



CLLAMMecology Research Cluster

Research in the Coorong, Lower Lakes and Murray Mouth

Final Report

NEED FOR RESEARCH

The Coorong, Lower Lakes and Murray Mouth (CLLAMM) region is one of Australia's largest wetland systems. Located south-east of Adelaide in South Australia, the region is of international ecological significance and is one of the Murray-Darling Basin Authority's Living Murray Icon sites. The region hosts an economy based on agriculture, fisheries and tourism, and is the traditional country of the Ngarrindjeri nation. Modifications to the flow regime of the River Murray have resulted in a significant change in the ecological character of the region. Currently consumptive use of water across the Murray-Darling Basin has reduced the average annual stream flow at the Murray Mouth by 61 per cent. Water use and a regional drought have resulted in siltation of the Murray Mouth channel to the sea and extreme hypersalinisation of the Coorong's South Lagoon.

Through CSIRO's Flagship Collaboration Fund, the CLLAMMecology Research Cluster began in 2006 and completed its work in June 2009. It brought together scientists from a range of disciplines in the most comprehensive ecological research program undertaken in the region. The team gathered ecological information and developed a decision-support framework to assess the effectiveness of interventions aimed at restoring and managing the Coorong and Murray Mouth.

The framework uses ecosystem-level models that allow natural resource managers to assess potential consequences of actions and evaluate water benefits, particularly for migratory birds and estuarine fish. The framework has been used to evaluate 20 potential longer-term climate and management scenarios for the Coorong and Murray Mouth region.

COLLABORATION

Facilitated by CSIRO's Water for a Healthy Country Flagship, the CLLAMMecology research cluster involved the University of Adelaide, Flinders University, and the South Australian Research and Development Institute (SARDI) Aquatic Sciences. Management agencies supporting the research cluster include the South Australian Department for Environment and



Sharp-tailed Sandpipers are a common migratory wader in the Coorong, arriving in November and feeding through the summer before returning to Siberia in March – Photo by Joel Allan, University of Adelaide

Heritage, the SA Murray-Darling Basin Natural Resources Management Board, and the Murray-Darling Basin Authority. Additional research and funding partners included Land & Water Australia, Geoscience Australia, and the Fisheries Research and Development Corporation. CLLAMMecology received \$2.2 million from the CSIRO Collaboration Fund with partner contributions taking the total investment to \$5.3 million.

RESULTS

River Murray inflows

Modelling studies showed that inflows from the River Murray were a determining factor in the ecological state of the Coorong and Murray Mouth through their influence on the water level and salinity regimes. River Murray flows inject fresh water; maintain higher water levels in the Coorong, and keep the Mouth channel open.

Salinity

In the absence of freshwater inflow, an extreme salinity gradient developed in the Coorong during the study. In the Murray Mouth, salinity levels ranged from marine to twice that of seawater. In the North Lagoon salinity ranged from two to four times seawater, while the South Lagoon recorded hypersaline conditions more than four times seawater.





Nutrients

The River Murray, through the Lower Lakes, was an important source of nutrients for the Coorong during high flow years. Part of this nutrient input is stored in Coorong sediments and recycled during low flow years, helping maintain productivity in the system.

Food sources

Field surveys of the aquatic plant *Ruppia tuberosa*, an important food source for the area's water birds, found that changed environmental conditions had caused its decline in the South Lagoon, but it was starting to colonise parts of the North Lagoon. Its re-establishment in the South Lagoon was thought to be increasingly difficult as unfavourable conditions persisted and its viable seed bank is depleted.

Researchers also found the diversity and abundance of benthic, or bottom-dwelling, macroinvertebrates declined with increased salinity in the Coorong and Murray Mouth. These are important food sources for many Coorong fish and birds.

Fish distribution

Salinity strongly limited fish distribution in the Coorong and Murray Mouth. The most abundant and salt-tolerant species, Smallmouth Hardyhead, was found throughout the Murray Mouth and North Lagoon, while increased salinity had significantly decreased their numbers in the South Lagoon. Most other fish species were only found in the Murray Mouth region where salinity remained less than twice seawater.

Waterbirds

The Coorong has traditionally supported a wide range of local and migratory waterbirds. Waterbird communities were found to be geographically related to the wetland's salinity gradient. Declines in the abundance of key waterbird species, such as the Australian Pelican and the Fairy Tern, in the South Lagoon between 1985 and 2000, has intensified in recent years. However, the Banded Stilt, a saline lake specialist, is using the South Lagoon in increasing numbers. These changes in the bird community are driven by changes in the food sources available in the Coorong.



The research vessel 'Thalasia' in the Narrows at Narrung during a sampling trip to measure the water quality in the Lower Lakes – Photo by Justin Brookes, University of Adelaide

Habitat maps

A range of habitat maps were generated to show the distribution of key habitats in the region, such as mud flats. These maps can be used to explore how changes in salinity and water level regimes will influence habitats for key Coorong species.

Ecosystem model

Using environmental and biological data, different potential ecosystem states were defined for the Coorong and Murray Mouth, including estuarine, marine and hypersaline states. The environmental trigger points for when different regions could switch from one ecosystem state to another were also defined.

Climate and management scenarios

To illustrate how the framework can be used, a preliminary analysis of 20 future climate and management scenarios was carried out using the hydrodynamic and ecosystem state models for conditions envisaged by mid century. This analysis suggests that climate and river flows will be the strongest determinants of the ecological condition of the Coorong and Murray Mouth in the future. While management actions such as dredging the Murray Mouth could bring environmental benefits, the most effective lever remains the generation of River Murray environmental flows from the Lower Lakes barrages.

CONCLUSIONS

This project delivered the first comprehensive ecological assessment framework to evaluate the potential outcome of management interventions on the ecological character of the Coorong and Murray Mouth region. The framework's ability to determine ecological impact from physical manipulation of the system is not only very powerful, but is one of the few examples of its kind in Australia and worldwide. The framework allows managers to evaluate how to best use the available management levers, such as environmental flows and dredging the Murray Mouth, to maximise environmental outcomes.

The project's summary report concluded that a similar framework should be developed for the Lower Lakes and that future environmental flow releases from the Lower Lakes barrages should be used as further opportunities to study the ecology of the Coorong and Murray Mouth.

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