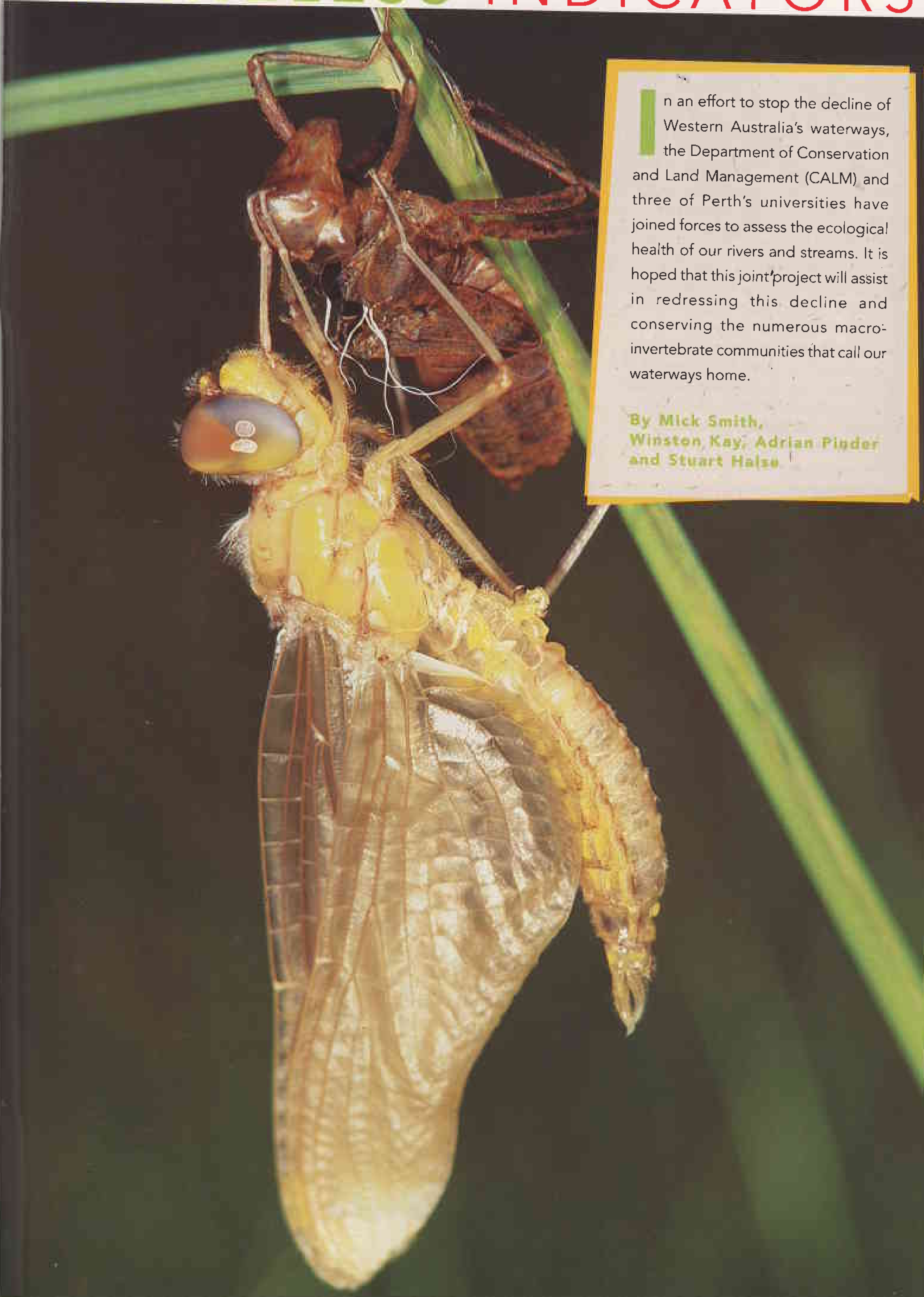
SPINELESS INDICATORS



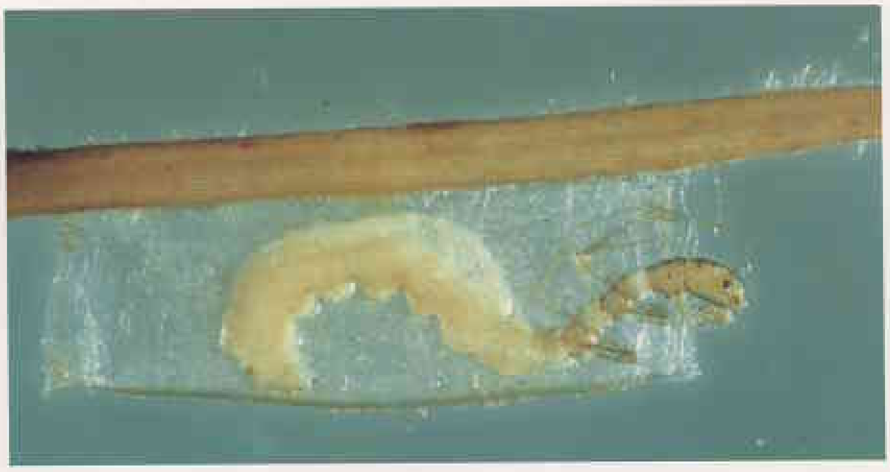
In an effort to stop the decline of Western Australia's waterways, the Department of Conservation and Land Management (CALM) and three of Perth's universities have joined forces to assess the ecological health of our rivers and streams. It is hoped that this joint project will assist in redressing this decline and conserving the numerous macro-invertebrate communities that call our waterways home.

By Mick Smith, Winston Kay, Adrian Pinder and Stuart Halse

Australia's rivers are fast becoming a focus for environmental concern with declining water quality and increased competition for water resources. In regional Western Australia, much of this concern is focused on rivers in the south-west, where the pressures of human activity are most prevalent.

The foremost concern is the increasing problem of salinity in agricultural areas. The State Government's recent Salinity Action Plan aims to address high salinity levels by promoting and coordinating surface drainage of farmland, groundwater pumping and large-scale planting of deep-rooted tree species, such as blue gums and oil mallees (see 'Tree Crops for Farms', *LANDSCOPE*, Summer 1992–93.)

Another growing problem is eutrophication (nutrient enrichment) of our waterways caused by fertilisers, detergents and other sources of nutrients washing into rivers and streams. Eutrophication can contribute to excessive algal growth and sometimes lead to toxic algal blooms. Further environmental concerns include pesticide levels, the extent of industrial discharge into rivers and streams, and the continuing erosion of river banks and silting of river channels resulting from grazing and clearing of river bank vegetation.

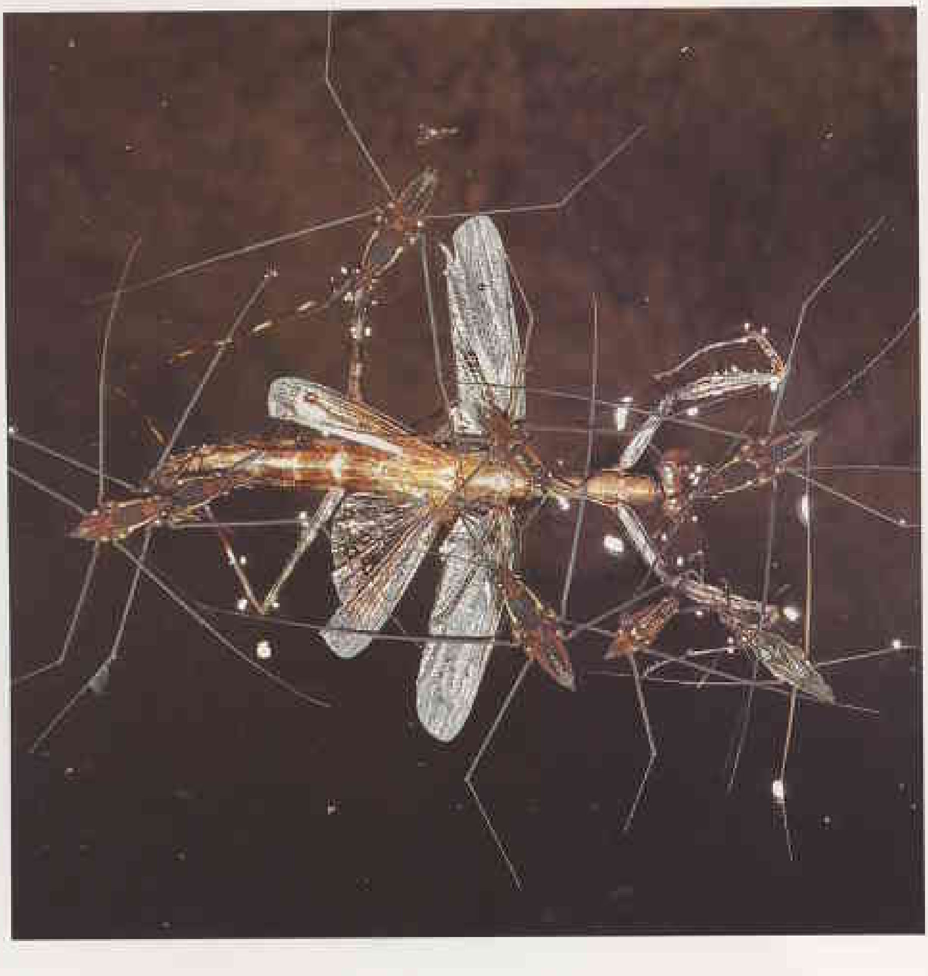


BIOMONITORING

In order to efficiently target resources to remedy these problems, it is necessary to assess the ecological condition of rivers and streams. Biomonitoring (monitoring the response of plants or animals to changes in their environment) is an economic and information-rich way to do this.

The response of plants and animals to their environment provides a better measurement of a river's health than chemical measurements—their response is a direct reflection of the health of the river or stream, whereas chemical analysis is indirect. Moreover, organisms integrate water conditions over a period of time, depending on their own life-span. This means a single period of adverse water quality during their life-cycle may result in death. Such a pulse of poor quality water is unlikely to be detected by chemical measurement. Another benefit of using plants and animals, is that they take into account the proportion of the contaminant which is in a form that will affect flora and fauna. Contaminants may be detected in high levels in chemical analyses, but have no ecological effect, as they are rendered harmless by their attachment to organic compounds in the water. In this situation, chemical analysis can give a false alarm.

Many organisms can be used for biomonitoring, but macro-invertebrates are often used in rivers and streams, as they are common, widespread and easily sampled. They are large aquatic invertebrates that can be seen with the



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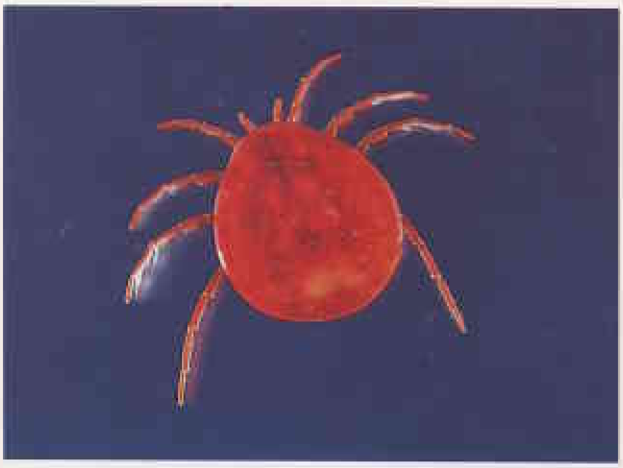
Adult dragonfly (*Orthetrum caledonicum*) emerging from its nymphal case. The adult is terrestrial, the nymph is aquatic.
Photo – Jiri Lochman

Above: The aquatic larva of the caddis-fly (*Acritoptila globosa*) lives in a silken case attached to a reed or small twig.
Photo – Jenny Davis

Left: Aquatic bugs, or water strides, of the family (*Gerridae*), feed on a dead preying mantis on the water surface.
Photo – Jiri Lochman



naked eye and include all aquatic insects, snails, worms and larger crustaceans. Some macro-invertebrates, particularly insects, spend only their larval stages in water and have terrestrial adult stages. Dragonflies, midges and mosquitoes are better known examples of these.

The size of macro-invertebrates is variable. At the larger end of the spectrum is the belostomatid bug, which can be more than eight centimetres long and inflict a painful bite with its strong grasping front legs. Other well-known large macro-invertebrates include marron and gilgies. Among the smaller macro-invertebrates are midge larvae, nematodes and water mites, which can all be less than one millimetre long.

Macro-invertebrates often have specific requirements in terms of water quality and are adapted to these conditions, just as terrestrial animals may be adapted to tropical conditions or high altitudes. Some macro-invertebrates cannot survive in polluted or disturbed streams, while others thrive in degraded conditions. Thus the condition of a river or stream greatly affects its macro-invertebrate community.

THE PROGRAM

In 1994, the Commonwealth Government funded CALM to set up a biomonitoring program for rivers and streams in WA as part of AUSRIVAS (Australian River Assessment Scheme). Under AUSRIVAS, macro-invertebrates are used to monitor environmental conditions. Most of the research on macro-invertebrates in Western Australia has been done by the State's universities. To take advantage of this expertise, AUSRIVAS was run as a partnership between CALM, Edith Cowan University, Murdoch University and The University of Western Australia. There were three stages to setting up the AUSRIVAS program.

To begin, the universities collected samples of macro-invertebrate communities from 138 pristine or minimally disturbed river and stream sites in regions where agriculture and urban development are most intensive. CALM sampled 51 sites in the Murchison, Gascoyne, Pilbara and Kimberley regions in spring 1994 and autumn 1995.

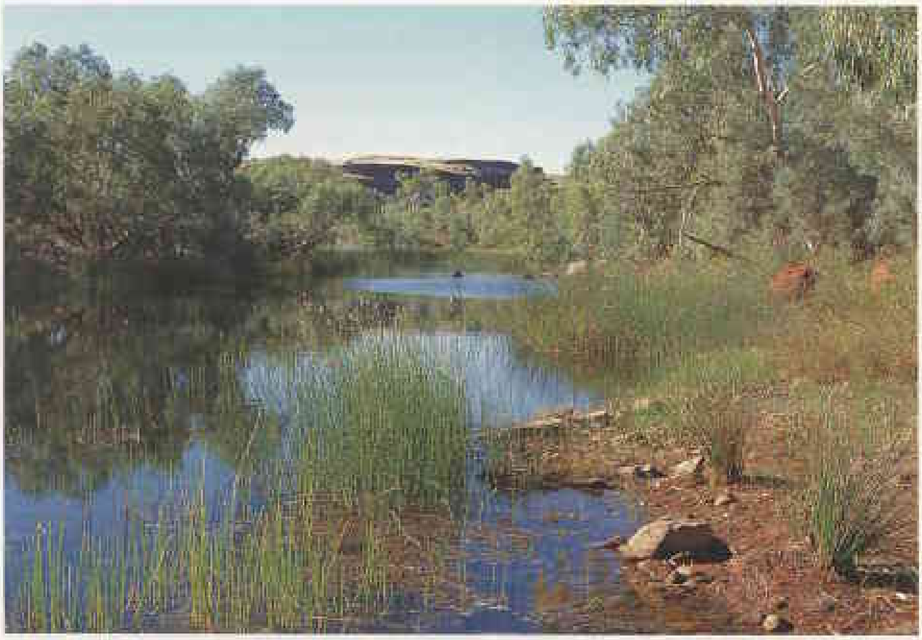
The sampling methods and analytical techniques employed were very similar to those used in a highly successful macro-invertebrate biomonitoring program in the United Kingdom called 'RIVPACS'—River InVertebrate Prediction And Classification System. The main difference between the two programs is that in WA, separate sampling of major habitats at each site was undertaken to make comparisons between streams easier.

In the second stage of the program, biomonitoring models were developed. These included a model for channel habitat, the central part of the stream bed, and a model for macrophyte habitat, which encompassed the areas of submerged

Above: Water mites, such as this species of *Eylais*, are usually small, brightly coloured and sensitive to changes in water quality.
Photo – Jenny Davis

Above right: The marron (*Cherax tenuimanus*), a common macro-invertebrate in south-western Australian streams, is sensitive to eutrophication and salinity.
Photo – Marie Lochman

Right: Access to remote river pools, like the Kimberley's Fletcher Creek, was by helicopter.
Photo – Stuart Halse



water plants and areas where rushes and sedges emerged out of the water.

The computer models were developed by grouping sites with similar macro-invertebrate communities. The environmental characteristics of the sites, supporting different types of macro-invertebrate communities, were determined using environmental descriptors, such as geographical position, seasonality of flow, annual discharge and the position of the site along the stream (whether it was a headwater or lowland site).

When the ecological condition of a new stream site is tested, its environmental characteristics are fed into the appropriate biomonitoring model, which then produces a list of macro-invertebrates it would expect if the site was undisturbed. The ecological rating of the test site is measured by comparing the biomonitoring model's predicted community type with the macro-invertebrates that were actually collected. If the match is good, the test site is classified as undisturbed, whereas if a high proportion of expected macro-invertebrates are missing, the site is classified as disturbed.

The third stage of the program involved checking the validity of the ecological ratings produced by the models. So far, 31 sites have been assessed. Sixteen of the sites were expected to be undisturbed on the basis of visual inspection and their catchment history. The models' ratings agreed in 15 cases, with one site rated as marginally disturbed—an error rate of six per cent.

The other 15 test sites had surrounding land uses and catchment history that suggested they would be disturbed, and the models rated 12 of them this way, giving an error rate of 20 per cent. It is possible that the observed

Top left: The Fortesque River, in Milstream-Chichester National Park, supports an abundance of aquatic invertebrates.

Centre left: Tarda Pool on the Fortescue River is fed by a spring and retains water all year.
Photos – Stuart Halse

Left: Many of the Kimberley's rivers, such as the Mitchell River, contain extremely fresh water and support twice as many species as WA's south-west rivers.
Photo – Winston Kay

level of disturbance at these three sites did not translate into ecological damage, so the true error rate may be less than 20 per cent. The models seem to be producing accurate results with acceptable low error rates. Future improvements to the models should reduce the error rate further.

LARGE SCALE USE OF THE PROGRAM

The first broad-scale use of AUSRIVAS in WA will occur in the Wheatbelt region in spring 1997, in conjunction with the biological survey and ecological monitoring being undertaken as part of the Salinity Action Plan. The ecological condition of 150 stream sites on public and private land will be assessed to identify areas with the highest biodiversity and those where salinity and other land disturbance have most affected river health. This information will help plan drainage and tree-planting schemes. It will also provide a basis against which future changes in ecological conditions of the Wheatbelt's waterways can be measured. This is one of the ways the success of the Salinity Action Plan can be assessed.

FUTURE BENEFITS

In the longer term, ecological conditions of many rivers and streams throughout WA will be assessed and monitored. This will enable a State-wide comparison of river health and identification of the ecological problems in different regions. This information will be a key element in environmental planning for managing the State's water resources.

One of the aims of the program is to encourage long-term monitoring of the health of rivers at selected sites. Long-term monitoring makes it easier to assess the impacts of water usage and land development, and to plan appropriate remedial action if adverse effects arise. It also enables the benefits of river restoration and land-care projects to be measured.

As with all natural systems, rivers and streams cannot be managed without knowledge of how they function. Wildlife research provides part of the basis for managing natural systems. AUSRIVAS is a step towards better management of rivers and streams in WA and the conservation of its macro-invertebrate fauna.

The Lyons River near Mt Augustus is a tributary of the Gascoyne River and contains a mixture of tropical and south-western species of aquatic invertebrates.
Photo – Robert Garvey

Mick Smith (e-mail micks@calm.wa.gov.au), Winston Kay (e-mail winstonk@calm.wa.gov.au) and Adrian Pinder (e-mail adrianp@calm.wa.gov.au) are the consultants, employed by CALM to work on AUSRIVAS and the Monitoring River Health Initiative. Stuart Halse (e-mail stuarth@calm.wa.gov.au) is a principal research scientist with CALM's Science and Information Division. They are based at CALM's Wildlife Research Centre and can be contacted on (09) 405 5100.

Collectively the authors have more than 30 years experience in the research of Western Australia's rivers and streams.

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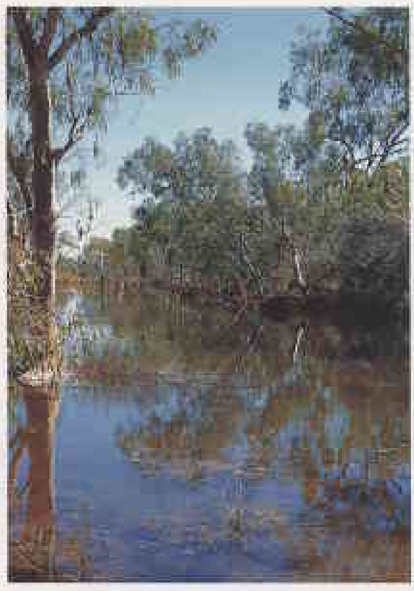
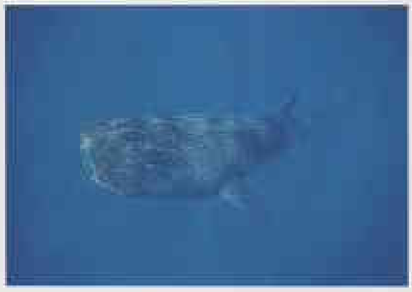
FEATURES

REGULARS



Aquatic bugs are helping scientists to determine the health of WA's waterways. See Spineless Indicators on page 49.



CALM's new Marine Conservation Branch gets in deep (page 10) to play its vital role in safeguarding the health of WA's unique marine environment.

Called 'Karlamilyi' by desert Aborigines, Rudall River National Park (page 28) is steeped in history and bristling with wildlife.

The economic, social and conservation potential of Acacia in WA , a story of a golden future on page 16.

Fancy a walk? Join us while we look at the environment, history and building of a new Bibbulmun Track. See page 36.

COVER

The tiny pebble-mound mouse of the Pilbara (see story on page 42) is a tireless night-worker and the architect of many odd, red gravelly mounds, which look like miniture volcanoes among spinifex.

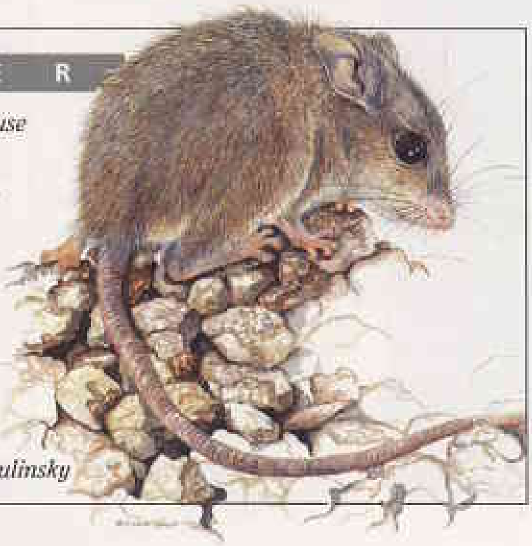


Illustration by Philippa Nikulinsky

Managing Editor: Ron Kawalilak
Editor: David Gough
Story Editors: Verna Costello, Mitzi Vance, John Hunter
Scientific/technical advice: Andrew Burbidge, Ian Abbott, Paul Jones and staff of CALM's Science & Information Division
Design and production: Maria Duthie, Sue Marais
Finished art: Maria Duthie, Sue Marais, Gooitzen van der Meer
Illustration: Gooitzen van der Meer, Ian Dickinson
Cartography: Promaco Geodraft
Marketing: Estelle de San Miguel ☎ (09) 334 0296 Fax: (09) 334 0498
Subscription enquiries: ☎ (09) 334 0481 or (09) 334 0437
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