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

continued from page 1

The Yarra River
under the microscope

This will be done by looking at different parts of the food web in each segment, starting with the nutrients that are bound up in the river sediments. The field work will also include water quality analyses and microbiological work. Ecological functioning in the river will be assessed by measuring the production and use of oxygen and carbon in both the water and sediments of the river.

Macroinvertebrates, or bugs, will also be sampled at 30 locations along the three study segments to evaluate patterns in the ecological structure of the river. Dr Breen said that macroinvertebrates, by their presence or absence, could tell us quite a bit about conditions in particular locations. They are used extensively by water managers throughout Australia as indicators of stream health.

The study will examine the relationship between the macroinvertebrate communities and local and catchment scale environmental variables, and whether these relationships are similar in the small tributary streams and main stem of the Yarra.

To date, bottom-dwelling macroinvertebrates, as well as those living on snags, have been sampled over autumn and spring.

Dr Breen said that despite years of de-snagging in the Yarra, there was still an abundance of large, woody debris in the river and so plenty of habitat for log-dwelling invertebrates.

"This is probably because the streamside vegetation along much of the Yarra's lowland section is quite intact", he said. It means, however, that snags are likely to be an important habitat for bugs in the river, and that future management actions will need to protect this habitat.

"We've also noted from analyses so far that there seems to be a link between increasing urban development and decreasing abundance and diversity in the invertebrate communities. However the impact appears to be variable and snag communities appear to be less affected than benthic, or bottom-dwelling, communities".

Previous studies conducted by the CRC for Freshwater Ecology on small streams in the Melbourne area have indicated that urbanisation does have an impact on stream health.

"It is likely, however, that these impacts will be less severe in larger waterways such as the Yarra where such a high proportion of the total catchment is presently outside the metropolitan area," Dr Breen said.

Melbourne Water's General Manager of Waterways and Drainage, Ross Young said that the study would lead to a better understanding of the ecology of the Yarra River. This would improve the management of this essential natural resource.

Mr Young said the project was an important new initiative in Melbourne Water's program to improve local waterways.

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Macroinvertebrates, or bugs, are being sampled at 30 sites along three segments of the Yarra River as part of a comprehensive study to determine how the river functions. Despite the Yarra being one of Melbourne's best-loved icons, we know very little about how the river works.

A note from the Director...

Karen Markwort has resigned from the CRC for Freshwater Ecology to take up a position with the Australian Greenhouse Office.

Karen has done a fabulous job for the CRCFE. We are probably the best-recognised CRC, and the quality of our publications continues to attract positive comment from many sources. When we started the CRCFE, there was some scepticism about us investing in a Communication Manager, but this attitude quickly turned around as Karen showed us how her skills and professionalism have added value to our work as well as having an impact with our target audiences.

We wish her well as she moves from the liquid to gaseous phase of the water cycle.

Peter Cullen
Director

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WaterShed

contents

The CRCFE was established under the Commonwealth Government's Cooperative Research Centre Program in July 1993.

The Cooperative Research Centre for Freshwater Ecology provides ecological understanding to improve inland waters through collaborative research, education and resource management.

The Yarra River
under the microscope

The $1 million Yarra project will study the food web in three segments of the river, starting with the nutrients that are bound up in the river sediments.

The CRCFE is a collaborative venture between:

- *The ACT Government*
- *ACTEW Corporation*
- *CSIRO Land & Water*
- *EPA Victoria*
- *Goulburn–Murray Water*
- *La Trobe University*
- *Melbourne Water*
- *Monash University*
- *Murray–Darling Basin Commission*
- *Murray–Darling Freshwater Research Centre*
- *NSW Fisheries*
- *University of Canberra*
- *Southern Rural Water*
- *Sydney Water Corporation*
- *Wimmera–Mallee Rural Water*

A $1 million study, being conducted by the Cooperative Research Centre for Freshwater Ecology and Melbourne Water, will investigate the changes brought about by urbanisation on one of Melbourne's most famous landmarks—the Yarra River.

The Yarra River plays an important role in the lives of more than 2.5 Melburnians. From its source high up in the Yarra Ranges, it provides most of the city's water supply and in the outer east, the Yarra River supports an agricultural industry worth more than $135 million annually. In metropolitan Melbourne, the Yarra has become the focal point for recreational and tourism activity. Yet very little is known about what makes this lowland river tick.

Project Leader, Dr Peter Breen, said that while there had been no major problems with the Yarra, increasing development in the catchment meant that it was important to ensure a secure future for the river.

"European settlement has resulted in some very significant changes to the river and its catchment.

"Land use has changed dramatically with about 18% of the catchment now urban, while 46% is agricultural and 36% is used for water supply and timber production.

"Urbanisation and agricultural development have increased runoff and the transport of sediment, pollutants and nutrients into the river.

"By building dams and levees, we have reduced the river's interaction with its floodplain—the source of much of the river's carbon, or fuel, supplies."

The study will focus on three of the Yarra's five distinct segments: rural lowland (from Wesburn to the upper end of Warrandyte Gorge), gorge (Warrandyte Gorge to Fitzsimons Lane), and urban lowlands (from Fitzsimons Lane to Dights Falls). It will examine and compare the impact of urbanisation on each of these segments.

continued on page 8

Conflicts over water for NSW

Director, Prof Peter Cullen

As the competition over water hots up, there are more and more strident calls to 'zap the cap' and move away from the reforms that New South Wales is painfully edging towards.

It is of little surprise that some irrigators would like to do away with water controls. Upstream irrigators would receive a licence to print money at the expense of downstream irrigators and the environment. The over-allocation of water in NSW has already led to a reduced security of supply, and it should be clear that this is not in the interests of irrigators.

From time to time the quality of the science underpinning the various reforms comes under attack.

Science is never complete, and we will never have perfect understanding. However, I believe that the science underpinning the NSW river flow objectives is good and appropriate to the issues at hand. If irrigators can see flaws in the science, then they should explain exactly what aspects are flawed so that we can debate the issue.

As I see it, the science revolves around three major propositions:

Proposition 1.
NSW rivers are degraded

I doubt that there are many disputes about this. The Federal State of the Environment Report and the NSW State of Environment Report catalogue the problems. The NSW Rivers Survey, conducted by the CRC for Freshwater Ecology and NSW Fisheries, showed that our rivers have suffered major losses of native fish. It also showed that carp infestations were greater in more regulated streams. Added to this, the algal blooms in the Lower Murray in 1991 caused major dislocation to rural communities and tourism, as well as threatening human health.

In my view the community is well aware of the mismanagement responsible for this degradation to our rivers. Even Sydney residents are now aware that failed catchment management can have huge economic, environmental and social costs on the community.

Proposition 2.
Altered flow regimes are one of several important causes of degradation

We have inverted the natural flow in many of our rivers. These rivers now run bank full in summer as they deliver irrigation water, and are at low flow in winter as the storages fill. The loss of small to medium floods is no doubt responsible for the failure of native fish to recruit, and this is probably one of the causes of the carp explosion, since the native fish do feed on young carp.

In some NSW valleys the water is grossly overcommitted, with not only serious environmental consequences, but also leading to a loss of security of supply to irrigators.

Proposition 3.
Restoring appropriate environmental flows will reduce degradation

Reducing one of the major stresses, altered flows, will hopefully improve the health of our rivers. We do know that treating symptoms without addressing causes does not work; a fact that is amply demonstrated by our approach to salinity.

There are of course other stresses that must also be addressed, such as water regulators and weirs that stop fish migration, and agricultural chemicals that kill zooplankton and fish (probably leading to algal blooms). Dams with inappropriate release structures have been shown to release cold water that alters downstream temperatures for up to 300 km in NSW, with significant impacts on fish. Fertilisers and inadequately treated sewage effluent provide nutrients to promote algal blooms.

The CRC conducted a workshop in December 1997 to enable a group of 40 scientists, including CRC researchers and representatives from most states, to scrutinise the science behind the reforms. The scientists involved with setting the river flow objectives made presentations and were questioned at length by the audience. At the end of the day it was agreed that the science was appropriate and the work should proceed.

Peter Cullen
Director

Marshes, swamps and billabongs—bugs love 'em

Far from being boggy wastelands, Australia's temporary wetlands harbour a teeming diversity of life—in fact bugs love 'em!

Recent work by CRC for Freshwater Ecology postgraduate student, Rhonda Butcher, has revealed the importance of temporary wetlands as distinctive and highly diverse aquatic habitats.

Based at Monash University, Ms Butcher has been studying 16 wetlands of varying permanency in the Western Wimmera region of Victoria. Looking particularly at the macroinvertebrates, or bugs, she is comparing the diversity of ephemeral systems to that of more permanent wetlands. She will also investigate whether commonly used techniques for assessing biodiversity are suitable for conserving invertebrates in temporary wetlands. Methods for sampling invertebrates in both ephemeral and permanent wetlands will also be evaluated.

Ms Butcher said that more emphasis tended to be given to permanent, rather than temporary wetlands in Australia because of the continent's lack of permanent freshwater sources. However, Victoria had lost about 4000 temporary wetlands, mostly through drainage, since European settlement while it had gained some 1800 permanent systems as a result of the construction of artificial ponds and storages.

"While our temporary wetlands are certainly the most numerous type in Australia, they're also the most threatened by human activities," she said.

"Australian landscapes are strewn with pockets of temporary wetlands that are periodically filled by floods or rain. These wetlands and the species they harbour are peculiarly adapted to an ecosystem that is both wildly variable and unpredictable.

"So our temporary wetlands are actually far more diverse than our permanent systems because that's the type of environment that suits plants and animals that are adapted to extreme, not average, conditions."

Ms Butcher's study focuses on the small, invertebrate fauna of these wetlands—since much of the diversity of temporary wetlands lies in the bugs and microscopic animals that make their home there.

Current methods for classifying wetlands tended to exclude invertebrates in favour of approaches using plants or birds, water regime or salinity, she said.

Four categories of freshwater wetlands—two temporary and two permanent—have been identified by the Department of Natural Resources and Environment in Victoria using water regime, plant associations and salinity. The two temporary wetlands categories are: freshwater meadows, which contain water for about four months each year, and shallow freshwater marshes, which contain water for six to eight months of the year. The permanent freshwater wetlands categories include deep freshwater marshes, which often fluctuate in levels but are usually less than a metre deep, and the permanent open wetlands, or lakes, which usually contain water up to five metres in depth all year round.

Ms Butcher's study was conducted at four sites from each of the four freshwater wetland categories. Each wetland was sampled for invertebrates at one, three and five months from filling. Physical and chemical data was also gathered and waterfowl counted during each wetland visit.

"There are just enormous amounts of animals in these wetlands, Ms Butcher said. "From just four of the temporary wetlands, with only a few minutes sampling in each wetland, I collected 220,000 animals (invertebrates).

"This in itself makes temporary wetlands very important for biodiversity, because invertebrates are an important food for fish, birds and other larger invertebrates.

continued on page 5

Invertebrates, or bugs, form a large part of the biodiversity of temporary wetlands. From top: a shield shrimp, a native mollusc and a diving beetle. These small animals are an important food for fish, birds and other larger invertebrates.

Captive–rearing might save endangered corroboree frog

A captive-rearing and breeding program is underway in a last ditch effort to save the strikingly–coloured southern corroboree frog.

The program is being conducted by researchers from the University of Canberra in cooperation with the NSW National Parks and Wildlife Service and the Amphibian Research Centre (ARC) in Melbourne.

Famous for its spectacular yellow and black colouring, the southern corroboree frog *(Pseudophyrne corroboree)*, which is found only in the Snowy Mountains, has undergone a dramatic, yet mysterious decline during the last decade. Its cousin, the northern corroboree frog *(Pseudophyrne pengilleyi)*, found in the Brindabella and Fiery ranges, is also experiencing decline, although not to the same extent.

CRCFE member, Dr Will Osborne and a small team of postgraduate students from the University of Canberra, are leading the charge to save this nationally endangered frog.

Dr Osborne said the population augmentation program for the southern corroboree frog was aimed at assessing whether a combination of captive breeding and field management would be effective in reducing tadpole deaths in the field.

It would also determine whether increasing the recruitment level through to metamorphosis could boost the number of breeding adults in remnant frog populations.

Famous for its spectacular yellow and black colouring, the southern corroboree frog is the subject of a breeding program aimed at saving this unique mountain-dwelling amphibian.

The experimental work, now in its second year, has involved collecting half of each clutch of eggs from three Snowy Mountains' sites for captive-rearing at the Australian Research Centre where conditions were set to mimic the field environment.

Field enclosures were constructed in natural breeding pools for the half clutches left in the field so that their progress could be monitored and compared to the laboratory-reared individuals.

Future of CRC for Freshwater Ecology

The CRC for Freshwater Ecology, along with some 45 other CRC applicants, has now been interviewed. The Minister for Industry, Science and Resources, Senator Nick Minchin, is expected to announce the 30 successful CRCs towards the end of March.

We have put together a good proposal and are optimistic of our chances. If successful, we will open a Northern Basin Laboratory at Goondiwindi to enable us to undertake research into environmental allocations and the ecological effects of pesticides on the summer rainfall streams of the North. We have new partners with the QLD Department of Natural Resources (DNR), NSW Department of Land and Water Conservation (DLWC) and Victorian Natural Resources and Environment (NRE) all joining, along with Griffith University. Sydney Water is also planning to become a full member and will then join the CRCFE Board.

I hope that we will have the opportunity to continue the work we have started. Our vision remains the same—to improve the condition of our waters. We will continue to do excellent science and we will continue to strive to get the results to the people who may be able to use the emerging knowledge.

Peter Cullen

A sphagnum bog in Kosciuszko National Park, typical habitat for the corroboree frog.

Strict protocols were maintained for both the field and laboratory work to prevent disease, contamination and poor practice from confounding the results. The captive-reared tadpoles were returned to the field in mid-spring, after snowmelt, where they were released into enclosures within the same pool from which they were taken some months earlier. Two batches were released one month apart and housed in separate enclosures within the same pool so that their progress could be independently assessed.

Masters student David Hunter said that the results from the first year of work confirmed that captive-breeding could be successful in increasing recruitment in the southern corroboree frog.

"We found that overall the tadpoles that had been reared in the laboratory were more likely to survive," Mr Hunter said. "The high field mortality might be the result of the particularly poor climatic conditions experienced during that year—lack of rain during autumn and late snow. We really need to repeat the experiment during climatically good years to verify our result. "In more recent work Mr Hunter has found that by simply placing eggs directly into the shallow pools the same reduction in over-winter mortality could be achieved as that obtained by captive-rearing. It is hoped that in the longer term, this will be a more cost-effective option than captive-rearing.

While the survivorship of the captive-reared tadpoles was relatively high, many died once released into the field. The tadpoles released first, however, had a greater chance of survival than those released later.

Mr Hunter added that the reasons for the decline in corroboree frogs were still unknown, although it was possible that there was a link between ultraviolet-B radiation at high altitudes and declining frog species.

The NSW National Parks and Wildlife Service (NPWS) has produced a Recovery Plan for the Southern Corroboree Frog, written by Dr Will Osborne, in response to the work that has been done to date.The work has been funded by the Endangered Species Program of Environment Australia, the NSW NPWS, the University of Canberra, the Amphibian Research Centre and a generous donation from a member of the public, made in honour of Colleen McCarthy. The project is an in-kind contribution to the CRC for Freshwater Ecology.

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continued from page 3

Marshes, swamps and billabongs—bugs love 'em

Tony Overman, formerly of the Victorian Department of Natural Resources and Environment, assists with sampling in the Meereek wetland.

"Furthermore, the suite of animals found in each wetland are quite distinct and there are often dramatic changes in the species found in a single wetland from one field trip to the next. This indicates that timing is a very important factor in any wetland study and that sampling programs need to be linked to flooding events rather than staff availability. It seems critical to sample when wetlands are at the same inundation stage, rather than seasonally or on an *ad hoc* basis."

In addition to their role in conserving biodiversity, temporary wetlands are also a source of clear, clean water. In shallow temporary wetlands sunlight can usually penetrate their depth, allowing a thriving plant life, which play an important role in absorbing nutrient and pollutant runoff from rural lands.

Ms Butcher said that the information gathered from each of the four types of wetlands would be compared to provide a better understanding of how water permanency influenced aquatic communities.

Ms Butcher is supervised by CRCFE members, Professor Sam Lake (Monash University, Department of Biological Sciences) and Dr Richard Marchant (Museum of Victoria).

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Ecoregions being used to set standards for river health

Setting obtainable ecological objectives for streams is likely to be made easier by a new classification system being developed by CRCFE scientists from the Environment Protection Authority (EPA) in Victoria.

Dr Peter Newall sampling a Victorian stream for macroinvertebrates. CRCFE scientists from the EPA Victoria are putting together a new classification system based on topographical, climatic, terrestrial vegetation as well as aquatic invertebrates to help natural resource agencies set ecological targets for the streams they manage.

The new system, which classifies Victorian streams into one of five regions, is based on topographical, climatic, terrestrial vegetation as well as aquatic invertebrate features. It aims to provide natural resource managers with the ability to set ecological targets for the streams they manage based on these 'ecoregions'.

The project follows on from work already conducted by EPA Victoria under an ANZECC grant, the CRCFE, and the National River Health Program.

Project leaders Leon Metzeling and Peter Newall said that in the past 'ecoregions' had been based on land and climate features, such as soil types, topography and rainfall and didn't really take into account what actually lived in the water.

The new classification system relies on macroinvertebrates or bugs—grouped according to similar assemblages of animals—thereby maximising the uniformity of the ecoregions.

"We decided to let the bugs do the talking" said Mr Metzeling. "These group boundaries are then refined according to topographic and climatic characteristics."

The project draws upon the huge macroinvertebrate dataset that has been assembled by the Monitoring River Health Initiative (MRHI) under the National River Health Program, which was set up by the Federal Government to assess the condition of streams throughout Australia. More than 200 reference sites, or sites assessed as being examples of what to aim for in terms of stream condition, were sampled throughout Victoria to assemble this dataset.

Stream edge and riffle habitats from the MRHI samples were identified to species level, and then combined in the analysis to come up with site groupings that defined regional boundaries. This information was related to a few environmental variables to come up with a map of proposed ecoregions.

These regions were examined and fine tuned by a workshop that included Victorian scientists and agency staff who have expertise in macroinvertebrate ecology and distribution.

The project will develop a geographic framework within which streams of similar types can be assessed. This approach has been compared to other regional classification systems, such as the Interim Biogeographic Regionalisation for Australia (IBRA) , set up by the Australian Nature Conservation Agency in 1995 for the purpose of terrestrial ecosystem management.

To date five distinct 'ecoregions' have been identified. Region 1 includes the alpine areas of the State while Region 2 is an assemblage of areas including some of the mountainous and wetter areas of Victoria as well as East Gippsland, the Grampians and the foothills and mountains of the Great Dividing Range. Region 3 takes in other areas of the foothills of the Great Divide where lower rainfall may be differentiating this area from Region 2. Region 4 includes the lowland coastal streams mainly in the eastern part of Victoria as well as central parts of the State. Region 5 covers most of the western half of the State and extends to the riverine plains of the River Murray, including the lower reaches of streams such as the Campaspe, Goulburn and Ovens rivers.

Mr Metzeling said that because the classification system was based on reference sites, or examples of desired stream health that had been sampled for the MRHI, the Melbourne metropolitan area had been excluded as its urban streams did not meet the reference site criteria.

He said that the project was prompted in part by a concern that too many of Victoria's sites were being assessed as equivalent to reference condition under the National River Health Program's statewide AUSRIVAS models, or having attained a satisfactory level of stream health.

"Clearly, this was not the case for many sites," he added. "It was too easy to be assessed as a reference site, so we felt that the benchmark under that protocol was too low. Because this new approach is based on geographic as well as invertebrate homogeneity, it gets rid of a lot of variation. We hope it will improve the resolution or sensitivity offered by the AUSRIVAS models."

"The approach we're using is relevant to all states and territories in Australia and we believe that the concept could even be exported internationally, " Dr Newall said.

The work also demonstrates the usefulness of a large dataset, such as that provided by the National River Health Program's Monitoring River Health Initiative.

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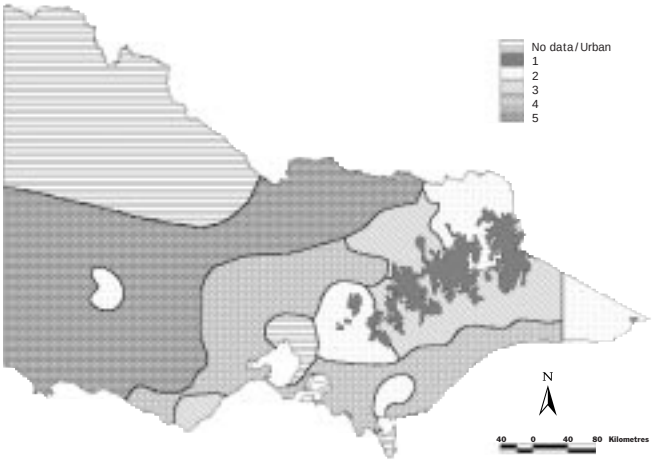
Leon Metzeling lets the 'bugs to the talking'. The new classification system, based on ecoregions, draws upon the huge macroinvertebrate dataset that has been assembled by the Monitoring River Health Initiative (MRHI) under the National River Health Program.

Stream macroinvertebrate ecoregions



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