WaterShed

contents

The CRC 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.

Rivers in urgent need of restoration

Results of NSW survey paint a grim picture

The alien pest species carp is the most common fish in the Murray and Darling river systems, a comprehensive survey of NSW freshwater fisheries, has revealed.

The two-year survey found an average of one carp per square metre in the lowland reaches of the Bogan River. Not a single Murray cod or catfish was caught in the Murray River catchment during the survey despite intensive fishing with the most efficient types of equipment available.

The scientists conducting the survey have urged the State and Federal governments to accept that our riverine heritage is in a generally degraded condition and in urgent need of restoration.

Fish and Rivers in Stress: The NSW Rivers Survey, was a collaborative study conducted by the NSW Fisheries Research Institute and the Cooperative Research Centre for Freshwater Ecology. The survey, the most comprehensive look at the freshwater fish resources conducted anywhere in Australia, was also funded by the NSW Resources Conservation and Assessment Council.

More than 50,000 fish representing 55 species were sampled during the survey, which took in all ecological regions and river types in NSW. Four surveys were conducted over the two-year period in 80 randomly selected sites that included rivers in the Murray, Darling, North Coast and South Coast regions. Represented in each region were

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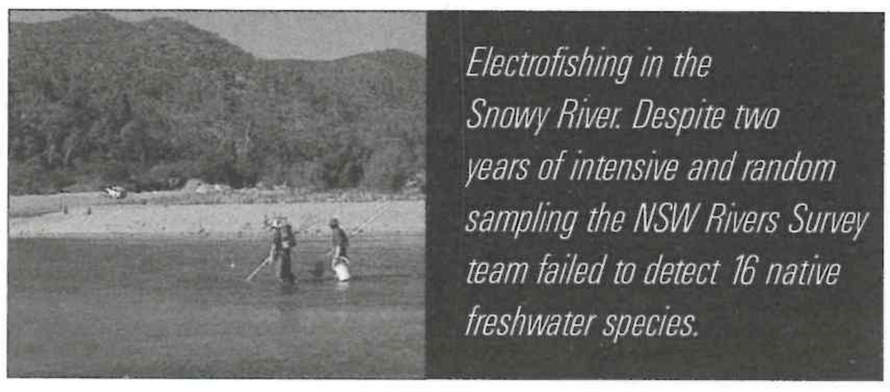
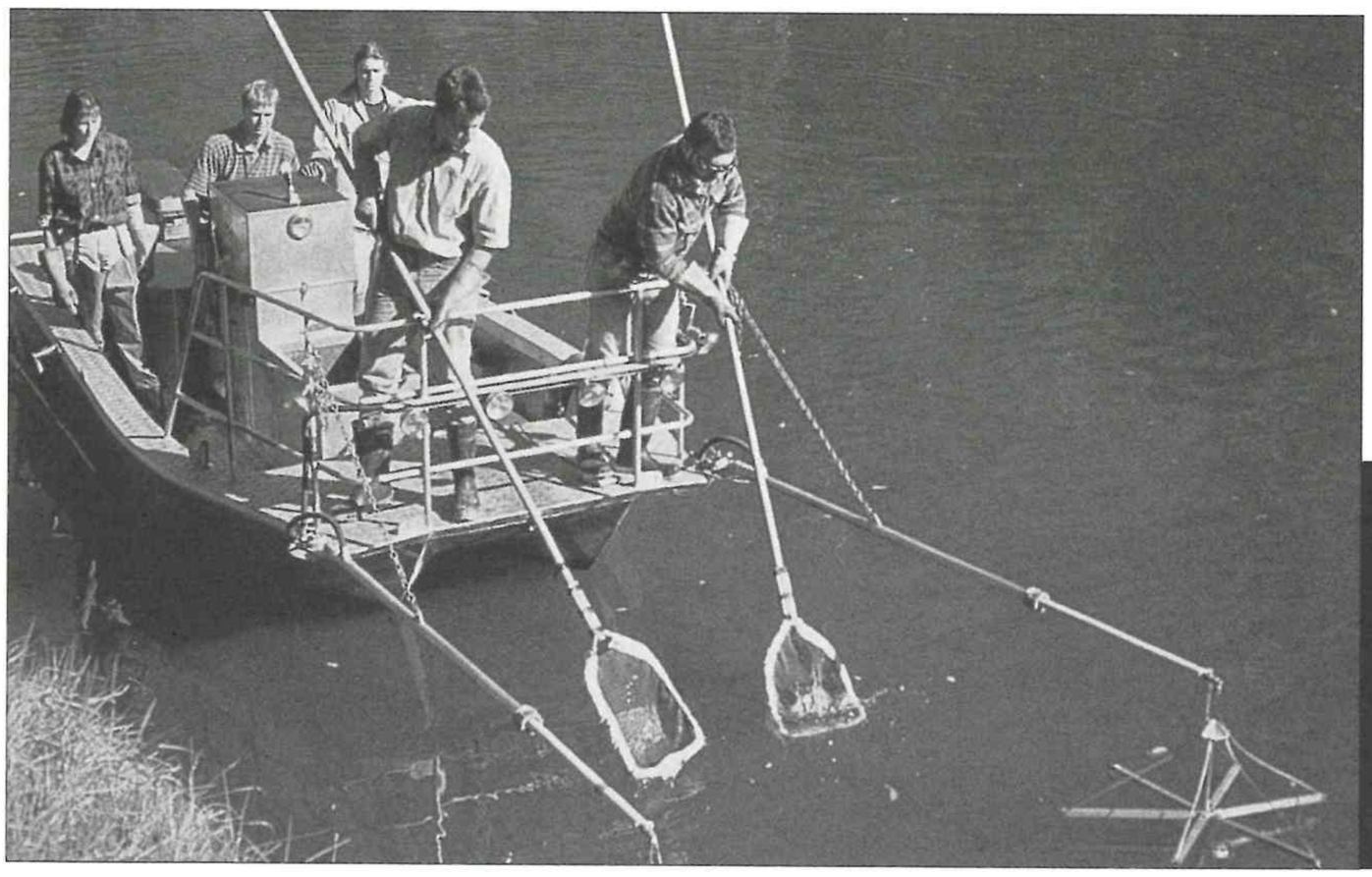


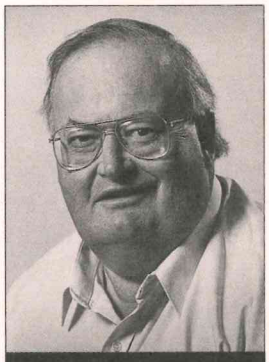
Electrofishing in the Snowy River. Despite two years of intensive and random sampling the NSW Rivers Survey team failed to detect 16 native freshwater species.



The NSW Rivers Survey team sampling freshwater fish by electrofishing. Not a single Murray cod or freshwater catfish was caught in the Murray River catchment during the two-year survey.

The CRC is a collaborative venture between:

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



Director, Prof Peter Cullen

Mortimer report – "shallow and ill-informed"

While the Mortimer Report into financial help for Australian business may have some useful ideas about setting goals and reducing duplication and red tape, the areas relating to research and development are shallow, ill-informed and deeply flawed.

This is hardly a surprise since these aspects seem outside Mortimer's terms of reference (programs to support business) and so he did not receive submissions on these topics from many of the key players. Certainly, he produces no facts or argument to support his sweeping changes, which seem designed to free up funds that can be diverted directly to business.

Mortimer recommends effective closure of the CRC Program. He proposes an 85% cut to this Program, from $150 million to $20 million. The CRCs, however, are established as seven-year legal contracts with industry. Suggesting Government walk away from such contracts hardly meets Mortimer's own plea for certainty and continuity of programs.

He believes the Program is not effective because it funds institutions rather than activities. If Mortimer had bothered to examine a CRC contract he would see the emphasis is on research activities to be undertaken rather than just funding institutions. But building capacity to do this work is also a critical part of being able to undertake technical tasks. Much of the international aid program is about building capacity; Mortimer is about shedding capacity.

Those of us in CRCs never imagined we were part of an industry support program. We thought that we were a bridge between the producers and users of research. CRCs were designed to encourage a lift in the abysmal level of industry funded research. They were developed to lift the management competence of Australian companies to make them more understanding of research so that they might become more innovative. Researchers and governments are tired of Australian industry turning its back on good research, which is then taken off-shore to be developed. CRCs were also designed to make universities more understanding of commercial realities and to encourage their interaction with industry.

Mortimer's proposal that CSIRO be required to lift its external income from the present 30% to 50% is another wild card recommendation. I believe that at least in some areas the 30% requirement has already severely limited CSIRO's capability in strategic science. This recommendation might deserve consideration had any analysis been presented of the impacts of present policies or the proposed change.

Given the problems of land and water degradation in Australia the proposal to close the Land and Water Resources Research and Development Corporation is a breathtaking burst of myopia which could only come from people who rarely venture outside the factory gate. This Corporation was set up because the agricultural research organisations controlled by growers, which Mortimer praises and supports, were not doing the longer term work to underpin agriculture and make it sustainable. The Corporation is doing work that benefits all Australians, not just the farmers. It is truly delivering a 'public good' in terms of moving to sustainable land and water management. Without this knowledge base we will not have a rural industry. We will not even have safe drinking water.

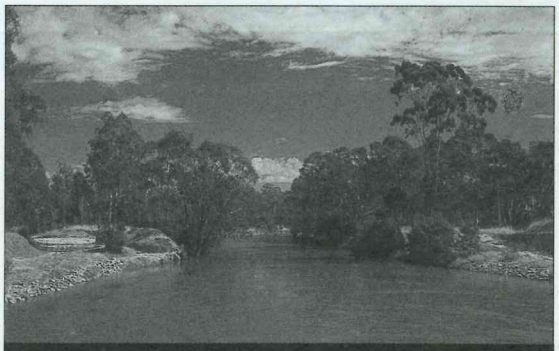
Peter Cullen

Director

CRCs were designed to encourage a lift in the abysmal level of industry funded research.

The Federation Rivers Program

A wetland on the Murray River, a national icon under stress. A recent survey of NSW fish resources revealed regulated rivers are under stress and dominated by alien fish species such as carp.



The mighty Murray River – one of Australia's highly regulated rivers.

Blue-green algae – a visual reminder of the degraded state of many of Australia's rivers.

The CRC for Freshwater Ecology has called for $50 million from the Prime Minister's new $1 billion Federation Fund to restore eight rivers back to the condition they would have been in at Federation.

Each river chosen would be a prominent symbol and identifiable as a major natural asset, according to CRCFE Director, Professor Peter Cullen.

"The project would be comprehensive and the rivers chosen would typify the range of issues and problems affecting Australian waterways," he said.

The eight rivers would provide recognised demonstration sites showing the compounding value of restoring our rivers. Restoration techniques and the environmental, social and economic benefits of river restoration, all documented with high-quality science, could then be developed, compared and demonstrated for the regional and broader community.

Depending on the needs of each river, the project would include reinstating environmental flows, renewing water quality, controlling pest species such as carp, rejuvenating riparian vegetation, rehabilitating native fish populations and stabilising catchments. Catchment and Landcare groups throughout Australia would be involved in the project.

Furthermore, the program would provide direct employment in rural areas over its proposed seven-year life. Economic activity would be stimulated through the concentration of regional employment programs and increased tourism. Australia's international standing as a leader in environmental issues would also be enhanced.

Professor Cullen pointed out that disagreements between the States about river use almost stopped Federation in 1901.

"So the Federation Rivers Project, which would span all States and Territories, has a lot of relevance to what the Government is seeking to achieve with its Federation Fund," Professor Cullen said.

"Yes, it is an ambitious project," he conceded. "But without ambition and commitment, backed up by adequate government support and sound scientific knowledge, our grandkids won't have a hope of being able to swim, fish and boat on many of Australia's rivers.

"Rivers are a vital part of our natural heritage; irreplaceable, priceless assets which play a crucial role in our nation's social, spiritual and economic well-being."

Professor Cullen pointed to the problems that now plague our rivers: conflicts over the use of water, frequent signs of environmental degradation, damaged catchments, water-quality alerts, declining natural resources and threatened biodiversity.

Our river heritage is in need of repair, Professor Cullen said.

Rivers restored to mimic their condition at Federation would be a report card on the maturity of Australia, one hundred years after the event, he said.

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examples of montane, slopes, regulated and unregulated river reaches.

Survey leader, Dr John Harris, said that as top-order consumers in the aquatic environment, fish provided a good indication of the condition of our rivers.

"If the fish are in trouble, which appears to be the case, then our rivers are in trouble," Dr Harris said. "While the survey paints a pretty grim picture, it does improve our understanding of how our rivers are faring and what actions we might take to improve the health of our waterways."

A total of 49 native fish species were sampled during the survey, including 39 freshwater and 10 estuarine species. The 39 freshwater species sampled represent only 71% of NSW's known freshwater species – leaving a staggering 16 species unaccounted for during the survey.

Dr Harris said that while these 16 species were not detected during the two-year survey other recent records had confirmed that some of these fish were still present in some NSW waterways.

"However, the fact that these species were not detected during the survey is sending us a clear message," he said. "The data we obtained confirms the status of 11 species classified as threatened. It also tells us that we need to review the conservation status of other previously abundant freshwater species, such as the catfish. Stocks of Murray cod and the short-finned eel also need to be closely monitored."

The six alien fish species sampled during the survey: the common carp, brown trout, rainbow trout, redfin perch, gambusia and goldfish made up almost 20% of the total catch.

"River regulation is having a significant impact on river species by reducing their resilience to invasion by alien species," Dr Harris said.

"The proportion of native species was much greater in unregulated rivers than it was in rivers that were heavily regulated. There were significantly more native fish found in the unregulated rivers in each of the four regions."

Right and below: Electrofishing on the Brogo River. Eighty randomly selected sites were sampled during the NSW rivers study, the most comprehensive survey of freshwater fish resources ever conducted in Australia.

The native species most affected by river regulation, according to the survey results, were western carp gudgeons, bony herring and striped gudgeons. Other species which did not appear as abundant or as wide-spread as previously predicted were the olive perchlet, the common jollytail, the crimson-spotted rainbowfish, short-finned eels, and the flyspecked hardyhead.

Significantly, carp were not found in any unregulated coastal lowland rivers, nor were they found in any of the 20 sites sampled in mountain areas. Carp densities were also much higher in inland rivers compared to coastal sites. Factors that appeared to favour high carp densities were altered flows and water temperatures, physical barriers to fish migration such as dams and weirs, as well as agricultural effects such as river sedimentation.

"Importantly, the NSW survey also points to areas needing further research if we are going to improve the health of our river systems," Dr Harris said.

"Effective ways of controlling carp and other pest species is an obvious knowledge gap, which we are currently attempting to address through other studies.

"Programs for protecting and rehab-ilitating populations of each of the 11 freshwater species recognised as being threatened with extinction are also needed.

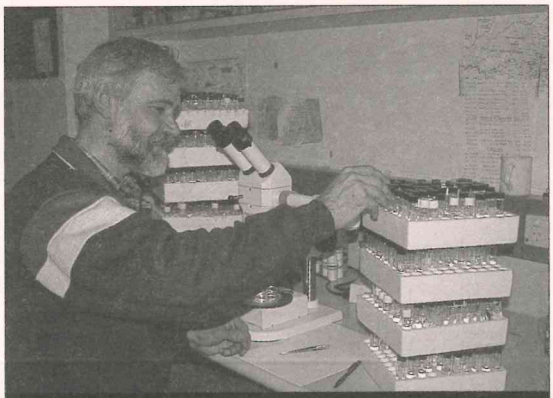
"The techniques and benefits of restoring floodplains and wetlands should be assessed and we need more inform-ation to enable us to manage the diseases which affect populations of some freshwater species."

Dr Harris also recommended that the Rivers Survey be continued so that the benefits of any river restoration programs could be assessed.

The techniques, methods and knowledge base established during the first NSW Rivers Survey provided the foundation for continued work in assessing the condition of our waterways.

30 new species for the books

While scientists throughout the world are recording declines in plant and animal diversity, one La Trobe University ecologist is busy documenting new species.



A taxing job - Dr Phil Suter has sifted through more than 20,000 insect specimens in his bid to identify and classify Australian mayflies.

After sifting through more than 20,000 insect specimens during the past year, Dr Phil Suter, a member of the Cooperative Research Centre for Freshwater Ecology, has identified 30 new species of mayflies.

His work, aimed at identifying and classifying mayflies, is part of the Federal Government's National River Health Program and is funded by the Land and Water Resources Research and Development Corporation.

Mayflies are best known to anglers as fish food. Their juvenile stage is spent in freshwaters while their short-lived adulthood is spent on the wing looking for mates.

Material for Dr Suter's taxonomic work has been gathered by river monitoring teams from more than 1,000 sites throughout Australia.

"The mayfly is one of Australia's most abundant freshwater insects, yet we know very little about its juvenile stage, even though very little of its life is spent out of the water as an adult," Dr Suter said.

"Nearly everything we've looked at has been an undescribed species. Wherever you go, you're looking at animals new to science."

Mayflies were an important part of the aquatic food chain, Dr Suter said. Located near the bottom of the chain, mayflies provide food for fish and other larger aquatic animals. Because each species has very specific habitat requirements, they are also valuable indicators of habitat quality and river health.

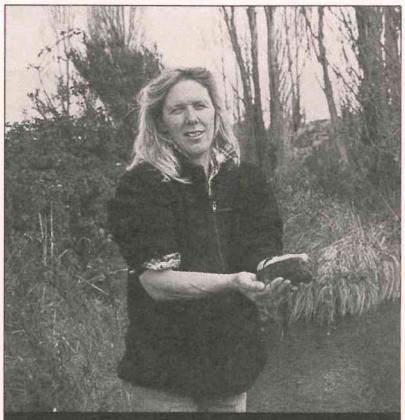
Taxonomy, or the science of identifying and classifying animals and plants, was an essential building block for all ecological work," Dr Suter said.

"If you can't identify the plants and animals you're dealing with, you have a very difficult time interpreting and explaining what is going on around you," he said.

Mayfly, Coloburiscidae

Mayfly, Baetidae

Interdisciplinary study focuses on Snowy flows



Honours student Teresa Rose is bringing together geomorphology, hydrology and ecology in a bid to assess the impacts of regulation on the Snowy River.

Assessing the impact of regulation that has reduced flow in the Snowy River downstream of Jindabyne Dam by 99 percent, is the aim of an interdisciplinary study being conducted by Teresa Rose, an Honours student at the University of Canberra.

Teresa is bringing together the sciences of geomorphology (channel structure and change) and hydrology with that of ecology in a bid to understand how the Snowy River has responded to substantially reduced flows in its downstream reaches.

In addition to assessing what is happening in the river today, Teresa will assess what has happened in the river in the past. She is using aerial photographs, historical cross-sections and flow data to help her piece together the jigsaw of a river before and after regulation.

Riverbed sediments are being analysed to determine changes in the physical characteristics of the riverbed. Teresa is also drawing on biological monitoring work conducted by the CRC for Freshwater Ecology for the National River Health Program. She is using the AUSRIVAS (first national assessment of river health) predictive model to assess the impacts of the dam on the Snowy River both now and in the past.

It is the first time the AUSRIVAS model, which uses macroinvertebrates as biomonitoring tools, has been used to help estimate the historical condition of a waterway. By using AUSRIVAS, Teresa hopes to quantify the changes in the availability as well as the quality of macroinvertebrate habitat as a consequence of flow regulation. Macroinvertebrates form an important part of the river ecosystem: processing organic material and providing food for fish.

"In 1962 the Local Government Act allocated 49ML/day of water for the downstream Snowy," Teresa said. "These flows were deemed sufficient for riparian use, that is the needs of the landholders. The needs of the river did not enter into the equation.

"The river is hardly flowing in places. It's more like a lentic (lake) environment. In places, the river channel has adjusted to the low flow conditions."

Permanent sandbars and willows have now invaded long stretches of the river bank, changing the habitat and nutrients available to the aquatic invertebrates.

Changing flow regimes can significantly alter the physical structure of a river, Teresa explained. This is because the discharge of water as well as the transport of sediment determines the way a channel is formed. Channel structure in turn influences aquatic vegetation which, by providing habitat, influences the in-stream fauna present.

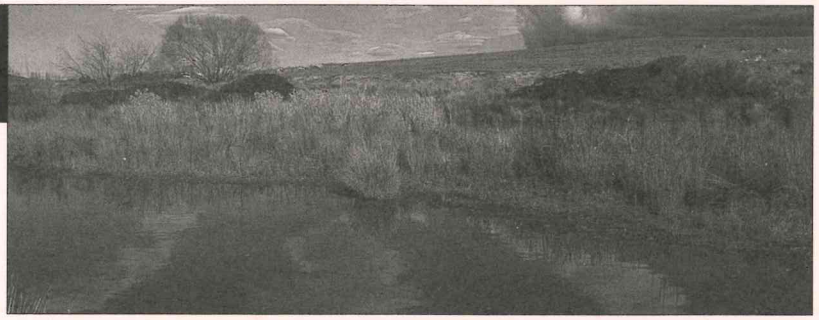
"If we can benchmark what is happening now and what has happened in the past, we may be able to assess what may happen in the future if given more flows," Teresa said.

The study, expected to be completed by the end of this year, will provide another scientific perspective on the calls for increased flows to the Snowy River.

It also promises to shed light on the ecological processes in an Australian upland, gravel bed stream.

Teresa's study, *Impact of flow regulation in a gravel bed river: case study of macroinvertebrates and their habitats in the Snowy River, Australia,* is being supervised by two CRC for Freshwater Ecology researchers, geomorphologist, Dr Martin Thoms and Assoc Prof Richard Norris, who has developed the AUSRIVAS predictive model. She is supported by funding from the NSW Environment Protection Agency.

The Snowy River downstream of Jindabyne Dam – 'more like a lake environment than a flowing stream'.



Managing 'unmanageable' rivers

A 3km stretch of the Bell River near Wellington is perhaps the most expensive river real estate in NSW, says Dr Martin Thoms, a geomorphologist with the CRC for Freshwater Ecology and the University of Canberra.

The highly dynamic Bell River has changed its course over the floodplain during the past 120 years.

In calling for a more interdisciplinary approach to river management, Dr Thoms, pointed to the planning mistakes made on the Bell River which have cost the Wellington Shire more than $2 million since 1965.

The Bell River is one of those Australian rivers often labelled 'unmanageable' because of its highly variable physical characteristics, says Dr Thoms whose studies during the past five years have focused on river channel structure and changes.

"There are many rivers in Australia that are quite dynamic in a physical sense because they're always expanding and contracting their channel dimensions, Dr Thoms explained.

"During extended periods of drought, the size of the river channel will contract quite considerably, but during flood-dominated periods the river channel will increase its dimensions to accommodate this new regime.

"Over the last 100 or 120 years, the Bell River has changed naturally from one part of the floodplain to another."

This has had a series of implications for the residents of Wellington Shire who, during the drought-dominated regime, built homes and other infrastructure on river banks. Now that the system has reverted to a flood-dominated regime, the river is attacking its banks as it expands to accommodate the new regime. Houses are under threat and roads have been blocked off.

Called in by Wellington Shire to advise on management options for the Bell, Dr Thoms undertook a geomorphic study to investigate the river's hydrology and energy and how that had changed during the past 120 years. Historical data including old maps and aerial photographs were gathered as evidence and combined with current river models. Sediment cores were taken from the floodplain and process studies were conducted to examine sediment transport.

"Legislative change was the most obvious way forward in managing the 'erosion problem' created by the highly dynamic Bell River, Dr Thoms said. Changing zoning regulations to prevent development on a wide buffer strip would save property such as houses from being undermined by a travelling river channel.

"River restoration, Dr Thoms said, required a stronger multidisciplinary focus, particularly when dealing with highly dynamic rivers. Such an approach has been adopted by Teresa Rose, an Honours student from the University of Canberra, being supervised by Dr Thoms. (See article on page 6).

"Rivers could also be characterised in terms of process and physical behaviour, Dr Thoms said, providing useful planning information.

In the Border Rivers, for example, five main processes were identified:

1. a zone dominated by large pools separated by bedrock rifles;
2. a gorge where the channel was constrained by surrounding geology;
3. small floodplains with stable riverbeds comprised of big boulders on top of a layer of smaller intermeshed boulders;
4. mobile zone with high level floodrunners and a dynamic in-channel structure; and an
5. anabranch zone.

"These processes can be very important in terms of planning," Dr Thoms said. "You'd never, for example, let anyone build on a river bank within a mobile zone because you know the channel is going to change course. An armoured area, however, would be quite a good spot to locate infrastructure such as bridge supports because of its stability."

Dr Thoms said that there was potential to use river characterisation in conjunction with biological monitoring tools, such as the AUSRIVAS protocol developed by the National River Health Program to assess river health throughout Australia using macroinvertebrates.

"Geomorphology had long taken a back seat to river engineering", Dr Thoms said. Used within an interdisciplinary approach, however, it could bring us to a much greater understanding of the nature and behaviour of our rivers, perhaps enough to allow us to manage these "unmanageable" rivers.

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River turbidity

As a measure of catchment disturbance

Carefully planned and placed roads within logged forests would significantly reduce the risk of roadside soil slips and improve water quality in adjacent waterways, a cooperative study by Melbourne water researchers has found.

The project, *River turbidity and catchment condition*, was aimed at developing a water turbidity predictive model based on data obtained from a network of automatic turbidity meters and a range of catchment variables.

The research team has produced guidelines for monitoring stream turbidity. It also found that it was possible to use turbidity, which has the advantages of being simple and inexpensive to measure, as a surrogate for suspended solids concentration and total phosphorus in many Australian waterways.

With funding provided by the Land and Water Resources Research and Development Corporation, the research team also tested the extent to which runoff and catchment factors such as land use, vegetation cover, geology, soil type and erosion potential affected river turbidity.

The collaborative work was conducted by Prof Barry Hart from the Cooperative Research Centre (CRC) for Freshwater Ecology and Assoc Prof Brian Finlayson, Dr Chris Gippel and Mr Tarek Sadek, all from the CRC for Catchment Hydrology and based at the University of Melbourne.

Tarek Sadek taking a turbidity measurement at Traralgon Creek.

The work was conducted over four years in the Traralgon Creek and La Trobe River catchments in south-east Victoria.

"This work has shown that catchment managers could potentially use turbidity as a tool to determine sources of water pollution", Prof Hart, also the Director of the Water Studies Centre at Monash University, said.

"Turbidity is basically the muddy appearance that water has when there are fine silts and clay-sized particles suspended in it," he explained. "It can also be regarded as an index of catchment and waterway condition. This is because turbidity is closely associated with slope and bank erosion, underwater light conditions, nutrient and contaminant transport and the visual appearance of the water."

"While turbidity was regularly measured during water quality monitoring programs, the frequency of measurement and the catchment area covered were not capable of pinpointing storm events or distinguishing between point and diffuse sources of pollution", Prof Hart said.

The project included: investigating the effectiveness of methods used to measure turbidity; establishing turbidity monitoring stations in an experimental catchment; and modelling the relationships between turbidity and catchment condition.

Laboratory and field studies were conducted to determine the best practice for establishing a turbidity monitoring network, and to determine the relationship between turbidity and variables such as suspended solids concentration and total phosphorus concentration.

Continuously recording turbidity sensors were located within the Traralgon Creek at 10 sites that reflected different types of land use, vegetation cover and geology. Small, remote and discretely-placed instruments were used to overcome problems of vandalism as well as floods.

Nevetheless, it was necessary to visit the field sites at least once a fortnight to ensure that good quality data was obtained.

"The modelling exercise, using a GIS as well as a flood event estimation model, enabled us to draw strong correlations between catchment land use and turbidity," Prof Hart said.

"The results showed that unsealed roads and landslides in forested catchments had a significant impact on stream turbidity and suspended sediment," Prof Hart said.

"Turbidity was also much higher in disturbed catchments during storm events than in undisturbed catchments. In fact the estimated sediment loads from storm runoff in disturbed catchments was between 10 and 100 times greater than that from undisturbed catchments."

"Agricultural activities also produced higher turbidity than runoff from undisturbed land", Prof Hart said. A marginal increase in turbidity was noted in runoff from the Traralgon urban area.

"While the study provided excellent site specific information as well as an understanding of catchment processes, the models developed were, at this stage, too time consuming and complex to be generally adopted as catchment management tools," Prof Hart said.

The models do, however, graphically demonstrate to catchment stakeholders the major sources of contaminants that pollute our rivers.

Further work is being undertaken to refine these models.

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