Project E.1.15
Science to inform artifical floodplain inundation: movement and habitat use of Murray cod during testing of the Chowilla Creek regulator

Status Completed

Project Leader:

Dr Brenton Zampatti, SARDI

Project Partners:

SARDI, University of Adelaide

Research Theme:

Environmental Water

Roadmap:

River Murray

Project Overview

Despite the pervasive impacts of river regulation on riverine ecosystems, further regulation in the form of weirs, levees and pumping is being used to artificially inundate floodplains of the River Murray with an aim to improve floodplain health. Such approaches are unprecedented and contemporary ecological models of riverine ecology and autecology suggest they carry substantial risks. In response to terrestrial floodplain degradation at Chowilla, in the lower River Murray, the Chowilla Creek regulator was constructed with the primary objective of *maintaining or improving the condition of floodplain overstorey vegetation*. Chowilla also supports regionally significant Murray cod (*Maccullochella peelii*) populations, in particular providing preferred lotic (flowing water) habitats and promoting recruitment during periods of low-flows and limited recruitment in the main channel of the River Murray.

Operation of the Chowilla Regulator has the potential to alter the hydrodynamics of lotic habitats, interrupt longitudinal connectivity, and decouple riverine and floodplain hydrographs. As such, the regulator poses significant risks to the movement, habitat use, spawning and recruitment of Murray cod. In spring–summer 2014, the Chowilla Regulator was used to artificially raise upstream water levels by 2.7 m, over the spawning season of Murray cod. The over-arching objective of this project was to conduct a one-year investigation of the movement and habitat use of Murray cod in the Chowilla system and adjacent River Murray in association with the initial testing of the Chowilla Creek regulator in spring–early summer 2014. The specific aims were to use an existing remote radio-receiver network and population of radio-tagged Murray cod to:

1. collect preliminary data on Murray cod movement and habitat use over the period of regulator operation;
2. quantify the hydraulic characteristics of micro (0.1–10 m) and meso -habitats (10s–100s m) used by Murray cod during the period of regulator operation; and
3. investigate Murray cod behaviour in the immediate vicinity of the regulator.

Progress Update and Key Findings

Over the period of regulator operation (5 September–5 December 2014) radio-tagged Murray cod exhibited high fidelity to core regions in the perennial anabranch habitats of Chowilla and specific regions of the River Murray main channel, and either moved little within these regions or moved between them. Murray cod predominantly occupied habitats characterised by flowing water and large wood, but not ephemeral floodplain habitats. Patterns of movement and habitat use were similar to those previously observed at Chowilla during both low-flow periods and natural flooding. During natural flooding, however, several Murray cod undertook large-scale (>200 km) upstream movements in the River Murray. Similar movements were not observed during low-flows, but during regulator operation, six fish initiated upstream movements that appeared to be aborted when these fish reached the River Murray. Murray cod may have initiated exploratory behaviour in anticipation of a flood, but instead encountered the homogenous habitat of the Lock 6 weir pool. These altered behavioural patterns may have resulted from decoupling of floodplain and riverine hydrology.

Operation of the regulator substantially altered the hydraulic characteristics of key Murray cod reaches and the micro-habitats used by individual fish, particularly in Slaney Creek, the primary Murray cod habitat in Chowilla. During peak regulator operation, mean water velocities in Slaney Creek were approximately 50% of those measured when the regulator was not in place and hydraulic complexity, as measured by strength and frequency of water circulation, was similarly reduced. At a site occupied by Murray cod in Chowilla Creek, mean water velocities and hydraulic complexity varied little between regulator operation and when the regulator was not in place, although discharge in Chowilla Creek was three times greater during regulator operation. Whether decreased habitat quality resulted in increased movement rates as fish searched for alternative habitats, or had an impact on spawning, remains unresolved in this short-term study.

Chowilla Creek provides the primary conduit for the movement of reproductively mature Murray cod between the River Murray and the structurally complex, lotic habitats of Chowilla. Maintenance of connectivity between these habitats is considered fundamental to sustaining the integrity of Murray cod populations in the lower River Murray. During the operation of the Chowilla Regulator, radio tagged Murray cod were delayed or prevented from moving both downstream and upstream past the regulator. Three large (>1 m total length) female fish did pass downstream of the regulator with one attempting unsuccessfully to return upstream. It is uncertain if these fish passed downstream over the weir or through the vertical slot fishway. Fragmentation of longitudinal connectivity is a major risk of the Chowilla regulator and fishways could be effective in partly overcoming this impact. As such, the hydraulic and biological function of the fishways on the Chowilla regulator (and ancillary structures) should be assessed as a matter of priority. In parallel, the efficiency of fishway attraction should be evaluated, potentially using electronic tagging approaches.

Adoption and Impact

Engineered artificial floodplain inundation carries substantial ecological risks and to date, untested benefits; yet the concept has been embraced enthusiastically by natural resource management agencies across the southern MDB. Operation of the Chowilla regulator

exacerbates the impacts of river regulation on Murray cod. Therefore, given the conservation status of Murray cod and the regional significance of Chowilla to Murray cod populations in the lower River Murray, mitigating potential impacts of the regulator should be a priority. Preserving the hydraulic characteristics of fluvial habitats and maintaining longitudinal connectivity present two key challenges for operation of the Chowilla regulator. We also advocate that the regulator be operated in synchrony with the riverine hydrograph to limit the potential for anomalous behavioural responses and maximise opportunities for positive outcomes, such as improved larval survival during higher riverine flows.

Operation of a regulator on Chowilla Creek to promote floodplain ecosystem health represents an unparalleled experiment in lowland river restoration. As such, robustly designed monitoring and research is required to elucidate ecological outcomes, mitigate risks, maximise benefits, and provide the essential feedback loops for adaptive management. Whether altered habitat availability, rates of movement and disrupted connectivity impact individual fitness and/or spawning and recruitment, and ultimately population dynamics, remain to be tested. These are fundamental questions for future operation and management of the Chowilla regulator, and other large-scale floodplain regulators proposed for the River Murray Floodplain. For long-lived species such as Murray cod, robustly answering these questions will be a long-term (decadal) proposition.

http://www.goyderinstitute.org/projects/view-project/32

Accessed 24 July 2018