Wetland forest restoration ARC Linkage Project (LP 150100682) 31/05/18

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Students: Sarah Fischer (PhD), Rob Dabal (MSc), Luke Westerland (BSc Hons), Sarah Moser (MEnv), Alice Duong (MEnv), Georgina Zacks (BSc Hons)

Project update

The project team has been very busy with the project entering its third (and final) year in March this year. Along with the hydrology works finally reaching the exciting implementation phase, several other projects have been completed and their findings published or are now well underway, while a few others are just beginning! Here is a summary of the various projects:

Cockatoo Swamp hydrology works

Hydrology works

The pumps have been set up and two separate trial pumping events were conducted in April this year (Fig. 1). From the trials, suitable operating rules were established to enable a full season of pumping (Jan-Apr) next year aimed at improving vegetation condition within the Cockatoo Swamp.

Cockatoo Swamp vegetation condition monitoring program

A fourth year of vegetation condition monitoring was completed in March this year. Data on tree and stand condition and understorey vegetation composition will soon be assessed against water level data to assess for any background (prior to pumping) variation in vegetation condition with hydrologic variability. The monitoring program was recently complemented by drone surveys (multilevel LiDAR and multispectral imagery) of both the Cockatoo and Macclesfield Creek floodplains (Fig. 1). We will use this data to assess changes in vegetation structure and condition at the landscape scale across the duration of the pumping trial (next three years). We have also recently redeveloped the existing hydraulic model for the Cockatoo Swamp using TuFLOW allowing us to model flooding within the Cockatoo Swap across the entire available flow record (1998–present). This will allow us to test for landscape-scale associations between our field and drone survey data with flooding regime (Russel et al. 2018).



Fig. 1. Inlet site for the pumping trial (left) and LiDAR image of Cockatoo swamp showing transition zone between intact and severely-dieback affected forest (right).

Completed student projects

Woori Yallock billabong reengagement

Alice Duong's Masters project investigated the potential use of managed flooding to restore wetland vegetation in billabongs along the Woori Yallock Creek. Using a managed flood of McColl's Swamp, Alice found that reinstating more natural flooding regimes can promote native wetland plant communities, while concurrently suppressing terrestrial exotic species. Alice's research is published in *Restoration Ecology* (Duong et al. 2018) and is available here: <u>https://rdcu.be/OyGY</u>. The vegetation survey data and code for analyses used in the study are publicly available on Open Science Framework: <u>https://osf.io/TSY8U/</u>.

Assessment of revegetation success at Yellingbo

Sarah Moser studied the effect of key environmental determinants on the success of revegetated woody plants in wetland forests at Yellingbo. In particular, Sarah examined the potential of planting within the perimeter of sedges ('cryptic planting') to deter browsing. Sarah found that 'cryptic planting' can provide a low-cost effective option for reducing browsing damage to planted woody seedlings. Sarah's research is published in *Forest Ecology and Management* (Moser and Greet 2018).

Flooding tolerance of critical shrub species

Georgie Zack's research explored the flooding tolerance of two ecologically important shrubs at Yellingbo. She investigated how depth and duration of flooding affects *Melaleuca squarrosa* and *Leptospermum lanigerum* at important life history stages. Her research provides further evidence that water regime acts as an important ecological filter in wetlands forests at Yellingbo. Georgie's study is currently in review at the *Australian Journal of Botany*.



Fig. 2. Panoramic view of McColl's Swamp showing the successful establishment of revegetation over the last two years following fencing, revegetation, and flooding (top photo, 14/4/2016; bottom photo, 08/05/2018).

Current student projects

Several other projects are well under way, including:

- Spatial survey of growth forms and associated regeneration strategies of key woody species (*Eucalyptus camphora, Leptospermum lanigerum* and *Melaleuca squarrosa*) along a hydrological gradient to provide insights into flooding regimes required for desired vegetation structure (e.g. structural complexity) (Sarah Fischer; Fig. 3).
- Nursery trials assessing competition and flooding regime effects on *Phalaris arundinacea* colonisation and growth (Rob Dabal).
- Assessment of potential of cutting and flooding to control *Phalaris arundinacea* at McColl's Swamp (Rob Dabal; Fig. 3).
- Vegetation surveys to assess ecological drivers promoting forest stand characteristics conducive to lowland Leadbeater's possums habitation (Luke Westerland; Fig. 4).



Fig. 3. Photos from two current student projects: Sarah's survey of tree growth form – an E. camphora tree exhibiting high capacity for vegetative regeneration (left); and a cleared patch of Phalaris arundinacea within McColl's swamp for an assessment of the potential of cutting and flooding to control Phalaris.

Just around the corner...

A couple of other projects are just getting under way, including:

- Sarah Fischer will investigate recovery mechanisms from physical disturbance via coppicing. This trial will test best practice for management interventions to promote vegetative regrowth in the absence of appropriate disturbance and thus limited regeneration (Fig. 4).
- Vegetation response monitoring for the Macclesfield Creek floodplain reengagement trial.



Fig. 4. Luke is measuring the basal area of different trees species in areas occupied and not occupied by Leadbeater's Possums (left). Extensive regeneration of a Melaleuca squarrosa tree following coppicing (middle). Channelized section of the Macclesfield Creek to be targeted for greater floodplain engagement (right).

Project publications

Journal articles

Duong A, Greet J, Walsh CJ, and Sammonds MJ (2018) **Managed flooding can augment the benefits of natural flooding for native wetland vegetation**. *Restoration Ecology*. DOI: 10.1111/rec.12816

Moser S, and Greet J (2018). Unpalatable neighbours reduce browsing on woody seedlings. *Forest Ecology and Management*. 414(1): 41-46.

Zacks G, Greet J, Walsh CJ, Raulings E (in review) **The effects of flooding on two wetland shrubs at important life history stages**. Submitted to *Australian Journal of Botany*.

Greet J (2016) **The potential of soil seed banks of a eucalypt wetland forest to aid restoration**. *Wetlands Ecology and Management*. 24: 565-577

Greet J, King E, and Stewart-Howie M (2016) **Plastic weed matting is better than jute or woodchips for controlling the invasive wetland grass** *Phalaris arundinacea*, **but not** *Phragmites australis*. *Plant Protection Quarterly*. 31(1): 19-22.

Greet J (2015) The marked flooding tolerance of seedlings of a threatened swamp gum: implications for the restoration of critical wetland forests. *Australian Journal of Botany*. 63: 669-678

Technical reports

Russell K and Greet J (2018) **Cockatoo Swamp Inundation Modelling**. June 2018 (Draft 01). Melbourne Waterway Research-Practice Partnership Technical Report 18.1. the University of Melbourne

Greet J (2017) **Cockatoo Swamp Vegetation Condition Monitoring Program 2015–2017: baseline data**. The Waterway Ecosystem Research Group. Technical Report 17.2. The University of Melbourne.

Greet J (2016) **Cockatoo Swamp Vegetation Condition Monitoring Program: baseline data for 2015-2016**. Waterway Ecosystem Research Group Technical Report 16.4. The University of Melbourne.

Theses

Duong A (2017) **Investigating the effect of flooding duration on wetland plant functional groups in floodplain wetlands**. Masters Thesis. The University of Melbourne.

Moser S (2016) Environmental determinants influencing woody plant persistence: implications for wetland forest restoration using 'infill' and 'cryptic' planting. Masters Thesis. The University of Melbourne.

Zacks G (2015) **The flooding tolerance of two ecologically important woody riparian plant species**. Honours Thesis. The University of Melbourne.

Please don't hesitate to contact me, Joe Greet (<u>greetj@unimelb.edu</u>) if you would like any further information on any of the above projects or copies of any the listed publications.