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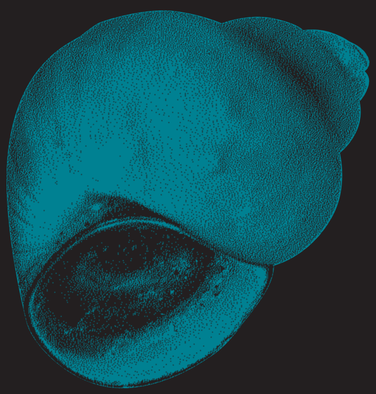
WaterShed

contents



New Chief Executive for CRC

Following an international selection process, Professor Gary Jones has been appointed as the new Chief Executive of the Cooperative Research Centre for Freshwater Ecology, and Professor of Freshwater Sciences at the University of Canberra. Previously the CRC's Director of Knowledge Exchange, he took over on 1 July from founding CRCFE Chief Executive, Professor Peter Cullen.

Professor Jones is an internationally respected authority on the ecology and management of toxic cyanobacteria (blue-green algae), his expertise reflected in a long list of influential publications, consultancies, research projects and committee memberships.

He has provided advice on toxic cyanobacteria and water quality management to many governments, agencies, companies and communities in Australia and overseas, including working with the World Health Organization on the development of international best management practices for toxic cyanobacteria in drinking and recreational waters.

Professor Jones considers water resources management activities undertaken in developing countries among the most rewarding of his professional experiences.

'In particular, work I undertook in Brazil over a number of visits in the late 1990s was extremely fulfilling, both professionally and personally', he said.

'Brazil had been rocked by a major catastrophe when over 60 people were killed following exposure to water contaminated with cyanobacterial toxins at a liver dialysis clinic. We worked closely with state water authorities to implement management and monitoring plans, integrated from catchment to consumer, to minimise the risk of future problems.'

COOPERATIVE RESEARCH CENTRE FOR
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The Cooperative Research Centre for Freshwater Ecology develops ecological understanding to improve and protect Australia's inland waters.

CRC AUSTRALIA

He continued, 'It was exciting to have the opportunity to put the research knowledge I had gained into action, and work with the local Brazilians who are committed to their research and management endeavours, often under difficult circumstances.'

Professor Jones outlined some of his key philosophies for leading and managing the CRC for Freshwater Ecology.

'Freshwater ecology, the science of understanding how rivers, lakes and wetlands are shaped and function, is now accepted as a key part of the knowledge needed to sustainably manage Australia's water resources. The challenges for the CRC are to undertake cutting-edge research that will fill the critical knowledge-gaps in water resources management. Equally importantly, we must ensure that the new knowledge we produce is packaged and communicated to the water industry and regional communities efficiently and in a timely manner.

'High quality research is a top priority, but the job is not over for any of us, whether CRC researchers or knowledge brokers, until the new research knowledge has been considered and used by the water industry and community. Knowledge exchange is not merely a desirable add-on to research; it is a critical partner in achieving successful knowledge outcomes.'

In his capacity as Chair of the River Murray Expert Reference Panel on Environmental Flows and Water Quality, Professor Jones recently helped provide key advice on environmental flows to the Murray-Darling Basin Ministerial Council. His approach in leading this project, and more broadly, is typified by a holistic, or system-level, philosophy.

Professor Gary Jones being congratulated by University of Canberra Pro Vice-Chancellor Professor Mohamed Khadra. Photo: A Tatnell

Professor Gary Jones, new Chief Executive of the CRC for Freshwater Ecology. Photo: L Sealie

Professor Jones noted, 'We hear a lot about the importance of taking an "integrated" approach to research and management. I find that, in practice, this means rivers and catchments are seen as a collection of numerous separate pieces that can be pulled apart, examined, then reassembled. Conceptually, holism is different from integration. With a holistic approach, you start to recognise that there are properties of river systems that only exist at the whole-of-river scale. It isn't that holism is better than integration: both approaches are important for effective research and management.'

He continued, 'One thing we have learned from Australia's existing salinity problems is that we must think at the landscape scale, as well as locally and regionally, if we are to get the best results from our management efforts and money.

'I will be building on our current strengths to ensure that the CRC for Freshwater Ecology provides concise and objective ecological advice to support water management policy and actions. This advice will be based on high quality and visionary research undertaken at a range of scales, from the river reach to the river basin, and effective and timely knowledge exchange.'

Waterholes in Dryland Rivers: Oases and Refuges

Dryland rivers in semi-arid and arid areas of the Murray-Darling and Lake Eyre basins are renowned for their boom and bust cycles. Their floodwaters extend over vast floodplains, but most of the time the rivers exist as a network of turbid waterholes. Many of these river systems are essentially unregulated at the moment and would be greatly affected by any future development.

The CRC for Freshwater Ecology's Dryland River Refugia Project aims to predict the ecological impacts of water resources development on dryland rivers. The project will also provide information to landowners and agencies to assist in the management and protection of dryland rivers and their biodiversity.

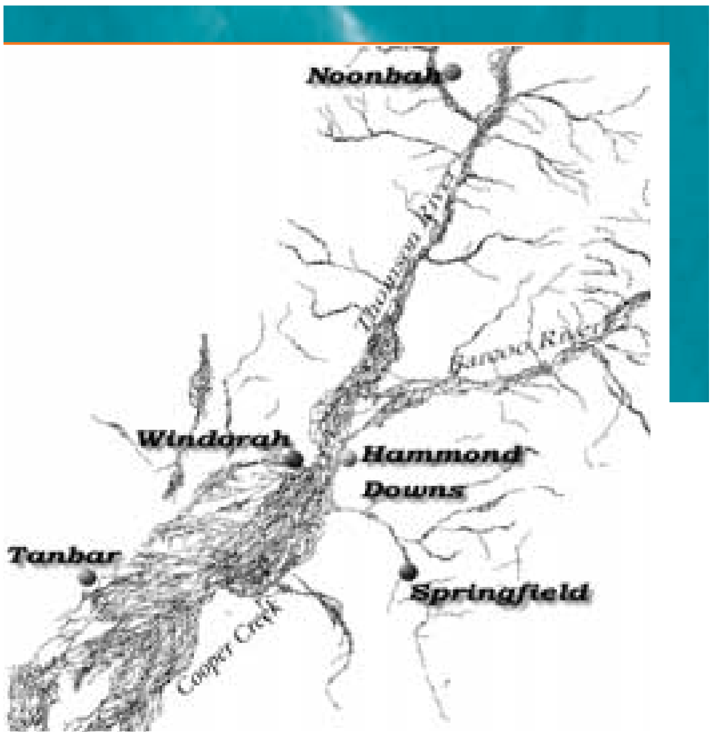
Between floods, for much of the time, dryland rivers exist as a braided network of dry channels and turbid waterholes. The large waterholes are the only permanent freshwater habitat available in these arid areas, so they act as refuges for animals and other organisms, from which they can spread out onto the large floodplain habitat after rain or flood. For the purposes of this project, refuges in dryland rivers are defined as places where plants and animals survive during periods when their habitat contracts in size.

Researchers from the CRC for Freshwater Ecology want to know if biodiversity of the waterholes is related to the physical attributes of individual waterholes. Are the populations of fauna in different waterholes similar or related? How do the populations live and function in these dryland river refuges? Why are some waterholes the main sites for turtle populations?

Ultimately, the research team wants to be able to predict how changes to the management of a river and its floodplain will affect biodiversity and ecosystem function in dryland river refuges. What happens, for example, if the floodplain and its associated waterholes become isolated from the main channel? Can ring tanks and other on-farm storages in the northern Murray-Darling Basin take over the role now played by natural waterholes?

When changes like these occur, the team wants to be able to suggest management options that will counteract or minimise adverse impacts on biodiversity and ecosystem health. Even if there is no development, the knowledge gained will help landowners and agencies to manage dryland rivers effectively.

Three separate river catchments are under investigation — the Cooper Creek, the Warrego River and the Border Rivers — with the team sampling waterholes on four separate reaches in each. Initial study trips, one in April 2001 and one in September, have focused on the Cooper Creek and Warrego River catchments where there is little water resources development. Later, ring tanks and other artificial waterbodies on developed parts of the floodplains will be sampled for comparison with the waterholes.



The Cooper Creek, a braided dryland river with study sites on the Windorah, Springfield, Tanbar and Noonbah reaches

Already the team has a clearer picture of the waterhole environment. Martin Thoms and Louisa Davis from the University of Canberra are recording the physical features of the waterholes, which are quite varied. For example, water depths range from 40 centimetres to over 10 metres, and waterholes can be anything from a few hundred metres to over 20 kilometres in length.

Some waterholes seem to lose very little water by evaporation, suggesting that freshwater is entering them. This must be understood before the team can determine how the waterholes act as refuges and how water extraction and flow alterations might affect these ecosystems in the future.

Angela Arthington and Stephen Balcombe of Griffith University and Glenn Wilson of the CRCFE Goondiwindi Laboratory are sampling fish to see if different species occur in different refuges, and whether that is related to the waterholes' physical features, permanence and water quality. All fish are identified to species, counted (to calculate catch per unit effort) and returned to the waterhole after a sample of selected species has been measured and weighed. Exotic species such as goldfish are not returned. Catches differed widely between waterholes, particularly in April, and were smaller in almost every waterhole in September after several months of falling water levels. Up to thirteen species were caught per waterhole in April and up to nine in September.

The knowledge gained will help landowners and agencies to manage dryland rivers.

Turtles also live in these waterholes. Arthur Georges and Fiorenzo Guarino of the University of Canberra have found at least two mature populations of *Emydura macquarii*, and at least one maturing population where turtles are breeding. Illegal netting may be a factor in turtle survival here, as well as climate, since the permanent populations were found in holes protected from netting. Turtles soon drown when trapped in some nets.

Jane Hughes, Chris Bartlett, Katrina Goudkamp, Fran Sheldon, Ben Cook and Gio Carini of Griffith University, working with the Queensland Department of Natural Resources and Mines, are sampling freshwater invertebrates (water animals without backbones). They have identified four distinct species of mussel, with more than one species living in each waterhole. Little or nothing is known of the life histories of these new species.

The team is also investigating the connectivity of the waterholes — that is, whether there is interaction or movement between the animals of the waterholes. Having collected and examined freshwater prawns (*Macrobrachium australiense*) and river snails (*Notopala* sp.) from waterholes along four rivers in this region, the researchers find that the prawns and also, surprisingly, the snails, mingle freely with others of their species within a river when it is flowing, but, even during widespread floods, the populations do not mix with those from other rivers.

For biodiversity to survive at a reasonable level between floods, there must be adequate food supplies. Christy Fellows, Stuart Bunn and Joanne Clapcott of

Collecting plankton at Shed waterhole, Windorah Reach. Photo: J Marshall

Griffith University are measuring the amount of oxygen produced by waterhole algae; it is a key to assessing the primary productivity of the waterholes. The primary productivity of a waterhole affects the whole food chain including the water bugs and the fish. Water bugs that feed on algae, for example, are important food sources for fish. The greater the productivity, the larger the populations of animals a waterhole is likely to support.

The waterholes are generally too turbid for light to penetrate far for use in photosynthesis underwater — the depth of light penetration ranged from 10 to 48 centimetres. As a result, productivity seems mostly restricted to a vigorous band of algae in the shallow water at the edge of a waterhole, like a bathtub ring. This means that the perimeter of a waterhole and the slope of its banks are important controls on its productivity.

The next step in the project is combined studies to further examine the relationships between productivity and shape, and productivity and population sizes, for each waterhole.

Setting fyke nets at Yoraka waterhole, Tanbar Reach. Photo: J Marshall

This article is derived from the first newsletter of the Dryland River Refugia Project (May 2002).

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Freshwater snail Notopala sublineata. *Photo: J Hawking*

The creature feature for this issue is the freshwater snail *Notopala sublineata*.

Family:	Viviparidae
Genus:	*Notopala*
Species:	*sublineata*

These freshwater snails live in eastern Australia and central South Australia, in inland waters such as the Cooper Creek. The snails are up to 25 mm long, and feed on plant material by scraping or grazing. Herbivorous freshwater molluscs such as these play an important role in the breakdown of dead vegetable matter and as grazers of algae. As the family name suggests, they give birth to live young rather than laying eggs.

Between a Rock and a Hard Place: Saving the Booroolong Frog

Frogs are among our most popular and familiar wetland animals, their calls a pleasant and curious sign of their presence. From suburban backyard ponds to remote mountain streams, these shy, often spectacular animals have attracted children, scientists and non-scientists alike to study their unique lifestyles.

In recent years a disturbing silence has spread through our wetlands. Many frog species have disappeared altogether, while others are confined to small isolated communities. In Australia, eight species have vanished in the last twenty years from the eastern states alone and more than twenty other species are considered vulnerable or endangered. Worldwide, many species of frog have become extinct.

Scientists are unsure why this is happening. One theory is that many populations of frogs, already stressed by loss of habitat or pollution, have then been exposed to a very virulent fungal disease, the chytrid fungus.

Dave Hunter, a PhD student at the University of Canberra under the supervision of Dr Will Osborne, is studying the life history and physical adaptations of the Booroolong frog (*Litoria booroolongensis*) in an attempt to stop its extinction. He has found the frog lives most of its life around cobble-bank and bedrock structures along streams. Throughout the year it shelters under rocks next to streams. From late spring through to early summer, females lay their eggs under small in-stream rocks.

Described by scientists in the 1950s, the Booroolong frog was once common throughout the New England Tablelands stretching south into northern Victoria. Today, most of the remaining populations are found in streams in the Tumut area of the New South Wales Southern Tablelands.

Most of the streams still supporting the Booroolong frog are at fairly low altitudes on private land used for grazing. Much of the native vegetation in these areas has been removed, but many of the streams still contain cobble-bank structures that shelter the frog. In some regions, though, agricultural practices are changing, resulting in greater erosion and larger silt loads in runoff. Increased sediment fills up the small gaps under rocks — the homes that harbour and protect the frogs and their eggs. As well, there is concern about the spread of noxious weeds such as blackberries and willows, which also reduce the amount of habitat available to the frogs.

Degradation of its home sites is not the frog's only problem. The chytrid fungus is also taking its toll. Discovered in Australia in the 1990s, it is not known where the fungus originated, or exactly why our frogs are succumbing to it. What is known is that the fungus killing Australian frogs is the same one that is killing frogs on other continents, including North and South America.

Understanding the life history of the Booroolong frog may help to protect this endangered species. Photo: D Hunter

This cobble-banked stream is typical of the habitat preferred by the Booroolong frog.
Photo: W Osborne

The fungus kills the frog by destroying the protein keratin found in the frog's skin. The fungus does not affect tadpoles because their skin does not contain keratin, but they can carry the fungus in their keratinised mouthparts. When a tadpole carrying the fungus reaches metamorphosis (the time when it changes into a frog), keratin develops through the young frog's skin, the fungus spreads across its whole body and it dies within weeks.

The Booroolong frog is one of the less well-known affected species, its story perhaps overshadowed in recent years by the sudden and dramatic decline of spectacularly-coloured species such as the southern corroboree frog and the green and golden bell frog.

Unfortunately, the Booroolong frog and the chytrid fungus share a liking for cool moist places. The chytrid fungus is intolerant of temperatures above 30°C and any degree of drying. This may explain why the Booroolong and many other frogs appear more susceptible to decline at higher altitudes in cool moist habitats, despite the fact that the majority of these sites are found within national parks and nature reserves. The Booroolong frog faces a double-edged sword. Higher altitude sites receive more habitat protection, but the fungus is more dangerous there, whereas lower altitude sites that do not support the fungus are under increasing agricultural pressure that degrades the frog's habitat.

The Booroolong frog faces a double-edged sword

Dave and Will believe that understanding the demography of the frog and its capacity to adapt to different environmental conditions holds the key to adequately managing this and other threatened species. Tadpoles develop at different rates, depending on the streams they grow up in. If habitat alterations reduce tadpole development and growth, delaying maturity, the ultimate size of the breeding population will be affected. Delayed maturity increases the risk of a frog dying as a result of the chytrid fungus before it gets a chance to breed.

This research also indicates that although the fungus is prevalent in all remaining populations, not every frog is affected. Understanding more about the Booroolong frog's life history and habits may help us learn why some individuals and populations do not succumb to the fungus, and will possibly provide the information necessary to guide the conservation management of this endangered species.

This study is supported by the CRC for Freshwater Ecology, the University of Canberra and the NSW Parks and Wildlife Service.

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By George, It Really Is a Lake!

by Sarah Cartwright and Gary Jones

The waters of Lake George come and go like a mirage. When full, the lake spreads over 155 square kilometres, but it often dries to such an extent that the lake-bed is used for grazing. Today, a distant shrinking pool is the only sign that the lake actually holds water. All this natural variability makes Lake George, in the Southern Tablelands of NSW, an ecologically interesting system.

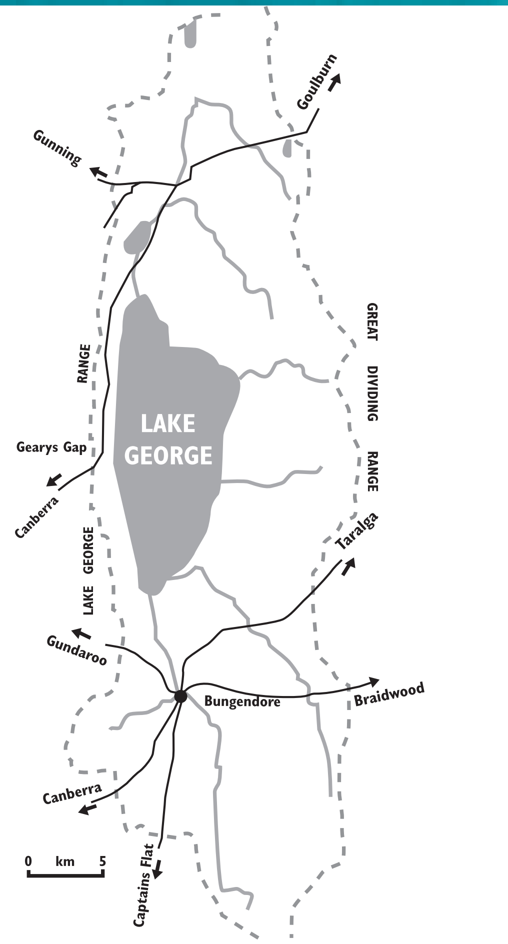
Lake George, one of the world's oldest lakes, is shallow and has a history of dramatically fluctuating water levels, despite being closed with no outlet. Originally there was no lake at all, and water drained from the Great Dividing Range west to the Yass River. That was before geological uplift, five million years ago, which formed the Lake George Range — a natural dam blocking the creeks. During the last 164 years, water depth in the lake has ranged from 0 to 7.3 metres and the lake has dried up entirely several times since 1820.

The lake held enough water during the late 1800s to support a commercial Murray cod fishery, but a dry spell at the turn of the century lasted fifty years and led to the collapse of that industry.

Believed to be the source of all redfin populations now spread throughout the ACT, the lake was stocked with 1,000 redfin in 1959. By the mid-1960s there was an enormous population of redfin in Lake George and anglers were catching up to 200 redfin in a day. In the late 1960s Lake George almost dried up and the fish population crashed, although some redfin survived to recolonise the lake.

When water is present, Lake George becomes an important breeding and refuge habitat. It supports 201 species of birds, 31 mammal species, 29 species of reptiles and 12 amphibian species.

At those times, most of the lake's surface is open water, with the exception of the northern and southern tips where cane grass swamps and reed beds provide important waterbird habitat. Many of the waterbird populations using Lake George are nomadic, and their numbers vary enormously over time. The freckled duck (uncommon) and glossy ibis (rare) have been recorded there. A range of other waterbirds found at the lake are classified as rare and uncommon in the ACT region — the musk duck, great crested grebe, royal spoonbill, Australian spotted crake, banded lapwing and whiskered tern, for example.



Lake George, a closed lake located in the Southern Tablelands of NSW, 40 km north east of Canberra

In response to the lake's unpredictability, many of its animals, plants and organisms are opportunists, well equipped to take advantage of good times. Equally as important, they have survival strategies for extended dry periods and episodic flooding. These strategies include:

- mobility, as used by birds, turtles and frogs;
- short aquatic stages in the life-cycle, as in some macroinvertebrates; and
- a life-cycle that includes the formation of resistant spores, eggs or seeds, as in algae, zooplankton (microscopic animals) and plants.

When episodic lakes like Lake George refill, algae boom and zooplankton emerge from their dormant state in the lake sediments. Macroinvertebrates that fly when adult, such as dragonflies, recolonise the lake. Freshwater plant seeds germinate. Teeming with life, the water becomes a swimming soup of algae, bugs and other tiny animals and plants. This, in turn, provides food for larger invertebrates, fish and waterbirds. A succession of organisms appears and the lake becomes a functioning ecosystem.

Being a closed lake, Lake George has accumulated the salts and nutrients that have flowed in from its catchment over the millennia. Consequently, when wet, the lake tends to have salty water, rich in nutrients — a potentially major influence on the area's ecology.

Many myths have evolved over time to explain the transient waters of Lake George. One of the most popular theories is that the water comes from a secret underground spring and drains away through a crack in the earth (to China, it has been said). In fact, the water levels simply depend on the balance between the evaporation rate at the lake and the rainfall and water flow in its small catchment.

Glossy ibis. Photo: D Eastburn, courtesy of MDBC

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As the waters of Lake George recede, the drying land is used for grazing. Photo: W van Aken © CSIRO Land and Water

Talking Point

by Dr John Whittington*

As funds become available from the National Action Plan for Salinity and Water Quality and the second phase of the Natural Heritage Trust, regional catchment organisations will have far greater responsibility for the management of our catchments and rivers than they have in the past. Allowing the community to prioritise investment for managing Australia's rivers and catchments is a significant and welcome change.

Regional catchment organisations have some very difficult decisions and trade-offs ahead. The recently released Assessment of River Condition (National Land and Water Audit) found that, nationally, one third of the river lengths assessed have 'impaired' freshwater biota and over 85% of the assessed river reaches are classified as having 'significantly modified' environmental features. The stakes — healthy rivers — are high and it is in everyone's interest that the relevant investment decisions are underpinned by the best available knowledge.

The question for the CRC is how to make knowledge available so that regional catchment organisations can reach informed decisions. We know from our own research, and that of others, that most groups prefer to receive their information from people they know and trust. As much as we might like to try, an organisation the size of the CRC cannot hope to engage the trust individually of each regional catchment management group in Australia. However, our regional laboratories in Albury, Mildura and Goondiwindi have developed close links with their local catchment organisations.

The relationships forged by our regional laboratories are teaching us about the issues that concern catchment management organisations, and they provide us with a context in which to deliver knowledge as we accumulate it. It is as a result of these relationships that we are developing the River Management Series of brochures. The philosophy behind this product is to synthesise the CRC's latest ecological knowledge on topics directly related to river management, and make it widely available.

The first two brochures in the River Management Series, *Conserving Natural Rivers* and *Assessing River Condition Using Existing Data*, have been produced and distributed with the last two editions of *WaterShed*, and there are another four in the pipeline.

We see the brochures as an 'experiment'. After speaking with a number of catchment managers, we have produced what we think is a useful product, but we need to test that assumption. In time we will conduct a formal evaluation of these brochures, but for now I am very interested in finding out what you think. Have you found the first two brochures useful? Should they contain more detail or less? What topics would you like to see addressed? Please drop me an email, <Whittington@lake.canberra.edu.au>, or give me a ring (02 6201 5369) with your thoughts.

The Knowledge Exchange team aims to make sure the CRC's growing knowledge is relevant and accessible to all groups that have a stake in managing our freshwater resources. We need your feedback to make this happen.

Copies of the brochures are available from the CRC for Freshwater Ecology.
Phone: 02 6201 5168
Email: pa@lake.canberra.edu.au
Also available at http://freshwater.canberra.edu.au under Publications, and then under Books and Guides.

*Acting Director of Knowledge Exchange

SideStream

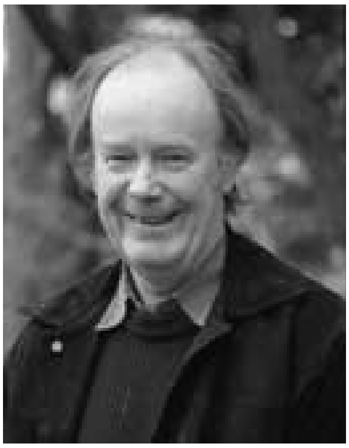
The Audit's assessment of river condition is now available

For the latest information and data on Australia's land, water and vegetation resources, look at the 'National Land and Water Resources Audit: Australian Catchment, River and Estuary Assessment', which has recently been released by the Federal Minister for Agriculture, Fisheries and Forestry, Warren Truss. The CRC for Freshwater Ecology, together with CSIRO Land and Water, carried out the first national Assessment of River Condition for the Audit. The Audit is available at <http://www.nlwra.gov.au/>.

New technical report

The latest in the technical report series from the CRC for Freshwater Ecology is *Perspectives on the Scientific Panel approach for determining environmental flows for south-eastern Australian rivers*, by Peter Cottingham and colleagues. It describes the outcomes of the workshop held at the Department of Natural Resources and Environment in Melbourne on 3 December 2001, and will be available by the end of August at <http://freshwater.canberra.edu.au>. Printed copies can be ordered from the CRC for Freshwater Ecology by phoning 02 6201 5168 or emailing <amilligan@enterprise.canberra.edu.au>.

Prestigious award for Professor Sam Lake



Professor Sam Lake, recently awarded the North American Benthological Society's Award of Excellence

Professor Sam Lake of the CRC for Freshwater Ecology was recently awarded the North American Benthological Society's Award of Excellence. As far as we know, this is the first time the award has been made to a scientist who is not from North America. To quote from the citation in NABS Bulletin, Spring 2002, '[Professor Lake] is probably best known for his insightful papers on the effects of disturbance on stream communities, but has worked on a wide range of topics, including crustacean taxonomy, heavy-metal toxicity, impacts of pollution, restoration ecology, invasion biology, and macroinvertebrates of wetlands and standing waters. His work has given direction to benthic ecology in Australia and around the world.'

Developing research proposals

Stage 2 of the CRC for Freshwater Ecology's research portfolio will commence in July 2003, about 11 months from now, with a new suite of project agreements. On July 18, program leaders and other senior scientists met with the Board Research Committee, Program Advisory Committee members and our Knowledge Brokers to finalise a short-list of research themes to be taken forward for project proposal development.

PhD students complete their studies

Four PhD students in the CRC for Freshwater Ecology have recently submitted their theses. Alison King's PhD has been granted, while David Crook, Stephen Balcombe and Alison Mitchell have yet to hear their results.

In her thesis, Alison King proposes a new generalised model to explain the habitats and flows that fish in floodplain rivers need for spawning and larval development. David and Stephen have studied the ways in which golden perch, carp and gudgeons make use of their habitats, and Alison Mitchell has examined the transformations of nutrients in freshwater sediments in the absence of oxygen.

CRCFE web site:
http://freshwater.canberra.edu.au

Comments, ideas and contributions are welcome and can be made to:

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- 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
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