RIPRAP

LWRRDC'S RIPARIAN LANDS MANAGEMENT NEWSLETTER

Patricia

Monitoring and Evaluation

Monitoring and evaluation strategies are essential components of any riparian or river rehabilitation project. Evaluation is the best way to improve our knowledge about what works, what doesn't and how we can best direct our rehabilitation efforts. Monitoring is a process of continuous evaluation, where measurements and assessments are made before, during and after a project. This means that the project can be adjusted and improved as it goes along. Monitoring strategies are key components of the overall evaluation process that allows you and others to learn from the project and discover whether your rehabilitation aims have been met. Given that monitoring and evaluation strategies are so useful and important, why then, are they so rare?

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CONtents

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LWRRDC's mission is to provide national leadership in utilising R&D to improve the long-term productive capacity, sustainable use, management and conservation of Australia's land, water and vegetation resources. The Corporation will establish directed, integrated and focused programs where there is clear justification for additional public funding to expand or enhance the contribution of R&D to sustainable management of natural resources.

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RIPArian lands:

WHERE LAND AND WATER MEET

From the Editor

Monitoring and evaluation is a vital part of any rehabilitation or management project. It is for this reason that this edition of *RipRap* is focusing on understanding what monitoring and evaluation involves; how you can incorporate monitoring and evaluation into your rehabilitation project; and, what techniques are being used across the country to monitor and evaluate the impact of rehabilitation work in rivers and riparian zones.

The theme piece of *RipRap* provides an overview of the different levels of evaluation you can use to assess the impact of rehabilitation works, as well as the key features that need to be incorporated into a robust monitoring and evaluation framework. Findings from the National Land & Water Resources Audit outline where work on riparian condition assessment is at in Australia, and makes some recommendations about how we can improve our current situation. A case study from Jervis Bay shows how one group is trying to monitor the cumulative impacts of rehabilitation works, rather than focusing on single aspects or indicators of change.

And, finally, It's a Wrap provides an overview of what is happening in each state and territory in the area of monitoring and evaluation. Plenty of reading — so get to it!!

MONITORING and Evaluation

(continued from page 1)

Modified from Rutherfurd et al. *A Rehabilitation Manual for Australian Streams* vol. 1, pp. 164–73.

In recent times, there has been a growing level of awareness about the need to incorporate monitoring and evaluation strategies into any riparian or river rehabilitation project. This awareness is as a result of people starting to ask questions about whether their rehabilitation efforts are actually achieving anything. For example, are there really more fish? Is there better water quality? Has erosion decreased as a result of rehabilitation efforts? Without monitoring and evaluation strategies in place before, during and after a rehabilitation project, these questions cannot be answered.

Evaluation ensures that you, funding agencies and the public, will know if the rehabilitation project has achieved its aims. Monitoring (continuous evaluation) means the project can be adjusted and improved as it goes along, thereby protecting the rehabilitation effort. Without evaluation, a lot of time and money can be spent using techniques that a simple evaluation could have shown to be unsuitable for that application.

So why, then, are many rehabilitation projects being undertaken in Australia without monitoring and evaluation strategies in place? There are two main reasons, firstly, natural systems are complex, and they are also often slow to respond to change — this means that evaluation can be difficult, slow and expensive. Secondly, the agencies that fund projects can't usually wait the years it can take to get results from evaluation, or commit money to such a drawn-out process.

Given these problems what should those undertaking rehabilitation projects do about evaluation? All projects should be evaluated in some way, but the key point to emphasise is that there are **different levels of evaluation**. Not all projects need to be major scientific experiments. The level of evaluation that you require depends first upon how confident you are that what you have done will work, and second, who you want to convince that your project has worked. You need to decide on the level of evaluation at the start of the project and remain committed to it for a few years.

In the table below, five different levels of evaluation are described that correspond to awards ranging from plastic through to gold medal, indicating the level of confidence the proposed evaluation techniques can provide the group undertaking the rehabilitation exercise.

Evaluation level	Description	Example	Level of confidence
1. Plastic Medal	Unreplicated, uncontrolled, anecdotal observation after rehabilitation	"I saw lots of platypus after we had done the work"	Very low
2. Tin Medal	Unreplicated, uncontrolled, sampling after rehabilitation	"There was a gradual increase in the number of platypus in the two years after the work"	Low
3. Bronze Medal	Unreplicated, uncontrolled, sampling before and after rehabilitation; OR Unreplicated, controlled, sampling after rehabilitation	"There were more platypus after the work than before" OR "After rehabilitation there were more platypus in the control reach than in the treated reach"	Moderate
4. Silver Medal	Unreplicated, controlled, sampling before and after rehabilitation	"The number of platypus increased after rehabilitation in the treated reach, but not in the control reach"	High
5. Gold Medal	Replicated sampling, replicated controls, sampling before and after rehabilitation	"The increase in the number of platypus in the treated reach was greater than any increase at either control reach"	Very high

Source: Rutherfurd, I., Jerie, K. and Marsh, N., 2000. *A Rehabilitation Manual for Australian Streams.* CRC for Catchment Hydrology and Land & Water Resources R&D Corporation. 1: 171.

MONITORING and evaluation

These levels of evaluation are based on the following set of features — you do not have to include all, or even any of the features outlined, however, you should be aware that including or excluding these elements will have an impact on the confidence you have in your evaluation.

1. **Sample before and after rehabilitation**

   This is the main way to tell if your rehabilitation really caused a difference to the stream. You have to know what was there before to see if there is any difference after.

2. **Include a control site**

   A control is a site that is as similar as possible to where you do your rehabilitation, but is not influenced by your rehabilitation. By comparing the two sites, you can check that any changes you see at the rehabilitation site are the results of your work, rather than because of some stream-wide changes that would have happened anyway. Having a control site is possibly the most important aspect of your evaluation.

3. **Replicate the rehabilitation techniques**

   Replication means having multiple sites that you use as control, and multiple sites that you rehabilitate. At first glance, this seems quite excessive, but replicates can be important if you want to apply the results of the evaluation to other riparian/river sites with a high level of confidence.

4. **Consider how big an effect you expect**

   If you are expecting the results of your rehabilitation work in the stream to be startling and obvious, then you may not require a subtle evaluation strategy and opt for a crude bronze medal design. However, if the effect is expected to be less dramatic, for example ten fish before and fifteen after, then the more detailed gold medal design, using a control site, would be needed to ensure that was a real increase in fish numbers, rather than a chance variation.

5. **Who is your evaluation audience?**

   The complexity of your evaluation depends not only on what would convince you, but also on what would convince others that your rehabilitation efforts have met their objectives. For example, your evaluation audience may be a funding agency, a local landholder, a journalist or a geomorphologist — each of these groups may require the information gained through evaluation presented in a different way.

6. **Assess whether you have the resources available to support your evaluation**

   Evaluation can be time consuming and expensive, particularly if you are using a high level design. It can be difficult to obtain sufficient funding to support a long evaluation, and to keep the money safely stored away for work that must be done in eight or ten years. You should always keep in mind that the evaluation of biological, physical or social outcomes may well be a long-term project!

MONITORING and evaluation

What should be included in an evaluation plan?

Once you have decided what type of objectives you will evaluate, and the level of evaluation you will use, you then need to work out the detail of the evaluation plan. An elegant evaluation can be cheap, efficient and convincing. Furthermore, a well-designed evaluation may be able to tell you not only if your project succeeded or failed, but also the reason for that success or failure. In working out the detail of your evaluation plan, the following six issues need to be considered.

What should you measure?

As a minimum, your evaluation needs to indicate if you have met the objectives of your project. Thus, you have to measure anything that is related to those objectives. For example, if you proposed to increase numbers of certain fish species by adding woody debris to the stream, then you need to monitor the numbers of those fish. A good evaluation will go further than this and also tell you why you have succeeded or failed. To work out why a change occurred in the stream, you must measure not only elements directly related to your objectives, but also the stream elements that caused the change.

How frequently should you measure?

Many groups are monitoring without knowing how the information they are gathering relates to overall project objectives. This is a waste of time and money. There are two possible sampling strategies that can be used:

(i) sample at regular intervals which will show up trends and variation in the data. This is good for things that respond slowly but steadily to your rehabilitation, such as fish populations.

(ii) Sample after any flood events greater than a certain size. This strategy is appropriate for projects that involve structures that are really tested only during high flows, such as log weirs.

What is your evaluation timeframe?

Ideally, you should monitor until the riparian zone/stream has responded in full to the rehabilitation project. It can be difficult to know how long this will be. For ideas on suitable monitoring periods, it is best to look at what other people have found sufficient in similar systems.

Who will take the measurements?

For evaluation to be worthwhile it is important that you can trust your results. The people responsible for the evaluation must have the necessary expertise to use the chosen techniques, as well as being persistent and objective as they undertake the monitoring required.

How will you record the results?

It is very important to have a standard recording sheet for data collection, especially during field-work. Without one it becomes very easy to forget to take some measurements at the end of a long day. A standard recording sheet also makes collating the results easier.

How will you analyse the information?

For the simpler types of evaluation, the analysis of results will be fairly straightforward — a matter of comparing photographs or plans of an instream structure with surveys of the structure. However, for silver and gold medal evaluations of physical or biological effects, analysis may be a lot trickier. In fact, it may involve some form of statistical analysis. In such cases, it is vitally important to have considered the analysis at the planning stage of your evaluation, as many statistical techniques are restricted in the sorts of data they can handle.

To check that you have designed an evaluation appropriate to your needs, ask yourself these questions:

- Do you want to evaluate the completion of the project (outputs), or the influence of the project on the physical or biological character of the stream (outcomes)?
- Will the level of evaluation design convince the people that you want to convince about the success or failure of the project?
- Have you worked out the details of your evaluation plan? (What you will measure, how frequently and for how long you should measure it, who will measure it, how they will record the measurements, and how you will analyse the results?)
- Will your evaluation tell you why the project succeeded or failed?

MONITORING and evaluation

Summary

In summary, monitoring and evaluation strategies are essential components of any riparian or stream rehabilitation plan. Without an evaluation plan you will never know if your project was worthwhile, and you will never learn how to improve your techniques. The information provided here shows that evaluation need not be difficult, and that we are getting better at working out the different types of evaluation strategies that can be used according to project objectives.

The need to improve our understanding and implementation of monitoring and evaluation techniques has been recognised as a priority for the second phase of LWRRDC's National Riparian Lands R&D Program. This decision was based on discussions with agencies and catchment groups, who identified the need for simple but effective monitoring techniques to enable the evaluation of riparian and river rehabilitation projects. These techniques will need to include geomorphic, ecological, and socioeconomic aspects of the projects. The aim of the work undertaken in phase two will be to test and further refine existing and new techniques across a range of sites, in collaboration with agency and catchment group personnel. The time frame for this work will be five years, and we will keep *RipRap* readers up to date with developments!

Further information

If you would like further information on anything discussed in this article please refer to Volume One, *Step Ten* and Volume Two, *Evaluation Tools of A Rehabilitation Manual for Australian Streams* by Ian Rutherfurd, Kathryn Jerie and Nick Marsh. Both these volumes are available on the www.rivers.gov.au website, as well as being available in hard copy for $25.00 from the Agriculture, Fisheries, Forestry – Australia shopfront on 1800 020 157.

What is AUSRIVAS?

AUSRIVAS stands for the Australian River Assessment System and provides a platform upon which a standard national approach to water quality assessment can be based. It allows water managers to compare the condition of streams and rivers both within and between states and territories.

AUSRIVAS uses macroinvertebrates as the key to monitoring river health. Macroinvertebrates, by their presence or absence, tell us a lot about the condition of our waterways. While the physical and chemical tests traditionally used to test water quality will tell us about a stream's current condition, macroinvertebrates provide an overview of the conditions that have prevailed over weeks, even months — they are living organisms that provide a direct measure of health.

AUSRIVAS has developed a national protocol for the sampling, identification and sorting procedures used to collate data about macroinvertebrates. Standard codes have also been developed for taxa, and this facilitates the sharing of data and collaboration among agencies. It is a flexible monitoring technique that enables managers to assess a specific river site or a whole catchment. It identifies a number of reference sites, or near pristine sites, where invertebrates and the physical and chemical properties are sampled. Each state or territory has a nominated agency responsible for site selecion and sampling.

Data collected from sampling is fed into the AUSRIVAS model that expresses outputs as a ratio: the number and type of animals found at the test site compared to the number and types of animals that were expected. Interpreting these ratios is simple and easy to apply to management decision-making, and uses four bands that categorise the degree of disturbance at a particular site.

AUSRIVAS is managed from a central site through the National River Health Program, with all agencies having access to the software via the internet. It is planned that AUSRIVAS be made widely available to consulting firms, schools, universities and community groups, representing a great leap forward in our ability to assess the condition of our rivers throughout Australia.

For further information

Check out the website www.ausrivas.canberra.edu.au
article modified from *Rivers for the Future*, Issue 8, 1999, pp. 12–13.
Back issues available by contacting LWRRDC.

ASSESSING Australian riparian vegetation
Findings, recommendations and pragmatic approaches

By Jim Tait

The National Land and Water Resources Audit

The National Land and Water Resources Audit (Audit) is a five year program of the Natural Heritage Trust that has been tasked to provide data, analysis and appraisal to facilitate improved natural resource decision making. The primary focus of the Audit is in the natural resource management (NRM) information needs of Commonwealth, state and territory agencies. The activities of the Audit have been structured within seven key themes, one of which is 'Ecosystem Health'.

The Ecosystem Health theme includes five Australia-wide projects that are assessing the condition of Australia's landscapes, catchments, surface water quality, rivers (see associated article on River Assessment, page 11) and estuaries. Recognition of the process based linkages between these systems and how this drives 'condition', is a key feature of the data analyses and assessment methodology being used across these projects.

Focus on riparian vegetation

The extent and condition of riparian vegetation is thought to play a particularly important role in the biophysical processes that maintain the conditional stability of catchments and the ecological health of their aquatic environments. Consequently, data on the extent and condition of riparian vegetation provides important information for the assessment of the environmental condition of catchments, rivers and estuaries and for strategic planning of catchment based NRM initiatives such as revegetation, weed control, bank stabilisation, habitat protection and monitoring.

It is also recognised that an ability to assess trends in the status of riparian zone vegetation would allow NRM agencies to assess the effectiveness of existing policy or management regimes, including investment in community based NRM programs such as the Natural Heritage Trust. In the past two decades, the Natural Heritage Trust, and its predecessor the National Landcare Program, have sponsored riparian vegetation management initiatives across Australia. In many instances, the ability to assess the strategic merits of sites chosen for on-ground works and their long-term contribution to the improvement of riparian vegetation condition and extent, has been limited by the availability of appropriate scale riparian vegetation mapping and data collection.

At a more detailed level, monitoring activity in the riparian zone can include a plethora of physico-chemical and biological data that combine to support environmental assessment processes. The extent and condition of riparian vegetation is recognised to be a key driver for many instream processes and, as a result, often makes a robust surrogate for the collection of such data. Alternatively, it can provide an appropriate spatial framework for stratifying the collection and analyses of physico-chemical and biological data to further our understanding of linkages between riparian vegetation and its functional roles in water quality management, channel morphology / stability and, habitat provision / biodiversity maintenance.

For these reasons, developing a capacity to measure and relate management mediated changes in riparian vegetation condition, with improvements in monitored physico-chemical and biological data, would be particularly valuable and powerful in serving catchment management initiatives.

Audit riparian vegetation scoping study

Based on the identified need for comparable riparian vegetation data nationally, a 'Riparian Vegetation Scoping Study' (download report from http://www.nlwra.gov.au) was funded within the Audit Ecosystem Health Theme. This project assessed the national availability of riparian vegetation data and scoped methodological options to collect data for areas where it does not currently exist, or is unsuitable for supporting national-scale ecosystem health assessment.

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National Land & Water Resources Audit

The main project findings from this work have been summarised in Table 1 against each state and territory. Overall, the project found that:

- Most existing vegetation maps are at a scale (1:100,000 – 1:250,000) that is too coarse to define riparian vegetation.
- Vegetation mapping approaches vary significantly between jurisdictions and between agencies depending upon the purpose for which it is intended.
- At a national level there has been limited riparian specific vegetation mapping.
- There is no standard method for defining riparian vegetation among Australia's states and territories.
- Where riparian vegetation is defined the methods vary greatly between jurisdictions and include floristic and structural boundaries, arbitrary corridor widths and the use of geomorphic or landform definitions.
- The diversity of methods used and agencies involved in riparian vegetation mapping is also reflected by the range of data custodians, although data is increasingly (but not always) being stored digitally within a GIS.
- Classification systems usually include floristics and structural attributes, but seldom condition descriptors except for project specific cases.
- Coverage of riparian vegetation mapping (specifically) and vegetation mapping (generally) vary significantly between jurisdictions.
- Some states, that is, Qld, SA, TAS, VIC and some areas for example, inland NSW floodplains / the MDB, are relatively well served in terms of riparian vegetation coverage.
- Even where there riparian vegetation mapping exists at an appropriate scale, the attributes recorded and classifications systems used vary greatly and limit its application for supporting comparable Australian-wide assessments.

As Table 1 and the points above show, the project found that there is insufficient existing riparian vegetation data to support national scale assessments. In addition, the data that is available is highly variable in terms of format, scale, recorded attributes and usefulness for assessment of condition or management purposes.

The report concluded by providing a fully-costed proposal for national mapping of riparian vegetation extent and condition data, as well as providing a series of recommendations which sought to produce nationally comparable riparian vegetation mapping. These recommendations are outlined below:

Geomorphic definition

- A geomorphic definition was recommended for defining the riparian zone (and hence the boundary of riparian vegetation) as equivalent to the extent of the floodplain /alluvial terraces. In the absence of floodplain development ie, upland areas with a combined structural floristic definition was proposed. This approach is seen to offer promise in terms of uniformity of definition.

Variable scale related to land-use intensity and management priority

- 1:25,000 is the largest scale suitable for accurate riparian vegetation mapping and capable of serving management purposes. Finer scale (1:10,000 – 1:5,000) has advantages but is inappropriate for regional mapping.
- For Australia's Intensive Land-use Zone (ILZ), see map on page 12, it is recommended that 1:25,000 scale mapping be used for locally or state defined priority areas with 1:100,000 scale mapping used for remaining lower priority areas. Suggested that lower priority areas include existing protected areas, that is, National Parks.
- For Australia's more Extensive Land-use Zone (ELZ) 1:250,000 mapping is recommended for broad scale applications with priority areas (identified by states and territories) to be mapped at 1:100,000. Broad scale mapping recommended for ELZ is based on perceptions of (i) less pressures, (ii) slower rates of change and (iii) less government and community resources available to be expended.

Data source

- Aerial photographs at 1:25,000 scale and less than five years old are required for mapping priority riparian management areas. Where vegetation mapping requirements are at 1:100,000 scale or greater, LANDSAT data was identified as being most appropriate due to currency, continental coverage and relative cost.

Table 1: Summary of riparian vegetation mapping status per state and territory

State / territory	Definition of riparian vegetation	Specific riparian vegetation mapping	Classification method	Mapping scale and map scale	Condition assessment	Coverage
ACT	No standard, usually not defined in vegetation mapping	Yes, for limited number of river sites	Dominant species and limited structural information	1:5000 – 1:10,000 Most vegetation mapping >1:100000	Not explicitly	Selected river systems ie, Murrumbidgee and Molonglo. Currently combining available information into common attribute coverage.
NSW	No standard geomorphic definition has been used for several projects. Another approach used involves standard 10–20m strip	Most mapping too coarse a scale to define riparian vegetation though there is a large number of site and project specific riparian vegetation maps, particularly inland floodplains.	Up to eight different approaches for terrestrial vegetation usually both structurel and floristics	1:25,000 Most vegetation mapping 1:100,000 – 1:250,000	Not commonly, some project specific	Limited area of the state. Good coverage of inland floodplains. Limited uniformity. Multiple custodians.
NT	Distinct floristic 'bands'	No	Structural and floristic	Most vegetation mapping 1:1000000	No	Virtually non-existent. ERISS have mapped Magela Creek floodplain
QLD	Association with landform and floristics.	Yes, but only along with surrounding vegetation where definable at mapping scale	Structure, floristics and landform attributes	1:25,000 – 1:80,000 Most vegetation mapping 1:100,000	Not commonly, some project specific coverages include disturbance and weediness	~50% of the state mainly coarse scale
SA	Floristic or structural 'bands'	Yes	Floristics and sub-association and sometimes environmental attributes	1: 10,000 – 1: 20,000 Existing maps 1:20,000 – 1:40,000	Yes, mainly as part of water course condition assessment includes degree and type of modification and ratio exotic: native species	Most of the state Multiple custodians
TAS	Where obvious boundaries can be defined on aerial photography	Yes, filling in gaps left by RFA 'forest' mapping but mapped at relatively coarse scale	Extent only recorded, not floristics	1:42,000 to produce maps at 1:25,000	Weeds distinguished	Currently being completed although riparian vegetation defined at relatively coarse scale.
VIC	Floristic community or ecological vegetation class. Where can be defined from adjacent vegetation, or modelled on topographic features.	No specific mapping, has occurred as part of larger scale surveys therefore only where definable	Number of classification methods dependent upon purposes usually structure and floristics	1:25,000 – 1:40,000 Most existing maps 1:100,000 with selected areas at 1:25,000	Not mapped. Data has been collected as part of other programs such as Index of stream condition.	~85% of the state Level of detail and riparian definition highly variable. Floodplain and high altitude riparian systems poorly sampled.
WA	Structural or floristic distinctions	Done opportunistically but uses standard format	Structure and floristics	1:20,000 (aerial photos) – 1:100,000 satellite images dependent upon scale of riparian corridor. Most existing maps 1:100,000	Yes for some specific areas.	Only south-west agricultural area. Generally only at coarse scale.
Murray-**D**arling **B**asin **C**omm.	Topographic (floodplain) and flooding frequency boundaries or arbitrarily ie, 'outer extent contiguous riparian vegetation'	Yes	Digitally (>20% crown cover) and manually plus dominant floristics, growth form and density classes	~1:100,000 LANDSAT supported by aerial photos 1:25,000. Maps produced at 1:50,000	Degraded areas (weeds, altered flooding regimes, poor regeneration areas) identified and mapped.	Entire MDB. Standard methodology.

Single hierarchal classification scheme

- Requirement for adoption of single classification scheme reproducible across space and time for extracting floristic and structural information from aerial photography and satellite imagery.
- Recommended that hierarchal classification scheme being developed as part of the Audit's Theme 3 National Vegetation Information System (NVIS, for further information see http://www.nlwra.gov.au) be used. Allows for the collection of different levels of information dependent upon the scale at which the information needs to be used. Suggested hierarchal classification framework for ELZ and ILZ (see Table 2).
- Edge mapping across jurisdictions was seen to be important for comparability particularly where basins lie across state and territory borders.

Use of regionalisations

- The use and development of appropriate regionalisations possibly including: catchments, drainage regions, drainage divisions, Bioregions, provinces or climatic zones, as well as the ILZ / ELZ definitions referred to above, is seen as essential to support aggregated and stratified riparian condition assessments.

Condition attributes

- To be able to assess and track the condition of riparian vegetation within priority management areas, recorded structural and floristic attributes need to have sufficient resolution to identify weediness and structural changes associated with disturbance.
- Recognising that threatening or ameliorative processes operating upon riparian vegetation can often exist external to the vegetation itself, it has also been recommended that condition mapping frameworks record the extent of such phenomena including: presence / absence of stock fencing / stock access, fire regime, groundwater hydrology / waterlogging and salinisation.

Linkages to fundamental data sets and other indicator programs

- There are a range of other riparian zone monitoring and evaluation programs pursued by NRM agencies in addition to riparian vegetation mapping per se'. To obtain the emergent monitoring, evaluation and management benefits that may be derived from good riparian vegetation mapping, linkages need to be established (via GIS spatial data protocols) with fundamental data sets and other indicator databases. These include, for example, land tenure, surface water quality and flow, groundwater monitoring and other programs such as AUSRIVAS, Wildrivers and Victoria's Index of Stream Condition.

Data management

- Metadata standards, including clear reference to scale, source and date of imagery be used to develop national data sets and support reliability layer definitions on produced maps. Other needs in the data arena include fewer custodians and capacity for standard data transfer protocols.

These recommendations, if implemented, would have two main benefits. Firstly, the riparian vegetation mapping approach suggested above would provide national coverage, and, secondly, it would be scalable through the use of the NVIS hierarchal classification scheme allowing areas of management priority and interest to be mapped at appropriate scales. The cost, estimated in conjunction with state and territory agencies for achieving a national riparian vegetation mapping coverage using this scheme, was approximately $9.6 million. (For the full report and discussion, down load the report from the Audit website.)

Table 2: Recommended scale for riparian vegetation mapping in relation to land use zone and management priority

Land-use zone and riparian management priority	NVIS classification level	Map scale	Data source
ELZ low priority	Vegetation class	1:250,000	LANDSAT
ELZ high priority / ILZ low priority	Formation	1:100,000	LANDSAT
ELZ higher priority / ILZ low priority	Sub-formation	1:100,000	LANDSAT / aerial photography
ILZ high priority	Association	1:25,000	aerial photography
ILZ locally high priority	Sub-association	1:25,000 +	aerial photography

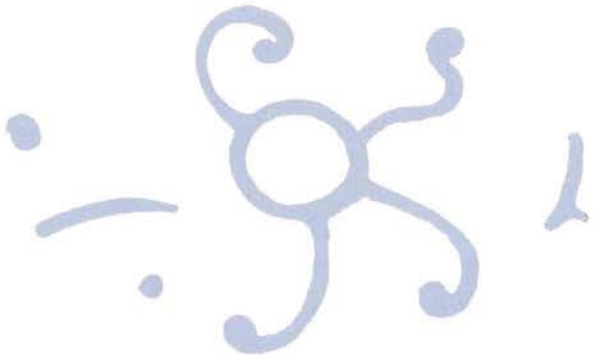
Where does this leave us? Pragmatic approaches for meeting current assessment needs

The findings of the study are useful, as they highlight the variability that currently characterises riparian vegetation mapping in terms of detail, scale, focus and useability of the data. However, it may take some time to implement the recommendations made by the report, and this does not help projects already underway that require riparian vegetation assessment. For example, within the same Ecosystem Health theme, two other projects have a specific requirement for riparian vegetation data. These are: the Assessment of River Condition (see next article), and the 'Catchment Condition Reporting' projects. Both projects are now well advanced and are required to report before the types of initiatives proposed in the 'Riparian Vegetation Scoping Study' are implemented fully. Having identified that there is limited national coverage, multiple custodians and a range of other limitations associated with existing riparian vegetation mapping, the project teams have found it necessary to develop and apply surrogate methods.

To provide some comparable national assessment on the status of vegetation within the riparian zone, two sources of information are being drawn upon. Broad scale national vegetation mapping (now becoming available for the Australian intensive land use zone as part of the Audit's Theme 3 National Vegetation Information System (NVIS) initiative) and AUSRIVAS data.

1. Most NVIS mapping is predominantly of a scale 1:100,000–1:250,000 or greater that precludes delineation of riparian vegetation communities, let alone describe condition attributes. The approach being trialed is to use the intersection of drainage lines with discernible (mapped) extant vegetation as an indication of where riparian vegetation is likely to have greater integrity. This approach will potentially overvalue areas that have not been subject to broad acre clearing but have been disturbed by other processes such as grazing. Alternatively, areas with good, albeit narrow (unmapped) riparian vegetation bands could be undervalued in terms of riparian vegetation condition.
2. Where available, point data on riparian vegetation collected as part of the AUSRIVAS monitoring River Health program will also be used to validate the broad assessment approach.

Although these approaches are less than ideal, such methods should still provide a relative, robust, nationally comparable means of assessing riparian vegetation status at a catchment or river reach scale.



RIVERCARE SNAPSHOTS

Rivercare Snapshots are a series of ten case studies hot off the press from Nowra. They detail Rivercare work undertaken by community groups on the NSW South Coast. The aim of the snapshots is to encourage landholders and landcare groups in their Rivercare work, ensure valuable knowledge is shared between groups and promote Rivercare in the broader community.

A broad range of projects have been case studied including: caring for urban streams, restoring rural creeks, working on tidal rivers, dealing with gully erosion, the work of environmental groups taking on Rivercare projects, and school involvement in a landcare nursery to name a few.

For copies of Rivercare Snapshots contact

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ASSESSMENT of river condition

By Brendan Edgar

The Assessment of River Condition, undertaken by the National Land and Water Resources Audit, in partnership with the CRC for Freshwater Ecology and CSIRO Land and Water, will provide a nationally consistent and integrated assessment of the quality of rivers across Australia. It will do so by drawing together information from major river and catchment processes. Due to limited availability of data, the project will report within the area known as the 'Intensive Landuse Zone of Australia' as illustrated in Figure 1.

The Assessment of River Condition is based on a hierarchical model of river function where broad-scale catchment characteristics affect local hydrology and habitat features which, in turn, influence the aquatic biota. Aquatic biota are considered the best indicators of river health. The project is reliant on aquatic invertebrate data from AUSRIVAS, as data for other aquatic biota such as fish is not available at a national scale.

The results of the Assessment of River Condition can be used as both a comparable measure of river condition across reaches, and as a tool to identify management priorities and options for rivers at a national scale.

The method of assessment involves deriving a final condition score for each river reach based on the following five indices:

1. Aquatic Biota
2. Catchment Condition
3. Water Quality
4. Hydrology
5. Physical Habitat

To make national reporting possible, it has been necessary to determine a common reporting framework. River reaches are lengths of river that are similar in physical form and will be defined consistently across Australia. River reach definition is based on slope, discharge and stream power — the key variables that determine the physical character of a river reach, including channel size and shape, bed material size and major bedforms such as riffles and pools.

The Upper Murrumbidgee catchment will be the first catchment to be assessed, and 133 river reaches have been defined. Assuming similar reach intensity across the study area, there will be approximately 13,800 reaches in the basins that make up the Intensive Landuse Zone.

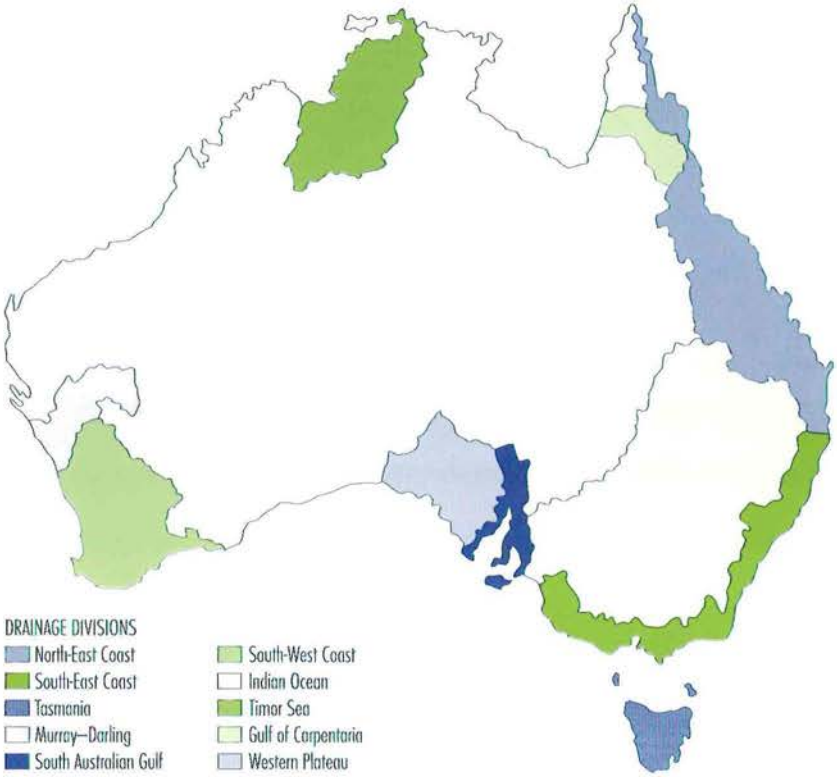

***Figure 1**: Assessment area — Intensive Landuse Zone of Australia (Source: AUSLIG 1997 AWRC drainage basins)*

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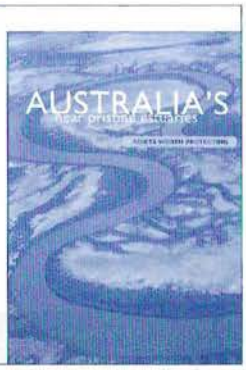
National Land & Water Resources Audit

The Audit is starting to produce material based on its findings over the past two years — three new brochures have been developed to provide information about some key outcomes of their research:

- *Water in a Dry Land* — covers the issues and challenges facing Australia's management of this key resource
- *Australia's estuaries* — focuses on work completed on assessing the condition of estuaries throughout Australia
- *Australia's near pristine estuaries* — specifically deals with those estuaries in each state and territory of Australia that are important assets needing protection.

If you would like copies of these brochures please contact the National Land & Water Resources Audit on tel: (02) 6257 9516 or check out the website at www.nlwra.gov.au



New Products

NEW HANDBOOK

Managing Streamsides: Stock Control, Fencing & Watering Options

Failure to properly manage streambank land can add up to environmental damage and reduced income for farmers. A new practical handbook *Managing Streamsides: Stock Control, Fencing and Watering Options* by David Wright and Terence Jacobson has just been released by the Tasmanian Department of Primary Industries, Water & Environment with joint funding by the Natural Heritage Trust.

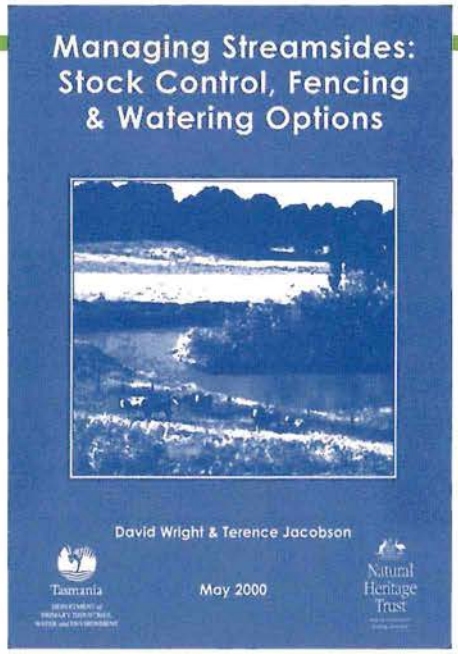
The handbook has been produced as a result of raised awareness about livestock being a major cause of damage to rural riparian land. A primary solution to both streambank erosion and water quality problems in waterways is to exclude stock. However, there is a need for information about the different ways that stock exclusion can be managed. This handbook provides a range of different options and goes into detail about fencing, grazing strategies and watering options.

Tasmanian farmer Ian Dickenson, of "Elverton", Blessington, the winner of the Tasmanian Landcare Primary Producer Award 1997, is featured in the handbook as a landholder with a strong sense of social responsibility and practicing riparian management. The Burns and Musselboro Creeks and North Esk River run through Mr Dickenson's "Elverton" property and feeds into the Launceston catchment. About 12 kilometres of electric fencing has been erected. Another 8 kilometres of fencing should complete the job.

Mr Dickenson found a reduction in streambank erosion, better water quality, stock safety and improved property management were the main advantages of fencing streambanks. Commercial interests also motivated Mr Dickenson's actions as fencing riparian land meant that stock, particularly young calves, did not run the risk of being swept away by floods.

"Because we live in a main water supply catchment for Launceston, it is important that we maintain the water quality."

– IAN DICKENSON



The handbook also includes practical information about:

- fencing streambanks;
- stock watering;
- managing vegetation on riparian land;
- weed control on riparian land;
- funding options;
- taxation incentives for managing riparian land;
- key organisations and joining groups; and
- further reading and useful websites.

Further information and copies of

Managing Streamsides: Stock Control, Fencing & Watering Options by David Wright and Terence Jacobson are available from:

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"Research in the United States has shown that soil loss along streams has been reduced by 40 per cent after cattle had been fenced off from those streams. Reduction in water sediment content by up to 60 per cent has been recorded after storms where streams have been fenced off."

RIP roving

A new segment bringing you up to date with work overseas

Update on proceedings of an international conference on riparian ecology and management

By Thorsten Mosisch

I recently attended the American Water Resources Association Summer Specialty Conference on *Riparian Ecology and Management in Multi-Land Use Watersheds*, held in Portland, Oregon (USA) from 28–31 August, 2000.

Approximately 520 delegates attended, with a total of 197 presenters, including scientists from universities, government departments, private consulting firms, managers and policy makers, as well as representatives from catchment councils and private industry. While most delegates were from the USA, other countries represented were: Australia, Canada, France, India, Japan, the Netherlands, New Zealand, Taiwan and Turkey. Three main topic areas were covered 1. Processes, functions, and structure of riparian areas, 2. Multiple human influences on riparian areas, and 3. Future management of riparian areas — Use and restoration. These general headings were subdivided into 27 concurrent sessions dealing with a wide range of biological, chemical, physical, social and economic aspects of riparian zones.

Overall, the conference highlighted that limited funding is affecting riparian restoration projects and associated research worldwide. This is in spite of the fact that riparian zone protection is gaining acceptance as an important management tool, with scientists being increasingly asked to provide answers to specific questions on riparian areas and how to design riparian buffers to meet specific management goals. Some of the other issues that came out of the conference included the fact that there is a general lack of studies that integrate social, cultural and economic aspects of riparian zone restoration. Furthermore, research on riparian zones is still mostly focused on streams located in agricultural and forestry areas, with less research on streams in urban and suburban settings. It was noted that it is essential to include restoration projects located in these areas, so that people can experience the benefits of restoration (both environmental and social) first hand — the survival of riparian landscapes depends on ecological and cultural sustainability.

In addition, several papers highlighted that research on the function of riparian ecosystems has mostly been focused on their role in sediment and nutrient removal, especially the removal of nitrogen, with less quantification of other functional attributes. In the USA, future research will be focusing on temperature and riparian shading effects on in-stream processes. Another issue raised was that catchment land management is becoming more important, as poor land management will have detrimental effects on the best riparian rehabilitation projects. In particular, cattle grazing was identified as a major causative agent for the failure of restoration projects if not properly managed. It was also widely acknowledged that tools are needed for predicting when riparian buffer zones will have the desired effect on water quality, and if there is a level of catchment disturbance at which riparian buffer protection / restoration is not a useful tool. There also needs to be a set of standards for reporting riparian zone research, which would then lead to an easier identification of priority research needs in riparian areas.

Another important point noted at the conference was that there is a definite need to step up educational programs for the public and for legislators/managers. In this respect, many delegates praised the LWRRDC Riparian Lands R&D Program for the exemplary presentation of the project outcomes and making these easily accessible through integrated publications, workshops and the internet site. This conference touched on many riparian restoration issues, from the relationships between ecological, social and economic aspects of riparian management and restoration, to human influences, riparian restoration and biophysical processes at site to whole catchment scales. New approaches and techniques for riparian characterisation, assessment and restoration were presented, and future directions for riparian management, restoration and research discussed. It was most interesting to see how these issues are being addressed.

For further information

Check out the American Water Resources Association website: www.awra.org

or

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RIP roving

The future of ecological assessment

Pellston workshop reviews state of the art and future application of ecological assessment to aquatic resources

By Nick Schofield

In just a week in outback Michigan, a group of 40 "experts" gathered under the auspices of SETAC (Society of Environmental Toxicology and Chemistry) to understand and record the progress, application, implementation and communication of the science of "ecological assessment". The motivation for this workshop was to elevate the use of ecological assessments in decision-making for the protection and restoration of aquatic resources.

The focus on aquatic ecosystems was based on the emergence of water as a critical management issue for the 21st century. Ecological information gathered in the last few decades has uncovered a serious global decline in aquatic ecosystem health. A larger proportion of aquatic organisms (34% of fish, 75% of unionid mussels and 65% of crayfish) than terrestrial organisms are classified as rare to extinct.

Assessment of the health of aquatic ecosystems requires biological information — physiochemical data do not tell the whole story. Environmental decisions are being made daily throughout the world with little ecological input. Many of these decisions are driven by societal or political concerns and interests and are not based on best scientific methods. However, at the end of the day, the health and future utility of our resources will be critically dependent on the use of rigorous, integrated systems of assessment. This was the context and workshop challenge for scientists, economists, managers, practitioners and industry representatives drawn from the USA, Canada, Spain, United Kingdom, Sweden and Australia.

The workshop was carefully designed to explore and develop written reports on three key issues:

Initiating the assessment process

This involves establishing the appropriate goals and identifying the roles of the various stakeholders. This initial stage is crucial for establishing a framework in which scientific data will be linked to the end product of decision-making. The participants addressed this stage through two topics "Formulating the right questions" and "Establishing stakeholder networks".

Implementation of ecological assessments

This was addressed through two topics "Designs of ecological assessments" and "Conducting integrated assessments". Some of the discussion centred on exactly how comprehensive "Ecological assessment" is: for example, biological, chemical, geomorphological, hydrological, habitat, social, economic, conservation, indicators, risk analysis, sustainability, cumulative etc and consequently what that means for integration.

Communicating relevant information

This was considered under two topics "Defining ecological significance and valuing ecological resources" and "Translating scientific results into relevant management information". This issue was viewed as particularly important if ecological assessment is to make a greater contribution to decision-making, management, planning, on-ground practice and policy development in a world of increasing environmental stress and biodiversity loss.

Outputs from the workshop

The outputs of this workshop will include a book (drafted during the week) in the SETAC Pellston series and available within 12 months; SETAC Tips (Technical Issue Papers); powerpoint slide presentations, and CD-Rom and web-based materials. An immediate outcome was the establishment of new networks and relationships developed in almost round-the-clock team building.

The workshop was conducted on the shores of Lake Douglas at the University of Michigan Biological Field Station, the oldest station in the US, dating from 1909. Let's hope this historical location spawned an historical event.

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JERVIS BAY Cumulative Impact Monitoring Program

By Charles Jacoby

Good luck rather than good management

Many people say good luck rather than good management has allowed Jervis Bay to 'escape' construction of a nuclear reactor, petrochemical plant, steel works, power station and major fleet base. Although these large-scale proposals did not proceed, the region is pressured by a 'tyranny of small decisions' related to population growth (4.2% per annum), increased construction of residential dwellings (19.2% per annum) and an annual influx of visitors (the population trebles during peak season).

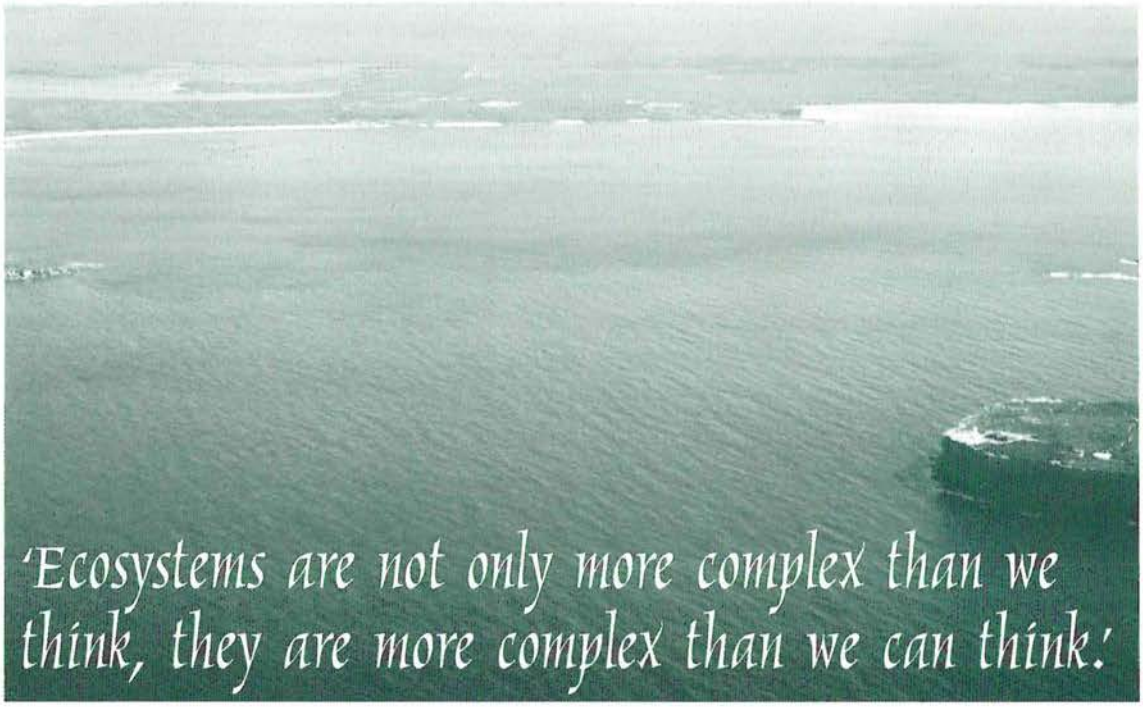
Regional managers and the public are addressing these pressures through the Jervis Bay Cumulative Impact Monitoring Program (JBCIMP). Their aim is to protect the values that put Jervis Bay on the Register of the National Estate and led to the establishment of Booderee National Park, the New South Wales Jervis Bay National Park and the New South Wales Jervis Bay Marine Park.

History of the JBCIMP

Two sets of circumstances led to the JBCIMP. On one hand, the New South Wales government developed regional environmental management. In parallel, the community responded to perceived environmental changes. In 1990, the New South Wales Government prepared a Regional Environmental Plan (REP) for Jervis Bay.[1] The REP incorporated 'modern' management principles, including integrated coastal management (ICM).

One mechanism for promoting ICM was to identify water quality objectives (WQOs) and then ensure that all management supported them. The REP pinpointed cumulative impacts from small and seemingly independent management decisions as significant threats. A monitoring program was seen as the way to assess cumulative impacts and track progress toward WQOs. Community support was strong for the proposed program, as a phytoplankton bloom (a coccolithophorid, *Gephyrocapsa oceanica*) and repeated

Jervis Bay without phytoplankton bloom.



accumulations of red algae (*Gracilaria* sp. and other species) on certain beaches had caused considerable alarm amongst locals.[2] Many people blamed these unusual events on the Shoalhaven City Council's sewage outfall. They felt that the 'algal blooms' were caused by excessive nutrients from this obvious point source.

Ultimately, two community organisations requested funding for water quality monitoring from the National Landcare Program (NLP). Agencies involved with the REP supported the intent of these applications, but they felt that an integrated program was needed. The community organisations agreed to help develop the JBCIMP.

***Left**: Jervis Bay with phytoplankton bloom.*

***Right**: Close up of red algae on beach. Photo by Mia Campion.*

Joint efforts

A Technical Working Group (TWG) oversees the JBCIMP (Figure 1). The Shoalhaven Catchment Management Committee has managed the program on behalf of the New South Wales Department of Land and Water Conservation. The TWG includes representatives from the community and from Commonwealth, state and local government agencies. The program employs a project officer and a scientific adviser from CSIRO.

***Figure 1**: Current organisation of the JBCIMP.*

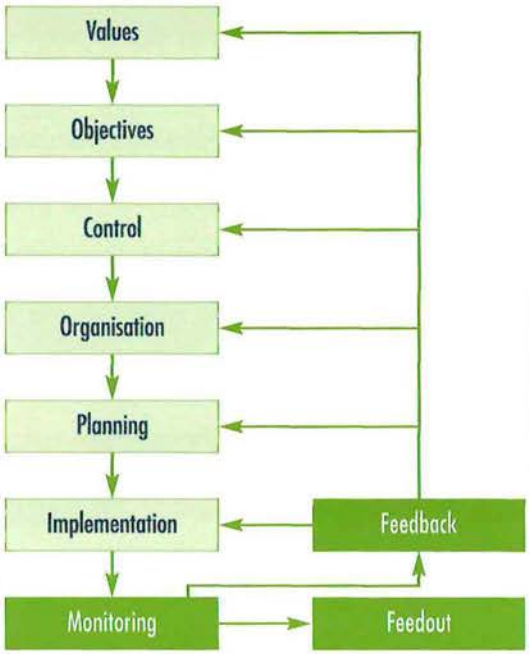


***Figure 2**: Management process.*[4]

Values	=	expressions of societal and ecological aspirations and concerns (for example, beneficial uses and ecological integrity)
Objectives	=	measurable goals derived from values
Control	=	methods to influence the activities of people (for example, legislation, standing orders, operating procedures and education programs)
Organisation	=	administrative structures and cooperative arrangements that integrate management over an appropriate region, timeframe and suite of issues (for example, total catchment management)
Planning	=	details of current and future uses of the environment; integrated plans, schedules and procedures for controlling them; and concrete strategies for altering them if undesirable changes are detected
Implementation	=	resourcing for control, organisation, planning and monitoring, which includes funding, administration, management, supervision and reporting
Monitoring	=	auditing activities subject to managerial control, detecting changes in the environment, and linking the outcomes of these two tasks
Feedback	=	disseminating the results of monitoring in order to assess the effectiveness of management and adapt it according to the functioning of the managed system
Feedout	=	disseminating the results of monitoring in order to display accountability

Members of the TWG set the program's objectives, contribute resources, and receive data and reports for their individual and collective use. Agreements are 'formalised' in memoranda of understanding.

Adaptive not prescriptive management

The JBCIMP relies on adaptive management. This approach recognises that many attempts to prescribe management are doomed because:

> 'Ecosystems are not only more complex than we think, they are more complex than we can think.'[3]

In an effort to cope with this complexity, the JBCIMP put a 'learning loop' into management (Figure 2). Monitoring to assess performance, feedback to adjust management, and feedout to ensure accountability, represent critical but neglected parts of the management process.

Successes

Ultimately, the JBCIMP will comprise several monitoring projects. In particular, measures of human use, physicochemical parameters and biological components will be combined in 'closed loops'. Changes in human use must be monitored so that managers can 'target' their responses. Physicochemical measures (e.g. water quality) often change first in response to human pressures, but their natural variability makes it difficult to detect changes reliably. Biological components (e.g. seagrasses) are highly relevant indicators, and they provide managers with 'safety nets' by integrating pulses or low-level pressures.

Like all programs, the JBCIMP has limited resources; therefore, efforts focus on agreed priorities. Thus far, faculty and students from the Australian Catholic University monitor mangroves and saltmarshes, the community monitors birds, and community and agency personnel combine to monitor freshwater quality.

Monitoring of freshwater has generated critical background information and proven the community can contribute successfully. For example, sampling has shown nutrient inputs vary in space and through time. Basal loads of phosphorus from the largest and most developed subcatchment (Currambene) are an order of

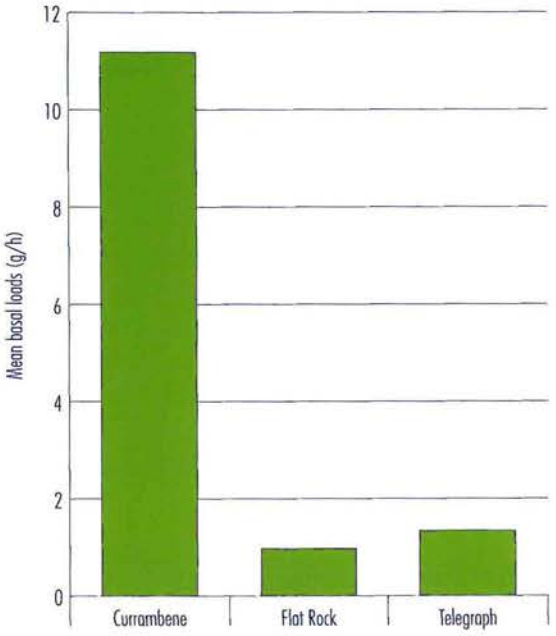


***Figure 3**: Variation in total phosphorus loads from basal flow of three creeks.*

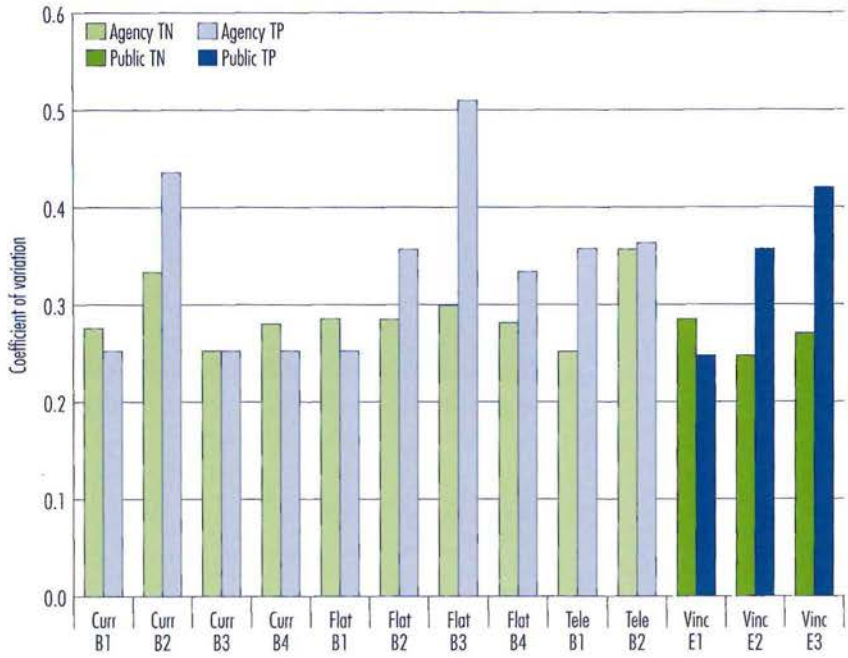


***Figure 4**: Precision for replicate samples taken by agency personnel and the community. TN = total nitrogen; TP = total phosphorus; B = basal flow; E = event flow; Curr = Currambene Creek; Flat = Flat Rock Creek; Tele = Telegraph Creek; Vinc = runoff at Vincentia boat ramp*

magnitude greater than those from other subcatchments (Figure 3), and rainfall events can generate 'pulses' up to 7–10 times larger than basal loads. Most importantly, estimates of precision from replicates have shown the community can collect samples and estimate flows successfully (Figure 4). This is a critical result because the community's input is vital for the program's viability.

The future

The JBCIMP strives to deliver results that managers can use in their day-to-day operations and in their 'big-picture' planning. The results from monitoring are influencing management. For example, stakeholders are reallocating or increasing their sampling of freshwater quality to better characterise inputs into Jervis Bay. In addition, the TWG is investigating ways to 'close the loop' by adding projects targeting marine water quality and seagrass distribution (a biological 'safety net').

Not surprisingly, generating and maintaining resources will be a key to continued success. The need to move monitoring off 'research and monitoring' funding and onto 'operational' funding has been reinforced by the unexpected loss of Commonwealth seed funding. The Coasts and Clean Seas Coastal Monitoring Program shifted support from monitoring as a way to 'get ahead' of unpredicted or unpredictable problems like cumulative impacts, back to a more typical management approach, that is, spot an obvious problem and take immediate action to address it.

Certainly, there is nothing wrong with identifying and attacking problems, but managers have been doing this for many years and the environment still suffers. Maybe we are in danger of falling into one type of insanity, that is, doing the same thing over and over and expecting a different result. The JBCIMP is an attempt to break such a cycle.

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References

1 New South Wales Department of Planning. 1996. *Draft Jervis Bay Regional Environmental Plan.* New South Wales Government, Sydney.

2 Jacoby, C. & Ward, T. 1993. An algal bloom in Jervis Bay, New South Wales, Australia. *Marine Pollution Bulletin*, vol. 26, pp. 295–96.

3 Egler, F. 1977. *The nature of vegetation: its management and mismanagement.* Aton Forest, Norfolk, Connecticut.

4 Jacoby, C., Manning, C., Fritz, S. & Rose, L. 1997. Three recent initiatives for monitoring of Australian coasts by the community. *Ocean and Coastal Management*, vol. 36, pp. 205–26.

ENVIRONMENTAL action through community monitoring

By Kate Gowland and Nadia Kingham

WATERWATCH Australia

Communities Caring for Catchments

What is Waterwatch?

Since 1993, Waterwatch has grown into a network of over 50,000 people, and over 2,000 groups regularly monitoring over 5,000 sites across Australia. Through water monitoring, Waterwatch provides the community with the capacity to build a picture of the health of their catchment and make a valuable contribution to the protection and management of their local waterways.

How does Waterwatch work?

David Hodgkins is the regional Waterwatch coordinator for the Goulburn-Broken catchment in Victoria. David looks after 76 groups and individuals, many from landcare and schools or simply landholders concerned about the health of their catchment. These 76 or so volunteers regularly monitor their local waterways for parameters such as salinity, turbidity and phosphorus. Together with other catchment health indicators like aquatic macroinvertebrates and habitat assessment, Waterwatch is providing a tool for monitoring catchment health.

David has trained each of his 76 volunteers and ensures that they know how to clean and calibrate their equipment and collect and record their data. David helps the monitoring network to upload their data into the Goulburn-Broken Waterwatch database and then assists them to undertake simple analysis of the data and prepare easy to read reports and graphs. The regional network get together with David on a regular basis to discuss arising catchment issues and actions that could be taken to address these issues. Special regional projects like the *Nutrients in Drains* projects have developed out of a recognition of the increasing concern for rising nutrient levels in the Goulburn River and the Murray-Darling system generally. Regional Waterwatch coordinators are the lynch pin to the Waterwatch Program. Coordinators all over Australia, like David, are working directly with the community to establish and coordinate community monitoring programs in their region and facilitate the community to take action to address water quality and catchment issues.

Regional, state and national linkages

Regional coordinators work with the community monitoring network to develop an 11 step monitoring plan that identifies key aspects and sets achievable outcomes for their monitoring activities. This also involves training the community and providing them with the necessary skills and knowledge to undertake sampling, use and care of field equipment and to collect data to the level of quality required for its use. This is an ongoing job for a regional coordinator as skills need to be updated and refresher courses provided on quality assurance and quality control procedures.

The most important job that the regional coordinator does, however, is to facilitate the feedback process and ensure that the information collected by the community network is translated back to the broader community, raising awareness about local issues. Waterwatch ensures that local community has immediate and ongoing access to information about the health of their waterways. Waterwatch data also feeds into other regional monitoring programs and contributes to the information collected for State of Environment Reporting. In the future we will see Waterwatch data available on state water quality data warehouses.

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It's a WRAP

In this edition of RipRap, the It's a Wrap articles all pick up on the theme of monitoring and evaluation, with each State, Territory and Commonwealth contribution highlighting efforts in this area. The thought and time that has gone into preparing these articles will be evident as you read through the excellent work that is being done across the country!

Queensland by Denise Johnson

State of the Rivers

State of the Rivers is an ongoing project of the Department of Natural Resources to describe the ecological and physical condition of Queensland's watercourses. This is being achieved by conducting a survey of streams on a catchment by catchment basis.

Since the development of the approach by Dr John Anderson in 1992, one third of the state has been completed.

The reports generated through this approach provide an assessment of the physical and environmental condition of these streams at the time of the survey, relative to their presumed natural or original condition. The basic approach is to estimate the ecological condition by assessing instream habitat. This contrasts with commonly used techniques that conduct flora and fauna surveys, by focusing on the broad attributes recognised as being important to instream and riparian fauna and flora. The approach is designed to be independent of flow conditions and water levels at the time of survey, and aims to provide a basic set of data that accurately describes the condition of the streams surveyed. Condition ratings are produced for:

- the land immediately bordering the stream;
- the bed and banks of the stream;
- channel diversity;
- riparian and aquatic vegetation;
- aquatic habitat; and
- scenic, recreational and conservational values.

It also provides a method for assessing the extent of stream degradation and locates where both major and potential problems exist, as well as identifying possible causes. The survey comprises the completion of 11 data sheets for each survey site. This results in significant amounts of data that are entered onto a database (dBase IV) and interpreted through various data analysis programs.

***Above**: Natasha van Menen carries out cross-section and sediment sampling in Currajong Creek in the Lower Condamine River catchment, southwest Queensland.*

***Below**: Courtney Henderson and Natasha van Manen assess the conditions of the banks of the Burnett River, Central Queensland.*

These programs produce the condition ratings for the streams. Classifications can then be revised and verified against other available information on the condition of the streams and rivers in the catchment and the relevance of the sectioning.

The final output of this work is a document describing the physical and ecological condition of the streams (State of the Rivers), as well as a comprehensive database of the data sheet information and an extensive library of photographs of all the sites.

Completed catchments include the Maroochy River, Upper Condamine River, Dawson River, Herbert River, Lockyer Creek, Bremer River, Mary River, Tully/Murray Rivers, Burnett River, Border Rivers and Moonie River, Comet, Nogoa and Mackenzie Rivers. Forthcoming publications are Cooper Creek, Caboolture/Mooloolah Rivers, Lower Condamine/Maranoa/Balonne Rivers.

Determination of the size, extent and seriousness of problems is necessary before the condition of rivers and streams throughout the state can be improved. By identifying processes and causes of deterioration, interested organisations, groups and individuals can pinpoint actions required to rectify problems and establish priorities so that limited resources can be used best.

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Rivercare monitoring and evaluation in Tasmania

Tasmania has a significant Rivercare program currently being funded through the Natural Heritage Trust. These projects vary in both the outcomes they seek to achieve and in their scale. For example, some projects are small revegetation and fencing projects, others involve willow removal and revegetation over a few kilometres of river, whilst some aim to remove upwards of 60 kilometres of willow from rivers and tributaries. The need to monitor, and have in place maintenance provisions for each of the projects varies accordingly, but all those undertaking works are required to address the issue beyond the funded life of the project.

Monitoring and evaluation in Tasmania operates at several levels. Individual groups establish monitoring programs for their projects usually involving photopoint records and basic recording of change at a given sites. Waterwatch has established sites on many of the state's rivers, and the groups are able to use this information to establish baselines prior to any restoration works commencing, and then to monitor change during the restoration works and beyond.

The Tasmanian NHT Unit has a team that evaluates projects funded under the different NHT Programs including Rivercare. The evaluation attempts to identify the positive outcomes arising from the project, as well as any existing or potential problems. Evaluation includes both administrative and technical areas, with the recommendations resulting from the evaluation being fed back to the groups.

Rigorous scientific monitoring within the Tasmanian NHT program has been limited. However, a new Bushcare extension project that replaces the existing project, proposes a baseline data collection program that will form the basis of a long-term monitoring program into the effectiveness of fencing and other methods of protecting remnant vegetation. This project will focus mainly on non-riparian environments. The various devolved projects operating in Tasmania, such as Greening Australia's Fencing Incentive Scheme, will also implement baseline monitoring across various sites that will allow for long-term assessments.

Tasmania has recently established a Rivercare Technical Extension team that will provide technical support to groups undertaking rivercare projects. The team plans to setup baseline monitoring covering a range of sites and activities, including channel cross sections, pool and riffle sequences, existing and introduced woody debris, and revegetation and habitat surveys for riparian fauna.

By February 2001, Tasmanian's non-forest vegetation, including riparian, will be mapped on GIS. This will provide baseline information regarding the distribution of willows along Tasmania's rivers and possibly other weeds such as gorse and hawthorn. Information on willow removal, fencing and revegetation will be collected over the life of the Rivercare project and matched against mapped data. The mapped data will also enable change over time for native riparian vegetation to be monitored. This information will allow the state to make an assessment of the impact of the Rivercare Program with regards to willow control, and will also aid in the development of a long-term strategy for river management, conservation and rehabilitation.

DPIWE's Nature Conservation Branch is also developing a protocol for monitoring that will be applied to existing as well as new projects. The protocol will introduce a minimum standard and will allow the Branch to prioritise projects within its monitoring program so that the Branch's conservation objectives are more truly reflected. This includes work on the conservation of threatened species, plant communities and a range of environments.

Tasmania recognises the importance of monitoring works that are being undertaken along its rivers. Without this information it is difficult to assess the effectiveness of those works and be able to respond to any problems that may arise.

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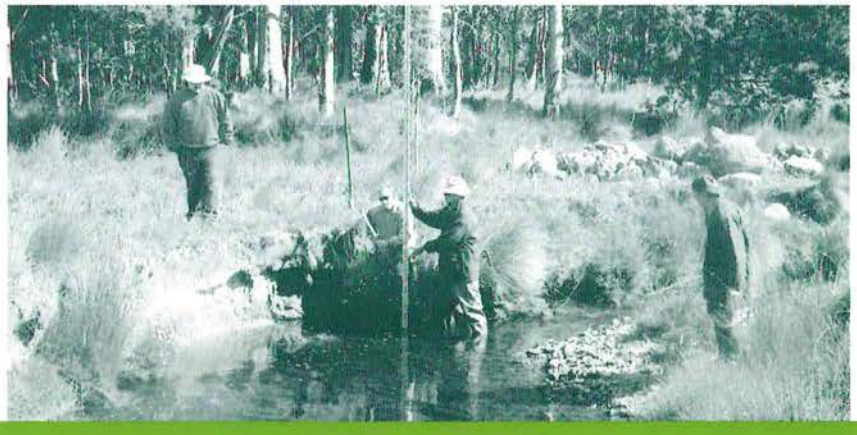


Measuring the long profile of a section of the Meander River, Tasmania.
Photo: Michael Askey-Doran.

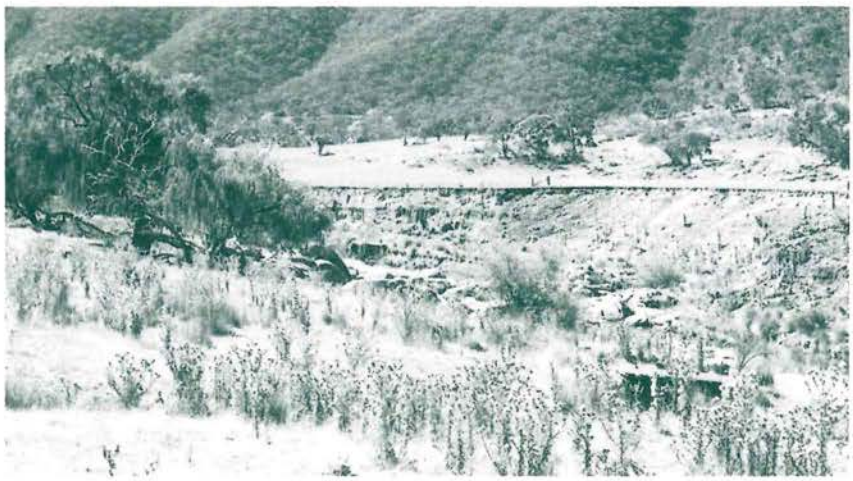
Riparian ACTion

The first devolved Natural Heritage Trust funding project targeting riparian zones is now underway in the ACT. Called "Riparian ACTion", the project is a joint initiative of Greening Australia (ACT & SE NSW) and Environment ACT in the ACT Department of Urban Services. The funds are sourced from the Murray-Darling 2001 Program of the Natural Heritage Trust. Riparian ACTion seeks to target incentive funding to landholders and land managers to undertake erosion control measures and vegetation restoration within riparian zones along the Murrumbidgee River and its tributaries in the ACT.

Greening Australia field staff are assisting Environment ACT in delivering the program by providing a field officer to liaise with property owners and provide technical advice on riparian zone revegetation. The project also closely links with Greening Australia's "Bidgee Banks" project operating in the NSW Middle and Upper Murrumbidgee River Catchments (see next edition of *RipRap* for more about 'Bidgee Banks). This project is delivering similar funding to landholders to provide for actions such as off-stream watering points, fencing of riparian vegetation and rehabilitation of degraded watercourses.

Considerable efforts are being taken to target funds in the areas of greatest need. An ACT wide analysis of stream condition over time is being undertaken to inform decisions about funding. This approach will use historical records, such as aerial photographs, to identify any changes in drainage networks. This is seen as an important first step before funds are allocated. Many streams, channels and gullies in the ACT are still undergoing natural processes of change that need to be better understood. Similarly, much gully erosion is no longer active and under natural processes of revegetation and stabilisation.

In looking at the priorities for funding a number of factors are being considered by the community/government steering group for the project. Of importance, are links to other initiatives being undertaken in the ACT to address the conservation of natural values in rural areas. For instance, the ACT's Rural Conservation Fund, also supported by the Natural Heritage Trust, addresses the conservation of remnant native vegetation on rural properties. The joint delivery of these two projects by Greening Australia will achieve significant outcomes in addressing erosion and land degradation issues comprehensively across each landholding.



Much of the Naas River in the ACT has high vertical banks which appear to be eroding (right of ground photo). Aerial photograph interpretation has revealed, however, that these banks have been exposed by the lowering of the bed of the river since 1944. The bed of the river was then at the base of the willow tree to the left of the photograph above. While some bank erosion is occurring due to deflection of flows by bedrock, cadastral information indicates that the location of the banks has not change significantly since first surveyed in the mid 19th century. Photograph courtesy of Barry Starr.

Funding is available to property owners to assist with fencing materials, earthworks, tubestock, direct seeding and so on. It is expected that funding be matched by applicants, either in-kind or with cash contributions. It is anticipated that on-ground works using this funding will commence in the autumn of 2001.

Monitoring water quality improvements following on-ground works is an important aspect of Riparian ACTion. The monitoring work will be done in collaboration with the ACT Waterwatch Program that is well established in most sub-catchments of the ACT.

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NEW CONTRIBUTOR

Riparian condition assessment for the Daly River catchment

The riparian lands of the Daly River catchment are, overall, close to their natural state. This is the main conclusion of a recent survey undertaken by the Department of Lands, Planning and Environment (DLPE) to assess, describe and report on the condition of several major Northern Territory rivers.

The Daly River is one of the Northern Territory's largest rivers, draining a catchment area of 52,500 km^2. The Katherine River, and its spectacular gorge, is probably the better known of the Daly Rivers' tributaries. The region's wet/dry tropical climate is characterised by highly seasonal rainfall and river flows. High river flows and intense rainfall render the river banks and riparian zones particularly vulnerable to human-induced disturbance.

The DLPE survey applied a modified version of the method developed by John Anderson for Queensland rivers (see this issue Queensland It's a Wrap). Field surveys assessed the following:

1. the use and level of disturbance along rivers,
2. types and extent of impacts,
3. the size, shape and form of the river channel,
4. stability of the river bed and banks,
5. location and length of pools and other habitats (for example, riffles and rapids)
6. inferred condition of the aquatic habitat; and
7. type, extent and cover of aquatic and riverine vegetation.

In total, 131 sites were assessed.

The condition of most sites rated highly. Importantly, the riparian vegetation was relatively intact with no extensive clearing or development having taken place. The most significant disturbances of the riparian zone, relative to its pristine state, were the presence of exotic weeds such as *Passiflora foetida* (a naturalised vine) and, to a lesser extent, *Hyptis suaveolens* and *Xanthium occidentale* (Noogoora Burr). Localised disturbances by livestock and feral animals (pigs, horses, donkeys, buffaloes) also occur. Additionally, roads, tracks and river

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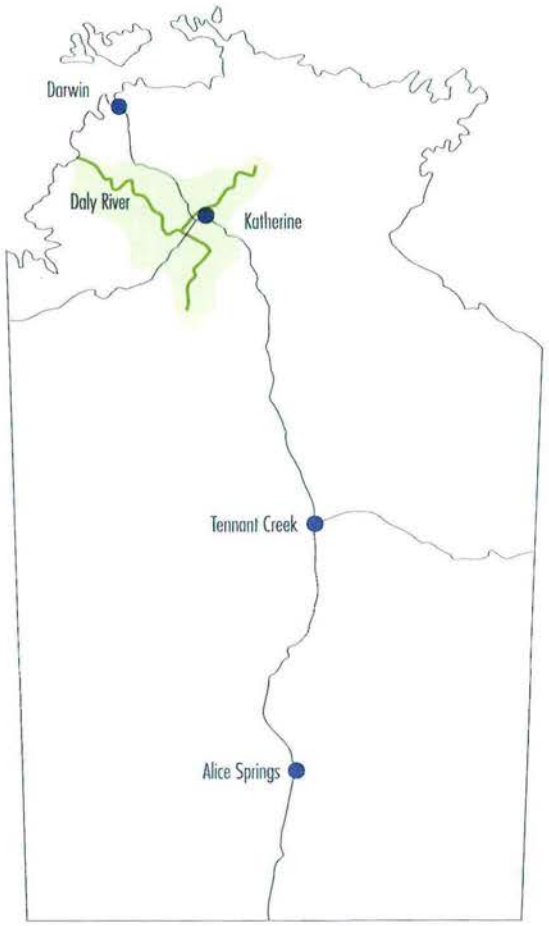

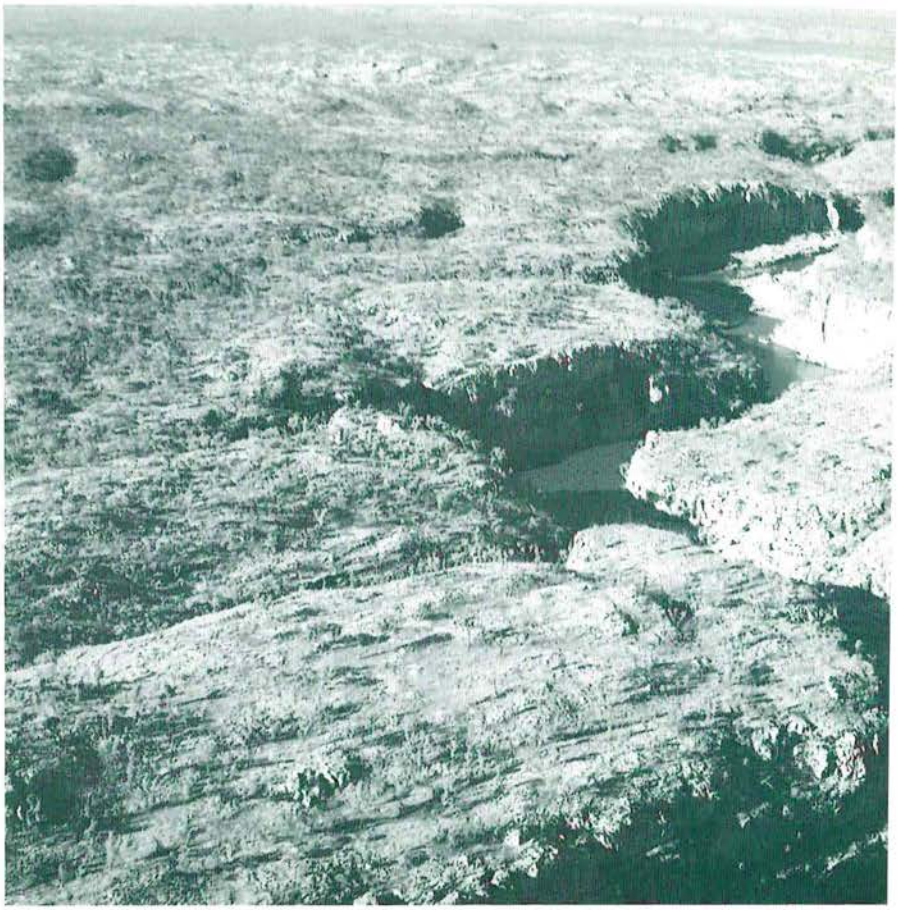

crossings were often the cause of localised erosion.

As a result of this survey, and other studies such as AUSRIVAS and further research into the application of remote sensing technologies, a priority for the Northern Territory is to develop a monitoring program for the catchment's riverine environment and riparian zone. This will contribute to overall natural resource management within the Daly River catchment, which has considerable potential for agricultural development and is recognised as a priority catchment.

The challenge for the Department is to develop resource efficient monitoring methodologies. Whilst this is clearly the case throughout Australia, it is especially pressing for the Northern Territory where resources available for monitoring, both government and community, are relatively small compared to the length and spatial extent of Northern Territory rivers, streams and wetlands.

***Top**: The Daly River.*
***Middle**: The Flora River, a major tributary of the Daly River – very high overall condition.*
***Below**: The Douglas River, a major tributary of the Daly River – very high overall condition.*
***Left**: Aerial view of Katherine Gorge, one of the largest gorges in the Northern Territory.*

Monitoring and evaluating the National Rivercare Program

The Natural Heritage Trust (NHT) is the largest environmental rescue effort ever undertaken in Australia, representing an investment by the Commonwealth Government of $1.5 billion. The Trust is a partnership of all Australians, bringing together the efforts of individuals, communities and governments, targeting our environmental problems at their source. It focuses on five key environmental themes — land, vegetation, rivers, coasts and marine, and biodiversity.

The National Rivercare Program (NRP) focuses on the management of river systems and riparian vegetation and represents a significant investment in activities that will improve the health of Australia's river systems outside the Murray-Darling Basin. Together with Murray-Darling 2001, both programs will assist in improving the health of river systems across Australia and ensure that resources are effectively allocated for this purpose. Funds are allocated to organisations from community groups to state agencies, for the implementation of projects of varying size and scope. For example, projects can range from a few thousand dollars to devolved grants of several hundred thousand dollars.

Part of the funding requirements for all projects under the NHT, is the inclusion and documentation of monitoring and evaluation activities. The NHT also commissions reviews of the performance of all its programs in relation to their goals. The most recent of these, and of particular relevance to readers of *RipRap*, is the Mid Term Review of the NHT and, in particular, the National Rivercare Program. The mid-term review of the Trust is an extensive, independent exercise, commissioned to evaluate the efficiency, effectiveness and appropriateness of programs and administration in achieving the goals and objectives of the Trust. The review concluded that the Trust has contributed significantly to the conservation, sustainable use and repair of Australia's natural environment.

The Rivercare component of the Mid Term Review, carried out through desktop review and site validations, incorporated the achievements of 82 projects managed by organisations from community groups to state agencies across Australia. The review states that there are four important factors that influence the scale of challenges for river management in Australia:

- the fact that we do not have integrated institutions or institutional arrangements;
- the Australian environment and Australian rivers are highly variable both spatially and temporally, and in many respects are different to most of the world's rivers;
- we have not achieved sustainable production from most of our resource based industries;
- people love rivers but there are many opportunities to improve our understanding and management of them.

In this context, the goal of the National Rivercare Program was found to be sound, fills an important need and contributes directly to NHT objectives.

However, the value of the review cannot only be measured in successes. Recommendations for improvements often offer as much, if not more, than the success stories. The review considers that improvements in National Rivercare Program performance can be achieved by changing management and reporting arrangements for individual projects and attempting to tackle the barriers to river health more directly, including overcoming information and institutional barriers.

This informative review has not only provided those involved with NHT, natural resource managers and independent river managers and groups with the assurance that the money expended under the Trust has been well utilised, but also with valuable insight into the best structure of future natural resource management funding programs.

Information on the Mid Term review of the NHT is available at: www.nht.gov.au

Don't forget that the 2001–02 funding round is the final for the Natural Heritage Trust. Application forms should be out around October and will be available online (electronic form) and/or to order (hard copy) through the Natural Heritage Trust internet site www.nht.gov.au

AUSTRALIA

Natural Heritage Trust

Helping Communities Helping Australia

National Rivercare Program

For more information

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River foreshore assessment in south-west Western Australia

Unlike a wetland or an estuary, it is impossible to gain a view of a river from a small number of vantage points, even from the air. Looking at a river is like watching cars on a racing track. At any particular point all that can be seen is a small part of the action. Yet gaining an overall view of a river and its condition is essential to management, especially if more than one group is going to be involved. A single common view is needed to enable planning to be effective.

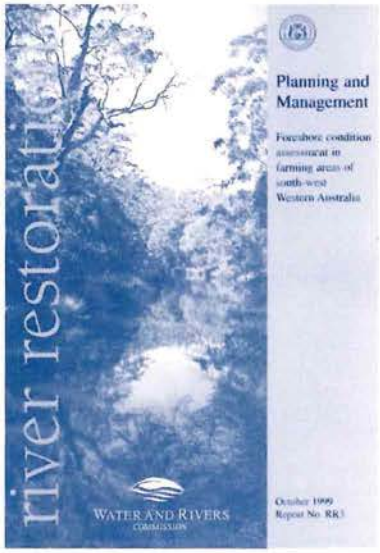
Since 1992, the Water and Rivers Commission has sponsored the surveying of river and creek foreshores in broad acre farming areas. The work is usually done in partnership with community groups that have assumed at least some responsibility for the management of their local streams. Surveying is done for two reasons: to build an awareness of the river, its values and management problems and, secondly, to enable groups to use the information for action planning.

Foreshore surveying has proved very popular in the south-west, with over 20 rivers and 3000 kilometres of foreshore having been surveyed. In many cases the outputs of this work have been used to plan National Heritage Trust (NHT) projects.

The beginning

Foreshore surveying began in 1992 on the Kalgan River near Albany on the south coast of Western Australia. It followed a call by the Oyster Harbour Catchment Group (OHCG) to fence off and protect the fringing vegetation of the river from over-grazing, both to protect the river itself and its estuary (Oyster Harbour), which was showing the effects of severe eutrophication. This call was supported by research carried out by the then Department of Agriculture, which found that streams that retained fringing vegetation showed superior water quality to those that had lost their vegetation (SCEP 1992; Weaver et al. 1994). In order to identify key sections of fringing vegetation in need of protection and key areas for revegetation, a survey was conducted along the 110 kilometre length of the main channel of the river. The results (Pen 1994) were used as a basis for funding support from the National Landcare Program and, subsequently, the NHT.

Photographic and plant community surveys were carried out along the river at the same time as the condition survey. The former enabled a slide-show to accompany the presentation of foreshore condition results, while the latter identified suitable plant species for revegetation. For the first time, the Kalgan community began to see their river; what they had to be cherished and what they were losing (see Pen 1999). This roused considerable support and many landowners, with some encouragement from the OHCG, began to fence and replant their river foreshores.



Today, over 90% of the main channel between Oyster Harbour and the Stirling Ranges has been fenced and many hectares revegetated. In more recent years the OHCG has worked steadily up the tributaries following further surveying (APACE Greenskills and Pen 1997) and assistance from the NHT.

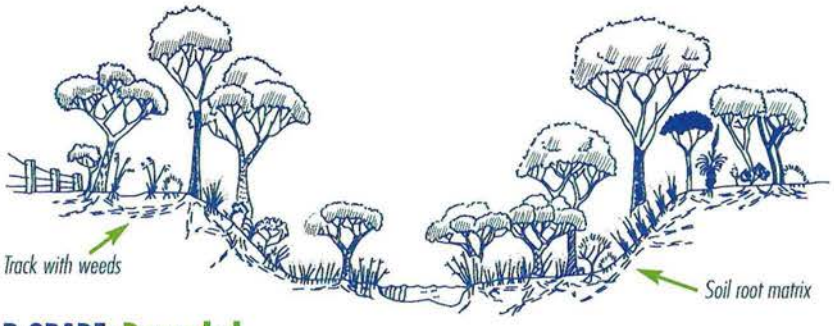
Basic methodology

The work on the Kalgan River could be considered a pilot study. The basic method having proved successful was then refined during work on the Blackwood River (Pen and Scott 1995; BBG 1999). The method basically consists of grading a section of river into one of four broad contiguous categories — A, B, C and D — which follow the slow process of foreshore degradation in agricultural areas.

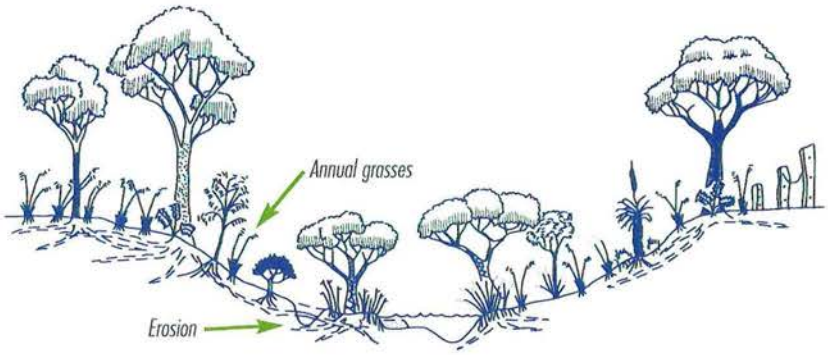
- 'A grade' is essentially a foreshore that retains good bush;
- 'B grade' retains bush but with significant displacement of native understorey species by weeds;
- 'C grade' is trees over pasture species (parkland cleared); and,
- 'D grade' is an eroding or completely weed infested foreshore, which usually follows the belated fencing off of highly degraded streams.

Surveys can be done at this basic level or refined to incorporate three subcategories for each grade, as detailed overleaf:

A GRADE: Pristine to slightly degraded

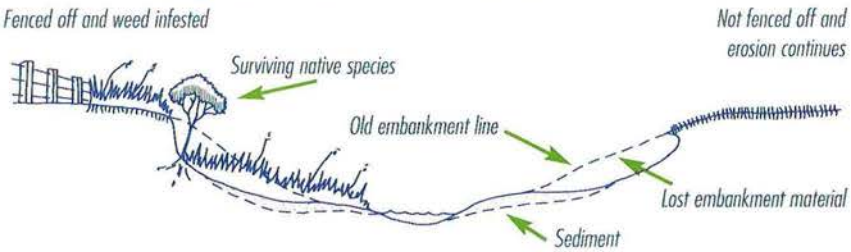


B GRADE: Degraded



C GRADE: Erosion prone to eroded

D GRADE: Eroding ditch to weed infested drain



A GRADE: Pristine to slightly degraded

A1. Foreshore with healthy bush, no weeds, no soil disturbance of any kind.

A2. Healthy bush, some weeds, and no soil disturbance

A3. Healthy bush, with very localised weed infestations about sites with soil disturbance, such as along tracks. No serious erosion.

B GRADE: Degraded

B1. Foreshore with healthy bush, but where many weeds have invaded the understorey. Soil disturbance may be common. No serious erosion.

B2. In the understorey weeds about equal the native plants in abundance. Soil disturbance may be common, but not extensive. No serious erosion.

B3. Understorey just about replaced by weeds, but some natives remain. Soil disturbance may be common, but not extensive. No serious erosion.

C GRADE: Erosion prone to eroded

C1. Foreshore supports remnant trees over pasture or weeds, or just pasture. There may be some soil disturbance, but no significant erosion. This is the erosion prone stage.

C2. The foreshore has large areas of exposed soil and has begun to erode slightly.

C3. Large chunks of foreshore of the foreshore embankment have been cut out, undercut or have subsided, but only in a few spots. In other words, some localised major erosion. Anything from trailer-size loads to truck loads of soil have been washed away.

D GRADE: Eroding ditch to weed infested drain

D1. Here most of the foreshore is eroding or subsiding and undermined trees are a common site. Large sediment deposits are common.

D2. The river resembles a ditch with few or no trees remaining to support the embankment. Here erosion and sedimentation are the rule.

D3. Weeds infest the streamline, where the former 'ditch' has now been fenced-off.

Recognising a section of river foreshore and collating results

A section of foreshore is recognised as that immediately opposite a discrete paddock or block of land. Each paddock or block tends to have a uniform land use history, reflected in the state of the foreshore lying along it or passing through it. For this reason, surveys are conducted paddock by paddock or block by block. Separate forms are filled out for each discrete foreshore section and the data collated to produce an overall picture of the river, usually presented as tables or maps, and sometimes broken down into different landforms through which the river system passes.

Recognising condition

Having recognised a section of foreshore, it is unlikely to have a uniform condition. For this reason, the range of a condition is assessed along with the average condition, given as for example "B2-3, C1", which says the foreshore is mainly B2 to B3, with spots of C1. When combining data across sections, this section would be assessed as a B overall. For a section falling exactly across two categories, the lower grade is taken to enable the summation of results across the broad categories. But it is important for the individual section assessments to show the range. In this case the B category highlights that understorey plants remain, which may be able to regenerate following fencing or provide a source of seed.

Why survey only foreshores?

From the perspective of a land manager, it is the foreshore that requires management in order to protect and manage the stream ecosystem. It is also the edge of the paddock and is readily comprehensible as part of sustainable farming, both to protect the farm from soil erosion and to minimise off-site impacts. Below the water is another world and, as such, is more remote from the day to day activities of farmers and most other land managers. Systems for assessing overall stream ecosystem condition have been promoted along side foreshore assessment, but have not been widely adopted.

Collecting other information

Foreshore condition becomes a powerful tool when other information is collected. For example, foreshore slope and soil cohesion in conjunction with condition provide an assessment of erosion hazard. Other information may include fencing status, livestock crossings, channel obstructions, erosion types, sediment deposits, stock access, major weeds, litter, fire history and feral animals. If the expertise is available, vegetation surveys should be conducted concurrently, with perhaps an assessment of health and stress levels (for example, insect and fungal attack; waterlogging and salinisation effects).

Why this basic approach?

The overall approach is to equate the degradation of stream systems with the degradation and loss of bushland, but including the added complication of erosion as the channel becomes increasingly denuded of protective vegetation. The use of 'A, B, C and D' is to create a language synonymous with quality or health, as in getting an A for a test or being of A1 health. At the other end of the spectrum is C grade in referring to a basic pass, and at the extreme end, D grade meaning a fail. These are concepts used in every day speech and do not require non-experts to learn new jargon.

It is hoped that by grading foreshores land owners will begin to see that their current state is but a stage on a pathway to greater degradation or to improvement. In having A or even B grade foreshores, landowners may see streams of such quality as a source of prestige and an indicator of sustainable management. Indeed, anything above C1 category can be considered sustainable management, giving land managers some flexibility in achieving minimum requirements by simply fencing off and controlling

The assessment process is based on concepts used in every day speech and does not require non-experts to learn new jargon.

foreshore grazing, at least in the short term. The next step, which may be some years away, would consist of replanting the understorey and going from C1 to B2 grade, with even lower levels of grazing, until perhaps grazing is excluded altogether and the foreshore achieves a B1 or even A3 category. At this level, foreshore management would also require ongoing weed and fire control and may prove to be too expensive to have wide application, but concentrated along particularly valuable stream sections, which may support rare species, or to connect high quality bushland blocks.

Target setting

Recognising a range of sustainable foreshore conditions enables realistic targets to be set to rehabilitate stream systems. For example, within the financial and land use context of a particularly degraded catchment, a sustainable 5 year target may consist of no less than 5% A grade, 30% B grade, 60% C grade with a small proportion at D grade to account for 'desilting' and drain construction to combat salinity. The next 5 year target would aim to increase the proportions in A and B grades. This sort of staged target setting provides the flexibility required by farmers facing hard times and would nonetheless deliver water quality and habitat outcomes.

How and where foreshore assessment is used

The Pen and Scott (1995) foreshore assessment method has, or is being used, in the broader south-west of Western Australia between Geraldton and Esperance. In some areas it is used simply to generate awareness of the plight of local streams, while in others it is a form of action planning. Under other circumstances it is merely used as a system to compare the condition of streams over space and time. On some rivers contractors do the work, while on others local people gather the data, which is synthesised and mapped by experts. Surveys are done by walking, boating, trail biking and horse riding and it's all great fun. Surveys can be stand-alone studies or part of comprehensive investigations into sedimentation or the effects of salinisation. Modified systems are now being developed to assess the foreshore of artificial drains and new methods have been developed to assess streams in urban areas (Shepard and Siemon 1999).

Prioritising stream sections to be managed is complex. More often than not, what actually gets managed in the short term comes down to the attitudes and financial circumstances of adjoining land owners. Within this context, prioritisation at property level is usually done on the basis of recognising the most valuable areas in need of protection, those areas that can be repaired easily and at little cost and those that are degrading quickest or are most at risk.

Long term use of foreshore assessment

In the long term, foreshore assessment can be used to monitor the state of streams and, as described above, in target setting, especially since the system can be used anywhere in the south-west agricultural zone of WA. The Blackwood Basin Group has used the system to set targets for its regional initiative (BCCG 1998). The system is also used by the Department of Environmental Protection in Western Australia through its annual reporting of the state of the environment (DEP 1999). The simplicity of the system enables its use and comprehension by a broad range of people and makes the collection and interpretation of data a simple and cheap exercise, lending itself to ground truthing of remote sensing data which may assist in covering broader areas. In the meantime the A, B, C method is doing a good job in making rivers less remote to the south-west community.

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Department of AGRICULTURE FISHERIES & FORESTRY – AUSTRALIA

National Water Week

15 – 21 October 2000

National Water Week 2000 will be held in all states and territories in Australia from Sunday 15th until Saturday 21st October. It provides a focus for the public as well as for industry, government and environmental groups to raise awareness of water issues. It reminds us all that "*Water is Life*".

This year we have an exciting line-up of events including school activities and displays, competitions, conferences, seminars and trade shows. Local government initiatives include library displays, catchment area family days, children's water monitoring and more.

Watch out for Karl Kruszelnicki on TV talking about water in Victoria, and listen to your local radio station to hear Rex Hunt, Sam Riley, Ian Kiernan and others telling us what water means to them.

National Water Week is a great opportunity to work with other people who are interested in the future of water in Australia. If you have an idea for a National Water Week activity or want to know more about what is happening in your local area contact your state coordinator from the list.

Free poster offer!

If you would like a colourful free poster for National Water Week for yourself or your school/organisation, email your name and address to the national coordinator, veronica.varsanyi@affa.gov.au or telephone 02 6271 6609.

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by Bruce Chessman, Simon Mitrovic and Glenda Orr

Biofilms, birds, bugs, blue-greens, bullrushes and more besides
New generation river monitoring for New South Wales

The water reform process has spurred a gamut of new initiatives in river monitoring across New South Wales. Gone are the days of total dependence on standard and routine physical and chemical tests. The new programs take an ecosystem perspective and they include ecological process measurements and biodiversity assessments of almost every major group of river plants and animals.

This shift has come about because of the changing policy agenda. The reform process has focused firmly on better sharing of our scarce water resources, both to improve environmental conditions of rivers and wetlands and to provide greater certainty for water users. The provision of water for the environment is based on a whole-of-catchment, ecosystem approach. The government has embraced the concept of the natural flow regime as a key driver of healthy river systems. It has established generic River Flow Objectives for NSW rivers, which focus on preserving and restoring elements of the natural regime.

River Management Committees (for regulated river systems) and Water Management Committees (for unregulated systems) have been established throughout the state. Their job includes translating generic flow objectives into locally relevant and achievable environmental flows and extraction rules for each valley, and to prepare management plans. The rules and plans are submitted for endorsement by the government.

Rules and plans need to be based on an understanding of ecosystem behaviour and biodiversity conservation values, and feedback is needed on whether they are achieving expected improvements in river health. Two ecological monitoring programs have been established by the Department of Land and Water Conservation (DLWC) to help understand ecosystem properties, processes and responses.

IMEF

The Integrated Monitoring of Environmental Flows project (IMEF) is aimed at assessing the ecological effects of the environmental flow rules that have been recently introduced to the major regulated rivers. IMEF applies to the Barwon-Darling, Gwydir, Hunter, Lachlan, Macquarie, Murrumbidgee and Namoi rivers. The Border Rivers and the Murray River, which are subject to interstate agreements, may be included in the future.

IMEF is based on specific predictions (hypotheses) about the ecological benefits that may result from specific flow regimes and,in particular, environmental flow rules. These benefits include:

- the suppression and flushing of cyanobacterial (blue-green algal) blooms
- improving the biofilms (algal — fungal — bacterial — protozoan mixtures) that coat stony river beds and are a food source for many macroinvertebrates ("water bugs")
- wetting terrestrial organic matter (fallen leaves) to stimulate river food webs, and allowing organic carbon and nutrients carried by rivers to reach estuaries
- replenishing wetlands to support biodiversity of birds, frogs, fish, macroinvertebrates and macrophytes (bullrushes, reeds and other water plants), and
- rehabilitating native fish communities by promoting breeding, migration and enhanced food resources.

IMEF is detecting changes and building ecological models by including and linking first, second and third order effects of flow rules. First order variables include water levels and velocities and wetted areas. Second-order effects include water quality characteristics, and third-order effects generally embody biological changes such as shifts in fish and macro-invertebrate assemblages caused by changed physical and chemical conditions. Second and third-order impacts are more difficult to measure because of the time delay and interactions with factors other than flow, such as the discharge of pollutants, clearing of riparian vegetation, desnagging and fishing pressures. Community concerns over the impacts of flow regulation on the ecosystem often relate to second and third-order impacts, so IMEF includes a combination of first, second and third-order variables.

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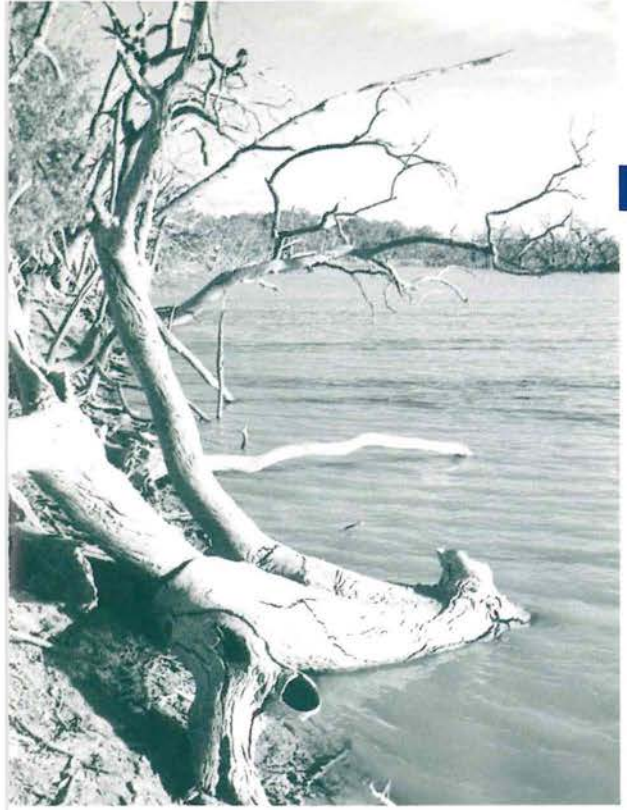
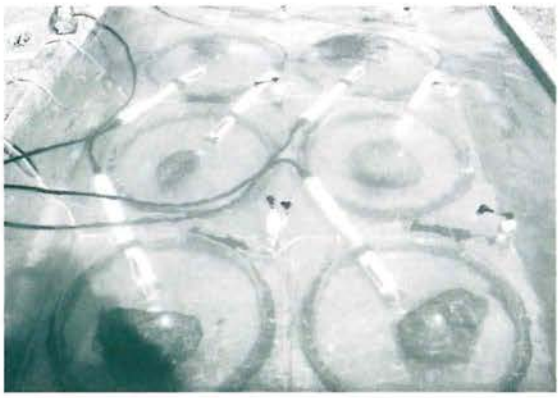




***Left**: The ecological effects of changes in flow rules are being measured in many of the valleys in NSW.*

***Above**: Biofilm studies in progress on the Goodradigbee River in the Murrumbidgee catchment, as part of IMEF. The study involves measuring biofilm composition, photosynthesis and respiration (P & R) as well as macroinvertebrate communities and stable isotope signatures, which help to track food chain pathways. A chamber being used for measuring P & R on river rocks.*

Pressure — biota — habitat (PBH)

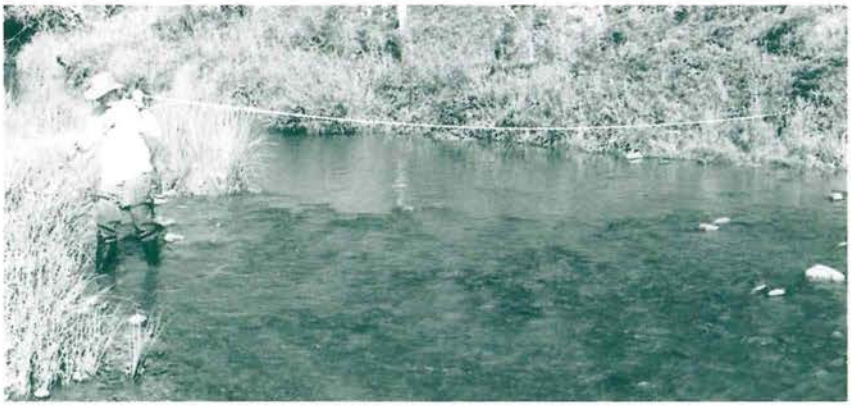
PBH (pressure — biota — habitat) is being trialed as a rapid assessment, mainly for the unregulated rivers that are too numerous for a detailed, quantitative approach like IMEF in the first instance. Its objectives are:

- to provide an evaluation of the biological stress in riverine ecosystems,
- to identify problems that are likely to be preventing the natural recovery of lost values (constraints), or jeopardising preserved values (threats), and
- to provide a baseline from which to evaluate general ecosystem responses to management changes in the medium to long term.

PBH is also being reviewed as to whether it can identify river attributes that are of conservation significance.

PBH integrates biological assessment (for example; diatoms, aquatic macrophytes, riparian vegetation, macro-invertebrates and fish) with water quality and physical habitat assessment. It generates a suite of summary indicators of biological stress, human-generated stressors and potentially, conservation significance, using field survey data and other available information. Indicator values are compared with reference values and thresholds for the same type of river, leading to an overall conservation and stress assessment for each zone in an unregulated sub-catchment. PBH also generates hypotheses about the causes of ecosystem stress that may need to be addressed in river planning and management, or may require further research.

In 1999–2000, PBH was trialed through once-off assessments of four river systems: Adelong Creek in the Murrumbidgee catchment, the Bega River on the south coast, the upper Castlereagh River in the north-west and Wollombi Brook in the Hunter Valley. The objectives of these trials were to test interim procedures for practicality, to refine the measurement of variables and the calculation and interpretation of indices, and to evaluate the performance of various indicators. The results of these trials are currently being evaluated.



***Above**: Measuring stream width on Adelong Creek as part of PBH habitat assessment.*

***Below**: Sampling macroinvertebrates with a sweep net for bio-assessment of Adelong Creek.*

Monitoring stream health programs in the Goulburn Broken Catchment

The Catchment

The name Goulburn Broken is derived from the Goulburn and Broken Rivers. The Catchment covers 17% of Victoria and stretches from close to the outskirts of Melbourne, to the Murray River in the north. It supports major agricultural (dryland and irrigated), food processing, forestry and tourism industries and generates 26% of the rural export earnings of the State of Victoria. Downstream users of water resources rely heavily on the water exported from the catchment.

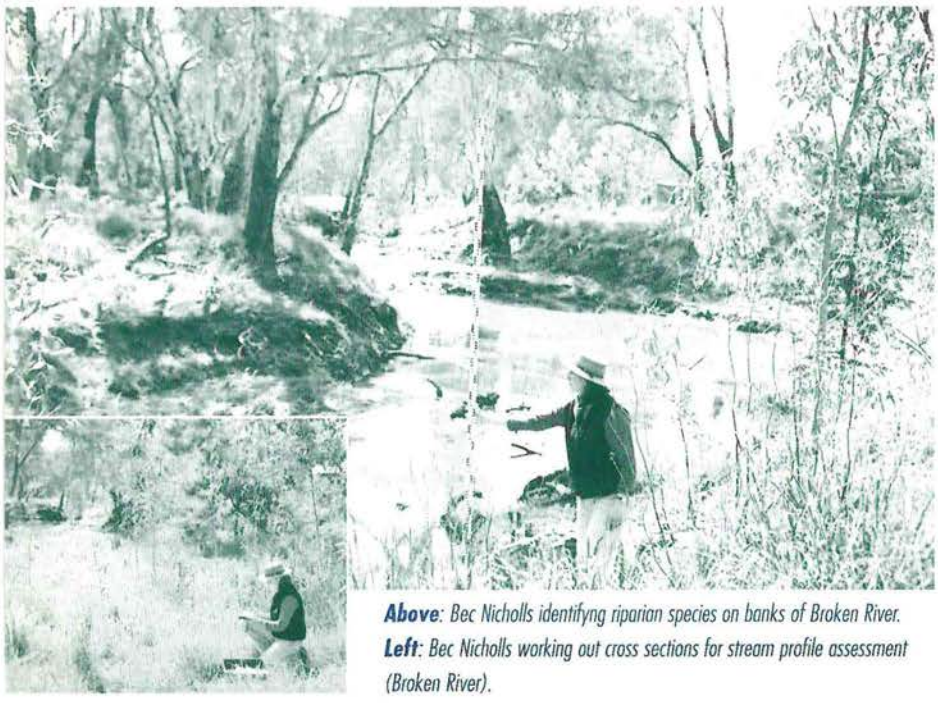
Targets

Goulburn Broken Catchment Management Authority is working with other natural resource managers to ensure that land and water resources are protected and enhanced. Priority goals for "*Waterway Health*" contained within the Regional Catchment Strategy are: a 65% reduction in nutrient loads leaving the catchment; reduce stream salinity; and improve the health of 3000 kilometres of streams to 'good' or 'excellent' over 30 years while maintaining the condition of streams currently rated as 'good', 'very good' and 'excellent'.

Performance monitoring

To gauge our progress, a range of monitoring programs have been set up. These programs vary according to the funding available, the goals of the programs and the range of values to be protected or enhanced. Two key methodologies are employed: snapshot/indicators (indicators of condition); and targeted monitoring (monitoring against stated goals).

It is essential that "performance monitoring" be linked to the goals of the program. Monitoring generally starts before the development of a strategy, design and implementation of works and activities to enable the establishment of benchmarks. In other instances control sites are established.

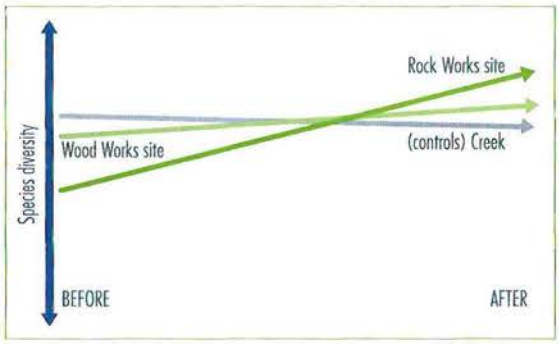


***Above**: Bec Nicholls identifyng riparian species on banks of Broken River.*
***Left**: Bec Nicholls working out cross sections for stream profile assessment (Broken River).*

Examples of monitoring programs

The CMA employed the Index of Stream Condition (ISC) to benchmark the condition of streams in the catchment. The ISC has been utilised by all Catchment Management Authorities in Victoria to assist in assessing the effectiveness of programs and to aid regional priority setting. The Index is a measure of a stream's change from natural or ideal conditions (DNRE, 1997). It presents an indication of the extent of change in respect of five key "stream health" indices: Hydrology; Physical form; Streamside zone; Water quality; and Aquatic life.

Benchmark conditions have been established for more than 120 sites within the catchment. ISC sites will be reassessed in 2005. In addition to the catchment scale initiative, project related monitoring has been employed using the Physical form and Streamside zone sub-indices. To date we have seen the ratings of some stream reaches improve within a two to five year time frame.



Schematic of fish and invertebrate species response to restoration in Ryans Creek.

Wayne Tennant, water sampling on the banks of the Broken River.

Examples of monitoring programs

Table 1 presents details of *some* of the monitoring programs being implemented within the catchment.

FISH PASSAGE	
Aim	To enhance native fish populations through the removal of barriers to fish movement.
Hypothesis	Should fish populations have free access past a barrier, then given comparable habitat, there should be no difference in fish communities either side of the fishway.
Method	Sites along the Broken Creek were quantitatively surveyed. The stream was divided into zones where migrational opportunities were provided and zones where barriers still existed.
Results	Prior to the installation of the fishways communities (species and numbers) reduced as barriers interfered with migration. The monitoring demonstrated that there are similarities in the fish communities where fishways have been installed. Above sites with no fishways (barriers still exist) fish communities were dissimilar. Overall, the work found evidence to support the conclusion that the fishways are working.
INTEGRATED WATERWAY/CATCHMENT PROJECTS	
Aim	To assess the impacts of waterway/catchment management programs on the quality of water entering Lake Mokoan. To monitor the impacts of grazing and instream works on aquatic ecosystems.
Monitoring	To assess the condition of aquatic communities within works and non-works sites using the nationally adopted RBA (Rapid Bio assessment) method for macro invertebrate monitoring. Eight sites were monitored during winter and spring. In addition a Water Quality Monitoring Program was initiated in 1991. Five separate monitoring programs have since been undertaken. The monitoring has been used to assist in assessing trends in water quality as a result of catchment and waterway management activities in the catchment.
Results	The works (reduction in stock access, grade control activities and revegetation) have been effective in improving waterway health. Long term monitoring has begun. Generally, water quality entering from the streams is poor, however, some improvements in water quality were observed in streams where works were initiated.
IMPACTS OF AQUATIC HABITAT REHABILITATION	
Aim	To evaluate the impact of stream rehabilitation works on the fish and macro-invertebrate communities.
Works undertaken	The addition of logs and boulders in the stream, replacement of willows with native vegetation, control of bank erosion and fencing to exclude stock.
Monitoring	Undertake a comparison of trends in biotic community attributes, such as fish and macro invertebrate diversity, with those in untreated reaches. Standardised indices of biodiversity were used to detect any changes in the aquatic fauna at each site. Data was collected before and after the treatments. Hydraulic surveys were undertaken to monitor changes in the stream before and after the rehabilitation treatments.
Results	Fish species diversity significantly increased in one stream but not in the other. No consistent trend for increasing macro-invertebrate diversity was observed in either stream. The implications of these results for the design of evaluation strategies for stream rehabilitation projects are under development.
IMPACTS OF GRAZING (A LWRRDC EVALUATION AND DEMONSTRATION PROJECT)	
Aim	To evaluate the impacts of grazing on aquatic ecosystems. This project monitors and assesses the impacts of grazing on the status and management of the riparian zone, in particular: Vegetation; Stream and soil erosion; and Aquatic ecosystems.
Monitoring	Seven monitoring sites have been set up. Each site has been managed by alternative grazing regimes (control grazing, total grazing and no-grazing zone) and are to be monitored over an 18 month period. Monitoring programs employed include longitudinal and cross section surveys, vegetation quality assessments, vegetation composition, application of the ISC, macro invertebrate sampling and shade.
Results	Monitoring still underway.
CONTROL OF EXOTIC (AQUATIC) VEGETATION	
Aim	To assess the impacts of control programs and the draining of Lake Benalla on the growth and spread of *Cabomba Caroliniana* and *Nymphaea Mexicana*.
Monitoring	Area of infestation — mapped and follow up monitoring undertaken following implementation of control strategies. Two stage strategy proposed: Stage 1 — control spread of weed; and Stage 2 — eradicate (if possible) and introduce native vegetation as a competitor.
Results	Initial monitoring highlighted reduction in the area of weed infestation.

In addition to the these programs, a range monitoring programs are undertaken by the Catchment Management Authority, the community and industry/agencies to assess the performance of programs and initiatives.

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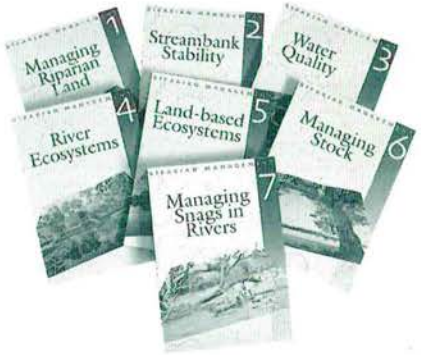

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