Edward/Kolety-Wakool system Environmental Flows Newsletter

Issue Number 5 | 1 July – 30 September 2020

Edward/Kolety-Wakool Monitoring, Evaluation and Research Program

What's in issue #5

Welcome to the issue 5 of the Edward/Kolety-Wakool Environmental Flows Newsletter - a quarterly newsletter that provides an update on our progress as we monitor and undertake research on the ecosystem outcomes of Commonwealth environmental watering actions in the Edward/Kolety-Wakool system.

The Edward/Kolety-Wakool MER Program is a collaboration between universities, state government agencies, consultants and local community organisations.
More information on the program can be found at:
https://flow-mer.org.au/selected-area-edward-kolety-wakool/
https://www.csu.edu.au/research/ilws/research/environmental-water

Update on monitoring

Weather and hydrology

The period from July to September was generally quite dry, with the mid-Murray region experiencing a rainfall anomaly of -25 to -50 mm (Figure 1).

We use data from flow gauges and information from water accounts to determine the contribution of environmental water to changes in flow and water level in the Edward/Kolety-Wakool river system. There were no Commonwealth environmental watering actions between July and September 2020. The discharge in the Edward/Kolety River downstream of Stevens Weir was extremely variable between July and September 2020, ranging from 324 to 1681 ML/day (Figure 2). In contrast, following a small pulse of approximately 350 ML/day in July, the discharge in the Wakool River at Wakool-Barham Rd (gauge 409045) between mid-July and 30 September 2020 was steady between 240 and 270 ML/day (Figure 2).

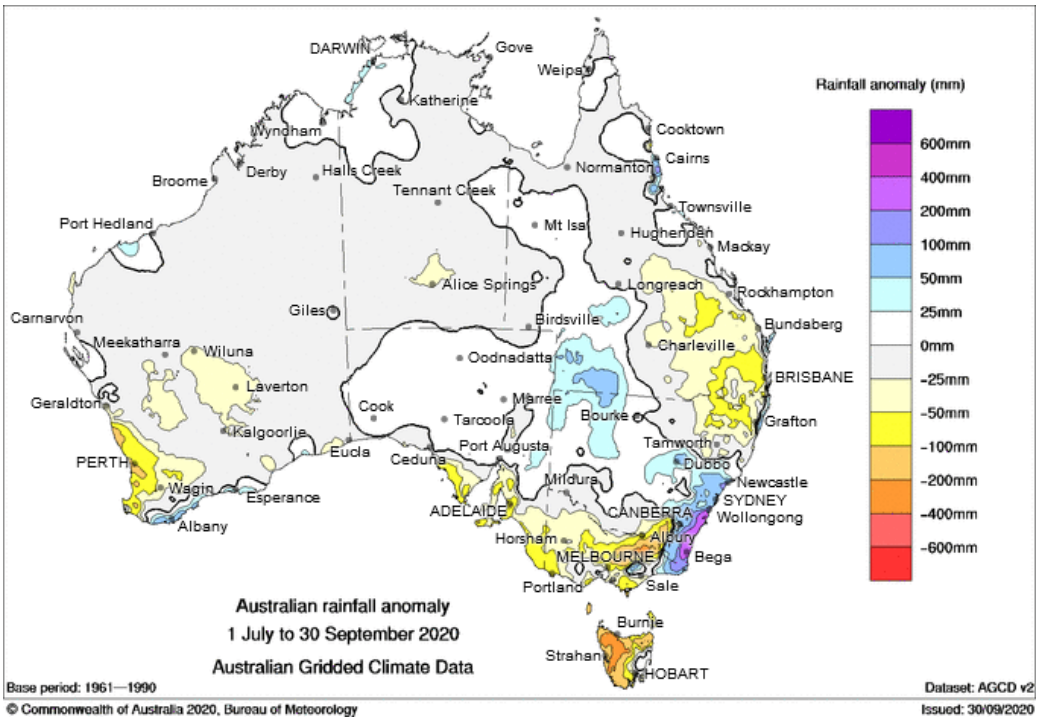

Figure 1: Australian rainfall anomaly 1 July to 30 September 2020 (Source: Bureau of Meteorology)

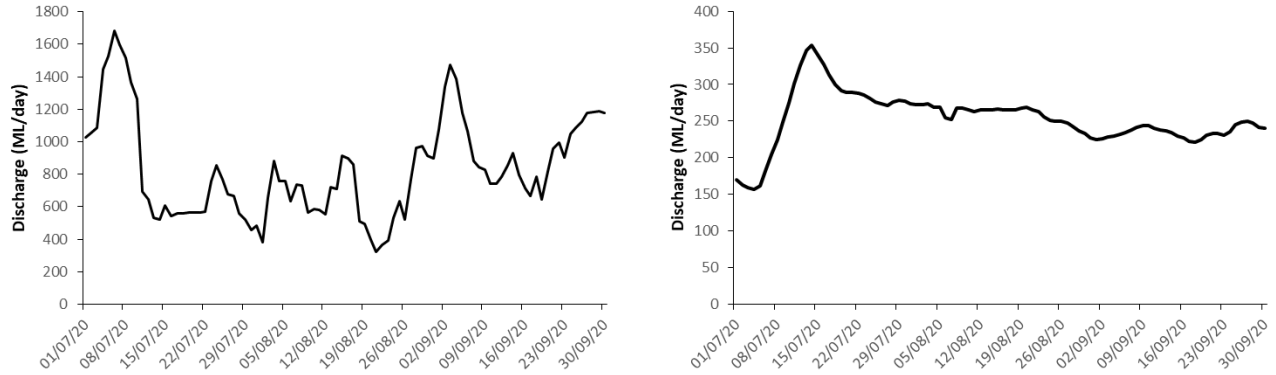

Figure 1: Left, Discharge (ML/day) in the Edward/Kolety River downstream of Stevens Weir (gauge 409023) from 1 July 2019 to 30 September 2020. Right, Discharge (ML/day) in the Wakool River at Wakool-Barham Rd (gauge 409045) from 1 July 2019 to 30 September 2020.

Water quality monitoring

We monitor water quality at 18 sites throughout the Edward/Kolety-Wakool river system to inform us about water quality under different flows. Dissolved oxygen and water temperature are monitored continuously at 10 sites by our automated loggers, in addition to the DO data that we obtain from WaterNSW water monitoring stations (gauging stations). Once per month we also monitor algae (concentration of chlorophyll), nutrients, dissolved organic carbon, turbidity, pH and electrical conductivity of the water at each site. We use these data to compare the water quality during environmental watering actions with results from operational flows and unregulated flow events.

Between July and September 2020 Shasha Liu and Sam Brouwer continued to maintain and download loggers and monitor water quality (Figure 3). Water quality was normal for this system at all locations between July and September 2020.

Figure 3: Left, Shasha Liu collecting water sample for analysis. Right, Sam Brouwer taking water quality measurements

Riverbank and aquatic vegetation monitoring

Due to COVID-19 restrictions the vegetation monitoring could not be undertaken in July and August 2020. Vegetation surveys commenced again in September and will be undertaken monthly (provided COVID restrictions are not reinstated). The banks of the Wakool River were observed to be quite dry in September (Figure 4), reflecting the lack of variability in flows in the Wakool River and the low rainfall over this period (Figures 1 and 2). There was very little evidence of new recruitment of vegetation, with the exception that a small amount of rush (*Juncus sp*.) and common sneeze weed (*Centipeda cunninghamii*) germination was observed.

Figure 4: Two of the vegetation monitoring sites in the Wakool River, September 2020 (Photos Nathan McGrath)

Fish monitoring

July to September is a usually a quiet period for fish monitoring, but due to COVID-19 restrictions the fish surveys were delayed this year and were completed in early July. Eight native fish species were detected in 2020 (Table 1), which was the same number as the past three years. Nine species were detected in 2015 and 2016. Murray cod (Figure 5) adult abundance has been increasing since the hypoxic blackwater event associated with the unregulated flood in 2016, however the abundance of Murray cod is still lower than before the flood. More results from the fish community surveys will be included in the annual report.

Table 1: Adult fish species detected in the Wakool River between Wakool Reserve and Thule Creek (zone 3) 2015-2020. Black shading indicates presence, white shading indicates absence.

Species	2015	2016	2017	2018	2019	2020
Native						
Australian smelt	■	■	■	■	■	■
bony herring	■	■	■	■	■	■
carp gudgeon	■	■	■	■	■	■
flathead gudgeon	■	■		■	■	■
golden perch	■	■	■	■	■	■
M-D rainbowfish	■	■	■	■	■	■
Murray cod	■	■	■	■	■	■
silver perch	■	■	■	■	■	■
unspecked hardyhead	■	■	■	■	■	■
Alien						
common carp	■	■	■	■	■	■
Eastern gambusia	■	■	■	■	■	
goldfish	■	■	■	■	■	■
redfin perch						

Figure 5: Left, Nick O'Brien (DPI Fisheries) with a very large Murray cod caught and released during the fish surveys. Right, John Trethewie (CSU) releasing a Murray cod.

Focus on physical habitat research

The Streamology team have been undertaking research to examine the effectiveness of drone-based survey methods to detect changes in the river banks and they have examined the effects of flow regime and river operations on erosion and deposition. Neil Sutton from Streamology completed field trip 4 in mid-July 2020 and the conditions were favourable for drone work, with light winds, zero rainfall, low river discharge and good light throughout the day. Imagery collected by the drone can be used to measure very small changes in riverbank physical condition over time by comparing results before and after the flow actions.

The research is being undertaken in three reaches that have different hydrology and geomorphology; the upper Edward/Kolety River in the Murray Valley National Park – Millewa, the Edward/Kolety River downstream of Stevens Weir in Werai Forest, and Colligen Creek.

The research has shown that the Digital Elevation Models of Difference produced by comparing two drone surveys before and after hydrological events provide a high resolution mosaic of change in deposition and erosion over time. This type of information cannot be gathered through other means such as LIDAR.

The research has investigated some parts of the river where there is deep bank notching (Figure 6). In these parts of the river system there is a distinct pattern in flow regime from year to year which can be summarised into a three step process (Figure 7). This process highlights how a simple sequence of events can result in large scale erosion, and arguably extensive channel widening, within a system:

1) Prolonged (+30 days) cyclical wetting and drying of a defined bank zone. ***Bank Response:*** **Notch Created**
2) Prolonged (+7 days) Inundation of bank zone above the notch. ***Bank Response:*** **Saturation**
3) Rapid draw-down of water level over the notch. ***Bank Response:*** **Mass-failure events above notch**

Figure 6: Left, Drone in flight. Right, A section of riverbank downstream of Stevens Weir highlighting the notch that aligns with the height where discharge in the range of 2300 to 2800 ML/day occurs.

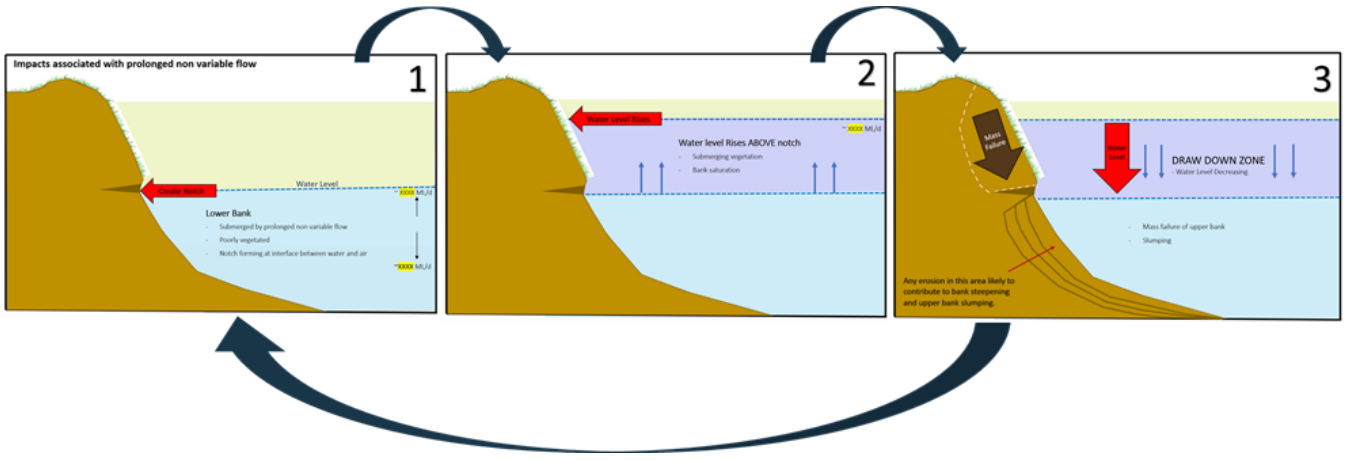

Figure 7: Conceptual diagram detailing the three stages of channel widening linked to sequence of events occurring at the site in the Edward/Kolety River downstream of Stevens Weir. These three steps are repeated annually in sequence, and can result in large scale erosion

Focus on social research: understanding the human aspects of environmental flows

Understanding the outcomes of environmental water delivery to the Edward/Kolety-Wakool (EKW) system is a complicated task. This is partly because the river system and landscape are complex, but also because of the wide range of human connections with, and expectations of, the EKW system.

Monitoring of environmental water in the EKW system over the past 10 years has focussed on hydrology, water quality, river productivity, vegetation and fish. We are excited that this year the MER program will include social research, led by Drs Catherine Allan and Wendy Minato from Charles Sturt University. The social research project builds on a small project undertaken by Catherine Allan and Robyn Watts in the district over the past six years. They found that all of the people interviewed expected environmental water to be managed in ways that lead to beneficial outcomes. However, what that means and what beneficial outcomes look like depends on the individual and their contexts.

The new project will develop a comprehensive understanding of the range of expectations of, and attitudes towards, environmental water and its management. It will use a large scale survey, developed and analysed with stakeholders to maximise the local and operational value of its findings. Anyone who has a 'stake', (that is, anyone who feels a connection to or is influenced by the Edward/Kolety-Wakool system) is a stakeholder*, and can be involved in designing, completing and/or benefiting from the survey.

Over the next year the project will have three stages:

- In the first stage we will seek out people who are interested and available to take part in survey design. Design will start with a guided group workshop session of two to three hours in two locations, probably Deniliquin and Barham. During these sessions we will reflect on what people know about environmental water in the EKW, what the workshop participants would like to know, and what will be important to include in the survey. We will also consider who the survey should go to, how it should be sent out, and what some of the physical and cultural boundaries might be.
- The second stage will involve expert questionnaire designers in developing the survey instrument. We will check back with the design group, and then distribute the questionnaire, following advice on how, and to whom, from stage 1.
- The third stage involves analysis, including workshops/field days where the researchers, communities and environmental water managers will share the findings and consider their implications.

We are hoping to involve representatives of local groups as well as interested individuals in this research. Please consider being part of designing this locally relevant social research. If you are interested in helping to design the survey, or would like to discuss the social research please contact Wendy 0437 420 911 or Catherine 0466 841 989. * If you are reading this newsletter, you are a stakeholder ☺

Figure 8: Left: Community field day in December 2019 (Photo Catherine Allan). Right: The Wakool River (Photo Robyn Watts)

Focus on turtle research

We are studying turtle populations at six wetlands along the Edward/Kolety River system from Deniliquin to Balpool Road Bridge. The aim of this study is to determine whether connectivity of wetlands affects turtle distribution, movement, and body condition. We are doing this by trapping and measuring turtles and at the same time following the movements of 24 Murray River turtles (*Emydura macquarii*, also known as short-necked turtles) that have been tagged with acoustic tags to see how they move in and out of wetlands throughout the year.

We will examine whether wetlands that are disconnected from the river and are at risk of drying during winter are unsuitable for turtles, because winter drying would mean that they would be suddenly exposed to the elements and predation by foxes. This is a risk because turtles are ectotherms, and during winter their body processes slow due to cold temperatures to the point that they cannot be very active.

This project is led James Van Dyke (La Trobe University), and Joseph Briggs, Liticia Ross, Tracey Hamilton, and Brandon Cooper from Yarkuwa Indigenous Knowledge Centre in Deniliquin have been doing much of the fieldwork. Their local knowledge and experience have driven the project's success, and it has given them an opportunity to learn new skills about how to trap, handle, and measure turtles, and monitor turtle populations. The turtle project is a great example of local people making a significant contribution to environmental research and management projects.

Over the summer of 2019-20 we caught 143 broad-shelled turtles (*Chelodina expansa*)(Figure 9), 139 eastern long-necked turtles (*C. longicollis*), and 209 Murray River turtles (*E. macquarii*). By February 2020, 20-30% of the turtles caught were individuals that we had caught and marked in previous trapping sessions, which suggests that we are surveying a considerable portion of the local turtle population. Due to the dry summer one of our lagoon sites had begun to dry. There was some water in this wetland but we caught no turtles there after December. We also had relatively low catch rates at Moonahcullah Lagoon and our highest catch rate was at Dahwilly Lagoon, near Deniliquin.

Figure 9: Left, Broad-shelled turtle (Chelodina expansa) caught from Horseshoe Lagoon near Barratta (Photo James Van Dyke). Right, The turtle research team from left Liticia Ross, James Van Dyke, Tracy Hamilton and Joseph Briggs (Photo: Liticia Ross)

The movements of 24 tagged Murray River turtles have been monitored since October 2019. We aimed to tag two male and two female turtles at each of six lagoons. However, we could catch only one male at two of our sites so we tagged a three females at these two lagoons, so this means we are following the movements of 10 male and 14 females. The results have been very interesting. Of the 24 turtles that we tagged, 20 moved into

the river rather than stay in their home wetlands, especially at the beginning of winter. This suggests that Murray River turtles usually move into the river to overwinter, which would protect them from experiencing winter drying of their home wetlands. This behaviour may represent an adaptation turtles have to surviving in wetland systems that are prone to drying over winter.

The males and females behaved differently. The male turtles all left their home wetlands over the summer and entered the river system. Five of the 10 males disappeared and have not been detected since. Of the other five, three have moved up or downstream 5 to 20 km to other wetlands in our study area. This includes one male that swam from Barratta Lagoon to Moonahcullah Lagoon, and another male that made the same trip in the opposite direction (Figure 10). The last two males have stayed in the river close to their home wetland. In contrast, four of the females have stayed in their home wetland, though they have occasionally moved back and forth between the lagoon and the river. All of the remaining 10 females left their home wetlands by May 2020, and five of these stayed in the river adjacent to their home wetland over winter. The remaining five moved out of range of the acoustic receiver stations over winter, but two that had overwintered in the river moved back into their home wetland in late August and early September 2020.

We will be trapping turtles again in November 2020 and will retrieve the receivers for their final download. The results from the will hopefully reveal what these turtles do as we transition into spring.

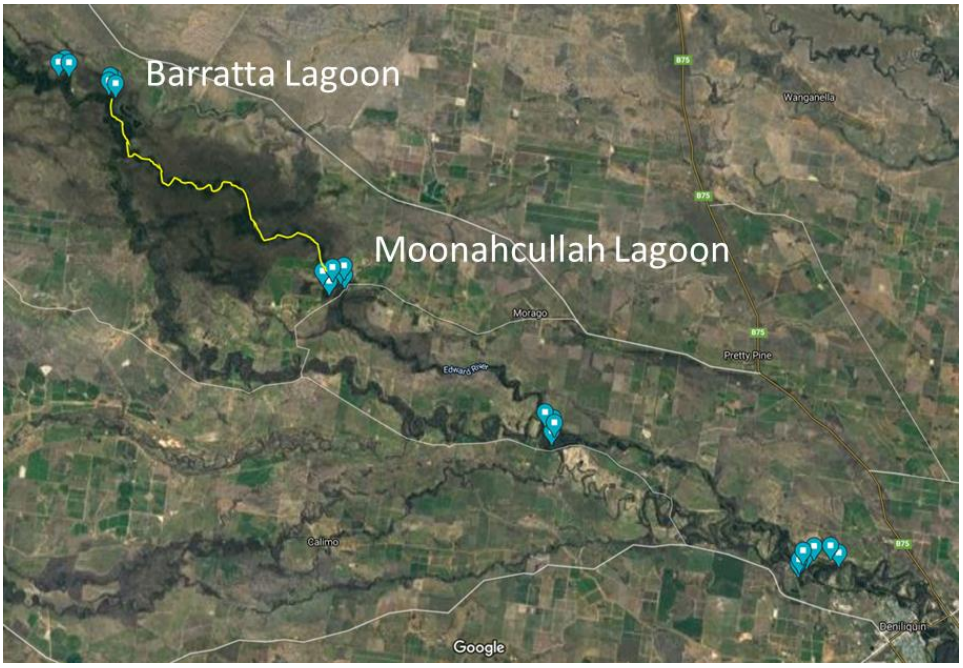

Figure 10: Map of acoustic receiver stations (blue pins) at the six wetlands of the study. The yellow line indicates a potential path of a male Murray River turtle that moved from Barratta Lagoon to Moonahcullah Lagoon, a river distance of >20 km.

More information

To join the newsletter mailing list please subscribe here or contact Professor Robyn Watts, Institute for Land, Water and Society, Charles Sturt University, Albury NSW. rwatts@csu.edu.au

We respectfully acknowledge the Wamba Wamba or Wemba Wemba, and Perrepa Perrepa or Barapa Barapa peoples, traditional owners of the land on which the Edward/Kolety-Wakool program is focussed. We recognise their unique ability to care for Country and their deep spiritual connection to it. We honour Elders past, present and emerging whose knowledge and wisdom has ensured the continuation of culture and traditional practices. The Edward/Kolety-Wakool team would also like to acknowledge the local landholders with whom we work and thank them for their contribution to the monitoring and research.

Watts R.J., Allan C., Minato W., Sutton N., Thiem J., Van Dyke J., Wright D. (2020) Edward/Kolety-Wakool System Environmental Flows Newsletter, Issue 5. Charles Sturt University.