cooperation and common goals.

Outlined below are the significant interactions for 2002–2003 between CRCFE staff and end-users: (i) highlights, (ii) our partners, (iii) consultancies, (iv) non-partners — government and non-government, industry and community groups, and (v) overseas.

HELPING END-USERS TO APPLY CRCFE RESEARCH

(i) HIGHLIGHTS

- Conducted a Scientific Reference Panel assessment of three theoretical environmental flows for the River Murray, under the Living Murray Initiative for our partner the Murray-Darling Basin Commission, and the Murray-Darling Basin Ministerial Council; the panel and evaluation groups together comprised over 60 scientists from across the Murray-Darling Basin.
- Collaborated with CSIRO Land & Water to begin further development of the CSIRO Environmental Flows Decision Support System, for use by the MDBC in their River Murray Environmental Flows Project.

- In regular discussions, advised and assisted our partner water authorities for Canberra in devising environmental flows for the Cotter River (Canberra's main water supply) during the drought of spring/summer 2002 and summer/autumn 2003, and in managing water quality and environmental flows in the Cotter River since the bushfires of January 2003.
- Led a scientific panel that recommended an environmental flow regime for the Goulburn River, Victoria.
- Organised the 'NISORS' international conference (being held in the first week of July 2003 at Albury, NSW): 'Ninth International Conference on River Research and Applications: The Nature of Variability in River Systems'.
- Publications for end-users: CRCFE staff produced 10 consultancy or technical reports, 2 software packages, 67 refereed journal articles, 13 book chapters and 1 book, 2 taxonomic identification guides, 13 non-refereed journal articles, 3 technical memoranda, 1 brochure and 1 fact sheet.
- Face-to-face forums for end-users: CRCFE staff ran or helped run 2 international symposia (hydrology at Alice Springs and dragonflies at Albury) during 2002–2003, 1 research discussion forum (at Mildura), 3 workshops (including one in USA), and a short seminar series.
- Presentations to end-users: CRCFE staff gave 71 conference and workshop papers and 19 seminars or other presentations (see chapter 7).
- Produced 10 media releases, and scored at least 105 media hits (that we know of).
- Provided information, publications and advice to at least 445 non-partner organisations and community groups (see below), and another 2000 addresses on the *Watershed* mailing list.

(ii) PARTNER ORGANISATIONS (I.E. CORE PARTICIPANTS)

ACTEW Corporation

- Participated in joint ACTEW Corp, ActewAGL, Environment ACT & CRCFE workshop on environmental flows in the Cotter River (J Whittington, M Thoms, P Liston, F Dyer, H Chester).
- Assisted with identifying long-term ecological strategies and issues for ACT's rivers and ACTEW in general, as part of a water benchmarking 'Future Issues' study (G Jones, A Scott, M Thoms, B Maher, F Dyer).
- Briefed ACTEW about potential changes to environmental flows in the Cotter River in the light of the drought (G Jones).
- Briefed ACTEW about potential responses to the Cotter Fires (G Jones).
- Contributed to meeting about ACT adherence to the Cap (G Jones).
- Contributed to ongoing meetings with ACTEW and Environment ACT on environmental flows in the Cotter River in drought and post-fire conditions (G Jones, M Thoms, F Dyer, R Norris, P Liston).

CSIRO Land and Water

- Contributed to the National Carp Workshop in Canberra on 5 and 6 March (P Humphries, S Meredith).
- Contributed to a document outlining CSIRO's response to the drought (D Baldwin).

Dept of Infrastructure, Planning and Natural Resources (DIPNR) (formerly Dept of Land and Water Conservation and Dept Sustainability and Natural Resources (DSNR))

- Helped build capacity in risk assessment through three presentations on Risk Assessment and Algal Blooms (Sydney, Dubbo, Bourke) (M Grace, A Webb).
- Provided advice on a stream flow management plan for Billabong Creek to the Murray Unregulated River Management Committee (J Whittington).
- Provided advice on environmental flow requirements to DLWC (Buronga) as part of the Darling Anabranch Management Plan (S Meredith).
- Discussed proposed CRCFE methods for the weir drawdown experiment at Euston (B McCarthy).
- Identified zooplankton in samples collected by the Riverwatch steering committee and gave advice on prevention of zooplankton in pipes (S Zukowski).
- Contributed to the National Action Plan Roundtable meeting in Mildura, and hosted a tour of nearby sites of interest (M Bald).
- Gave a Water Week seminar at the Centre for Natural Resources Parramatta (G Jones).
- Assisted the National Riparian Lands R&D Program review in December 2002 (S Bunn) (see also DNRM and DNRE).
- Provided advice on the aquatic ecology of the Border Rivers (G Wilson).

- Served on, and provided advice to the Riverwatch Steering Committee (S Zukowski (2), S Meredith (1)).
- Served on, and provided advice to the Waterwatch Steering Committee (M Bald, S Zukowski).
- Liaised with DLWC Hunter Region staff to promote more effective CRCFE Knowledge Exchange (A Kotlash).
- Managed a consultancy for State Water (NSW DSNR) producing a literature review of the aquatic ecological condition of the Keepit Dam and its immediate surroundings (A Kotlash).
- Liaised with DLWC staff to consider the recent bushfires and implications for water quality (D Baldwin).
- Liaised with Doug Westhorpe (NSW DLWC) on the inclusion of biofilms in river health monitoring (S Bunn).

Dept of Natural Resources & Mines (Qld)

- Considered Fitzroy River environmental flow allocations with QNRM staff (Rockhampton) (S Bunn)
- Identified possible future arrangements for Ecosystem Health Monitoring in SEQ along with Chris Robson and Bruce Simpson (QNRM), Andy Steven (Qld EPA) and Di Tarte (Healthy Waterways Partnership) (S. Bunn).
- Identified research priorities for limiting nutrients in SEQ Waterways with representatives from QNRM, CSIRO, Qld EPA, BCC) (S. Bunn, B. Hart).
- Identified opportunities for future collaboration on CRCFE projects between CRCFE and QNRM staff (S Bunn).
- Identified opportunities for data sharing between Project D201 and several regional NRM officers (Ellway, Wheeler, Moran, Smith, Pearson, van Manen) (G Wilson).
- With the Queensland Murray-Darling Committee Inc., identified priority funding for Border Rivers water quality projects to be funded through the National Action Plan (Floodplain and Riverine WQ Working Group) (G Wilson).
- Liaised with L&WA and the CRCCH to scope out a new project on nitrogen dynamics. The project will be run in collaboration with Heather Hunter (QNRM), Peter Davies (UWA) and Mike Grace (Monash), and will be linked to CRCCH project 2.5 (C Fellows).

- Provided an overview of Northern Laboratory capabilities to senior Qld Treasury and Qld NRM officials, Goondiwindi (G Wilson).
- Ensured stakeholder input into Northern Laboratory activities and staffing, in consultation with Tom Vanderbyl, Lamond Graham and John Amprimo (G Wilson, G Jones, B Gawne).
- Progress on the Narran Project, outlined under the MDBC entry, is of relevance to QNRM.
- Contributed to the National Riparian Lands R&D Program review in December 2002 (S.Bunn).

Dept of Natural Resources and Environment (Vic) (became Dept of Sustainability and Environment (DSE))

- Advised DNRE on site selection for the collection of cross-section data for the Goulburn River to support any future environmental flow studies (P Cottingham).
- Provided M Bailey (NRE Hopetoun) with information on aquatic plant selection for a dam and control of *Typha*. Also forwarded a copy of *Design Guidelines: Stormwater pollution control ponds and wetlands* (M Bald).
- Invited as members to the Victorian Technical Audit Panel to review groundwater management plans and streamflow management plans (B Hart, G Quinn, T Hillman).
- Advised on the key design aspects of a monitoring program proposed to evaluate the effectiveness of environmental flows delivered to Gunbower Island (P Cottingham).
- Served as a steering committee member for the Targeted Water Management project (P Cottingham) and provided advice on project experimental design (P. Cottingham and G. Quinn).
- Liaised with the Murray Scientific Reference Panel on behalf of the proposed Goulburn Scientific Panel being convened by DNRE (P Cottingham).
- Presented emerging results from CRCFE programs to Victorian CMA nutrient management coordinators at the request of DNRE (P Cottingham).
- Provided advice on the Lindsay and Wallpolla consultancy (S Meredith).
- Contributed to the National Riparian Lands R&D Program review in December 2002 (S.Bunn). This was also attended by the Program Advisory Committee, with representatives from DLWC, DNRE and NRM. Riparian rehabilitation R&D still remains a high priority for government agencies, and there are still important R&D issues to address.

- Convened and led the Goulburn Scientific Panel to conduct an environmental flow study for the Goulburn River (P Cottingham).
- Provided advice on identification of fish samples from the Murray River for DPI scientists based in Melbourne (P Humphries).
- Contributed to the 'Gunbower/Murray floodplain monitoring framework', liaising with Julia Reed (DSE) on developing a framework to monitor floodplain response to environmental flows (P Cottingham).

Environment ACT

- Facilitated a joint Environment ACT, ACTEW Corp, ActewAGL and CRCFE workshop on environmental flows in the Cotter River (J Whittington, M Thoms, P Liston, F Dyer, H Chester).
- Provided urgent advice on proposed modifications to ACT environmental flows releases (G Jones, R Norris, M Thoms, F Dyer, P Liston).
- Provided advice on the ACT adherence to the Cap (G Jones).
- Contributed to ongoing meetings with ACTEW and Environment ACT on environmental flows in the Cotter River in drought and post-fire conditions (G Jones, M Thoms, F Dyer, R Norris, P Liston).
- Provided technical advice for the Water Sensitive Urban Design Workshop February 2003 (I Lawrence).
- Provided technical advice about Sinclair Knight Merz (2003) 'Forde Residential Estate Study. Report for Gungahlin Development Authority (ACT Government)' (I Lawrence).
- Assistance to ACT Chief Minister's Department 'Hangzhou-Canberra Environmental Management Collaboration Program' and the 'Beijing-Canberra Environmental Management Collaboration Program' in the development by Canberra Environmental Consortium, of a Program of Environmental Studies for both the Hangzhou Environment Protection Bureau and the Beijing Environment Protection Bureau, 2002 (I Lawrence).

Environment Protection Authority (NSW)

- Continued to collaborate with the NSW Environment Protection Authority (and the Sydney Catchment Authority and DIPNR), on researching the ecological consequences of reduced connectivity and increased fragmentation of rivers in the Sydney region using genetic techniques.

Environment Protection Authority (Vic)

- Member of the Board of the EPA Victoria (B Hart)
- Member of the Scientific Advisory panel of the EPA Victoria (B Hart)

Goulburn-Murray Water

- Ran a workshop to support a CRCFE associated project that is using a risk assessment approach to examine the impacts of irrigation on native fish in the Goulburn-Broken catchment. (M Grace).
- As part of an associated project on ecological risk assessment of irrigation schemes in the Goulburn-Broken catchment, CRCFE staff conducted a workshop with teams working on two related studies in the Fitzroy and Ord catchments. Organisations represented at the meeting were Central Queensland University, University of Western Australia, Edith Cowan University, Melbourne University, NPIRD, Goulburn-Murray Water and Goulburn-Broken CMA. (M Grace)

Griffith University

- Supplied historic (1940s, pre-regulation) and current photographs of the Macintyre river to Angela Arthington for an overseas conference talk on flow alteration (G Wilson).
- Report on Dryland Refugia Project in *Watershed* (A Milligan, L Sealie).
- Report of Samantha Capon's PhD work in *Watershed* (A Milligan, S Capon).

La Trobe University

- Provided an overview of CRCFE work and capabilities to students and the general public at an open day at Mildura (M Bald).
- Presented information on CRCFE activities to Ron Broadhead and Dr David Gantz (M Bald).
- Gave a presentation to La Trobe University education students on environmental science curriculum (M Bald).

Lower Murray Water

- Gave a presentation outlining research projects in the lab (S Meredith).
- Held a Freshwater Forum to discuss issues for the lab's research portfolio and future direction with Lower Murray Water and other regional partners and stakeholders including the community (all staff).

Melbourne Water

- Reviewed the Melbourne Water decision support system STREAMS and identified opportunities for further refinement (2 workshops and a short report) (C Walsh, P Cottingham, A Webb, M Grace, B Hart).
- Reviewed Melbourne Water's Waterway Management Strategy (C Walsh, G Quinn, B Hart, P Cottingham, together with Tony Ladson from CRCCH).
- Ran the 5th Yarra Forum of researchers and managers in the Melbourne area (P Cottingham).
- Served on the organisation committee for International Symposium on Urbanisation and Stream Ecology being run in December 2003 (C. Walsh and P. Cottingham). The symposium is sponsored by CRCFE, Melbourne Water and CRCCH.
- Provided advice on the feasibility of providing alternative flow management to control sediment deposition in Armstrong Creek weir (P Cottingham, M Thoms).
- Contributed to the development of a long-term Melbourne Water monitoring program (P Cottingham), liaising with Melbourne Water staff and arranging for the project to be undertaken by Rhonda Butcher (Monash University).
- Consolidated Melbourne Water's eight years of RBA macroinvertebrate sampling data (>1800 samples from 468 sites) into a single database, taxonomically and systematically consistent, with an accompanying report. The new database will greatly enhance the utility of these data both for Melbourne Water and for proposed CRCFE projects. (C Walsh).

Monash University

- Initial scoping meeting of a new L&WA project on nitrogen dynamics was held, in collaboration with Heather Hunter (QNRM), Peter Davies (UWA) (M Grace).
- Report on Chris Walsh's work on urban stormwater piping in *Watershed* (C Walsh, A Milligan).
- Report on Andrea Ballinger's PhD work in *Watershed* (A Ballinger, A Milligan).

Murray-Darling Basin Commission

- Presentation to the MDBC Community Advisory Council meeting about the SRP Report (G Jones).
- Provided advice regarding environmental flows in the Darling Anabranch (S Meredith).

- Facilitated the formation of and Chaired Stage II of the River Murray Flows and Water Quality project Scientific Reference Panel (G Jones).
- Facilitated ongoing communication between the MDBC and CRCFE concerning the Murray Scientific Reference Panel chaired by Gary Jones (G Jones, A Scott, B Rennie).
- Reported on the justification for using an environmental flows decision support system for the Murray Flows Assessment Tool instead of alternative approaches (A Scott).
- Reviewed MDBC technical reports related to Scientific Reference Panel (Living Murray) (A Scott).
- Served as members of the Scientific Reference Panel for the Living Murray Initiative (G. Jones, A. Arthington, B. Gawne, T. Hillman, M. Thoms and K. Walker).
- Ran a workshop on the Murray Flows Assessment Tool, a decision support software package designed by the CRCFE and CSIRO Land and Water as part of the Living Murray project, for representatives of the Regional Evaluation Groups (REGs) (B Rennie, A Scott, G Jones).
- Convened and managed REG groups as part of the Living Murray initiatives (D. Baldwin, P. Cottingham).
- Served as REG group members as part of the Living Murray Initiative (D. Crook, B. Gawne, P. Humphries, J. Koehn, S. Meredith, K. Walker).
- Advised the Murray Flows Assessment Tool group on flow-fish ecology issues (P Humphries).
- Provided advice to Gary Bickford and Pat Feehan regarding storage risk assessment and environmental priorities on the River Murray (B Gawne).
- Provided technical and administrative support for Murray Scientific Reference Panel (B Rennie, A Scott).
- Attended a Drought Workshop in Canberra on 2 December, organised by River Murray Water (business unit of the MDBC) to discuss the 2002/03 Drought Operations of water in the Murray-Darling Basin (R Oliver, P Humphries).
- Provided advice at a two-day workshop on fish habitat issues in the Murray-Darling Basin (P Humphries).
- Contributed to meeting about ACT adherence to the Cap (G Jones).

- Coordinated the Scientific Panel for the Goulburn River environmental flows project, determining the environmental flows regime for the Goulburn River below Lake Eildon. Organised and coordinated Goulburn Scientific Panel workshops, and contributed to modelling, preliminary environmental flow recommendations, and liaison with DSE, MDBC and the Community Reference Group (P Cottingham).
- Established the Narran Lakes Project in partnership with the MDBC. CRCFE staff are members of the MDBC's project steering committee for the Narran Project (R Ogden), and the Narran Technical Management Group (M Thoms, G Quinn, G Wilson).
- Established the Narran Community Reference Panel (R Ogden, G Wilson, T Vanderbyl).
- Contributed to the 'Gunbower/Murray floodplain monitoring framework', liaising with Julia Reed (DSE) on developing a framework to monitor floodplain response to environmental flows (P Cottingham).
- Prepared a report on the impacts of hypolimnion water release from Dartmouth Dam for Gary Bickford (MDBC) (D Baldwin).

Sunraysia Rural Water Authority

- Meeting with CEO on research portfolio of Lower Basin Lab (S Meredith).
- Held a Freshwater Forum to discuss issues for the lab's research portfolio and future direction with the Sunraysia Rural Water Authority and other regional partners and stakeholders including the community (all staff).

Sydney Catchment Authority

- Attended an SCA ERP meeting 16/7/02 (G Jones).
- Hosted a small workshop to help the SCA explore methods and approaches to fish biodiversity monitoring (A Kotlash).
- Held an Ecological Risk Assessment Workshop in Sydney (A Kotlash, A Webb, M Grace).
- Hosted a workshop for SCA staff to present results and future directions of the CRCFE Project Connectivity and Dispersal (A Kotlash).
- Produced a short article for SCA on 'good' and 'bad' algae. (A Kotlash).
- Provided the SCA with comments on the initial stages of their Catchment Rectification Action Master Plan Project (A Kotlash).

- Supported and organised visit by Prof Jim Thorp to SCA (A Kotlash).
- Advised SCA on their risk management plan for the Sydney water supply catchments (G Jones, A Kotlash, A Scott).
- Reported on Tasks 2 and 3 for the Aquatic Biodiversity Program (A Kotlash).
- Submitted draft Task 4 report for the Aquatic Biodiversity Program for comment (A Kotlash).
- Provided SCA Education officer with material on blue-green algae and water sensitive urban design (A Kotlash).
- Recommendations from CRCFE scientists and Amanda Kotlash, contained in a literature review and report on ecological aspects of bulk water transfers, have been incorporated in a subsequent report to the Sydney Catchment Authority written by an independent consultant.



- Met with Barrie Turner, the new manager of the SCA's Environment and Planning Division, to further develop ways of improving knowledge exchange (A Kotlash).
- Provided advice to the SCA for their Bulk Water Transfers Project (which is being done by an external consultant) in the form of comments on draft reports, attendance at a number of workshops and meetings, and ongoing advice to the SCA's officer managing the project. As a result, the type and extent of bulk water transfers will now be made using the most up-to-date information. (R Norris, G Quinn, A Kotlash).

- Ongoing discussions have been taking place with the SCA's Risk Manager about holding a workshop to find out how a number of risk assessment projects (some ongoing, some just about to start) might relate to each other and how valuable experiences and existing knowledge might be shared. The projects mentioned so far are the National River Contaminants Program, the CRCWQT's Catchment Risk Management Project, and the CRCFE's Ecological Risk Assessment Project (D220). A number of key people have been contacted to gauge their interest for such a workshop. (A Kotlash).
- Met with the SCA's Knowledge Manager to discuss the SCA's Knowledge Audit (A Kotlash).
- Discussions with the SCA's Education Coordinator about the CRCFE's Education Program Leader carrying out an Environmental Education Audit for the SCA (A Kotlash).

University of Adelaide

- Report of Ben Smith's PhD work in *Watershed* (B Rennie, B Smith).

University of Canberra

- Contributed to separate panel discussions for the AUQA review process of the University (R Ogden, R Norris).
- Reports on Cotter catchment work and bushfire follow-up work in *Watershed* (F Dyer, T Nelson, H Chester, I Maddock, A Milligan).
- Report of Neil Sims's PhD work on Balonne Floodplain in *Watershed* (N Sims, A Milligan).
- Report of Sarah Cartwright's study of Lake George in *Watershed* (G Jones, S Cartwright).
- Report of D Hunter's PhD work in *Watershed* (L Regan, D Hunter).
- Report of Bronwyn Rennie's work on turtles in rice bays in *Watershed* (B Rennie, A Milligan).

(iii) CONSULTANCIES ACTIVE DURING 2002–2003

Research user	Name of consultancy and principal CRCFE staff involved
DNRE	Flows method — review transect requirements (Quinn)
DNRE	Flow requirements of key biotic biota — review database (Quinn)
DSE (was DNRE)	Goulburn River Scientific Reference Panel (Cottingham)
Melbourne Water	AUSRIVAS calculations (Walsh)
Melbourne Water (Walsh)	Review of biological data and recommendations for avoiding potential inefficiencies and errors
Various	Several small consultancies, various staff
MDBC	Weir drawdown trial (Gawne)
MDBC	Biodiversity monitoring program (Norris)
MDBC	Deflation lakes ecology study (Gawne, Meredith)
MDBC	River Murray ERP (Jones)
MDBC	Living Murray SRP/REG (Jones)
DNRM	NRM Balonne workshop (Thoms)
Mallee CMA	Environmental flows project management (Meredith)
Sullivan's Creek Catchment Group	Wetland Mosquito Survey (Lawrence)
EA	Tooma River (Harris)
EA	SIGNAL2 implementation (Norris)
US EPA	USEPA biodiversity program (Norris)
L&WA	Quantification of health in ephemeral rivers (Sheldon)
DLWC	Cudgegong River water transfer (Norris, Thoms)

(iv) NONPARTNER ORGANISATIONS

Universities, government departments, agencies and funding bodies

- For SA Water:* Provided advice on Environmental Flows Decision Support System (S. Meredith).
- For Gold Coast City Council:* Participated in Hinze Dam meeting (G. Jones).
- For Lake Eyre Basin Ministerial Council:* Overview of 'Water for Wildlife'. Discussion about a Lake Eyre Basin rivers assessment. (S. Bunn).
- For QLD EPA:* Investigated a fish and bird kill in Serpentine Lagoon, Goondiwindi (M. Southwell, A. Wallis).
- For Goondiwindi Town Council:* Investigated a fish and bird kill in Serpentine Lagoon (M Southwell, A Wallis).
- For EPA Qld:* Modelling dry season flows in Daly R. report (A Georges, M Thoms and colleagues).
- For Albury City Council:* Helped run a Year 6 Summer School held at Wonga Wetlands (R. Sinclair).
- For Victorian Fisheries:* Met with officers to discuss Lindsay Island fish larvae project outcomes (S. Meredith).
- For Albury City Council:* Provided a background paper on the effects of Drought on Water Quality to Daryl McGregor (Manager of Albury Water, Albury City) on 14 March (D. Baldwin).
- For Murray Wetlands Working Group:* Attended AGM on 28 November (B. Gawne).
- For Land & Water Australia:* Provided an aquatic perspective on the effects of bushfires to LWA (for a student project) (R. Ogden).
- For Central Queensland University, University of Western Australia, Edith Cowan University, Melbourne University, NPIRD, Goulburn-Broken CMA, Environment Australia:* As part of an associated project on ecological risk assessment of irrigation schemes in the Goulburn-Broken catchment, CRCFE staff conducted a workshop with teams working on two related studies in the Fitzroy and Ord catchments (M. Grace).
- For L&WA in collaboration with QNRM, UWA and Monash University:* 'In-stream and riparian zone nitrogen dynamics' project, linked to the existing CRCCH project 2.5 and another new L&WA project, led by CSIRO (C Fellows).

- For L&WA:* Conducted a review on managing wood in streams for a L&WA Technical update. (P Cottingham and S Bunn).
- For University of Sydney:* Provided computer code used for technical report 'Characterisation of flow in regulated and unregulated streams in eastern Australia' (N Marsh).
- For Landcare (DPI Vic):* Supplied article on bushfires from *Watershed* for their Landcare column in the *Bendigo Advertiser* (A Milligan).

Industry groups, professional organisations and NGOs

- For SunWater:* Discussed age-growth patterns in Murray cod with Goondiwindi SunWater staff and aged several fish for them (G. Wilson).
- For Sydney Water:* Presentation, 'Contextual factors guiding the selection & design of Gross Pollutant Traps' at Design of Gross Pollutant Traps Workshop (I. Lawrence).
- For Gold Coast Water:* Hinze Dam Risk Assessment Workshop 2002 (G. Jones).
- For Cotton CRC, Cotton RDC, Cotton Australia:* Held two workshops about potential collaboration on projects for improved environmental outcomes in the cotton industry (G. Wilson, G. Jones, R. Ogden, S. Bunn, G. Quinn, M. Thoms).
- For SW Water:* Provided phone advice regarding the likely impact of cyanobacteria in treated waste water used for irrigating pasture to graze dairy cattle (R. Oliver).
- For QAF Meat Industries P/L (formerly Bunge Meat Industries Ltd):* Provided advice on cyanobacterial blooms and methods of analysing cyanobacteria in their water supply (R. Oliver).
- For BecaSimon (wine company):* Advised on water quality (turbidity, suspended solids) so the winery could install an appropriate pumping and filtering system. (B. McCarthy).
- For Border Rivers Food and Fibre and MDBC:* Discussed the Living Murray Initiative, at Goondiwindi (G. Wilson).

Consultants

- For SKM:* Steering Committee meeting project on environmental indicators for water trading (B. Gawne, J. Whittington).
- For SKM:* Participated in Environmental Flows Workshop (B. McCarthy).
- For URS Australia:* Served as Reference Group member for the MDBC Watermark Project — 'Managing Water Quality in Irrigated Areas' (R. Norris).

Catchment management groups

- For* Institution of Engineers Australia, North East Catchment Management Authority, Albury: Presentations at launch of Draft Australian Runoff Quality Guidelines symposium (I Lawrence).
- For* Mallee CMA: Assisted with Hattah Lakes Management Plan, MCMA Water Quality Management Plan, MCMA Wetlands Operational Plan, and the Water monitoring Audit and attended regional Landcare Conference (M Bald).
- For* Mallee CMA: Provided advice on several consultancies (including Lindsay and Walpolla) and operational plans, and attended steering committee meetings (A Conallin, S Meredith, M Bald, S Zukowski).
- For* Mallee CMA: Attended committee meetings for management plans: Mulcra Island, Lindsay Island and Wetland audit and prioritisation projects (M Bald).
- For* Mallee CMA: Attended a regional catchment strategy meeting (S Meredith).
- For* Mallee CMA: Co-organised and attended the World Wetlands Day meeting and activities at Kings Billabong (M Bald and S Zukowski).
- For* Moreton Bay and Catchments Healthy Waterways Partnership, Science Advisory Panel: Advised on the development of the science and monitoring programs, relative to large-scale riparian/stream restoration projects, linked with the NAP program. (S Bunn).
- For* Lower Murray Darling CMB: Provided advice regarding the blueprint and funding strategy (M Bald).
- For* Goulburn-Broken CMA: Conducted a workshop on ecological risk assessment of irrigation schemes for teams working on studies related to D726 in the Fitzroy and Ord catchments (M Grace).
- For* North East Catchment Management Authority: Presented MDFRC research findings to the North East Catchment Management Authority Board (B Gawne).
- For* North East Catchment Management Authority: Provided a background paper on drought and water quality (D Baldwin).
- For* Border Rivers CMA: Discussed CRCFE collaboration at Goondiwindi (G Jones, B Gawne, G Wilson, M Southwell).

Community organisations

- For* Sullivans Creek Catchment Group: O'Connor Wetland Mosquito Survey 2002, report for SCCG (D Mawer, I Lawrence).
- For* Sullivans Creek Catchment Group: Technical advice on community, industry & government partnership agreement. (I Lawrence).
- For* Greening Australia: Discussions about CRCFE input into 'River Recovery', a regional project aiming to improve riparian zones on farms (R Ogden).
- For* Rotary: Educational camps in Mildura and Albury (M Bald, S Zukowski, J Hawking).
- For* Local Mildura stakeholders: Freshwater Forum at Mildura, 2 May 2003 (Mildura staff).
- For* Australian Salinity Action Network: A copy of D Nielsen's Salinity Fact Sheet number 1 was sent to the ASAN for inclusion in their newsletter.
- For* Wetland Care Australia: B Gawne was appointed as a Director.
- For* Waterwatch: Keynote address to National Waterwatch Conference (G Jones).
- For* Bookmark Biosphere, Berri: Two talks to high school students — one on the triple bottom line, and one on biodiversity. (S Meredith).
- For* Sunraysia Institute of TAFE: Guest lecture to the Aquatic Science students on sampling methods in aquatic ecology. (M. Bald).
- For* Holy Trinity Lutheran School: Provided information on the factors contributing to the decline of Murray Cod for 'Murder under the Microscope' Project (M. Bald).
- For* Gary Jeanes: Provided pamphlets on the Lower Basin Laboratory (N Whiterod).
- For* Cobram-Barooga River Cruises: Provided information on fish and river ecology for school education program (M Bald).
- For* Wentworth Show: Display on CRCFE (M Bald, B McCarthy, A Conallin, S Meredith, C Sharpe, N Whiterod, S Zukowski).
- For* Primary school student teacher: Provided information on salinity impact in the Murray-Darling Basin (M Bald).
- For* Landholders on Darling River (two groups): Provided information on the causes and incidence of algal blooms and potential treatment and prevention (O Schultz).
- For* Odyssey Travel Group: Gave presentation on Murray-Darling System (M Bald).
- For* Chaffey Secondary College: Assisted bug survey (S Zukowski).

For Landholder on Darling River: Identified plankton and gave landholder a demonstration under microscope (R Walsh).

For Mildura West Primary School: Ran activity on aquatic bugs and ecosystems (S Zukowski, N Whiterod).

For Walgett Local Aboriginal Land Council: Discussed Narran Lakes research and collection of local indigenous knowledge (M Southwell).

For Local residents at Goondiwindi: Identified a macrophyte sample (G Wilson).

For Albury Regional Museum: Display: *DRAGONFLIES! Explore the wonderful world of the Dragonfly* (J Hawking).

For Senior citizens group: Gave a talk about Murray cod, with display of 'real cod larvae' (C Sharpe).

For Rotary: Attended the Steering Committee Meeting of the Rotary Group for Lake Cullulleraine (S Zukowski).

For Fishermen on R. Murray: Talked about lab research on river/water quality (B McCarthy).

For Ranfurly Primary School: Presentation on human impacts on rivers (M Bald).

For Campers by the R. Murray: Spoke about lab research and the reason for dissolved oxygen recorders in the river (B McCarthy).

For Rotary: Attended the Steering Committee Meeting of the Rotary Group for Lake Cullulleraine (M Bald).

For Chaffey School: Conducted bug activities at Kings Billabong (S Zukowski).

For General community: Freshwater Forum — May 2nd, Highlighted the current research projects undertaken by the Lower Basin Lab to a range of key regional stakeholders including managers, irrigators, other industry and local government. Explained how our research is relevant to their business (M Bald, S Zukowski and the Lower Basin staff).

For National Water Week: Participated in planning meeting (M Bald, S Zukowski).

For Landholder at Deniliquin: Provided information on mosquito control mechanisms (S Zukowski).

For Waterweek activities: Assisted with bug surveys and quiz (M Bald, S Zukowski).

For Mildura West Primary School: Ran a Family Science Night for Science Week (M Bald).

For Local residents and Namoi Cotton Gin staff: Discussed fish and bird kills in Serpentine lagoon, Goondiwindi (M Southwell, A Wallis).

For Natural resource management students: Presentations to two groups of natural resource management students on research and issues relating to the Murray Darling Basin. (M Bald, S Zukowski).

For Landholder: Held discussions with a farmer and gave advice on an anoxic dam. Following recent rains the dam had received a large load of organic material (plant and dung) from the adjoining catchment. Gave advice on various options. (R Oliver).

For Waterwatch: Advice on sampling for 'Campfire' (R Ogden).

For Teacher at Yass Public School (primary): Sent information on river assessment by macroinvertebrates, and handouts for several classes (A Scott, A Milligan).

For Lower Balonne Community Reference Group: Presentation about the Narran Lakes project and proposal for the formation of a Narran Community Reference Panel (R Ogden, G Wilson, T Vanderbyl).

Other CRCs

For Cotton CRC: Discussions and two workshops about potential collaboration on projects for improved environmental outcomes in the cotton industry (G Wilson, G Jones, R Ogden, S Bunn, G Quinn, M Thoms).

For CRC for Catchment Hydrology: Considered issues related to the CRC Water Forum with CEO of CRCCH (R Ogden, G Jones).

For CRC for Catchment Hydrology: Submitted a review on managing wood in streams to L&WA for publication as a Technical update to the 1999 Riparian Management Guidelines. This was a joint CRC activity. (P Cottingham, S Bunn).

In addition, CRCFE provided publications or photos on request to:

ACTEW Corporation; Advanced Consulting; Australian Landscape Trust; Australian Parliament House Library; Australian Science Festival; Canada Health Services; Condamine-Balonne Water Committee; Condamine CMA; conference delegates at International Association of Hydrological Sciences symposium in Alice Springs, CRC

Association conference in Canberra, Waterwatch conference; CSIRO Land & Water library; Dept of Land and Water Conservation; Dept of Natural Resources & Mines; Dept of Natural Resources & Environment; East Gippsland CMA; Environment ACT; Environment Australia; EPA Adelaide; EPA NSW; EPA Victoria; Georges A & Cooks R, Streamwatch; Goondiwindi community; Goulburn-Murray Water; Griffith University; Healthy Rivers Campaign office; Hunter Water; Inland Rivers Network; Japan Embassy (for a Japanese professor); La Trobe University; Landcare Discovery Centre; Lower Balonne community; Lower Murray Water; Mallee CMA; Massey University (NZ); Melbourne Magazine; Melbourne Water; Mid Murray Local Action Planning, Cambrai; Mildura Rural City Council; Monash University; Murray-Darling Basin Commission; Murrumbidgee Irrigation; NIWA (NZ); NSW National Parks & Wildlife Service; numerous members of the public; Patterson Britton & Partners Consulting Engineers; Plum Media; Queensland EPA; 285 Regional Natural Resources Management groups; River Murray Catchment Water Management Board; school libraries at Mt Compass, McLaren Vale, Victor Harbor, Willunga and Munno Para (SA); Senator Robert Hill; South Australian Aquatic Sciences Centre; Sunraysia Rural Water Authority; Swinburne UT; Sydney Catchment Authority; Sydney Water; TAFE, Hunter NSW; Tamworth City Council; Terry Plowman (MP for Benambra); The Ecology Lab, Brookvale, NSW; University of Adelaide; University of Canberra; WA Water & Rivers Commission; Wetland Care; World Wildlife Fund (and 2000 others on the *Watershed* mailing list).

(v) RESEARCH USERS OVERSEAS

The CRC for Freshwater Ecology is involved in several ongoing research collaborations with researchers from overseas:

- 'Overlap in community structure between permanent and temporary ponds' with Dr Dani Boix Masafret, University of Girona, Catalonia, Spain (S Lake, Monash U).
- 'Algal and biofilm succession on LWD in sand-slugged streams' with Dr Serge Sabater, University of Girona, Catalonia, Spain (S Lake, Monash U).

- 'Cotter River project' with Dr Ian Maddock from University College Worcester (UK) (M Thoms, F Dyer, U Canberra).
- the RIVPACS (River InVertebrate Prediction and Classification Scheme) team, particularly John Wright and Ralph Clarke, based at the Institute of Freshwater Ecology in the UK (R Norris, U Canberra).
- G Wilson (Goondiwindi) continues to liaise with Bruce Paxton (Department of Zoology, University of Cape Town) regarding the use of otolith data to model patterns in fish spawning-timing and field sampling techniques.
- Regular hosting of international students, e.g. from Germany and Spain (R Norris, U Canberra).
- Tim Moulton and his Brazilian students doing field work on strong interactors in rainforest streams (using electric enclosures to determine the role of atyid shrimps) (S Bunn, Griffith U).
- Prof Rick Cunjak (Canadian Rivers Institute) visited Griffith University to plan a sabbatical visit in the first half of 2004. We are also planning to run the UNB Field Course on Habitats and Hydrology with Bob Newbury in April 2004 on the Mary River in SEQ. (S Bunn, Griffith U).
- (A Conallin) provided advice on electrofishing to Brendan Hicks University of Waikato NZ.

Staff of the CRCFE were members of committees related to water research in 2002–2003, including conference committees and editorial boards:

- the ICSU Scientific Committee for Water Research (SCOWAR) (a committee of the International Council for Science) (S Bunn, Griffith U).
- the Scientific Committee for the 4th International Workshop on Phosphorus in Sediments, Spain 2003 (D Baldwin, CSIRO).
- the Steering Committee for the 2nd International Symposium on Riverine Landscapes, Sweden 2004 (S Bunn, Griffith U).
- Scientific Committee for LARS2, the second international symposium on the management of large rivers for fisheries, Cambodia 2003 (A Arthington, Griffith U).
- *Hydrobiologia* Editorial Board, based in Belgium (R Norris, U Canberra).
- *River Research and Applications*, based in the United Kingdom (K Walker (U Adelaide) is Regional Editor for Asia and Pacific).

Staff of CRCFE were invited overseas to give advice and presentations:

- G Quinn (Monash U) visited NIWA in Christchurch, New Zealand to provide an overview of CRCFE research on aspects of environmental flows.
- P Cottingham attended a workshop to help formulate draft principles and guidelines for river rehabilitation to be presented at the 3rd World Water Forum, Japan, 2003.
- P Cottingham advised staff from the River Environment Bureau, Japanese Ministry of Land, Infrastructure & Transport on Australian blue-green algae alert levels and responses.
- R Norris (U Canberra) represented Australia at a United Nations Expert meeting on Indicators of Biological Diversity including indicators for Rapid Assessment of Inland Water Ecosystems, Montreal, Canada, February 2003.
- S Bunn was invited to be a keynote speaker at the 7th International Rangelands Conference in Durban in August, on 'Australian dryland river ecosystems and forest river ecology: implications for management'.
- S Bunn and B Chessman attended a meeting on developing ecosystem health indicators for the Mekong River, in Phnom Penh in July and discussed approaches used in SEQ and NSW.
- S Bunn assisted Dr B. Newbury and Prof R. Cunjak with a field course on River Habitats and Hydraulics at the University of New Brunswick. They also discussed the possibility of joint course offerings and staff/student exchanges with the newly formed Canadian Rivers Institute at UNB.
- S Bunn worked on the International Planning Committee for the North American Benthological Society (NABS), with the aim of raising the international profile of the society. Australia is one of the best-represented countries in NABS outside of North America.
- G Quinn and S Bunn were 'Discussants' at the 5th ICEF meeting in Zurich in March on the Environmental Future of Aquatic Ecosystems.
- I Lawrence was invited to Beijing to advise on water resources assessment, planning and management.
- M Thoms presented a paper at the Binghampton Geomorphology Symposium in Pennsylvania, and won prize for innovation in geomorphology.
- A Arthington (Griffith U) gave papers at two meetings of the Mekong Dialogue, a program of events in Australia and Thailand designed to open up debate and cooperation between civil society

and national and regional policy- and decision-makers in the Mekong River Basin countries, including Cambodia, Viet Nam, Laos, Thailand, Burma and Yunnan Province (China).

- J Koehn and A Arthington contributed papers for the Large Rivers Symposium (LARS2) in Phnom Penh.
- N Bond worked with Dr G Perry at Kings College, London, and also with Dr S Sabater at Girona in Spain, while overseas to present a paper on river restoration at the conference of the British Ecological Society.
- A Mitchell gave a talk at BIOGEMON in UK (and won a prize for best student presentation).
- E Harbott spent some time at Institute of Ecosystem Studies in New York, working with Dr S Findlay during her PhD studies.
- J Koehn presented a talk on carp for the US and Canada Joint Commission on Cross-Jurisdictional Issues of Invasive Species.

CRCFE sponsored visits by overseas scientists:

- Professor J Thorp (U Kansas, USA) gave lecture presentations and discussed lowland river function with CRC and partner agency staff at a number of sites at a number of centres (Adelaide, MDFRC, U Canberra, SCA and Griffith U).
- Dr I Maddock (University College Worcester, UK) worked with CRCFE staff at University of Canberra for much of 2002–2003.

The CRCFE also:

- responded to a survey for the Mekong River Commission, intended to find out how other international agencies, including CRC for Freshwater Ecology, manage the sales, marketing and distribution of their publications. The findings were to be used to improve MRC publication management.
- sent taxonomic ID guides to Department of Entomology, Cornell University, NY, and NIWA, NZ.
- continued to mail *Watershed* to the Environment Counsellor for the OECD in Paris, and to readers across nine European countries and USA, Canada, S. America, SE Asia, New Zealand and S. Africa.
- hosted a visit by the India-Australia Training and Capability Group Study Tour (an AusAid funded initiative), which included a presentation by MDFRC staff and a wide ranging discussion on environmental problems and the relationship between natural resource management and science, particularly in areas where there is multi-jurisdictional overlap.

Chapter 5 ~ Staffing & Administration

SPECIFIED PERSONNEL FOR 2002–2003

<i>Prof. Gary Jones</i> , replaced <i>Prof. Peter Cullen</i> on 1 July 2002		
University of Canberra	CEO	100%
<i>Dr Ben Gawne</i>		
MDFRC	Director (Regional Laboratories)	100%
<i>Prof. Sam Lake</i>		
Monash University	Chief Ecologist	75%
<i>Prof. Stuart Bunn</i>		
Griffith University	Program Leader	75%
<i>A/Prof. Richard Norris</i>		
University of Canberra	Program Leader	75%
<i>Dr Margaret Brock</i>		
DLWC/DIPNR	Program Leader	30%
<i>A/Prof. Gerry Quinn</i>		
Monash University	Program Leader	75%

STAFF CONTRIBUTED BY PARTNERS

Staff contributed to the CRCFE are detailed in the financial and staffing report (separate document).

STAFF COMINGS AND GOINGS IN 2002–2003

Dr John Whittington (Knowledge Broker), Lynne Sealie (Communications Manager), John Leonard (Executive Assistant) and Kelly Barr (Receptionist) left the CRCFE at University of Canberra.

Associate Professor Ralph Ogden replaced Professor Gary Jones who had become CEO on 1 July 2002. Dr Anthony Scott replaced Dr John Whittington; Ann Milligan replaced Lynne Sealie; Bronwyn Rennie started work as a Community Scientist; Carina New replaced Kelly Barr.

At Mildura Lower Basin Laboratory, Dr Rob Walsh joined the staff as a microinvertebrate ecologist.

At Goondiwindi Northern Basin Laboratory, Mark Southwell joined the staff as a Community Scientist.

MAJOR RENOVATIONS AND PURCHASES IN 2002–2003

No renovations to buildings were undertaken in the year. Major purchases during the year were related to the research effort of the CRCFE. Major purchases were:

Ultralow DNA freezer	\$12,500
Thermal cycler	\$11,000
Microscope	\$ 9,000
Computers	\$52,300
Two FWD vehicles	\$87,600



Chapter 6 ~ Publications

BOOKS OR CHAPTERS IN BOOKS

Breen, P & Lawrence, I. 2003. Chapter 2 Stormwater pollutant processes and pathways. In Wong, T. (Ed) Draft *Australian Runoff Quality Manual*, May 2003, Institution of Engineers Australia

Breen, P., Wong, T & Lawrence, I. 2003. Chapter 11. Constructed Wetlands and Ponds. In Wong, T. (Ed) Draft *Australian Runoff Quality Manual*, May 2003, Institution of Engineers Australia

Lake, P.S. 2002. Foreword. In *The World That Is*, by A.H. Weatherley. Dreamcatcher Publishing, Saint John, N.B., Canada. Pp. vii–viii.

Lake, P.S., Poore, G.C.B. and Lew Ton, H.M. 2002. Superorder: Syncarida Packard, 1885. Order: Anaspidacea Calman, 1904; Anaspididae Thomson, 1893; Koonungidae Sayce, 1908; Psammaspididae Schminke, 1974; Stygocarididae Noodt, 1963. In: *Zoological Catalogue of Australia*. 19.2A. Crustacea: Malacostraca; Syncarida; Peracarida: Isopoda, Tanaidacea, Mictacea, Thermosbaenacea, Spelaeogriphacea. (Ed. G.C.B. Poore). CSIRO Publishing, Melbourne.

Lawrence, I & Breen, P. 2003. Chapter 12. Urban Waterways. In Wong, T. (Ed) Draft *Australian Runoff Quality Manual*, May 2003, Institution of Engineers Australia

Lawrence, I & Phillips, B. 2003. Chapter 6. Water quality criteria guiding the selection & design of stormwater management measures. In Wong, T. (Ed) Draft *Australian Runoff Quality Manual*, May 2003, Institution of Engineers Australia

Lintermans, M. and Osborne, W. 2002. *Wet & Wild: A Field Guide to Freshwater Animals of the Southern Tablelands and High Country of the ACT and NSW*. Environment ACT, Canberra.

Marsalek, J., Urbonas, B & Lawrence, I. 2003. Stormwater management ponds. In Shilton, A. (Ed) *Pond Treatment Technology*. IWA Publishing. (in press)

Mitchell, A.M. and Baldwin, D.S. (in press). Interactions between organic phosphorus in aquatic nutrient cycles. In B.L. Turner, E. Frossard and D.S. Baldwin (eds.). *Organic phosphorus in the environment*. CAB International: Oxon, UK.

Phillips, B & Lawrence, I. 2003. Chapter 8. Hydrocarbon Management. In Wong, T. (Ed) Draft *Australian Runoff Quality Manual*, May 2003, Institution of Engineers Australia

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Suter PJ, Clair RS, Hawking J, Bryce C 2002. Aquatic macroinvertebrates from streams in the Mt. Kosciuszko area. In *Biodiversity in the Snowy Mountains*. (Ed. K Green) pp. 90–97. (National Parks and Wildlife Service Australian Institute of Alpine Studies).

Werren, G. and Arthington, A.H. 2002. The assessment of riparian vegetation as an indicator of stream condition, with particular emphasis on the rapid assessment of flow-related impacts. In: Playford J., Shapcott A. and Franks A. (eds), *Landscape Health of Queensland*. Royal Society of Queensland, Brisbane, pp. 194–222.

Whittington, J. and Liston, P. 2002. Australia's rivers. Chapter 14 – Environment, in *Year Book Australia 2003*, Australian Bureau of Statistics, Canberra.

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Arthington, A.H. and B.J. Pusey (in press). Flow restoration and protection in Australian rivers. *River Research and Applications* Vol. 4, 2003. Special Edition arising from the South Africa Conference on Environmental Flows.

Baker, A., Hughes, J.M., Sheldon, F., Bartlett, C., Goudkamp, K., and Bunn, S.E. (in press). Cryptic species and morphological plasticity in long-lived bivalves (Unionoida: Hyriidae) from inland Australia. *Conservation Biology*

Baldwin D.S., Rees, G.N., Edwards, M. and Robertson, A.I. (in press). A simple, reproducible method for studying biofilms in aquatic environments. *Environmental Technology*.

Bearlin, A.R., Schreiber, E.S.G., Nicol, S.J., Starfield, A.M. and Todd, C.R. (in press). Identifying the weakest link: simulating adaptive management of the re-introduction of a threatened fish. *Canadian Journal of Fisheries and Aquatic Sciences*

Boon, P.J., Slason, G.M.G., Lake, P.S., Ellis, B.K., Frank, C. and Boulton, A.J. (2002) Competition for water: international case studies of river management and conflict resolution. *Verh. Internat. Verein Limnol.*, 28, 1581–1587.

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- Harris J.H. 2003. Fish stocking and translocation in the Murray-Darling Basin: issues, benefits and problems. Keynote Address, in: *Managing Fish Translocation and Stocking in the Murray-Darling Basin* (B. Phillips, ed.), pp. 11–27. Proceedings of a workshop held in Canberra, 25–26 September 2002.
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Watson, G.O. and Nielsen, D.L. (in press). Zooplankton preferences: The relationship between egg-banks and habitat in an ephemeral wetland. *Journal of Plankton Research*.

NON-REFEREED JOURNAL ARTICLES

Bunn, S.E. (in press). Healthy River Ecosystems: vision or reality? *Water*, Journal of the Australian Water Association .

Cottingham, P., Bunn, S., Quinn, G. 2002. Using ecological knowledge to underpin river rehabilitation. *Water*, Journal of the Australian Water Association, 29(8), Dec., 25–28.

Hawking, J.H. and Theischinger, G. 2002. Vernacular names for the Australian Dragonflies (Odonata). *Australian Dragonfly Society Newsletter*. 3, 6–11.

Humphries, P. (in press). You've heard of Joseph Banks, but why haven't you heard of Johann Reinhold Forster and his son George? *Australian Society for Fish Biology Newsletter*.

Humphries, P. (in press). From Van Diemen's Land to Paris: the scientific discovery of a Tasmanian fish. *Forty Degrees South*.

Humphries, P. and Cook, R. 2002. Making the most of a drought: the Campaspe Flow Manipulation Project. *Angler Action*, Spring 2002–Summer 2003, p.34.

Jones, G. 2002. Keeping a focus on freshwater ecology. *Water*, Journal of the Australian Water Association, 29(8), Dec., 25–28.

Jones, G. 2003. Knowledge brokers. Online newsletter of the CRC program, at <https://sciencegrants.dest.gov.au/CRC/HTMLDocuments/Documents/PDF/autumn2003.pdf>

Koehn, J. 2002. Freshwater invaders in Victoria. Under control? *Pest Plant and Animal News*, 22 (December 2002), 12–14.

Kotlash, A. 2002. The importance of biodiversity. *Water*, Journal of the Australian Water Association, 29(8), Dec., 25–28.

Milligan, A., Walsh, C., Norris, R., Liston, P., Lawrence, I. 2002. Protecting Australia's rivers: urban and inland. *Water*, Journal of the Australian Water Association, 29(8), Dec., 25–28.

Quinn, G. and Thoms, M. 2002. Environmental flows: an ecological perspective. *Water*, Journal of the Australian Water Association, September 2002, 46–48.

Scott, A., Lake, S., Cottingham, P. and Jones, G. 2003. Improving river management during drought. *Water*, Journal of the Australian Water Association, 30(2), Mar., 88–91.

TECHNICAL MEMOS

Lawrence, I. 2003. CRCFE Technical Memo: Estimation of streamflow for ungauged sites.

Lawrence, I. 2003. CRCFE Technical Memo: Estimation of reservoir safe water supply yield.

Lawrence, I. 2003. CRCFE Technical Memo: pH, algae, DO river models.

CONSULTANCY AND TECHNICAL REPORTS

Astles, K., Winstanley, R., Harris, J. and Gehrke, P. 2003. Experimental study of the effects of cold-water pollution on native fish. NSW Fisheries Final Report Series No. 44, NSW Fisheries, Sydney.

Brock, M.A. and Nielsen, D. L. 2003. Predicting the Ecological Consequences of Increasing Salinity on Aquatic Ecosystems. DLWC Technical Report.

Choy, S., Ramage, D., Jones, G. and Barratt, P. 2002. Prioritising Research on Inland Aquatic Ecosystems in Queensland. Report prepared for the Consortium for Integrated Resource Management (CIRM), Brisbane.

Cottingham P. and Bunn S. eds. 2002. Managing wood in streams. Riparian land management technical guide update. Land and Water Australia, November 2002.

Cottingham P. and colleagues. 2002. Perspectives on the scientific panel approach to determining environmental flows for south-eastern Australian rivers. Technical report 2/2003. August 2002. CRC for Freshwater Ecology.

Gilligan, D., Harris, J. and Mallen-Cooper, M. 2003. Monitoring changes in the Crawford River fish community following replacement of an ineffective fishway with a vertical-slot design: Results of an eight-year monitoring program. NSW Fisheries Final Report Series, no. 45. NSW Fisheries, Sydney.

Norris, R. and Thoms, M. 2003. Windamere/Burrendong dam water transfers: effects on the riverine environment. CRC for Freshwater Ecology, University of Canberra, Canberra, 2601 Report to NSW Department of Land and Water Conservation, State Water. January 2003.

Theischinger, G. and Hawking, J.H. 2003. Dragonflies of Victoria: An identification guide to adult and larval dragonflies (Odonata). Identification Guide No. 46. (Cooperative Research Centre for Freshwater Ecology: Albury).

Thoms M, Quinn G, Butcher R, Phillips B, Wilson G, Brock M and Gawne B. 2002. Scoping Study for the Narran Lakes and Lower Balonne floodplain management study. Technical report 3/2002. December 2002. CRC for Freshwater Ecology.

Walsh, C.J. and McCasker, N. 2002. Melbourne Water Macroinvertebrate database 1994–2002. A report on its compilation, with recommendations for its use and for future biological monitoring. Cooperative Research Centre for Freshwater Ecology, Water Studies Centre, Monash University. Dec 2002.

NEWSLETTERS AND BROCHURES

Wetland salinity – predicting the ecological consequences Fact sheet no.1 – aquatic plants. <http://ecorewards.com/wetlands1.pdf>

Knowledge Exchange: Linking researchers and stakeholders. CRCFE brochure

SOFTWARE

Linke S., Norris R.H., Robinson W.R. 2002. *The Impairator*: Software simulating the effect of stressors on ecological communities. <http://lake.canberra.edu.au/~impairator/>

Todd, C.R., Lovelace, P.R. and Schreiber, E.S.G. 2001 *Essential*, software for population modelling: version 1.0. (www.nre.vic.gov.au/ari/software).

Chapter 7 ~ Presentations & Publicity

SEMINARS HOSTED

'Ecotoxicological Tools for Environmental Management', 4–5 November 2002; a workshop organised at the University of Canberra by the Embassy of Italy and B. Maher, and endorsed by the CRCFE.

Water Forum seminar series in Canberra: 'The integration of physical and ecological research on river systems'. Eight short talks from CRCFE staff and students.

3rd Worldwide Dragonfly Association International Symposium on Odonatology, at La Trobe University, Beechworth, 8–13 January 2003, convened by John Hawking, supported by the CRCFE.

International Association of Hydrological Sciences Symposium, run in Alice Springs partly by Fiona Dyer and Martin Thoms, September 2002.

North American Benthological Society Technical Issues Workshop on statistical methods for biological assessment of freshwaters (at the annual conference in Pittsburgh), run by Richard Norris, Stuart Bunn and Simon Linke, with N. American colleagues.

'Introduction to Modelling': a 3-day workshop at Monash University, Clayton, Victoria, 18–20 June 2003, run by Mike Grace of CRCFE and Project D220 (Ecological Risk Assessment).

'Sustainable environment = sustainable economy: a Freshwater Forum' at Mildura Lower Basin Laboratory, 2 May 2003, run by M. Bald and S. Zukowski, hosted by the Lower Basin Laboratory of MDFRC.

SEMINARS PRESENTED AND MEETINGS SPOKEN AT

Cottingham, P. 2002. Invited talk to CMA nutrient management coordinators, about the CRCFE research program, 13 November.

Gawne, B. 2002. The effects of drying on wetlands: a disturbance or an opportunity? Joint Murray Darling Freshwater Research Centre and CSU Summer Seminar Series, 6 November.

Harris, J. 2002. Regional discussion of the MDBC's draft native fish strategy. Bourke, late November.

Harris, J. 2002. Regional discussion of the MDBC's draft native fish strategy. Moree, late November.

Harris, J. 2002. Regional discussion of the MDBC's draft native fish strategy. Dubbo, early December.

Harris, J. 2002. Regional discussion of the MDBC's draft native fish strategy. Cowra, early December.

Humphries, P. 2002. Ichthyological explorations: a fishy tale 230 years long. Joint Murray Darling Freshwater Research Centre and CSU Summer Seminar Series, 13 November.

Jones, G. 2002. A seminar to Department of Land and Water Conservation in Parramatta, as part of National Water Week, 25 October 2002.

Jones, G. 2002. A seminar at the Sydney Catchment Management Authority meeting in Goulburn on 14 October 2002.

Jones, G. 2002. Hot solutions for cold water pollution: examples for Australian fish, rivers and reservoirs. Proceedings of the 37th annual general meeting, Australian Freshwater Fisherman's Assembly, pp. 44–59.

Koehn, J. and Nicol, S. 2001. Native fish in the Murray-Darling Basin, 2051. In Murray-Darling Basin 2051: *Setting the Vision*, pp.52–55. Biodiversity Workshop Proceedings, Canberra, 25–26 October 2001. World Wildlife Fund (Australia).

Koehn, J. 2003. Presentation on the status of carp in Australia, to the US and Canada International Joint Commission on cross-jurisdictional issues of invasive species. March 2003.

Norris, R. 2002. Presentations on the National Land and Water Resources Audit and the Snapshot of Murray-Darling River Condition at several North American universities.

Norris, R. 2003. Attended a national Monitoring and Evaluation Working Group meeting in Adelaide on indicators for national and regional monitoring.

Norris, R. 2003. Attended a workshop on the National River Health Program where the issue of AUSRIVAS website support was debated.

Oliver R. 2002. Measuring river metabolism: what can it tell us about river function and river management? Joint Murray-Darling Freshwater Research Centre and CSU Summer Seminar Series, 4 December.

Walsh, C.J. 2003. Stream Ecology and the City: Identifying and managing the cause of poor ecological condition of streams in urban catchments. Departmental Seminar, School of Biological & Chemical Sciences, Deakin University, Burwood, Apr 2003.

Wilson, G. 2003. Presentation to grain grower audience, on impacts of herbicides on stream ecology. Venue: a property 250 km from Goondiwindi, Queensland.

Wilson, G. 2003. Ways of managing drought impacts and water reforms in Queensland. Presentation to 2-day forum held by Queensland National Party, 11–12 February, 2003.

CONFERENCE PRESENTATIONS

- Arthington, A. 2003. Paper at the Second International Symposium on the Management of Large Rivers for Fisheries, LARS2: 'Sustaining livelihoods and biodiversity in the new millennium'. Phnom Penh, Cambodia, 11–14 February 2003.
- Baldwin D.S., Rees, G., Mitchell, A., Watson, G. and Williams, J. 2002. Effects of salinity on biogeochemical processes. Sediment Biogeochemistry Workshop, Lismore, NSW, 3–5 December.
- Baldwin D.S., Rees, G., Mitchell, A., Watson, G. and Williams, J. 2002. Processes and patterns: acute effects of salinisation on the biogeochemistry and microbial community structure in anaerobic wetland sediments. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Ballinger, A. 2002. Fallen timber as invertebrate habitat in floodplain forest. Ecological Society of Australia Conference, Cairns.
- Bond, N. 2003. A paper on restoration work on the Granite Creeks system. Annual Conference of the British Ecological Society, York, UK.
- Bond, N. 2002. Restoring fish populations in sand-slugged streams: the Granit Creeks project. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Bourguès, S. and Roberts, S. (2002). Production and respiration in streams of varying catchment urbanization. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.
- Bowen, P.M. 2002. Riverine microbial responses to flow-induced changes in carbon source. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Brock, M.A., Nielsen, D.L., Crosslé, K. and Harris, K. 2002. Effect of increasing salinity on freshwater biota. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Bunn, S. 2002. A paper on benthic metabolism and stable isotopes. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Capon, S. 2003. Paper on PhD work at Ozwater conference, Perth, WA, April 2003.
- Cottingham, P. 2002. River management and flow rehabilitation issues in the Murray-Darling Basin. Paper presented at the International Symposium on the Renaturalisation of a River Basin, 17 September 2002. The Ecosystem Conservation Society of Japan.
- Cottingham, P. 2003. Sustaining River Ecosystems. Presented to the Fabian Society, Melbourne, 26 May.
- Cousins, K., Glaister A. and Lake, S. 2002. Communities of snag and benthic habitats in three degraded lowland creeks, Central Victoria. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Croome, R. 2002. A presentation on stream assessment techniques. At Wise Waterways: A course in Stream Management Principles and Practices. La Trobe University (Beechworth), 27–31 October 2002.
- Davies, P.M. and Bunn, S.E. 2002. The structure of food webs from freshwater systems in Australia: insights from benthic metabolism and stable isotope analysis. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Driver, P. 2002. A paper on carp. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Evans, L. 2002. Prediction of riparian vegetation composition for rehabilitation uses. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Grace, M. 2003. Solving the great nitrogen riddle. IC-03, Conference of the Inorganic Chemistry Division, Royal Australian Chemical Institute, University of Melbourne, 2–6 February 2003.
- Grace, M.R., Walsh, C.J., and Webb, J.A. (2002). Assessing and preventing stormwater impacts to streams and priorities for restoration. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.
- Harris, J.H. 2003. Fish stocking and translocation in the Murray-Darling Basin: issues, benefits and problems. Keynote address to workshop, 'Managing Fish Translocation and Stocking in the Murray-Darling Basin' (B. Phillips, ed.), pp. 11–27. Canberra, 25–26 September 2002.
- Hart, B.T., Webb, J.A., Burgman, M., Allison, G. and Chapman, M. 2002. A protocol for assessing the ecological risks from Australian irrigation systems. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.
- Hatt, B. and Fletcher, T. (2002). Impacts of stormwater drainage and sewerage design on pollutant transport. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.

- Hawking J. 2003. Australian Dragonflies. Albury Regional Museum, 22 January 2003.
- Hawking, J. and LeBusque, K. 2002. Using fake plants to assess the influence of re-establishing macrophytes on invertebrate assemblages in a lowland river. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Howitt JA, Baldwin DS, Hart BT & Rees GN. 2002. Iron oxide catalysed photodegradation of aquatic dissolved organic matter. *Interact 2002*, Sydney, 21-25 July.
- Howitt JA, Baldwin DS, Hart BT & Rees GN. 2002. Sediments and carbon cycling: photochemical interactions between suspended particles and dissolved organic matter. *9th International Symposium on the Interactions Between Sediments and Water*, Banff, Canada, 5-10 May.
- Humphries, P. 2003. Bushfires and implications for water quality. NSW Asthma Conference, Albury, 15 March.
- Humphries, P. 2002. A presentation on fish migration and habitat. At *Wise Waterways: A course in Stream Management Principles and Practices*. La Trobe University (Beechworth), 27-31 October 2002.
- Jones G. 2002. Keynote address to National Waterwatch Conference, Launceston.
- Jones, G.J. 2002. Hot Solutions for Cold Water Pollution: Examples for Australian Fish, Rivers and Reservoirs. Proceedings of the 37th Annual General Meeting, Australian Fresh Water Fishermen's Assembly, 2002; ISSN 1036-952X, pp. 44-59.
- Jones, G. 2002. A presentation at the NSW Irrigators Council Meeting, 31 October 2002.
- Jones, G. 2002. A presentation at the ACTEW Workshop 'Water Futures', 28 October 2002.
- Keller, C. 2002. Water regimes: do they make a difference to macroinvertebrate assemblages in temporary ponds? 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Koehn, J. 2002. A paper on riverine protected areas and what they could protect — species, communities or ecosystem processes. World Congress on Aquatic Protected Areas, Cairns, 14-17 August 2002.
- Koehn, J. 2003. Paper at the Second International Symposium on the Management of Large Rivers for Fisheries, LARS2: 'Sustaining livelihoods and biodiversity in the new millennium'. Phnom Penh, Cambodia, 11-14 February 2003.
- Lawrence, I. 2002. New approaches to water resources management. Proceedings Beijing – Canberra Environmental Symposium, Beijing 2002.
- Lawrence, I. 2002. Catchment land and water management. Hangzhou – Canberra Environmental Symposium, Hangzhou 2002.
- Lawrence, I. 2002. Australian developments in lake & wetland restoration. Hangzhou – Canberra Environmental Symposium, Hangzhou 2002.
- Lawrence, I. 2003. Management of a national lake and its catchment. Presentation to Mayor of Hangzhou delegation.
- Lawrence, I. 2003. Sustainable urban water and landscape futures: Implications for garden city. Presentation to Building Science Forum on Draft Variation Plan 200 (Garden City).
- Lawrence, AI & Phillips, BC 2002. Recent developments in integrated catchment management practices in Australia. Proceedings International Conference on Urban Hydrology, Kuala Lumpur 2002.
- Maher, B. 2002. ICPMS: reality versus hype: current and future applications. Keynote address at *Interact 2002*, conference at UTS Sydney, 21-25 July 2002.
- Maher B. 2002. New revised Australian water quality guidelines and water quality monitoring guidelines. *Ecotoxicological Tools for Environmental Management*, 4-5 November 2002; a workshop organised by the Embassy of Italy and B. Maher, and endorsed by the CRCFE.
- Marchant, R. 2002. The ASL medal plenary talk on the impacts of reservoirs. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Marsh, N., Rutherford, I. and Bunn, S. 2002. The effect of riparian vegetation on sediment delivery and water temperature in a sub-tropical stream in south-east Queensland. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- McCarthy, Bernard. 2002. Drawdown of the Euston Weir Pool 2003: Pre-event biofilm results. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.

- McCasker, N. 2002. Macroinvertebrate colonisation of re-introduced large woody debris in the Little Yarra River. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- McGinness, H. 2002. Connectivity and fragmentation of floodplain–river exchanges in a semi-arid anabranching river system. (Best) poster paper at the IAHS Symposium, Alice Springs, July 2002.
- Meredith, S., Gawne, B., Sharpe, C., Whiterod, N., Conallin, A. and Zukowski, S. 2002. Fish larvae on Lindsay Island. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Merrick, C., Oliver, R., Humphries, P., Hawking J., Nielsen D., LeBusque, K. and Lorenz, Z. 2002. Using artificial submerged macrophytes to enhance fish populations in the Broken River, Victoria. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Mitchell, A. 2002. The interactions of the anaerobic nutrient cycling processes and phosphorus release from freshwater sediments. BIOGEOMON 2002, University of Reading.
- Norris, RH. 2003. Experiences and lessons from Australia's National River Health Program. United Nations expert meeting on biodiversity assessment. Montreal, 9–12 February.
- Phillips, BC, Lawrence, AI & Mokhtar, W. 2002. Constructed ponds & wetlands in tropical urban areas. Proceedings International Conference on Urban Hydrology, Kuala Lumpur 2002.
- Pollino, C.A., Feehan, P., Grace, M. and Hart, B. 2002. Using ecological risk assessment to quantify the risks to fish in the Goulburn-Broken catchment. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.
- Pusey, B.J., Arthington, A.H. and Kennard, M.J. 2002. Determinants of freshwater fish biodiversity in north-eastern Australian rivers: discharge, flow regime and history. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Quinn, G. A presentation on stream ecology. At Wise Waterways: A course in Stream Management Principles and Practices. La Trobe University (Beechworth), 27–31 October 2002.
- Rees, G. 2002. Water quality in freshwater environments. Invited paper at the Murray Catchment Management Board's Community Forum 'Healthy Catchments, Productive Landscapes — Our Future', Corowa, 23-24 October, 2002.
- Rees, G., Baldwin, D., Watson, G. and Mitchell, A. 2002. Development and application of a molecular DNA method to examine bacterial population dynamics. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Robinson, W., Bate, N. and Newall, P. 2002. Bioassessment using diatoms in Australian streams: sample size and scale implications. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Scholz, O. 2002. Will reinstating drying events reduce the incidence of algal blooms in the Menindee Lakes of western New South Wales. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.
- Sellens, C. 2003. Three things I wish I'd known. Presentation to CRC Association Conference, Canberra, May 2003.
- Sims, N. 2002. What happens when floodplains wet themselves. (Best) oral presentation at the IAHS Symposium, Alice Springs, July 2002.
- Stojkovic-Tadic, S. and Beardall, J. 2002. Interactions between phosphorus limitation and UVBR in regulating the algal and pigment composition of algae in freshwater biofilms. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.
- Suter, P. 2002. A presentation on stream assessment techniques, and Demonstration of Field Data Collection. At Wise Waterways: A course in Stream Management Principles and Practices. La Trobe University (Beechworth), 27–31 October 2002.
- Taylor, S., Roberts, S. and Hatt, B. (2002). Impacts of urban density and stormwater drainage systems on temporal and spatial patterns of benthic algal biomass. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.

Thoms, M. 2002. Dams and the fragmentation of Australian inland rivers. Presented at the Binghampton Geomorphology Symposium on Dams and Geomorphology, University of Pennsylvania, USA.

Tsyrlin, E., Walsh, C. and Newall, P. (2002). Impacts of stormwater and other urban factors on macroinvertebrate and diatom community composition. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.

Walsh, C.J. and Grace, M.R. (2002). A conceptual model of stormwater impacts on stream ecological function and structure. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.

Webb, J.A., Hart, B.T. and Grace, M.R. 2002. Assessing the ecological risks of salinity increases within the Goulburn-Broken catchment, Victoria. 41st Congress of the Australian Society for Limnology, Margaret River, Western Australia, 1 Oct 2002.

Whiterod, N. and Gawne, B. 2002. Flow related variations in diets of Murray-Darling fish species. 41st Congress of the Australian Society for Limnology, Margaret River, WA, October 2002.

PUBLIC COMMUNICATION

WaterShed, August 2002

WaterShed, November 2002.

WaterShed, February 2003.

WaterShed, May 2003

Annual Report, 2001–2002.

Financial Pages, 2001–2002.

Lower Basin Links, October 2002

Also Gary Jones and Ben Gawne represented the CRCFE at the annual Science Meets Parliament meetings on 12 and 13 November, at Parliament House, Canberra. In one-to-one talks, Gary met with Warren Snowdon (ALP, NT), John Cherry (Democrat, Qld) and Peter Andren (Independent, Bathurst region), while Ben met with Roger Price (ALP, south-west Sydney area) and Wendy Armstrong, senior adviser to John Anderson (Leader of the National Party, Gwydir).

COMMUNICATION VIA THE MEDIA

Extensive media interest in the potential sale of Cubbie Station focussed attention on the CRCFE Technical Report *Ecological Assessment of Flow Management Scenarios for the Lower Balonne*. CRCFE produced a media strategy and circulated to key CRCFE staff. Profs Jones and Cullen handled all media enquiries including radio and television interviews (Radio National, 60 Minutes etc).

At least 105 media hits were achieved during 2002–2003. A wide range of subjects caught the attention of the media, including artificial plants as habitat for fish, work on the geomorphology of floodplains, the drought and water supplies, water resources policy, and the effects of heavy rain after fires. The expectation that water would be made available for the River Murray environment caused much concern in river communities, and Professor Gary Jones was called often for comment. The move of the Albury-Wodonga lab of the MDFRC next financial year was announced in 2002–2003 and caused a large amount of media attention.

Media releases

Professor Gary Jones Appointed as New Leader of the Freshwater CRC (July)

Beyond the drought: water prosperity for the next century (October)

New staff member at Lower Basin Lab (October)

Drought Recovery funding shows forward thinking for the environment (December)

Protecting our dwindling waters (January)

3rd WDA International Symposium of Odonatology (January)

Cotter River catchment should survive its trial by fire (February)

Rotary Murray Darling School of Freshwater Research (April)

New Home for Freshwater Research Centre on LTU campus (April)

New study to throw light on water needs of the Narran Lakes (June)

Chapter 8 ~ Awards & Grants

AWARDS 2002–2003 AND COMMITTEE MEMBERSHIP

Dr Darren Baldwin has been awarded the Macquarie University School of Law Prize for International Environmental Law (2003).

Dr Nancy FitzSimmons won a Vice-Chancellor's Distinction Award for 2003 (University of Canberra) for innovative and creative teaching of Concepts of Biology.

Associate Professor Bill Maher won two Vice-Chancellor's Distinction Awards for 2003 (University of Canberra) (i) for developing creative and innovative partnerships across the NSW south coast region and the Australian Capital Region, and (ii) for being part of the innovative and creative Research Education Program.

Associate Professor Bill Maher was awarded the Royal Australian Chemical Institute's Analytical Chemistry Medal in early November 2003. The medal has been awarded only five times previously.

Debbie Heck was part of a Griffith University team that won the 2002 Allen Strom Eureka Prize for Environmental Education, awarded by the Australian Museum.

Associate Professor Martin Thoms won the prize for Innovation in Geomorphology at Binghampton Geomorphology Symposium at Bloomsburg University, Pennsylvania, USA.

Neil Sims won the award for best oral presentation at the International Association of Hydrological Sciences Symposium at Alice Springs in September 2003, for: 'What happens when floodplains wet themselves'.

Heather McGinness won the 'best poster paper' award at the International Association of Hydrological Sciences Symposium at Alice Springs in September 2003, for: 'Connectivity and fragmentation of floodplain–river exchanges in a semi-arid anabranching river system'.

Alison Mitchell won an award for best student oral presentation at the BIOGEMON 2002 Conference at Reading, UK, for her paper: 'Interactions of anaerobic nutrient cycling processes and phosphorus release from freshwater sediments'.

Professor Barry Hart was awarded a Centenary Medal for services to Australian society, in May 2003. Centenary medals were also awarded to Professor Peter Cullen, Dr John Langford (Chair of the Board), and Mr Don Blackmore (Chief Executive of our partner the Murray-Darling Basin Commission, and member of the Board).

The team of staff at Arthur Rylah Institute (Victoria) who undertook the River Murray resnagging project won the DNRE's David Ashton Biodiversity and Ecosystem Award for 2002. The team is John Koehn, Simon Nicol, Jason Lieschke, Jarod Lyon, John Mahoney, John McKenzie and Peter Fairbrother.

The Mildura Lower Basin Laboratory of the MDFRC was awarded a Recognition Award by CSIRO Land & Water, for exceptional team effort in providing a coordinated approach to working with local community groups and management agencies.



GRANTS 2002–2003

Researcher	Organisation	Project	Funding source	Period	Total Funding
Darren Baldwin and Gavin Rees	CSIRO Land and Water	Modelling blackwater events in Barmah Millewa Forest(MDBC)	Barmah Millewa Forum		\$100,000
John Beardall	Monash U	Effects of environmental stress on the susceptibility of microalgae to damage by UV radiation	ARC Discovery	2001–2003	\$207,031
Stuart Bunn	Griffith U	Riparian Lands, Phase 2	L&W Australia	2001–2004	\$228,500
Stuart Bunn	Griffith U	Ecological & Geomorphological Assessment for the Georgina-Diamantina River Catchment	QLD NR&M	2002	\$38,642
Stuart Bunn	Griffith U	Implementation arrangements for a stream health monitoring program in SEQ	Healthy Waterways partnership	2001–2002	\$125,000
Stuart Bunn with S.Capon (PhD scholar) and Margaret Brock (DLWC / DIPNR)	Griffith U	Flow-related responses of floodplain vegetation in arid, inland catchments (A809)		2000–2003	\$84,000
Stuart Bunn	Griffith U	Centre for Riverine Landscapes	Griffith University Research Centres Scheme		\$375,000
Stuart Bunn	Griffith U	Importance of Flood Flows to Productivity of Dryland Rivers and their Floodplains	Environment Australia	2001–2002	\$127,252
Stuart Bunn	Griffith U	Senior Research Position In Storage Research & Management	SEQWater and Brisbane City Council	2002–2003	\$60,000
Ben Gawne	MDFRC	The Living Murray	MDBC	2002–2003	\$20,000
Paul Humphries	Monash U	Campaspe Flows	Environment Australia	2001–2002	\$500,000
Ross Hyne	NSW EPA	Development of a passive sampler device for polar pesticides	Rural Industries Research & Development Corporation	2002–2004	\$55,580
Ross Hyne (as associate of G Batley (CSIRO, ANSTO) and Bill Maher (CRCFE, UC)	NSW EPA	Development of protocols for assessing the risks posed by metal-contaminated sediments	NSW Environmental Trust	2001–2004	\$300,000
Ross Hyne (as associate of G. Batley of CSIRO and ANSTO)	NSW EPA	Robust procedures for measuring metal speciation	CRC–WMPC	2001–2004	\$634,128
Sam Lake	Monash U	Restoration ecology of fish populations in degraded rural streams	AFFA	2002	\$65,000
Daryl Nielsen	CSIRO Land and Water	The effect of increasing salinity on the biota in freshwater wetlands	DIPNR		\$290,000
Daryl Nielsen	CSIRO Land and Water	Predicting ecological consequences of increasing salinity on wetland sustainability	DIPNR	2001–2004	\$163,900 +extension being negotiated

Researcher	Organisation	Project	Funding source	Period	Total Funding
Gerry Quinn	Monash U	Monitoring ecological effectiveness of environmental flows in the Wimmera and Glenelg Rivers	Victorian Dept. Sustainability and Environment and Wimmera Catchment Management Authority	April to October 2003	\$98,510
Fran Sheldon	Griffith U	Joint CRCFE and CRCCH project on Ephemeral Rivers	Land & Water Australia and the National Rivers Consortium	2003 to end of April 2006	\$350,000
Phillip Suter	La Trobe U at Albury-Wodonga (MDFRC)	Habitat profiles for selected Australian aquatic invertebrates	Environment Australia (Australian Biological Resources Study)	2002–2005 subject to annual review	\$163,000
Martin Thoms	U Canberra	Floodplain diversity: the role of patches and connections	L&W Australia	2003–2005	\$393,187
Martin Thoms	U Canberra	Native fish habitat in the Barwon Darling River	AFFA	2002–2003	\$368,171
Martin Thoms & Gerry Quinn	U Canberra & Monash U	The Narran Lakes ecosystem	Murray-Darling Basin Commission	2003–2006	\$1,600,000
Glenn Wilson	MDFRC	Influence of water resources development on the functioning of floodplain anabranch ecosystems in the Border Rivers Catchment	Border Rivers Catchment Management Association	2002–2003	\$6,250
Glenn Wilson	MDFRC	Use of SIMS to model environmental histories in a dryland river fish, the spangled perch (<i>Leiopotherapon unicolor</i>)	Australian Institute for Nuclear Science and Engineering	Jan 2002–Dec 2002	\$12,000



COOPERATIVE ARRANGEMENTS

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

Activities 2002–2003

- The CRCFE conducted an assessment of three environmental flows scenarios for the River Murray, under the Living Murray Initiative for its partner the Murray-Darling Basin Commission, and for the Murray-Darling Basin Ministerial Council. Using relationships between the health of biota and flow developed by a Scientific Reference Panel (SRP, six of eight members were from the CRCFE), ten regional evaluation groups (comprising over sixty scientists from across the Murray-Darling Basin, including CRCFE staff) performed zone-level assessments of the three scenarios. These are contributing to a whole-of-river level assessment of the scenarios being conducted by the SRP for delivery later in 2003.
- The Goulburn Scientific Panel for environmental flows in the Goulburn River, Victoria, was facilitated by the CRCFE, also as a part of the Living Murray Initiative. The panel used scientific knowledge generated by the CRCFE as the basis for developing environmental flow recommendations: e.g. the Low Flow Recruitment hypothesis for fish and wetland macroinvertebrate responses to inundation, and CRCFE work on the microbial processing of carbon and nutrients in relation to 'seasonal flow inversion' below Lake Eildon. The CRCFE researchers played a major role in the development of the FLOWS methodology used for this and other environmental flow studies in Victoria.
- In regular discussions, the CRCFE advised and assisted its partner water authorities for Canberra in devising environmental flows for the Cotter River (Canberra's main water supply) during the drought of spring/summer 2002 and summer/autumn 2003, and in managing water quality and environmental flows in the Cotter River since the bushfires of January 2003.
- The CRCFE has been collaborating with the Department of Sustainability and Environment (Victoria) to develop sustainable diversion limits for Victorian rivers.
- The CRCFE was invited to be part of the Victorian Technical Audit Panel to review groundwater management plans and streamflow management plans.
- A team from CRCFE reviewed Melbourne Water's Waterway Management Strategy and their decision support system STREAMS. CRCFE identified opportunities for further refinement.
- The CRCFE contributed to the development of a long-term monitoring program for Melbourne Water. This included liaising with Melbourne Water staff and arranging for the project to be undertaken by researchers from Monash University.
- The CRCFE gave advice to the Sydney Catchment Authority (SCA) on its risk management planning, and its Bulk Water Transfers Project. Recommendations from the CRCFE were incorporated into subsequent reports.
- The CRCFE continued to collaborate with the SCA, the Department of Infrastructure, Planning and Natural Resources (DIPNR), and the NSW Environment Protection Authority (NSW EPA) on researching the ecological consequences of reduced connectivity and increased fragmentation of rivers in the Sydney region using genetic techniques.
- At the Murray Unregulated River Management Committee meeting, CRCFE staff provided advice on stream flow management plan for Billabong Creek.
- Provided DIPNR with input to the Darling Anabranch Management Plan and provided advice on environmental flows.
- The Lower Basin Laboratory of the Murray-Darling Freshwater Research Centre (CRCFE) has been engaged to help manage environmental flows for the Mallee CMA in western Victoria.
- The CRCFE was commissioned by DIPNR to undertake a literature review of the aquatic ecological condition of the Keepit Dam and its immediate surroundings.

Activities 2001–2002

- Convened and led the Expert Reference Panel on Environmental Flows and Water Quality Requirements for the River Murray System, for the MDBC. The CRC provided a key technical report supporting the April 2002 Ministerial Council decision to continue development of River Murray environmental flows allocations.
- Described the environmental health of the rivers of the Murray-Darling Basin in a report to the MDBC titled *Snapshot of the Condition of the Rivers in the Murray-Darling Basin*.

- Coordinated Scientific Panel assessments for Victoria's Ovens River and Broken River, and produced a technical report reviewing the Scientific Panel approach to determining environmental flows for DNRE Victoria.
- Undertook a major Aquatic Biodiversity Assessment Pilot Study on behalf of the Sydney Catchment Authority.
- Facilitated a whole-of-water cycle benchmarking study workshop for ACTEW Corporation.
- Undertook assessment of proposed management scenarios for the Lower Balonne River system for DNRM Queensland.
- Produced two river management guides for regional catchment management organisations that were distributed to over 3500 stakeholders. There has been strong demand for these guides.

Activities 2000–2001

- 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 MDBC.
- Reviewed progress made towards 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 to, and oversaw, several riverine environmental flows assessment expert panels.

Activities 1999–2000

- The CRCFE's ability to improve water management is recognised by a wide range of stakeholders as shown by the high demand for the CRCFE's expertise from community groups, the water industry, politicians, the media and the general public.
- Many of the CRCFE's recommendations have been adopted via consultancies.

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

1999–2003

Large multi-disciplinary projects form the core of the CRCFE's research portfolio. These projects use expertise from across the CRCFE to focus on problems at an appropriate field scale (preferably at landscape scale) and are managed in an integrated way.

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.

Projects are managed by teams of project leaders who often represent several institutions. For example, of the research teams for the Phase II research portfolio (starting in 2003), one combines staff from the Arthur Rylah institute in Victoria and the University of Canberra, another team combines Monash University at Clayton and the Murray-Darling Freshwater Research Centre at Albury-Wodonga, and a third brings together leaders from the Murray-Darling Freshwater Research Centre at Mildura and the University of Canberra. The research program and the projects within them are held together by regular program and project meetings, and frequent phone and email contact. Another example is the newly begun Narran Lakes project, which integrates staff from Monash University, University of Canberra and the Northern Basin Lab at Goondiwindi. Phase I research teams (2000–2003), now dispersing, have combined staff across sites in a similar way.

MAINTAINING A STRONG PARTNER BASE

1999–2003

At June 2003, the CRCFE comprises 19 partners: universities, water management agencies, water authorities and enterprises in the water industry. The Senior Management Team and the Knowledge Exchange team are in regular contact with members of the CRCFE's partner organisations, discussing their requirements and supplying advice and information. The members of the Senior Management Team themselves belong to three partners, all universities.

The Program Advisory Committees consist of representatives of partner organisations, particularly the water agencies and the water industry. The committees interact with research teams and contribute to the design of research projects.

Wherever possible, CRCFE ensures that the involvement of partner organisations in CRCFE work is acknowledged in media publicity about the Centre. Partners are always acknowledged in publicity generated within the CRCFE.

Discussions are underway in 2003 with several prospective new partners. The University of Adelaide joined the CRCFE in 2000–2001.

RESEARCH AND RESEARCHERS

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. CRCFE projects have ranged from large, integrated three- to six-year projects looking at scientific questions underpinning sustainable water resources management, to short-term 6–12 month projects addressing immediate needs and knowledge gaps. For the new portfolio, just beginning, the large projects have a three-year span only. Additional targeted funding is provided through government and industry research grants.

We believe that most benefit will be gained if research projects are developed as collaborative partnerships between researchers and managers. The Program Advisory Committees (PACs), established for each research program, formalise the involvement of industry staff in research planning and activities. The PACs meet at least once per year and report their progress to the Board.

A new development in 2003 is the industry mentoring scheme for postgraduate students. Those who were awarded top-up scholarships in 2002–2003 have each also gained an industry mentor, to ensure that the student's training will produce a new scientist with a sound understanding of the water industry.

RESEARCH IS OF AN EXCELLENT STANDARD AND IS PUBLISHED IN REFEREED LITERATURE

All research projects undertaken within the CRCFE undergo a rigorous review process to ensure excellent

quality science which is relevant and of benefit to our partners. To reinforce this, we have a quality assurance review process that all research projects must undergo. It 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 by the CRCFE's Board.

One of the ways in which the CRCFE ensures its research is 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 CRCFE researchers share their knowledge.

The list of articles accepted by or published in refereed journals varies from year to year: 67 articles in 2002–2003; 50 in 2001–2002; 94 in 2000–2001; and 43 in 1999–2000.

EFFECTIVE PROJECT MANAGEMENT WITH REGULAR REPORTING TO BOARD

The CRCFE Project Management System tracks the achievement of milestones for individual projects. All staff access the Project Management System through the secure CRCFE intranet web site. Reasons for missed milestones are provided by the Project Leader and these form part of the Exceptions Report to the Board.

EDUCATION AND TRAINING

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

	2002–2003	2001–2002	2000–2001	1999–2000
PhD	51	47 (PhD+MSc)	41	51
MSc	1		1	12
Conferred	4 PhD	7 PhD, 1 MSc		8 PhD, 3 MSc
Associated projects	6			25

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

Ten CRCFE postgraduate students have non-university staff as co-supervisors. In 2001–2002, 2000–2001 and 1999–2000, the numbers were 10, 1 and 22, respectively. Additionally, each year the CRCFE has several students involved in collaborative projects with non-university partners of the CRCFE and benefiting from feedback and advice they receive from them.

SHORT COURSES AND WORKSHOPS DEVELOPED AND PRESENTED

Thirteen research planning, joint problem solving or communications workshops were organised in 2002–2003, 17 in 2001–2002, 17 in 2000–2001 and 3 in 1999–2000. See Chapters 3, 4 and 7 for details for 2002–2003.

APPLICATIONS OF RESEARCH

ADOPTION OF RESEARCH BY PARTNERS, 1999–2003

- River health assessment methods (Sydney Catchment Authority (SCA), MDB, QNR, DSE, DIPNR, Environment Protection Authorities (EPAs))
- Waterway condition assessment component of the NLWRA (National Land and Water Resources Audit)
- Integrated urban land and water management (ACT Government)
- Urban stream rehabilitation (ACT Government)
- Biodiversity assessment methods (SCA)

- Environmental flows assessment and setting (MDB, DSE, SCA, QNR, ACT Government, ACTEW Corporation)
- Taxonomic guides (DSE, QNR, DIPNR, EPAs)
- Catchment management planning
- Fisheries management
- Lake and reservoir management
- Stream rehabilitation
- Conservation programs
- CRCFE staff work as consultants for partner agencies.

ADVICE AND CONSULTANCIES PROVIDED TO INDUSTRY PARTNERS AND OTHERS, AND

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

CRCFE staff completed or were engaged in more than 19 consultancies generating income of \$508,000 during 2002–2003, and provided advice and assistance to 19 of all our industry partners, plus at least 107 non-partner groups (see Chapter 4, Use of Research, for details).

In 2001–2002, 2000–2001, 1999–2000, there were 28 consultancies (\$780,000 income), 16 consultancies (\$1.1 million income) and 36 consultancies (\$1.4 million income), respectively. In 1999–2000, staff provided advice and assistance on more than 250 occasions to industry partners and others.

PRODUCTION OF TECHNICAL PUBLICATIONS APPROPRIATE FOR END-USERS AND DEVELOPMENT OF OTHER VEHICLES FOR REACHING THESE GROUPS

	2002–2003	2001–2002	2000–2001	1999–2000
Technical reports	2	12	12	7
Consultancy reports	8	38	41	55
Software	2			
ID guides	2	7	10	7
Tech memos and electronic publications	3	1		

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.

CENTRE STAFF INVOLVEMENT IN GOVERNMENT AND OTHER ADVISORY BODIES

CRCFE staff are or have been members of 10 committees for various governments and advisory bodies during 2002–2003:

- NSW Scientific Committee for the Threatened Species Conservation Act
- ACT Environment Advisory Committee
- ACT Flora and Fauna Committee
- ACT State of the Environment Committee
- Lake Eyre Basin Scientific Advisory Panel
- EPA Victoria Scientific Advisory Panel
- Board of EPA Victoria
- National Environmental Education Council (Deputy Chair)
- International Council for Science: Scientific Committee for Water Research (SCOWAR)
- Board of Wetland Care Australia

During the first three years of this CRCFE, staff were members of 17 committees (chairing 3 of them) plus 3 expert advisory panels in 2001–2002, 59 committees (chairing 8 of them) plus 23 expert advisory panels in 2000–2001, and more than 56 committees and advisory bodies (chairing 11 of them) in 1999–2000.

MEDIA EXPOSURE BY CENTRE

Each year the CRCFE’s work is covered by a range of mass media outlets as well as industry newsletters.

In 2002–2003, staff and students of the CRC generated 105 media hits, that we know of. Also, much media attention focused on the continuing work of the Scientific Reference Panel for the Living Murray Initiative (without mentioning the CRCFE). CRCFE scientists lead and are providing a large part of the expertise for that project. Comparable numbers in 2001–2002, 2000–2001, 1999–2000 were 150, 130 and 103 media hits, respectively.

MANAGEMENT AND BUDGET

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 for the CRCFE. The Board’s Research Committee enables timely feedback on research project matters to the Senior Management Team and other senior research staff.

REPORTING PROGRESS TO THE BOARD AND TO THE COMMONWEALTH

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

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

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.

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

An induction program is carried out annually as part of the project management course for new students and staff. The postgraduate student manual outlines funding opportunities, applications, and other administrative procedures.

PROVIDE APPROPRIATE STAFF DEVELOPMENT OPPORTUNITIES WITHIN THE CENTRE

Staff are given opportunities to expand their scientific and managerial skills through CRCFE-funded attendance at national and international conferences and workshops, plus national scientific and managerial development training courses. The CRCFE provides substantial annual funding (in excess of \$50,000) for this purpose.

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

The CRCFE was paid \$508,300 during the year for consultancy work. Income from consultancies in the CRCFE's three earlier years totalled \$3.28 million.



ACRONYMS USED IN THIS REPORT

ACTEW	ACT Electricity and Water
BCC	Brisbane City Council
CMA	Catchment Management Authority
CRCCH	CRC for Catchment Hydrology
CRCFE	CRC for Freshwater Ecology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land and Water Conservation
DNRE	Department of Natural Resources and Environment
DNRM	Department of Natural Resources and Mines
DPI	Department of Primary Industries (Victoria)
DSE	Department of Sustainability and Environment
DSNR	Department of Sustainability and Natural Resources
EA	Environment Australia
EPA	Environment Protection Authority
L&WA	Land and Water Australia
MDB	Murray-Darling Basin
MDBC	Murray-Darling Basin Commission
NAP	National Action Plan
NECMA	North-east Catchment Management Authority
NHT	Natural Heritage Trust
NISORS	Ninth International Symposium on Regulated Streams (former title of conference later called 'Ninth International Conference on River Research and Applications')
NPIRD	National Program on Irrigation Research and Development
NRM	Shortened form of DNRM
QNRM	Queensland Dept of Natural Resources and Mines
R&D	Research and development
SEQ	South-east Queensland
SEQRWQMS	South-east Queensland Regional Water Quality Management Strategy
UWA	University of Western Australia

