Yanco Creek Environmental flows monitoring: 2015-16 wetland surveys

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Background

Between 21 July and 13 August 2015 environmental flows were delivered to the Yanco Creek System (Murrumbidgee Catchment, NSW) *to connect and inundate fringing wetlands to protect and maintain wetland and riparian native vegetation*. By facilitating overbank inundation, these flows also aimed to support the habitat requirements of river and wetland biota (including waterbirds, native fish and turtles) and to facilitate lateral connectivity, dispersing nutrients and biota within the system. Environmental flows used up to 22,000 ML of environmental water (18,263 ML Commonwealth environmental water and 4,566 ML of NSW adaptive environmental water) which successfully inundated fringing wetlands along Yanco Creek.

Charles Sturt University monitored wetland water quality, fish and frog communities at Molleys Lagoon (Plate 1) and Yellow Clay Creek(Plate 2), both located along Yanco Creek. Due to rapid drying over summer, Yellow Clay Creek was only sampled during November 2015. The subsequent sample at for Yellow Clay Creek was then shifted to Molleys Lagoon, which was sampled on three occasions (November 2015, January 2016 and March 2016) with conditions on the latter occasion permitting water quality and frog monitoring but not fish or tadpole surveys.

Methods

All methods used follow Category 3 wetlands survey techniques described in the Murrumbidgee Monitoring and Evaluation Plan (Wassens et al., 2014). Briefly, wetland fish and tadpoles were surveyed using 2 x large and 2 x small fyke nets, set overnight. Adult frogs were surveyed with 40 minute night-time spotlight direct searches, recording both observed and calling individuals. Vegetation surveys are undertaken along three fix transects each containing 30 1x1m quadrats spaced 3 meters apart, the percentage cover of each species, leaf litter, bare ground, open water and covariates, water depth and crown cover are recorded for each quadrats on each survey occasion.

Physicochemical parameters (electrical conductivity (EC, mS cm^{-2}), turbidity (NTU) and pH and dissolved oxygen (mg L^{-1})) were measured at three random locations at each site using a calibrated water quality meter (Horiba U-52G). Dissolved oxygen was surveyed continuously over 12 hours with a d-opto dissolved oxygen datalogger (Zebra Tech). Duplicate water samples were collected and later analysed for dissolved organic carbon (DOC), chlorophyll-a (CHLA), total nitrogen (TN) and total phosphorus (TP).

Plate 1 Molley's Lagoon November 2015.

Plate 2 Yellow Clay Creek November 2015.

Results

Water quality

Water quality results are typical for wetlands in forested systems, with relatively high concentrations of dissolved organic carbon, total nitrogen and phosphorus (Table 1). Increasing concentrations over time, particularly increasing DOC and chlorophyll-a, is consistent with the patter of drying seen in wetlands across the Murrumbidgee. Lateral and longitudinal reconnections will have mobilised large amounts of carbon and nutrients into Yanco Creek during the environmental flow.

Table 1: Mean ± standard error of physicochemical conditions and total nutrient concentrations measured at Yellow Clay Creek and Molley's Lagoon during 2015-16.

Site	Molley's Lagoon			Yellow Clay Creek
Sample Occasion	Nov 2015	Jan 2016	Mar 2016	Nov 2015
Conductivity (mS cm^{-2})	0.268 ± 0.000	0.314 ± 0.00	0.538 ± 0.002	0.335 ± 0.003
pH	6.92 ± 0.11	8.37 ±0.00	8.42 ± 0.02	7.14 ± 0.04
Temperature (degrees C)	22.26 ± 0.45	28.9 ± 0.13	28.03 ± 0.26	20.75 ± 0.29
Turbidity (NTU)	39.9 ± 8.5	63.1 ± 3.5	97.8 ± 15.3	20.3 ± 0.1
Measured DO (mg L^{-1})	5.48 ± 0.95	8.29 ± 0.01	12.32 ± 1.29	3.01 ± 0.12
Maximum DO (mg L^{-1})	4.92	9.56	NA	3.13
Minimum DO (mg L^{-1})	2.93	4.76	NA	1.92
Total Nitrogen (mg L^{-1})	1190 ± 40	1545 ± 5	2810 ± 10	3415 ± 15
Total Phosphorus (mg L^{-1})	190.0 ± 0.0	112.5 ± 2.5	225 ± 5.0	1490 ± 0.0
Dissolved organic carbon (mg L^{-1})	14.00 ± 0.30	18.3 ± 0.00	32.50 ± 0.50	32.75 ± 0.25
Chlorophyll-a (mg L^{-1})	16.0 ± 1.0	80.5 ± 0.5	110.5 ± 5.5	1.0 ± 0

Biological surveys

Molley's Lagoon contained an abundant community of native rainbowfish (*Melanotaenia fluviatalis*), and unspecked hardyhead (*Craterocephalus fulvus*) (Table 2). On the single occasion surveyed, Yellow Clay creek contained few fish, but was relatively frogs and tadpoles were abundant with 136 individuals recorded in November 2015, including tadpoles of the inland banjo frog (*Limnodynastes interioris*), Perons tree frog (*Litoria peronii*) and barking marsh frogs (*Limnodynastes tasmaniensis/ fletcheri*). Molleys lagoon also supported high numbers of frogs and tadpoles (185 individuals in Number 2015 and 18 individuals in January 2016) with tadpoles of the inland banjo frog, perons tree frog recorded in November and January and plains froglet (Crinia parinsignifera) recorded in January 2015. Frog and tadpole abundance declined as the wetlands dried, smaller numbers of frogs and tadpoles were recorded at Molleys in January and no frogs or tadpoles were recorded in March, while Yellow Clay creek was dry in January

Table 2: Presence/absence of biological data collected at Yellow Clay Creek and Molley's Lagoon during 2015-16. * Shaded cells indicate species was present.

			Molley's Lagoon			Yellow Clay Creek
Species		Stage	Nov 2015	Jan 2016	Mar 2016	Nov 2015
Frogs and tadpoles	*Crinia parinsignifera*	adult		*		
		call				*
		tadpole		*		
	Limnodynastes fletcheri	adult	*			*
		call	*			*
	Limnodynastes tasmaniensis	adult	*	*		*
		call				*
	Limnodynastes tasmaniensis/ fletcheri	tadpole				*
	Limnodynastes interioris	adult		*		
		call				
		tadpole	*	*		*
	Litoria peronii	adult	*	*		*
		call	*			*
		tadpole	*	*		*
Native Fish	*Nematalose erebri*					
	Macquaria ambigua					
	Carassius auratus		*	*		
	Hypseleotris spp.		*	*		
	Maccullochella peelii					
	Melanotaenia fluviatalis		*	*		
	Retropinna semoni		*	*		*
	Craterocephalus fulvus		*	*		
Introduced fish	*Misgurnus anguillicaudatus*		*	*		
	Cyprinus carpio		*			
	Gambusia holbrooki		*	*		

* *Limnodynastes fletcheri* and *tasmaniensis* tadpoles cannot be easily identified to species.

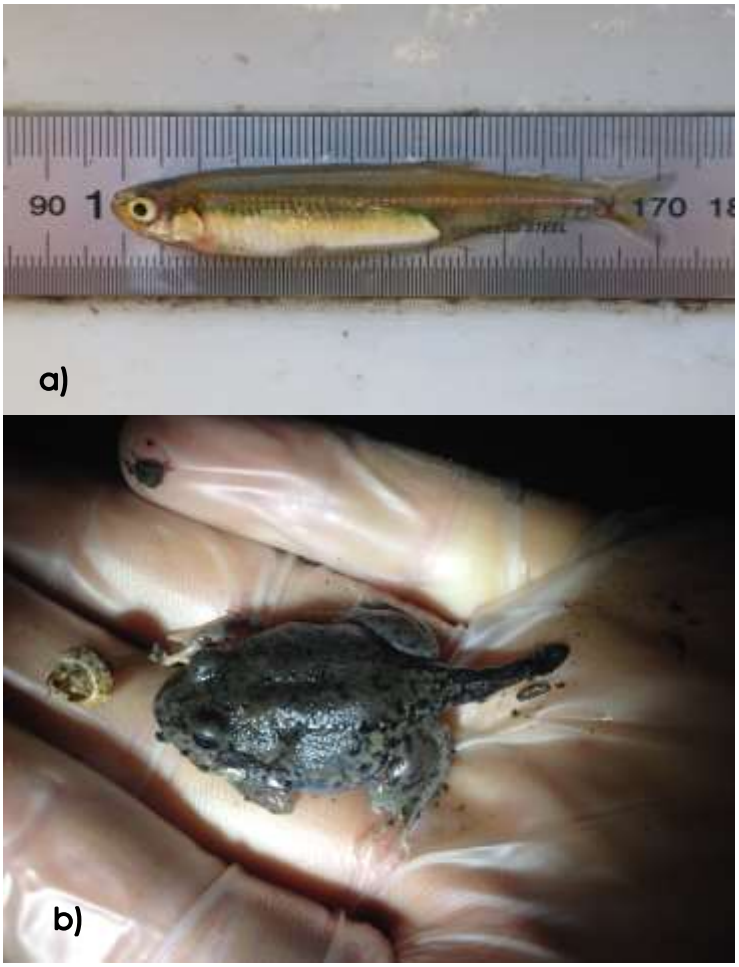

Plate 3: a) Australian Smelt (*Retropinna semoni*) captured in a fyke net and b) inland banjo frog metamorph (*Limnodynastes interioris*). Both photographed at Molley's Lagoon in January 2016.

Vegetation diversity

Molleys lagoon was surveyed on three occasions in November 2015, January and March 2016 while Yellow Clay Creek was surveyed in November 2015. Overall, vegetation coverage was low at both wetlands making up 16.5% of total percentage cover at Molleys and 10.8% at Yellow Clay Creek, both wetlands had a high percentage cover of bare ground and leaf litter (Molleys 65.3% and Yellow Clay Creek 66.8%), and open water (Molleys 18.1% and Yellow Clay Creek 22.4%). Despite low vegetation cover, species richness was high with 60 species recorded across both wetlands. Native species dominated at both Molleys (30 species) and Yellow Clay Creek (12 species). Similar to previous surveys between 2010 and 2013 (Wassens et al., 2013, Wassens and Spencer, 2012, Wassens et al., 2012), amphibious (wetland associated species) made only a small contribution to percentage vegetation

cover, 1.4% at Molleys and 3.9% at Yellow Clay Creek. Wetland associated species at Molleys included small spike rush (0.4%) and common sneezeweed (*Centipeda cunninghamii*) (0.4%), while at Yellow Clay Creek Lignum (*Duma florulenta*) (3.0 %) and common sneezeweed (0.4%) contributed the most to the overall percentage cover of wetland associated species. As expected, the composition of communities differed significantly between Molleys and Yellow Clay Creek (adjusted for differences in survey effort) (ANOSIM Global R 0.637, p = 0.05), but at Molleys the composition of vegetation community did not change significantly between surveys (ANOSIM Global R 0.251, p = 0.147). Other important native species at Molleys lagoon included tufted burr daisy (*Calotis scapigera*), creeping knotweed (Persicaria prostrata) and small knotweed (*Polygonium plebeium*), while at Yellow Clay Creek Warrego summer grass (*Paspalidium jubiflorum*), tufted-burr daisy and corrugated sida (*Sida corrugata*) had the highest percentage covers (see Appendix 1 for species list).

Recommendations

- The abundance of native species seen across both sites demonstrates positive ecological outcomes from the use of environmental water in Yanco Creek during 2015-16.
- Overall carbon concentrations in Yellow Clay Creek were high. Extended dry periods coupled with high litter fall can increase carbon loading in wetlands. Environmental flows, particularly to sites in the Yellow Clay Creek area, can assist in mobilising carbon and may improve water quality and productivity through the Yanco creek system.
- Molleys lagoon supports a high diversity of native fish and supported breeding by resident frog species. Molleys lagoon was historically highly persistent and may have acted as an off river refuge for fish, frogs and turtles in the Yanco Creek system. The value of these wetlands to native fish is reduced if drying occurs prior to reconnection, because fish become trapped in the wetland and die. Consideration to creating multiple reconnections to allow fish movement out of the wetland might improve the health of fish communities through the Yanco creek system.
- Both wetlands supported reasonably diverse frog communities, frogs respond strongly to inundation and both wetlands supported frog breeding in

November 2015, with breeding activity declining through summer as the wetlands dried. While Yellow Clay Creek did not support high numbers or diversities of fish, it did support significant numbers of tadpoles. While we do not have measures of recruitment for Yellow Clay Creek, it is import to note that metamorphosis of by inland banjo frog tadpoles occurred in January 2016 at Molleys lagoon, given this extending the inundation period at Yellow Clay Creek might better support tadpole development and metamorphosis and increase recruitment to sustain viable populations.

- Native species dominate vegetation communities in both wetlands, but percentage cover of wetland dependant species is low, this is in keeping with previous surveys of Molleys lagoon, and is a reflection of the underlying the geomorphology of the wetland which is characterised by steep sides and deep water, which limit the opportunities for aquatic plant species to establish (see Plate 1). Lignum was the dominant wetland depend species recorded at Yellow Clay Creek. While the 2015-16 watering actions were not sufficient to inundate the areas of lignum on our survey transects, larger scale watering actions that inundate areas might assist in maintaining the health of existing lignum and potentially trigger germination and growth of other understory aquatic species.

Appendix 1 plant species list for Molleys Lagoon and Yellow Clay Creek

Status	Functional group	Species	Molleys	Yellow Clay Creek
Introduced	Terrestrial	*Cirsium vulgare*	*	*
Introduced	Terrestrial	*Citrullus lanatus*	*	
Introduced	Terrestrial	*Conyza bonariensis*	*	
Introduced	Terrestrial	*Echium plantagineum*	*	
Introduced	Terrestrial	*Galium aparine*	*	
Introduced	Terrestrial	*Grass*	*	*
Introduced	Terrestrial	*Hordeum spp*	*	*
Introduced	Terrestrial	*Lactuca serriola*	*	*
Introduced	Terrestrial	*Lolium sp*	*	*
Introduced	Terrestrial	*Marrubium vulgare*	*	*
Introduced	Terrestrial	*Medicago polymorpha*	*	
Introduced	Terrestrial	*Mentha pulegium*	*	*
Introduced	Terrestrial	*Oxalis corniculata*	*	*
Introduced	Terrestrial	*Phyla canescens*	*	
Introduced	Terrestrial	*Polygonum aviculare*	*	
Introduced	Terrestrial	*Rumex crispus*	*	
Introduced	Terrestrial	*Sinapis spp*	*	
Introduced	Terrestrial	*Solanum elaeagnifolium*	*	
Native	Amphibious	*Centipeda cunninghamii*	*	*
Native	Amphibious	*Cyperus exaltatus*	*	
Native	Amphibious	*Eleocharis acuta*	*	
Native	Amphibious	*Eleocharis pusilla*	*	
Native	Amphibious	*Juncus sp.*	*	
Native	Amphibious	*Juncus usitatus*	*	
Native	Amphibious	*Marsilea drummondii*	*	
Native	Amphibious	*Muehlenbeckia florulenta*		*
Native	Amphibious	*Paspalum distichum*		*
Native	Terrestrial	*Alternanthera denticulata*	*	
Native	Terrestrial	*Asperula conferta*	*	
Native	Terrestrial	*Atriplex sp.*	*	*
Native	Terrestrial	*Austrodanthonia spp*	*	
Native	Terrestrial	*Austrostipa spp*	*	*
Native	Terrestrial	*Boerhavia dominii*	*	
Native	Terrestrial	*Calotis erinacea*	*	
Native	Terrestrial	*Calotis scapigera*	*	*
Native	Terrestrial	*Chamaesyce drummondii*	*	*
Native	Terrestrial	*Cynodon dactylon*	*	*
Native	Terrestrial	*Dianella sp.*	*	
Native	Terrestrial	*Einadia nutans*	*	
Native	Terrestrial	*Eucalyptus camaldulensis*	*	
Native	Terrestrial	*Eucalyptus largiflorens*	*	

Status	Functional group	Species	Molleys	Yellow Clay Creek
Native	Terrestrial	*Glinus lotoides*	*	
Native	Terrestrial	*Goodenia heteromera*	*	
Native	Terrestrial	*Haloragis glauca*	*	
Native	Terrestrial	*Haloragis heterophylla*		*
Native	Terrestrial	*Mentha australis*	*	
Native	Terrestrial	*Paspalidium jubiflorum*	*	*
Native	Terrestrial	*Persicaria prostrata*	*	
Native	Terrestrial	*Polygonium plebeium*	*	
Native	Terrestrial	*Pratia concolor*	*	
Native	Terrestrial	*Pseudognaphalium luteoalbum*	*	*
Native	Terrestrial	*Ptilous polystachyus*	*	
Native	Terrestrial	*Rhodanthe corymbiflora*	*	
Native	Terrestrial	*Rumex brownii*	*	
Native	Terrestrial	*Senecio runcinifolius*	*	
Native	Terrestrial	*Sida corrugata*	*	*
Native	Terrestrial	*Teucrium racemosum*	*	
Native	Terrestrial	*Themeda triandra*	*	
Native	Terrestrial	*Wahlenbergia fluminalis*	*	

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