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WaterShed

contents

Healthy working rivers: balancing scientific and community values

by Professor Gary Jones

When we are deciding on the requirements for a 'healthy working river', we need to analyse and balance the economic, social and environmental needs of the river and its stakeholders, all at the same time. We should have everyone's needs and values, including those of the river, on the table for consideration.

To my knowledge, this balancing and analysis rarely, if ever, happen in an effective manner. Even when economic, social and environmental objectives are defined for a river or river valley, there is usually little attempt to rigorously analyse whether they all can be achieved simultaneously. This is a clear recipe for disagreement between those whose values lean towards the environment and those who must consider human needs first.

Consequently, I am not surprised when I read in a rural newspaper that there is nothing wrong with the health of the local river, when at the same time I have in my hands a scientific report stating that the river is degraded.

Scientists pride themselves on being objective and independent when they undertake and report on their research and monitoring. Indeed, the ability to separate personal beliefs and unsupported speculation from rigorous interpretation of data and facts is a hallmark of high quality science. Therefore, when asked for scientific advice on the health or needs of the environment, good scientists attempt to separate their personal values and views on desirable environmental condition from the advice they provide.

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

CRC

Sometimes they are not entirely successful, though, because scientists are people, not robots!

River health assessments usually compare a river's existing state against a desired (or reference) condition. The reference condition may be 'near-natural', or it might only be 'best attainable', depending on the circumstances. But for many river scientists, natural condition, or something close to it, has largely been the benchmark for river health assessment.

From a strict scientific perspective, a river in which the water quality deviates markedly from natural condition is degraded to some degree. However, in the broader community, a river that scientists assess as 'moderately degraded' may be considered a healthy working river. It may also have good fishing sometimes, a few large gum trees along the riverbanks, and ducks and ibis on wetlands. From the community point of view, that river ecosystem is healthy enough and certainly not 'degraded'.

Which group is right?

Paradoxically, both are right and wrong at the same time. The difference in view points and understandings may be partly one of interpretation. Reference condition for scientific assessment of river health is not the same as target condition for management of a healthy working river. More significantly, the difference may be largely a matter of values rather than facts. The real challenge lies in the term 'healthy working river'.

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

Scientists assess river health with a focus on the way the river functions as a habitat for creatures and plants, and its water quality. They may measure the change in flow resulting from water extraction for irrigation and be conscious of the river's human uses — of how much 'work' the river is doing. But when they assess river health they do not attempt to judge the river's value to humans or to compare that to the needs of the river ecosystem. Their job is to advise objectively on the science, rather than to advocate a particular set of economic and social trade-offs.

The converse may apply to rural community members, especially those with personal interests in irrigation farming. They may reasonably consider the socio-economic needs of their farming community ahead of the needs of the river environment.

Again, neither group is absolutely right or wrong in its approach. Both simply have different attitudes to the triple bottom line of economic, social and environmental sustainability.

With these arguments I run the risk of over-generalising and of offending both scientists and members of the rural community. But I believe that if we are to advance the debate on healthy working rivers effectively, we all need to recognise a few attributes of the people and processes involved:

- Neither farming nor science is a value-free profession.
- Who we are, our backgrounds and life experiences, will affect our values and therefore our views on what constitutes a healthy working river.
- Rigorous evidence must be provided to establish a case for environmental condition; it is no more acceptable for a scientist to claim that a near-natural condition must be maintained than it is for a farmer to claim that an entire river is healthy based on their experiences camping under the gum trees at the local fishing spot.

- The present day ecological conditions of many working rivers may be unsustainable. They may continue to decline over decades, perhaps beyond many people's lifetimes and memories, and ultimately economic and social uses may be lost.
- There are many types of healthy working river — not just one. The best attainable condition for a working river will be a balance between the desired level of work and the effective management of the environmental resources available.
- The broad community has the right to decide on the acceptable level of work a river may be put to: this decision is not up to scientists, who are only a small sub-group of the community.

I believe the system proposed for classifying water resources in South Africa is a step in the right direction, and well worthy of consideration in Australia. Under the South African National Water Act (1998) each water resource will be classified on the basis of the level of human use, while at the same time management will strive for the best achievable ecological condition within that class. The river classifications proposed range from no human use other than minimal subsistence use by riparian communities (which we might equate to stock-and-domestic use) to rivers that have been modified by large dams for flood protection or that run through major cities.

Of course, if we were to apply a similar classification in Australia, there would be debates about which rivers should be protected from human development ('Heritage Rivers' is one term that has been coined), and which rivers should be subject to extensive use for irrigation. We would need to give serious consideration to protecting many of our northern, tropical rivers while also recognising that some may need to be sustainably developed in the coming decades. In the Murray-Darling Basin and coastal regions, rivers are already extensively used for irrigation, and it is unrealistic to expect that major reductions will occur unless sustainable levels have clearly been overstepped.

The needs of the environment must be balanced against the human need for social and economic sustainability. In the CRC for Freshwater Ecology I expect our scientists to offer ecological advice about a sustainable balance, rather than environmental advocacy. We are here to provide information which supports the debate and decisions on healthy working rivers, and environmental flows in particular. Science will play an advisory role in these decisions, and that scientific advice must be made available to all stakeholders without, fear, favour or prejudice.

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The community has the right to question and decide on the acceptable level of work a river may be put to. Scientists can advise, but should be careful to separate personal views and beliefs from the advice they provide. Photo: M Copland

Scape ecology: the study of patchiness

by Professor Sam Lake

Patches — sand pool plus debris dam. Photo: A Glaister

'Scape ecology' is the study of ecological patterns in ecosystems and their components, whether on land or in water. It is based on landscape ecology, which, as the name suggests, has been almost totally concerned with landscapes; but there are other scapes — seascapes, for example. Scape ecology is concerned with whole environments and the transitions within and between them.

The word 'scape', first used by Gilbert White in 1773, means: 'a view of scenery of any kind, whether consisting of land, water, cloud or anything else' (*Oxford English Dictionary* 1971).

In scape ecology, as in landscape ecology, all organisms and ecological processes are thought to live and interact in a world made up of patches (and areas between patches, called 'matrix') of varying shape, size, resources, duration and pattern. So, scape ecology is a way of perceiving how organisms, communities or ecological processes operate in their surroundings, whether natural or influenced by humans — and, most important, over a range of scales.

To detect the patches and their patterns that make up the living space of each organism or process, we need to observe, carefully and objectively, and this may take some time. Patches for one species may be matrix for another species. Patches can enclose different qualities or quantities of the resources needed by an organism or process.

In a stream, patches can range widely in size. Near one end of the size-scale are individual submerged leaves colonised by detritivores that break them down. Near the other end of the scale, some predatory fish operate in patches covering tens of kilometres.

Patterns of patchiness can also vary widely. For instance, within a river red gum floodplain forest, a predatory beetle population has a very different pattern of patchiness from a mammalian *Antechinus* population that feeds on the beetles. A fox population that feeds on both the beetles and the *Antechinus* has yet another pattern of patchiness. Identifying the patterns and interactions and scales of patchiness is not easy and usually takes a great deal of study. Patches also change with time.

Disturbance has a major influence on patchiness. It destroys some patches and creates conditions for the development of new patches. Humans have changed connectivity and the availability of refugia (refuges), and have undoubtedly affected patchiness while reducing biodiversity and modifying ecological processes. River and catchment planning will benefit if we recognise the complex dynamics of patches affecting habitat availability and biodiversity.

Scape ecology deals with flows across the boundaries of patches. For example, flow in a stream connects different kinds of patches within and beyond the stream. In a flood, the scapes of floodplains go through episodes of connectivity between patches, followed by the progressive weakening of connectivity as the flood level subsides. Drought, when there is no flow, cuts the connectivity between patches within stream channels. Then refugia of various kinds become patches of paramount importance.

In scape ecology, all organisms and ecological processes are thought to live and interact in a world made up of patches (and areas between patches)

Edges and boundaries are important features of patches. The forms of edges have powerful effects on movements of individuals, resources and processes across them. Corridors may allow the transfer of mobile biota and processes between patches. Alternatively, corridors, especially those made by humans, may act as barriers.

A stream might be regarded by some as a corridor, but scape ecology sees streams as complexes of patches. Patches within streams are normally subjected to continuous water flow that is often of such force that it strongly influences patch shape and dynamics. Patchiness in streams may thus be very active with rapid and sharp changes.

On land, edges of habitats such as remnant vegetation may have quite different occupants from the central parts (cores) of the habitat, but both edge and core are of equal significance to the overall scape ecology. In contrast, in a stream, edges appear to be more significant than the central core. For instance, a submerged log can have a rich biota on its surface but only a few highly specialised species inside it.

Patchiness is also three-dimensional, extending into the stream bed gravels and below. Upwelling and downwelling areas, linking patches within- and below-stream, generate distinct patchiness in ecological processes such as primary production.

A perception of patchiness is vital if we are to understand freshwater ecology

The land beside the water (riparian zone) is important as a link between the catchment and stream at large scale, and the floodplain (if present) and stream at smaller scale. Do these functions operate in a continuum, as if in a corridor, or are they distributed patchily? Are there patches in the riparian zone or is it one big linear patch? If humans break the continuity of the riparian zone, what are the effects? These are key unanswered questions.

Scale is central to an understanding of the types and patterns of patchiness. Stream ecologists and many resource managers think of streams in a hierarchy ranging from the total stream and its catchment to the microhabitat. For management purposes this is perfectly understandable, but it is hazardous to expect that such a hierarchy will reveal the patchiness. As patchiness is determined by the biota and the ecological processes, both the nature of patchiness and the forces determining that patchiness may vary considerably between biota and from ecological process to ecological process.

A perception of patchiness is vital if we are to understand freshwater ecology at both the small and the large scale. The principles of scale transition, if there are any, remain undiscovered for flowing waters.

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Further reading

Forman, R.T.T. 1995. *Land Mosaics. The Ecology of Landscapes and Regions.* Cambridge University Press, Cambridge, UK.

Turner, M.G., Gardner, R.H. and O'Neill, R.V. 2001. *Landscape Ecology in Theory and Practice.* Springer-Verlag, New York, USA.

Wiens, J.A. 2002. Riverine landscapes: taking landscape ecology into the water. *Freshwater Biology* 47, 501–516.

Even in a sand-bed stream there is complexity and heterogeneity — from islands, sand bars, and large woody debris down to individual emergent macrophytes and single leaves — all probably used by different biota. Photo: A Glaister

Effects of bushfire on stream ecology

By Tom Nelson and Ann Milligan

Bushfires, such as those that burnt catchments in southern Australia in January, cause major changes to terrestrial and freshwater ecosystems, but they offer not-to-be-missed opportunities to learn more about stream ecology.

Bushfire disturbances are complex and alter stream ecosystem dynamics in many ways. Several effects could be observed only two months after fires had burnt-out large percentages of the natural bush catchments of rivers and streams such as the Cotter in ACT, the Ovens in Victoria and Pipers Creek in NSW (a tributary of the Snowy River). Monitoring has been quickly set up, as new growth sprouts across the catchment.

Few effects of bushfire act directly on the stream ecology at the time of the fire. A number of detrimental effects occur following rain after the event.

In regular monitoring visits since the fires in ACT, Tom Nelson, of the CRC for Freshwater Ecology and the University of Canberra, has found sediment blanketing

Black sediment was common in the Cotter River after the severe fires the month before. Photo: F Dyer

A small tributary of the Cotter River, smothered by a shoulder-high bank of sand following an intense localised thunderstorm. Photo: F Tingle

the streambed of the Cotter River in places where there was an irregular rock and gravel bed before. Soil has been destabilised on the hillslopes by intense heat and the loss of plant roots during the fires, and thunderstorms since have washed it into the river. Other sediment has banked up nearby, poised to wash in if there is more heavy rain. Sediment clogs up the crevices and niches in the gravel and cobbles of a natural riverbed, destroying this habitat for a range of small creatures.

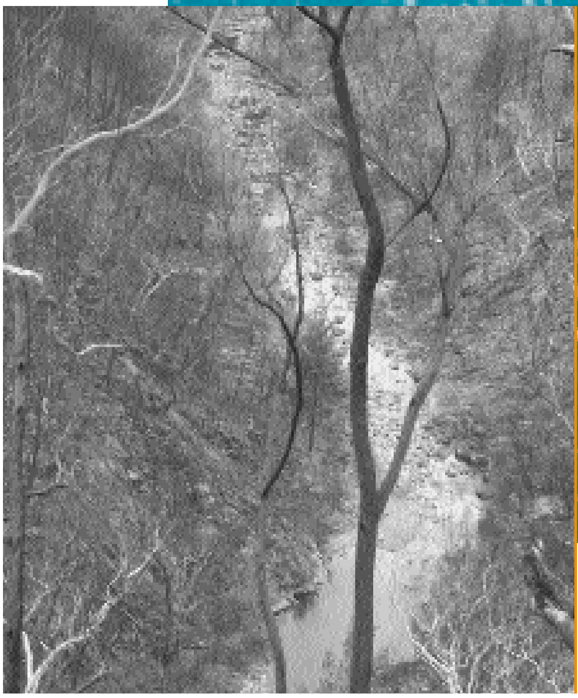
One obvious and unfortunate after-effect of the fires is fish death. According to newspaper reports[1], tonnes of mud and ash had washed into the Ovens and Buckland Rivers in north-eastern Victoria by early or mid-March, threatening fish. Murray cod and golden perch were reported[2] dead at sites in the Murrumbidgee River in ACT in the weeks after the fires. The cause of fish death in these circumstances is usually lack of oxygen in the water. As bacteria in the stream-beds work to break down the influx of organic materials and ash, so the oxygen in the water gets used up and the fish suffocate. As further evidence of poor water quality, freshwater crayfish were seen walking out of the Buckland and Murrumbidgee Rivers.

After the fires, organic matter washed or fell into the streams in the form of ash, charred leaves and burnt overhanging woody debris. Where flow was naturally blocked by snags in the stream, charcoal and ash scums developed, floating two to three centimetres thick. Fine black ash accumulated in bulk deposits, in pools and other slow-moving areas. The ash has added to sediment and filled-in the fine structure of the streambed. Our researchers are studying whether this insoluble carbon can be a food source for the visible stream organisms.

The bushfires in ACT and Kosciuszko National Park have burned right to the edges of streams such as the Cotter River, the Perisher Creek and the Thredbo River. With no leaves on the riverbank trees and shrubs, and only patches of overhanging grasses, the streams are open to the sunlight through much of the day. Water temperatures are likely to be higher as a result.

The extra light and higher temperatures, and the inputs of organic nutrients since the fires, are likely to alter the algal food resources in the water. Algae are at the base of the food chain and are a food source for macroinvertebrates (water insects and crustaceans). But grazing insects and larvae appear not to graze some of the algae that grow in well-lit conditions. Therefore changes in the algae may lead to different populations of macroinvertebrates. As these organisms are food for larger creatures such as fish, turtles and birds, the whole local food chain may be affected.

Although bushfires have marked impacts on freshwater ecosystems, streams usually return to pre-fire conditions within five to twenty years, depending on the severity of the fires. Meanwhile, for freshwater ecologists, the challenge is to better understand the links between post-fire inputs washed into the water, the freshwater food webs and the in-stream plant and animal assemblages.



The fires in the Cotter River catchment burnt the vegetation right to the water's edge, exposing the water to sunlight all day long. Photo: R Ogden

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1 *The Weekly Times*, 5 March 2003, 19 March 2003
2 *Canberra Times*, 15 March 2003

Pipers Creek, Koscuiszko National Park, pump station weir which was edged by dense alpine scrub before the January fires. Photo: C Lemann

Vegetation communities on dryland river floodplains

Two PhD studies, currently nearing completion in the CRC for Freshwater Ecology, are investigating the effects of flooding on patterns of vegetation cover across large inland river floodplains, at quite different scales. Samantha Capon at Griffith University in Queensland has been on the ground and digging in the arid floodplain of the unregulated Cooper Creek, examining plant community dynamics and the role of flooding. Meanwhile, Neil Sims at the University of Canberra has been working from space via satellite, mapping the plant and soil types and landscape structure on the Lower Balonne Floodplain in semi-arid Queensland.

Samantha has surveyed changes in plant community composition and structure and their relation to flood events. "I've looked at the effects of flooding on plant species distributions in the standing vegetation as well as seeds in the soil. Seeds can provide clues about flood history and plant species that have been growing in an area in the past. Investigating the presence of seeds in the soil, and their germination and growth responses to different types of flooding, also gives an indication of what might happen under various future scenarios."

Overall, Samantha's results suggest that the plant communities on the Cooper Creek floodplain are structured along a gradient of flood history. So knowing when the last flood happened and roughly how often an area is flooded, it should be possible for managers to broadly predict the plants that will be there. Her results suggest that if floods become less frequent or smaller, the floodplain pastures may gradually consist of fewer species, with less lignum and annual grass and more of the tougher drier grasses and perennial sub-shrubs. There could be flow-on effects to both wildlife and cattle.

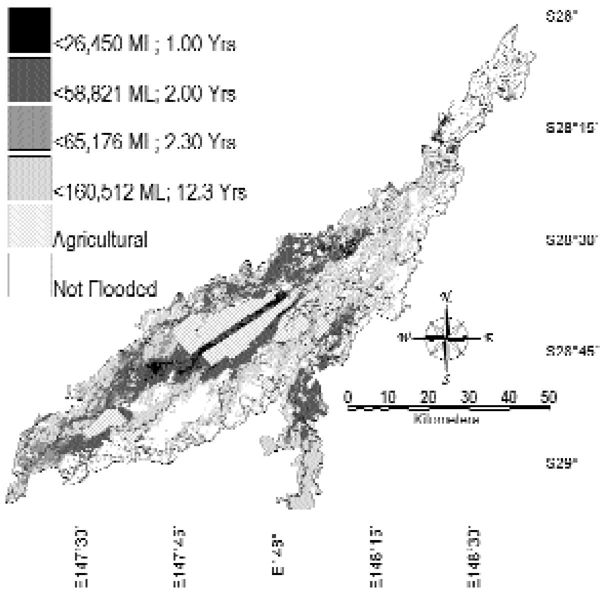
Floodplain vegetation one year after big floods on the vast expanse of the Cooper floodplain. Photo: S Capon

At the smallest scale, time since inundation is the most important factor, and recently flooded areas are likely to support diverse and abundant communities of annual grasses, annual legumes, sedges, nardoo (*Marsilea* spp.) and a wide array of ephemeral annual forbs. Even areas 30 km away from channels will have an abundance of aquatic plants when flooded. With drying, plant communities tend to become less diverse, and perennial species become dominant.

The flood history of a site is also significant as it determines what species are available to respond to flooding, either in the standing vegetation or as seeds in the soil. For example, lignum (*Muehlenbeckia florulenta*), which provides valuable habitat to waterbirds in the region, is restricted to areas which are frequently flooded, while areas of intermediate flood frequency support shrubland of Queensland bluebush (*Chenopodium auricomum*). Rarely flooded areas are dominated by perennial subshrubs such as *Sclerolaena* spp. and *Atriplex* spp. Neither lignum or Queensland bluebush seems to have seeds that persist for long in the soil, and the distributions of these shrubs could therefore be affected if small and medium-size flood events were reduced.

To the south-east, around the Queensland–New South Wales border, Neil is mapping the effects of flooding on landscape structure and function, and vegetation and soil patterns, using remote sensing.

The surface appearance of semi-arid floodplains is constantly changing because of seasonal and climatic effects on plant growth, and also from the effects of flooding. A single satellite-image cannot accurately show the general distribution of landcover types across them, so Neil has made a 'reference image' from seven Landsat TM images captured over 10 years, and has used it to make a composite map of landcover of the Lower Balonne Floodplain. The map produced from the reference image is much more comprehensive than other maps made from just one image.



Patterns of flood frequency on the Lower Balonne Floodplain in semi-arid southern Queensland.
Map: N Sims

Along the rivers, Neil's landcover map shows patterns of plant distribution that resemble those identified in Samantha's work. Upstream there are dunes forested with callitris and bimble box (*Eucalyptus populnea*). The frequently flooded deposition zones in the floodplain's mid-reaches are dominated by lush lignum on dark, organic-rich soils; and the landcover at lower reaches is a diverse open grassland that includes curly Mitchell grass (*Astrebla lappacea*), *Bassia* spp. and bufflegrass (*Cenchrus ciliaris*) on pale, fine-grained soils.

Across the floodplain, however, the landcover map shows the pattern of plant distribution is much more complex. Unlike most other floodplains, the Lower Balonne Floodplain floods from the inside out, and the most frequently inundated parts of the floodplain lie along its central axis away from river channels. All the riverbanks have riparian forests of river red gum (*E. camaldulensis*) and coolibah (*E. coolabah*), but the *frequently* flooded zones support coolibah open woodland or lignum. The remainder of the floodplain is grassland, with decreasing plant cover as you move towards the outer margins.

Neil has also examined how the landscape structure of the floodplain is controlled by flood frequency. He has measured the shape of patches of landcover across the floodplain from the reference image landcover map. Two types — the coolibah open woodland and the open grassland — have the most important influence on the structure of the floodplain landscape. If the river flow in this system were to be reduced, the probable result would be a smaller and wetter zone of frequent inundation, and drying of the remainder of the floodplain. Future changes to the landscape of the Lower Balonne Floodplain would then probably be similar to those described in Samantha's work: a shrinking area of coolibah open woodland, and forage with different characteristics. The changes would have impacts on wildlife habitat, inputs from the floodplain to the river systems, and grazing values.

These two projects continue the CRCFE's research focus on dryland floodplains. Although not often investigated by freshwater ecologists, dryland floodplains are turning out to be diverse, complex and valuable ecosystems, whether arid or semi-arid. We are seeing that floodplain structure and function are intimately linked to the patterns of flow that create them.

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SideStream

MDFRC to move to Wodonga, to La Trobe University

After an extended review of options, it has been announced that the Albury-Wodonga laboratory of the Murray-Darling Freshwater Research Centre (MDFRC), part of the CRCFE, will move from the Charles Sturt University campus in Albury to the Wodonga campus of La Trobe University, later this year. The move will help ensure the future of the MDFRC, by providing greater financial security, but will not affect the Centre's research or its commitment to service the knowledge requirements of the region.

The MDFRC will continue to collaborate with Charles Sturt University and other universities and organisations to the benefit of the entire Murray-Darling Basin. The MDFRC and La Trobe University already have a strong relationship through collaborative research projects, as well as a joint research facility in Mildura which should be completed late in 2003.

Centenary medals

Dr John Langford (Chairman of the Board of CRCFE), Professor Peter Cullen (former Chief Executive of the CRCFE), Professor Barry Hart (Monash University and member of the CRCFE) and also Mr Don Blackmore (Chief Executive of our partner, the Murray-Darling Basin Commission) have been awarded Centenary Medals. The medals are awarded in recognition of outstanding contributions to Australian society.

Reminder: Ninth International Conference on River Research and Applications (NISORS)

If you intend going to the `NISORS' conference in Albury, NSW, on 6–11 July, please register via web site http://www.conlog.com.au/nisors.

Closing date for registrations is Friday 20 June. If you don't have access to the Internet, please phone 02 6281 6624 for information and a registration form.

Dragonfly conference a success

The 3rd Worldwide Dragonfly Association International Symposium on Odonatology was held at the Beechworth campus of La Trobe University from 8 to 13 January. The symposium, being held in the southern hemisphere for the first time, was convened by Dr John Hawking (Murray-Darling Freshwater Research Centre and CRCFE). It attracted around 100 delegates from 14 countries.

UN Expert Meeting on Indicators of Biological Diversity

Associate Professor Richard Norris, of University of Canberra and CRCFE, attended a United Nations Expert Meeting on Indicators of Biological Diversity at Montreal, Canada, on 10–12 February 2003, as a nominated Australian representative. Richard's presentation was called 'Experiences and lessons from Australia's National River Health Program'.

Award for resnagging team

The team of staff at Arthur Rylah Institute (Victoria) who undertook the River Murray resnagging project has won this year's David Ashton Biodiversity and Ecosystem Award. The team includes Simon Nicol, John Koehn and Jason Lieschke, all of the CRCFE, as well as Jarod Lyon, John Mahoney, John McKenzie and Peter Fairbrother. The award was presented by the Hon. Bob Cameron MLA, Minister for Agriculture, Victoria, in recognition of the quality of the science and its relevance to on ground improvements in natural resource management.

Wetland appointment

Dr Ben Gawne, Director of the Murray-Darling Freshwater Research Centre (part of the CRCFE), has been appointed as a Director of Wetland Care Australia, Australia's leading wetland repair organisation.

Management of Large Rivers for Fisheries (LARS2)

The Second International Symposium on the Management of Large Rivers for Fisheries (LARS2): `Sustaining Livelihoods and Biodiversity in the New Millennium', was held on 11th to 14th February 2003 in Phnom Penh, Kingdom of Cambodia. LARS2 was attended by more than 220 river scientists and managers from 61 river basins around the world. Dr John Koehn of Arthur Rylah Institute and Professor Angela Arthington of Griffith University represented the CRCFE; Professor Arthington was also a member of the scientific committee.

Panel Chairs and the Steering Committee produced a set of recommendations, and the symposium called on the 2003 World Parks Congress and the 2004 Convention on Biological Diversity Conference of Parties to 'urgently consider how to stem and reverse the decline in riverine biodiversity'.

The abstracts and many of the draft papers can be viewed at www.lars2.org.

SideStream

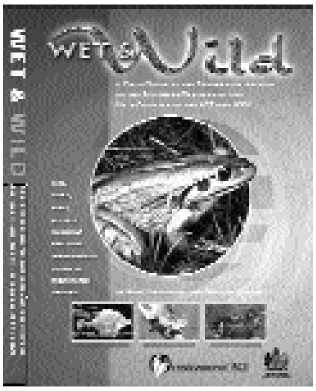
New project to study the ecology of Narran Lakes

The CRCFE is beginning a new four-year study of the ecology and functioning of the Narran Lakes area in northern NSW. CRCFE staff from Monash University (Victoria), the University of Canberra and the Goondiwindi laboratory of the Murray-Darling Freshwater Research Centre will work together, investigating the response of this RAMSAR-listed terminal wetland ecosystem to variable inflows. The project is funded by the Murray-Darling Basin Commission. This study will provide information for managers and the local community who are trying to achieve a balance between the requirements of the environment and water users in this region. The team will be actively seeking community input to build up their background knowledge of the area.

For further information, please contact Associate Professor Martin Thoms, phone 02 6201 2933 or email thoms@scides.canberra.edu.au, or Associate Professor Gerry Quinn, phone 03 9905 5633 or email Gerry.Quinn@sci.monash.edu.au.

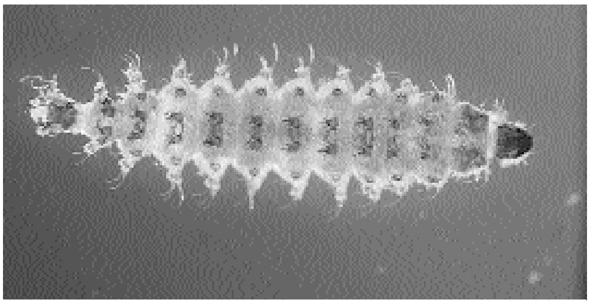
Wet & Wild

If you want to know the name and habits of the freshwater dragon that is looking at you warily, or where to find a reed warbler's nest, or whether a still, floating platypus is dead, or anything else about the freshwater creatures that live in the high country of NSW and ACT, you may be interested in *Wet & Wild: A Field Guide to the Freshwater Animals of the Southern Tablelands and High Country of the ACT and NSW*, by Mark Lintermans and Will Osborne (of the CRCFE), published by Environment ACT. The book costs $34.95, plus $6 if posted. For further information, please phone 02 6207 2126 or email mark.lintermans@act.gov.au.



The creature feature for this issue:
Ceratopogoninae larvae

Family	Ceratopogoninae
Sub-family	Forcipomiinae
Genus	*Atrichopogon*



Larva of the genus Atrichopogone.
Photo: J Hawking

The family Ceratopogoninae occurs throughout Australia. The adults of this family are a type of fly called 'biting midges'. Biting midges are extremely small, but some can inflict painful bites on humans. They also are known disease vectors in many parts of Australia. In Australia these biting insects are best known near the coast where they thrive in estuarine environments. However, they also occur inland where the larvae live in the wet sand or mud at stream or lake margins. The larvae are up to 12 mm long, with a slender body comprising bead-like segments. In AUSRIVAS (the Australian River Assessment System) the larvae have a sensitivity score of 4/10 (with 10 being the most sensitive), meaning that they can be found in both healthy and degraded aquatic habitats.

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

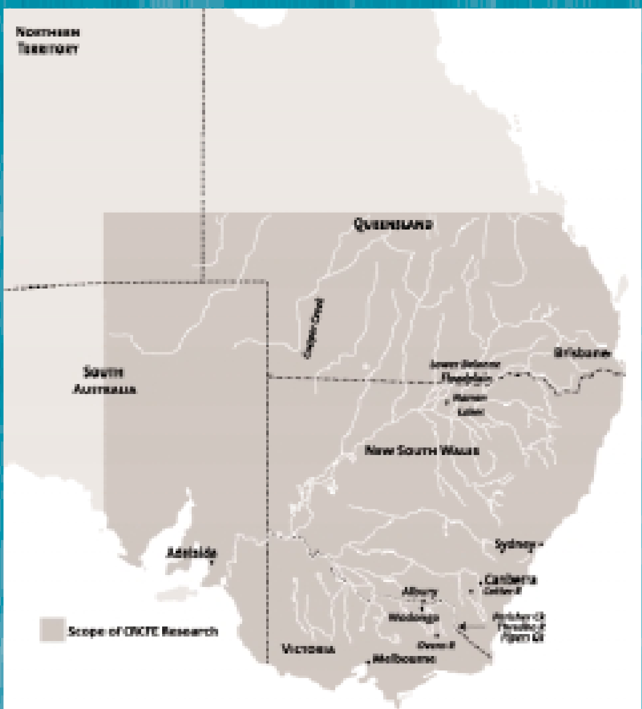
Feature Plant

by David Williams

River clubrush is the feature plant for this issue.

Family: Cyperaceae
Genus: *Schoenoplectus*
Species: *Schoenoplectus validus* (formerly called *Scirpus validus*)

The river clubrush is native to Australia and New Zealand, with a range that extends from the tropics to temperate zones. It forms dense emergent clumps near the banks of waterbodies (littoral), and can reach 3 m tall. River clubrush will grow in water down to 1.3 m deep, provided that annual change in water depth is only moderate, less than about 0.4 m. It tolerates brackish water and a range of sediment textures. Its stems are so closely spaced that they exclude other plant species, protect the banks of waterbodies from wave action, and provide cover and nest sites for waterfowl.



Areas mentioned in this issue.

Comments and ideas are welcome and can be sent to:

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