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Small signs of a salty past

Stuart Halse

In the past 60 years, rising groundwater in the wetlands of Western Australia's wheatbelt has resulted in an insidious salinisation and loss of biodiversity. Through its State Salinity Strategy, the WA Government hopes to arrest and in some cases reverse this disastrous trend, and the work of Dr Stuart Halse from the Department of Conservation and Land Management is part of the strategy.

Halse is involved in two projects that are providing information on the areas and species at risk from salinity and the biodiversity and conservation values of different wetland habitats. The projects will also enable the success of salinity management strategies to be determined.

'The first project I'm involved in is a biological survey of the wheatbelt,' Halse says. This will identify conservation values, document biodiversity, identify species at risk and provide information for salinity management decisions. The second project involves monitoring 25 wetlands in detail, to determine the effect of various management interventions.'

In both projects, Halse has been looking at how different levels of salinity affect species richness and community composition among three key components of wetland biodiversity: waterbirds, vegetation and aquatic invertebrates, including microinvertebrates.

'Because we're looking at biodiversity as a whole, it's important to understand that there are a range of biodiversity values within an ecosystem,' he says.

'One wetland may have a high biodiversity value for waterbirds, so monitoring plants could be misleading. Another may have shallow meadows and a large number of plant species, but will be unsuitable for waterbirds.

'Invertebrates provide a good measure of ecosystem health, because they are more sensitive to changes in water quality than plants or birds. So we need to look at a number of biodiversity values in order to round out the picture.'

Halse's studies have revealed a salinity threshold beyond which substantial changes in community composition will occur. In Western Australian fresh waters, however, this threshold is higher than that observed elsewhere, particularly among invertebrates and microinvertebrates.

'Our studies have shown the freshwater fauna of the wheatbelt is comparatively salt-tolerant and that substantial changes in community composition will be seen only when salinity exceeds 10 000 milligrams per litre,' Halse says.

Information on the areas and species at risk from salinity and the biodiversity and conservation values of different wetland habitats is central to the Western Australia's State Salinity Strategy. This involves monitoring waterbirds, vegetation and aquatic invertebrates including microfauna, which are highly sensitive to changes in water quality.

Main picture: Rain-filled granite rock pools are a conspicuous feature of the wheatbelt and provide a refuge for salt-sensitive microfauna and other aquatic invertebrates.

Inset top: The red-kneed dotterel feeds on invertebrates in shallow water and on the wetland margin. Found only in fresh or brackish situations, it avoids straongly saline wetlands.

Above: *Diacypris spinosa*, a widespread species of microfauna restricted to brackish and moderately saline waters. While this species occurs often in secondarily saline wetlands, it cannot tolerate really high salinities.

Calamoecia trilobata

Calamoecia clitellata

Mytilocypris tasmanica

Boeckella robusta

This level of tolerance is counter to the results of studies elsewhere, which have shown a strong relationship between salinity and the number of animals or plants. 'Generally, as you double salinity you halve the number of species. But in the wetlands we studied, we didn't see that pattern until salt concentrations were over 10 000 mg/l,' Halse says.

Halse believes this phenomenon is due to the naturally saline conditions in Western Australia, which have led to an evolution of salinity tolerance among freshwater fauna.

'Seasonal flooding and drying of many wetlands produce brackish conditions, and onshore winds bring a lot of salt inland,' he says. 'As a result we have a fauna adapted to higher salt concentrations than the same or similar species elsewhere.'

In terms of the salinity strategy, Halse's results indicate that management targets should aim for salinity levels below 10 000 mg/l. He says this may allow salt-sensitive species that have disappeared from wetlands to use these habitats again

Microfauna and salinity

Halse has worked with CSIRO's Dr Russell Shiel to identify several freshwater microfauna with greater salinity tolerance than their eastern counterparts. This microfauna includes calanoid copepods and cladocerans (see story on page 13) which are generally characterised as salt-sensitive organisms.

Halse has recently identified a new species of calanoid copepod (*Calamoecia trilobata*) from saline lakes in the central and southern wheatbelt. This discovery brings the number of salt-tolerant *Calamoecia* species described in Western Australia to three.

'Why more salt-adapted species of *Calamoecia* occur in Western Australia than other parts of Australia is not fully understood, but is probably the result of Western Australia being an old and geologically stable landscape with a relatively long history of natural salinity,' Halse says.

Not all microfauna in the wheatbelt are salt tolerant however. As part of his work in support of the salinity strategy, Halse surveyed freshwater pools in granite rock outcrops – a conspicuous feature of the wheatbelt landscape. These rock pools are filled by rainfall, usually in winter, and persist for weeks to months, providing a refuge for at least 230 species of aquatic invertebrates and microfauna.

Salty survivors: The freshwater microfauna of Western Australia show a greater tolerance to salinity than their eastern counterparts. Salt tolerant species include the recently identified copepod *Calamoecia trilobata*, from saline lakes in the central and southern wheatbelt, *Calamoecia clitellata*, found in secondary saline wetlands, and *Mytilocypris tasmanica*. The copepod, *Boeckella robusta* on the other hand, is restricted to fresh and slightly brackish water.

Halse says this represents about a quarter of the total wheatbelt aquatic invertebrate fauna, which is estimated to be at least 800 species. Many of these species are found in wetlands and other parts of Western Australia, but at least 50 species have only been found in the pools.

'Granite outcrops have particular conservation value for about 50 species, mostly rotifers, microcrustaceans and some worms and midges, which are restricted to them,' he says.

Like the ephemeral pools of the River Murray floodplain (see story on page 12), the community composition and species richness between different rock pools varies widely, largely due to the succession of different organisms at different times after flooding.

These observations indicate that granite rock outcrops may have an increasingly important conservation role as the wheatbelt becomes more saline over the next few decades.

'The primary conservation value of the outcrops however, is as habitat for the smaller number of species unique to the freshwater habitats the outcrops provide,' Halse says. 'And the heterogeneity between rock pool communities implies that a large proportion of granite outcrops in the wheatbelt will need to be protected in order to conserve all of the region's granite pool species.'

More about biodiversity and salinity

Halse SA and McRae JM (in press) *Calamoecia trilobata* n sp (Copepoda: Calanoida) from salt lakes in south-western Australia. *Journal of the Royal Society of Western Australia,* 83.

Halse SA Pearson GB McRae JM and Shiel RJ (2000) Monitoring aquatic invertebrates and waterbirds at Toolibin and Walbyring Lakes in the Western Australian wheatbelt. *Journal of the Royal Society of Western Australia,* 83:17–28.

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As part of Western Australia's State Salinity Strategy, Stuart Halse from the Department of Conservation and Land Management ismonitoring 25 wetlands to determine the effects of different salinity levels on invertebrate fauna, waterbirds and vegetation.

Top right: Weelhamby Lake in north-eastern wheatbelt of Western Australia, a naturally-saline lake and survey site.

Above right: At Walymouring Lake in the central wheatbelt, changes in the invertebrate fauna over time are being monitored as land-use patterns change. Dead vegetation (*Melaleuca* and *Casuarina* trees and samphire understorey) are already apparent.

Right: This paperbark swamp near Corrigin in the central wheatbelt is typical of most wheatbelt wetlands and is a monitoring site where deterioration in habitat quality and thus the invertebrate community are likely.