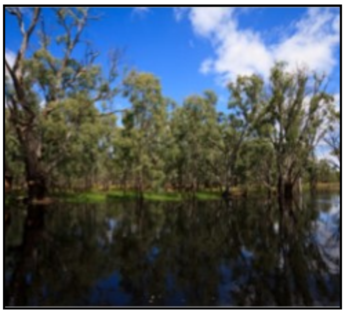
LA TROBE UNIVERSITY

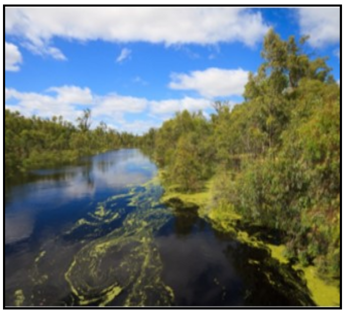
Centre for Freshwater Ecosystems

Fact Sheet

Breaking the drought: Floods, carbon and prolonged hypoxia in a major river system

Post-drought flooding in the southern Murray-Darling Basin, Australia, during spring and summer 2010–2011 caused a severe and prolonged hypoxic blackwater event that affected the lowland reaches of almost all rivers in the region and led to extensive fish kills.





What is blackwater?

Blackwater is characterised by a high concentration of dissolved organic carbon in the water column. Transfer of organic carbon from floodplains to the river channel is vital for the sustenance of riverine food webs. However, microbial respiration of this carbon consumes oxygen and if oxygen consumption exceeds re-aeration, dissolved oxygen concentrations may fall to levels insufficient to support aquatic biota. This is known as hypoxic blackwater.

The 2010-2011 hypoxic blackwater event

Floodplains in the southern Murray-Darling Basin were subjected to severe moisture stress during the decade prior to 2010, due to a combination of climatic drought and over-development of upstream water resources. This situation came to an abrupt end in late 2010, when unprecedented spring and summer rainfall caused the drought to be broken by a series of widespread flood events. The unseasonal, post-drought inundation of multiple lowland floodplains produced a plume of hypoxic blackwater that extended for over 2000 km and persisted for several months. Widespread fish kills resulted, although species were affected to differing degrees and the magnitude of the fish kills was lower than expected given the extent and severity of the event.

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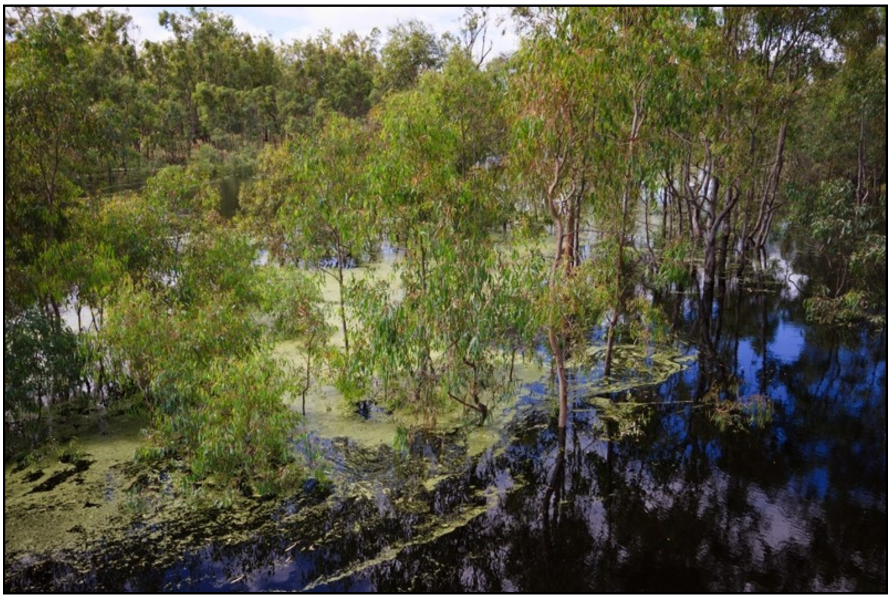

What caused theis extreme water quality event?

Hypoxic blackwater was generated primarily by inundation of river red gum forested floodplains under warm conditions. Multiple inundations interspersed by short terrestrial periods may have increased the overall availability of floodplain carbon. Soluble organic carbon derived from agricultural floodplains also contributed to hypoxic blackwater generation in several waterways. Post-drought flushing of the upper catchment also contributed to elevated carbon concentrations at some sites, but this carbon was less reactive than that from lowland floodplains. Localised instances of hypoxia resulted from hypolimnetic discharge from weirs.

What are the implications for future water quality?

Although the climatic conditions that combined to produce the 2010–2011 hypoxic blackwater event may be viewed as extreme and unseasonal, the predicted impacts of climate change on the Murray-Darling Basin include more extreme weather patterns and a shift towards higher summer rainfall, but lower annual average rainfall, in the southern Basin. The recent event provides insight into potential water quality issues under future climatic conditions. It is critical that lessons drawn from the recent event be incorporated into future water management plans, particularly when environmental water is to be used to attempt to mitigate the impacts of climate change.

How can hypoxic blackwater be managed?

The risk of future hypoxic blackwater events occurring may be reduced by ensuring that floodplains receive regular inundation events, by means of environmental water delivery where necessary. Water should be delivered during cool weather and before peak litter accumulation is reached and increased flow should be used to dilute floodplain discharge in receiving channels. If hypoxic blackwater does develop, dilution flows of oxygenated water may be used to reduce the severity of the hypoxia. Physical re-aeration strategies may be used to increase the rate of oxygen return to the water column, particularly at targeted refuge sites for biota.