Trashed or treasure? Finding alternatives in salty wetlands

An underwater meadow of macrophytes (*Ruppia polycarpa* and *Lamprothamnium* sp.) at Meeking Lake, Blackwood River catchment, Western Australia. This meadow provides a food source and habitat for black swans and a variety of waterfowl. *Photograph: Jenny Davis.*

If we can't restore original conditions in rivers, streams and wetlands, do we just give up – or are there acceptable alternative states that can still support our wildlife? Louise Ralph reports.

THICKETS of swamp sheoak, paperbarks and flooded gums, with rushes, sedges and woody shrubs at their feet once graced the fresh and seasonal wetlands of south-western Australia.

But human activity has resulted in changes in the water system and an increase in salinity. Increases in water depth and the loss of natural wetting and drying cycles have changed wetland plant communities.

Submerged plants are replacing trees and emergent vegetation. Birds and animals that rely on emergent plants are struggling to live with these changed conditions. Most move on or die out.

It doesn't stop there. Researchers say further increases in salinity will result in the loss of submerged plant species too. Without plant life, thick carpets (called benthic microbial mats) cover the lake floor and there is a further loss of biodiversity.

The before-and-after shots are grim, but there is hope. Valuing our wetland areas and protecting them from further salt damage is vital, says Dr Jenny Davis, a researcher at Murdoch University in Western Australia.

As part of the National River Contaminants Program, jointly funded by Land & Water Australia and the Murray-Darling Basin Commission, Davis and her team are investigating viable alternative states between degraded and healthy wetlands.

The idea of *alternative* or *multiple*

Looking at alternatives

Researchers are using a model of alternative stable states coming out of the northern hemisphere. The model says that all rivers and wetlands are one of two types, and researchers have added alternative states unique to our Australian conditions:

- **clear water, dominated by submerged plants;**
- **clear water, dominated by a benthic microbial mat, i.e. shallow clear water above a dense mat;**
- **turbid water, dominated by phytoplankton (floating and attached to plants);**
- **turbid water dominated by sediment.**

Salinisation results in the loss of freshwater species of submerged plants and dominance of a small number of salt-tolerant species, which also die out when salinity increases further.

In water bodies high in salinity a dense carpet of mucilaginous material, called a benthic microbial mat, forms on the lake floor. Once formed, these strongly cohesive mats stop discharge to groundwater and turn the water body into an evaporation pan.

Little White Lake, Arthur River catchment, Western Australia. This lake has undergone extensive secondary salinisation. The associated deaths of trees and emergent vegetation are clearly evident at the lake. However, high-rainfall winters appear to provide sufficient freshwater to the lake to enable growth of submerged macrophytes and use by waterbirds. Salinities recorded at the lake in 2002–03 ranged from 157,000 mg/L TDS (when nearly dry) to 29,000 mg/L (when re-filling with winter rain). ***Photograph: Jenny Davis.***

Did you know?

- **Inland waters can be saltier than seawater (35,000mg L-1) from secondary salinisation.**
- **Dryland salinity is estimated to affect more than 2.2 million hectares across Australia.**
- **Systems lose resilience from secondary salinisation, making them more susceptible to catastrophic events like drought and cyclonic rains.**

stable states has been used to explain vegetation change in systems from coral reefs to inland waterways.

It has also been successful in predicting the response of wetlands to changes in nutrient status, such as increases in phosphorus from fertilisers and sewage treatment plants.

Researchers are applying the theory to salinity problems in the rivers and wetlands of south-western Australia.

If successful, their work could help land managers predict how a wetland area will respond to changes in salinity, particularly salinity resulting from human activities (secondary salinity).

The rich soup of macroinvertebrates, (waterfleas and seed shrimps) present in the underwater meadows, which also provide a rich food source for waterbirds. *Photograph: Jenny Davis.*

"In some areas in Australia, we will never be able to restore systems to their original freshwater state – but we need to recognise and value them as functioning systems rather than thinking they are now useless," Davis says.

Many landholders are constructing deep drains to channel salty water off their properties. ▶

Meeking Lake, Blackwood River catchment, Western Australia. Secondary salinisation is occurring at this wetland, although salinities are lower than those recorded at wetlands and salt lakes in the lower rainfall zone further east. Salinities recorded at this wetland ranged from 23,000 mg/L TDS on drying, to 6600 mg/L on re-filling. *Photograph: Jenny Davis.*

While this may seem to be the perfect engineering solution, researchers say the results are disastrous.

"People believe these wetlands are beyond hope and it doesn't matter what we do to them," Davis says. "But adding large volumes of saline drainage water to an already salty wetland can be the last straw. It will lead to a switch from submerged aquatic plants that can tolerate certain levels of salinity to benthic mats. This represents a major change in ecological structure and a loss of biodiversity."

Research shows that submerged aquatic plants can still support some water birds, as well as aquatic invertebrates such as seed shrimps (Ostracoda), water fleas (Cladocera) and damselflies (Zygoptera) – but benthic microbial mats would not. Draining salty nutrient-enriched water into wetlands can also stimulate phytoplankton blooms, causing water quality problems when the phytoplankton decays.

Researchers suggest that a salinity of 60,000mg L^{-1} TDS (total dissolved solids) may be the upper threshold for dominance by aquatic plants. Any higher levels could result in benthic microbial mats developing. However, there is more work to be done before the thresholds are finalised.

"We need to find out what conditions cause these mats to form, and whether submerged plant dominance and benthic microbial mats can really be considered to be alternative states," Davis says.

The outcome of the project, which will be completed in March 2004, will be restoration goals that may involve recognising or promoting alternative states rather than restoring the ecology of these systems to their original condition.

"We are saying that although we've lost the diversity of species we had when they were freshwater, we still have a lot of systems that are functioning quite well," Davis says.

"Being able to recognise and predict changes to wetland ecosystems with changes in salinity will be a very useful tool for decision-makers and managers."

National River Contaminants Program

Contaminants and pollutants in our water system influence the quality of our irrigation and drinking water. They also affect the health of aquatic habitats, and the survival of our unique plant and animal life.

In 2001, the MDBC and Land & Water Australia jointly commissioned the National River Contaminants Program. The program focuses on the combined impacts of major riverine contaminants – salt, nutrients and sediments – and their role in ecosystem processes. Although they occur naturally, increased amounts of salt, nutrients and sediments can damage the environment.

The aim of the program is to improve our understanding and management of river contamination issues, reduce associated costs and better manage the risk of river contamination.

For more information visit <www.mdbc.gov.au/projects/contamin_prog.html>.