Yellingbo hydrology works monitoring program

Strategic alignment

Regional Performance Objectives (RPOs):

- This project relates the Cockatoo Swamp (Ck floodplain wetlands) priority wetland and the water regime performance objective group ie Water regime implemented (incorporating understanding of groundwater contributions) to meet ecological watering objectives, improve ecosystem services, cultural and social value.

Key Research Areas:

- Hydrology and Environmental flows: Improving our understanding of the responses of key environmental values to flow regimes to refine our environmental flow objectives.
- Wetlands and Estuaries: Improving our understanding of management technique that are most effective to protect and improve the ecological health of wetlands and estuaries.

Summary

This project supports a targeted monitoring, evaluation, reporting and improvement (MERI) program to inform the adaptive management of critical swamp forests at the Yellingbo Nature Conservation Reserve (YNCR). Over the past seven years, this monitoring has focussed on assessing the vegetation response to Melbourne Water's hydrology works at the Cockatoo Swamp.

The works, which included partial levee bank removals, a four-year pumping trial, and trial instream structures, aimed to naturalise water regimes within the Cockatoo Swamp, and thus arrest tree die-back and improve the condition of vital habitat for the critically endangered Helmeted Honeyeater and lowland Leadbeater's Possum.

Recommendations

- Enhance existing (at the 'rock chute'), and introduce new (e.g. at Young's Swamp), instream structures where incised channels limit river-floodplain connectivity. The aims of these works are to increase the frequency and extent of engagement of disconnected floodplain areas and reduce sediment inflows into dieback-affected areas.
- All current vegetation monitoring at Yell- ingbo be reviewed in collaboration with relevant stakeholders, and that the Traditional Owners, Wurundjeri Woi Wurrung people, be included in this process and future monitoring at the site.

What did we do?

1. Developed water regime recommendations to restore *Eucalyptus camphora* swamp forests that provide habitat for the critically endangered Helmeted Honeyeater and Leadbeater's Possum (Figure 1).

These recommendations were based on a range of investigations including:

- A review of the literature concerned with the interactions between water and ecological systems (ecohydrology).
- Nursery based seedbank and tree survival and growth experiments.
- Monitoring of plant phenology – flowering, seedfall and dispersal in the field.

2. Developed and implemented a water level and vegetation condition monitoring to assess the vegetation response to Melbourne Water hydrology works aimed to restore swamp forest within the Cockatoo Swamp (Figure 2).

This vegetation condition monitoring program implemented since 2018 includes:

- Surface water-level monitoring
- Annual individual tree condition assessments and stand condition assessments at six sites using hemispherical photography.
- Annual surveys of permanent quadrats at each site to monitor for seedling recruitment and mid/understorey vegetation change.
- Photo-point monitoring.

3. Ecohydrological investigation of potential instream structures (Figure 3).

We used a purpose-built TUFLOW hydrological model to examine the likely ecohydrological outcomes of the enhancement of existing and/ or introduction of new instream structures within the Cockatoo Creek where incised channels limit connectivity/watering of the Cockatoo Swamp (e.g. at the existing 'rock chute', and in the vicinity of 'Young's Swamp') (Russell and Greet 2020).

4. Review current vegetation condition monitoring at Yellingbo.

A review of the full range of vegetation monitoring activities at Yellingbo – including the current Cockatoo Swamp vegetation condition program, permanent quadrats established by

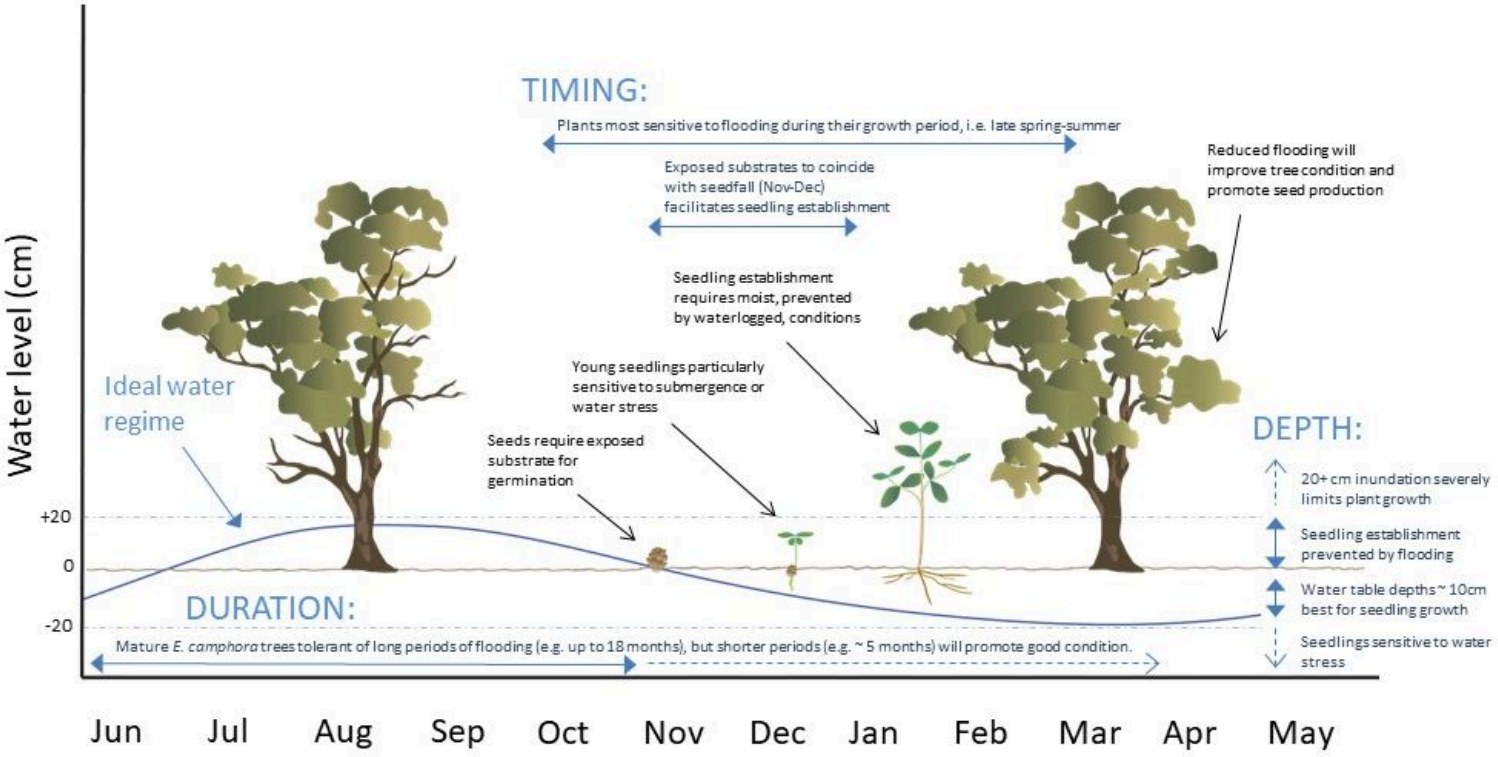

Figure 1. Environmental watering objectives for E. camphora swamp forests at Yellingbo Nature Conservation Reserve.

Melbourne Water in 2006, and vegetation monitoring recently commissioned by Parks Victoria (Dell 2020). This monitor- ing is being reviewed with regard to key objectives, including (but not limited to): ecohydrological understanding of Yelingbo's swamp forests; vegetation condition across the reserve and particularly in critical habitat areas; and ability to assess the outcomes of any planned management interventions (e.g. instream structures).

What did we find?

- Through a range of ecohydrological investigations, we determined the environmental watering requirements of threatened swamp forests that provide habitat for the critically endangered Helmeted Honeyeater and Leadbeater's Possum at Yellingbo (Figure 1).
- That temporary instream structures (weirs) and result- ing flooding had multiple vegetation benefits including increased growth of extant trees and planted seedlings, germination of seedlings and seedfall (Figure 2).
- The introduction of permanent instream structures would be successful in promoting floodplain engage- ment and thus improving wetting and drying regimes and vegetation condition more broadly at Yellingbo. The greatest benefit of the structures would be an increased frequency and duration of flooding, and increased flooding extent, during moderate to high flow events (Figure 3).
- In the longer term, instream structures also have the potential to reduce sediment loads flowing into die- back-affected areas of the Cockatoo Swamp and facili- tate the recovery of critical swamp forests therein.

Future direction and Knowledge gaps

- Ecohydrological investigation of potential instream structures. The TUFLOW modelling will be extended to further investigate either specific functional designs or additional structures as required
- For the purpose of setting key objectives for vegetation monitoring at Yellingbo, two specific gatherings are planned:
- A workshop of relevant stakeholder (Friends of Hel- meted Honeyeater, Zoos Victoria, Parks Victoria, etc.) to discuss objectives of any long-term monitoring of vegetation condition at Yellingbo;
- An 'On Country' day with the full Narrap Unit and relevant stakeholder to discuss long-term monitoring at Yellingbo.

How are we sharing findings?

Reports prepared for Melbourne Water

- Greet, J, Russell, K. and Fischer S. (2021) Cockatoo Swamp Monitoring Program 2015–2021: Vegetation response to hydrology works. The Waterway Ecosystem Research Group. Technical Report 21.2. The University of Melbourne.
- Greet, J., Fischer, S. and Fedrigo, M. (2020) Cockatoo Swamp Monitoring Program 2015–2020: vegetation response to hydrology works. Technical report 20.8. Melbourne Waterway Research Practice Partnership. The University of Melbourne.
- Russell, K. and Greet, J. (2020) Yellingbo instream structure investigation. Technical report 20.5. Melbourne Waterway Research Practice Partnership. The University of Melbourne.
- Greet, J. (2019) Cockatoo Swamp Monitoring Program 2015–2019: early vegetation response to hydrology works. The Waterway Ecosystem Research Group. Tech- nical

Report 19.2. The University of Melbourne.

- Russell, K. and Greet, J. (2018) Cockatoo Swamp Inundation Modelling. August 2018. Melbourne Waterway Research-Practice Partnership. Technical Report 18.1. The University of Melbourne.
- Greet, J. (2018) Cockatoo Swamp Monitoring Program 2015–2018: baseline and trial pumping data. The Waterway Ecosystem Research Group. Technical Report 18.4. The University of Melbourne.

Publications

- Greet J, Fischer S, Walsh CJ, Sam- monds MJ, Catford JA (2022) Restored river-floodplain connectivity promotes riparian tree maintenance and recruit- ment. Forest Ecology and Management 506, 119952.
- Fischer, S., Greet J., Walsh C. J., and Catford J. A. (2021) Restored river-floodplain connectivity promotes woody plant establishment. Forest Ecology and Management 493:119264
- Fischer S, Greet J, Walsh CJ, Cat- ford JA, Arndt SK (2022) Riparian trees resprout regardless of timing and sever- ity of disturbance by coppicing. Forest Ecology and Management 507, 119988
- Fischer, S., Greet J., Walsh C. J., and Catford J. A. (2021) Flood disturbance affects morphology and reproduction of woody riparian plants. Scientific Reports 11:16477.
- Gregor S, Greet J, Gaskill S (2021) Cockatoo Swamp Hydrology Improvement Project. In: Proceedings of the 10th Australian Stream Management Conference 2021, Kingscliff, NSW
- Sandercock P, Treadwell S, Greet J, Stuart L, Harley D (2021) Enhancing floodplain connectivity, first steps towards habitat restoration for threatened species. In: Proceedings of the 10th Australian Stream Manage- ment Conference 2021, Kingscliff, NSW

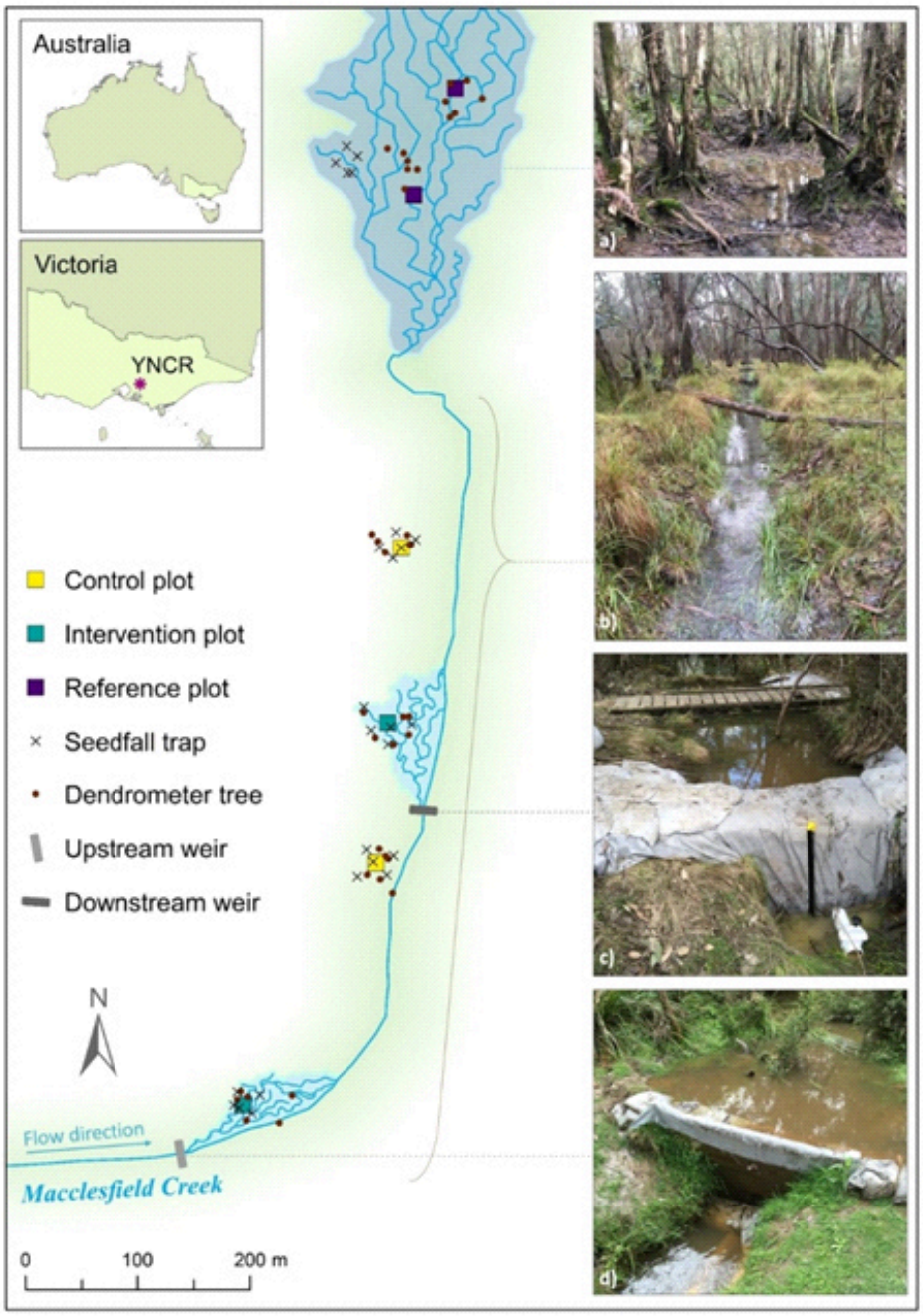

Figure 2. Schematic of Macclesfield Creek study Site showing the locations of two trial diversion Weirs built within a channelised section of the creek with the aim to reconnect adjacent floodplain areas and restore degraded swamp forests.

- Greet, J., Harley, D., Ashman, K., Watchorn, D., and Duncan D. (2020) The vegetation structure and condition of contracting lowland habitat for Leadbeater's possum (Gymnobelideus leadbeateri). Australian Mammalogy. doi. org/10.1071/AM20047
- Greet, J., Fischer, S. and Russell, K. (2020) Longer dura- tion flooding reduces the growth and sexual reproduc- tive efforts of a keystone wetland tree species. Wet- lands Ecology and Management. 28: 655-666.
- Duong, A. Greet, J. Walsh, CJ., and Sammonds, MJ. (2019) Managed flooding can augment the benefits of natural flooding for native wetland vegetation. Resto- ration Ecology. 27: 38-45.
- Greet J, King E (2019) Slashing Phragmites (Phragmites australis) prior to planting does not promote native vegetation establishment. Ecological Management & Restoration 20, 162-165.
- Zacks G., Greet J., Walsh CJ., and Raulings E. (2018) The flooding tolerance of two critical habitat-forming wet- lands, Leptospermum lanigerum and Melaleuca squar- rosa, at different life history stages. Australian Journal of Botany. 66: 500-510.

For more details on the research outcomes of this project, or other projects of the MWRPP, please contact:

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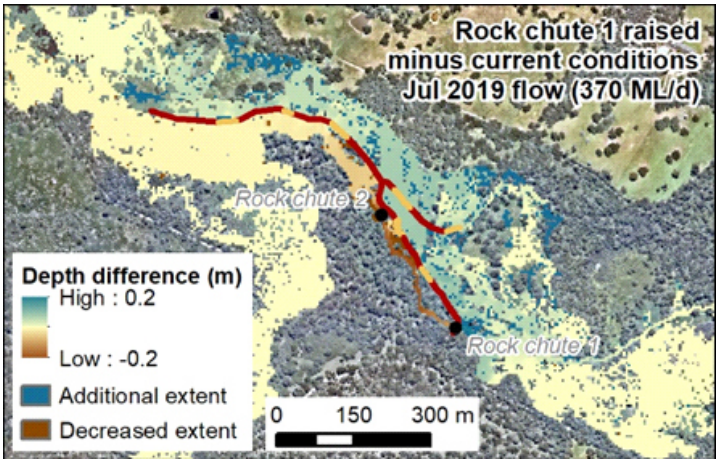

Figure 3. Depth and flooding extent differences between scenario 1 (rock chute 1 raised) and current conditions for July 2019 (370 ML/d) high flow event.