



Australian Academy of Science

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Scientific determination of ecological outcomes

The Murray-Darling Freshwater Resource Centre (MDFRC) at La Trobe University conducts extensive research in the Murray-Darling Basin as part of its mission to generate knowledge to support effective management of the Basin's ecology. To this end it undertakes a large range of studies of the Murray-Darling river system, including the Murray-Darling Basin Environmental Water Knowledge Project (MDB EWKP) funded by the Environmental Water Office in the Commonwealth Department of the Environment and Energy. The MDFRC publishes a complete catalogue of its research projects. The MDFRC also recognises its obligation to share the outcomes of this research, through public communication activities, community engagement and education events.

<https://www.mdfrc.org.au/projects/research/>

The Murray-Darling Basin Authority (MDBA) also conducts monitoring activities and scientific studies in support of its activities, and is a reliable source of data and analysis. In answer to the specific question regarding environmental outcomes in the Hattah Lakes, it should be noted that the MDBA has published its assessment of the environmental water requirements for the Hattah Lakes. This report details the scientific basis for the MDBA's environmental water decisions, and includes the site-specific indicators used to determine the environmental health of the region. The MDBA has also published independent monitoring reports for the Hattah Lakes, including waterbird abundance and Black Box tree health.

<https://www.mdba.gov.au/>

<https://www.mdba.gov.au/sites/default/files/archived/proposed/EWR-Hattah-Lakes-v2.pdf>

<https://www.mdba.gov.au/publications/independent-reports/hattah-lakes-monitoring-reports-0>

These two organisations are the main sources for the information in this document. However, these examples are illustrative, and do not represent all research or even all types of research carried out in the Murray-Darling Basin. Research by other agencies and institutions contributes to the national store of knowledge, and is similarly used to inform decisions around the use of environmental water in the Murray-Darling Basin.



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Water Flow

Management of water flow is a central component of the Murray-Darling Basin Plan, and determining optimum water flows is a core activity for the Murray-Darling Basin Authority and the Environmental Water Office.

Hydrological modelling

The MDBA uses hydrological models to understand, plan and manage river systems. A hydrological model is a tool that simulates the flow and behaviour of water along a river system, taking into account the movement of water through the system and landscape, based on a set of input conditions and the known behaviour of water in the environment.

These models can be used to simulate the behaviour of a river for a given set of inputs over a specified time. This can provide detail information on river flows, dam levels, losses and water consumption for each scenario.

The models are based on detailed real-world observations over many years, including more than a century of historical climate data. They are based on peer-reviewed methodology, and are rigorously calibrated and accredited.

Ongoing monitoring

The MDBA maintains an up-to-date report of water levels based on data provided from monitoring sites throughout the Murray-Darling system. Water level gauges throughout the system provide information about current levels which is used to estimate water flows and storage capacity. The MDBA reports both recent near-real-time data (based on a six-hourly interval) and various historic time series.

The MDBA also monitors rainfall in catchments to account for flow changes, water temperature and electrical conductivity as an indicator of salinity.

Water quality

Water quality measures are used at various sites throughout the Murray-Darling system as indicators of system health.

Blackwater

Blackwater events are a physical response to increased dissolved organic matter from returning floodwaters. Decomposition of this organic matter reduces the amount of dissolved oxygen in the river, which can result in the death of fish and other aquatic lifeforms. Blackwater events are monitored by the MDBA, as they can be mitigated by the release of oxygenated environmental water.

Cyanobacteria

Cyanobacteria, also known as blue-green algae, is used as an indicator of river health. Under favourable conditions – warm temperatures, sunny periods and increased nutrient load – cyanobacteria can flourish, resulting in visible “blooms”. As some cyanobacteria produce toxins, these blooms can cause illness in humans or livestock, as well as affecting the health of river life.



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Nutrient load

Sediment and nutrients are a natural feature of a river system, supporting plant and animal life. However, large changes in nutrient load – for example, runoff containing agricultural fertilisers or erosion – can distort the ecosystem by increasing populations of organisms like algae or bacteria. Dissolved nutrients – such as carbon, nitrogen and phosphorus – are monitored to determine the effects of changes in concentration, and mitigate these effects where possible and desirable.

Turbidity

Turbidity – the ‘cloudiness’ of water – is a measure of solid matter suspended in water. This matter can affect the taste and safety of water for consumption, and may affect aquatic life. Turbidity is measured by the transmission of light through water samples.

Temperature

Higher than usual river temperatures can affect water quality by stimulating algal or bacterial growth. Lower than usual water temperatures can damage ecosystems and ecological communities, which are sensitive to changes in conditions.

Salinity

High levels of salt in the Murray-Darling system can affect agriculture, ecosystems and infrastructure. Human activities such as irrigation development and land clear can mobilise salt and see it enter the river system, increasing salinity. Under normal circumstances, salt can only leave the river system by exiting through the Murray mouth into the sea. Salinity is measured by ongoing monitoring of electrical conductivity (high salt concentrations increase the capacity of the river water to conduct electricity) at multiple monitoring sites, reported by the MDBA.

Vegetation

Satellite observation

Satellite observation of vegetation density provides information on the relative health of different sites across the Murray-Darling Basin. The Terrestrial Ecosystem Research Network (TERN) maintains active coverage of Australian earth observations with multiple layers of information. The TERN Landscapes initiative (formerly AUSCover) provides datasets from MODIS (250m resolution) and Landsat (30m resolution) of vegetation cover fraction, including time series studies. These analyses – supported by on-ground observations – provide an overall perspective on the health of waterways.

Response of recruit saplings to flooding events

The MDBA monitors the response of river red gum, black box and coolabah populations on riverbanks and floodplains. These forests provide habitat and resources for aquatic, amphibious and terrestrial life, as well as providing shade and carbon resources to nearby rivers. By studying the response of saplings in different locations to flooding events, the MDBA can inform releases of environmental water, providing releases that encourage recruitment of saplings and improving vegetation density in areas where this is desired.

Lignum condition

Lignum is a shrub which dominates large areas of arid floodplains. Lignum shrubland contributes nesting sites to waterbirds and organic matter to the river. Studying the Lignum responsiveness to environmental water flows leads to better understanding of their requirements, allowing better management of Lignum communities and floodplain landscapes.



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Animal life

Fish

Fish populations provide information about the health of the river system and the responses of aquatic life to changes in conditions in water systems. As an example, the MDFRC is currently studying fish populations in the Hattah Lakes. Fish (currently carp, in future Golden perch) are implanted with acoustic tags which emit unique signals; these signals are recorded by receivers at strategic locations and the data recorded. This allows the creation of models which map the movement of fish across observed conditions in the lake. This information informs environmental watering strategies, with the aim of limiting benefits to carp during the watering cycles of the lakes while maximising benefits to large bodies of native fish.

Waterbirds

As with fish, observations of water birds provide an indication of the health of water systems. Many colonial nesting birds require wetlands to be flooded to initiate and complete breeding; large declines in waterbird populations likely reflect changes in water management throughout the system. Observational studies of these populations can help determine the relative health of a water system, and again inform environmental water strategies so that the birds are provided with the most effective habitats.

Invertebrates

The MDFRC is conducting an ongoing, long-term study of the Murray-Darling system's biological life. This project provides a long-term biological record that complements the physical and chemical data collected by the MDBA. The project reports on the diversity and quantity of macroinvertebrates at key sites, to inform assessments of river ecosystems and to provide a reference for the conservation of rare and endangered species.

Human impacts

Direct measurement of human impacts – through agriculture, development, mining, tourism or other activities – are the subject of study and provide useful information about the health of the river system. This can be done through historical data – a 2016 MDFRC study considered the legacy of historical goldmining in Victoria – or through current observations.

The Long Term Intervention Monitoring Project

The Commonwealth Environmental Water Office Long Term Intervention Monitoring Project is a comprehensive scientific study of the impacts of Commonwealth environmental water delivery in the Murray-Darling Basin. As part of this project, the MDFRC has undertaken a Basin-scale evaluation of the contribution of environmental water releases according to the environmental objectives of the Murray-Darling Basin Plan. This is supported and complemented by studies at a regional level, conducted by consortia of universities, Commonwealth and State government agencies, and other stakeholder organisations.

More information about this project, including its scientific reports, can be found at the Department of the Environment and Energy's website:

<http://www.environment.gov.au/water/cewo/monitoring/ltim-project>