Cesar Australia

Status of platypus populations in the lower Werribee River 2022/23.

Josh Griffiths

9 May 2023

Prepared for

Werribee River Association

Version history

Version	Date	Description	Author(s)	Reviewed by
1.0	28/4/23	Draft	JG	WRivA
2.0	9/5/23	Final	JG	

Project team

Team member	Role
Josh Griffiths	Project Manager
Taylor Gundry	Ecologist
Will Webster	Ecologist

Report Disclaimer: The professional analysis and advice in this report has been prepared for the exclusive use of the party or parties to whom it is addressed (the addressee) and for the purposes specified in it. This report is supplied in good faith and reflects the knowledge, expertise and experience of the consultants involved. The report must not be published, quoted or disseminated to any other party without prior written consent from Cesar pty ltd.

Cesar pty ltd accepts no responsibility whatsoever for any loss occasioned by any person acting or refraining from action as a result of reliance on the report. In conducting the analysis in this report Cesar pty ltd has endeavoured to use what it considers is the best information available at the date of publication, including information supplied by the addressee. Unless stated otherwise, Cesar pty ltd does not warrant the accuracy of any forecast or prediction in this report.

Contents

Abbreviations

Abbreviation	Description
WRivA	Werribee River Association
CPUE	Captures Per Unit Effort
eDNA	Environmental DNA

Executive Summary

The lower Werribee River is highly modified with flow regimes significantly regulated through Melton Reservoir and the Werribee Diversion Weir and the surrounding catchment highly altered by agriculture and urbanisation. The platypus population in the lower Werribee River is considered highly vulnerable due to its long-term decline during the Millennium Drought, current low abundance, low recruitment, isolation, and poor genetic health. This project aimed to update the current status of platypuses through several live-trapping surveys that haven't been done since 2019.

Two live-trapping surveys were undertaken in the Werribee and Mt Cottrell reaches of the Werribee River during February 2022 and March 2023 respectively. No platypuses were captured in during either survey, highlighting the low abundance throughout the area. However, other recent from live-trapping and eDNA surveys are encouraging and indicate the population in the Werribee reaches is starting to recover following a long-term decline. Platypuses appear to be at lower abundance in the Melton Reservoir to Werribee Diversion Weir reaches although data is limited. The platypus population in the lower Werribee River should still be considered highly vulnerable and there are concerns over the impact of increasing urbanisation throughout the area.

KEY RECOMMENDATIONS:

- Minimise periods of very low flows or cease-to-flow events.
- Minimise the impacts of increasing urbanisation of flow variability through water sensitive urban designs.
- Improving flow regimes in the Melton Reservoir to Werribee Diversion Weir reaches that may include reducing the variability and rate of changes in flows, and maintaining a minimum baseflow.
- Determine the level of connectivity and gene flow across Melton Reservoir through population genetic analyses.
- Develop a longer-term strategy to re-connect platypus populations in the lower and middle Werribee River (pending outcomes of the population genetic analyses).
- Improve the quality, connectivity, and width of riparian zone, particularly in the Melton Reservoir to Werribee Diversion Weir reaches, through stock exclusion, weed removal, and revegetation.
- Implement a holistic litter reduction strategy that may include a combination of gross pollutant traps, increased bins around the river, working with industry to reduce packaging and waste, community engagement and education.

Background

The iconic platypus inhabits a variety of freshwater systems throughout eastern and southern Australia (Grant 1992a). Due to their dependence on aquatic ecosystems, platypuses are potentially vulnerable to a variety of threats that can degrade their habitats such as drought, water diversion and extraction, altered flow regimes, clearing of riparian vegetation, reduced water quality, as well as direct mortality from introduced predators, litter, and fishing equipment (Grant and Temple-Smith 1998, 2003; Bino *et al.* 2020). Many of these threats are exacerbated in highly modified urban environments but the extent and severity of these threats across the species' range are poorly understood. As a result, there is considerable uncertainty about their true conservation status and the long-term viability of many populations at a local or catchment scale.

Long-term monitoring of platypus populations throughout Melbourne's catchments has revealed substantial declines in many populations over the past 25 years, largely attributed to the Millennium Drought and fragmentation, followed by variable levels of recovery since the end of the drought (Griffiths and Weeks 2011; Griffiths, Maino, *et al.* 2020). This has included regular live-trapping surveys in the lower Werribee River from the Werribee diversion weir to the Princes Freeway from 1997 to 2019 (Williams and Serena 1998; Griffiths, Maino, *et al.* 2020). These data have revealed a significant decline in captures-per-unit-effort (CPUE), an index of abundance, with the current population considered to be at very low abundance relative to other populations across Melbourne. More recently, environmental DNA (eDNA) surveys have provided another method for assessing platypus populations over much broader spatial scales including areas that have been problematic for trapping, such as the reaches between Melton Reservoir and Werribee diversion weir (Griffiths *et al.* 2017, 2018; Weeks *et al.* 2015). Data from the eDNA surveys support the trapping data with low site occupancy, proportion of sites where platypuses were detected, indicating a low density population.

When considering a number of different population indices, the Werribee population has been considered Threatened due to a long-term decline, current low abundance, low recruitment, isolation, lack of recovery since the end of the Millennium Drought, and poor genetic health (Griffiths, Maino, *et al.* 2020; Griffiths and Weeks 2018). One of the key concerns regarding this population has been the limited recovery of the population since the end of the drought, although there have been subtle encouraging signs such as halt to the declining CPUE, and even a slight increase in recent surveys, as well as the capture of several juveniles. However, the rate of recovery in this population has likely been limited by the very low abundance, relatively poor habitat quality and low reproductive output. Population growth has also been hampered by devastating incidents such as the drowning of seven individuals in an illegal fishing net near the Werribee diversion weir in September 2018 (Griffiths, Maino, *et al.* 2020).

The lower Werribee River is highly modified with flow regimes significantly regulated through Melton Reservoir and the Werribee Diversion Weir, the surrounding catchment highly altered by agriculture and urbanisation, and concerns over ongoing urban development throughout the area. This project aimed to build on previous work and continue the long term monitoring of platypus populations in the lower Werribee River and understand their current status through two live-trapping surveys, as none had been undertaken since 2019. In addition, the report provides an

overview of available data from all sources to describe the historical trajectory and current status of platypuses in the area.

Methods

Platypus live-trapping surveys were conducted using fyke nets (Serena 1994),consisting of a central capture chamber (mesh size 15 x 15 mm) with several one-way baffles that detain the animal without entanglement. Mesh wings on either side of the entrance were positioned to block the width of the waterway and guide platypuses into the capture chamber, with rocks used to weigh the bottom edge down and prevent platypus passage. The distal end of the capture chamber was securely suspended above the water level to allow captured platypuses (and bycatch) access to air. At each site, a pair of fyke nets was deployed with one facing upstream and one facing downstream to capture platypuses travelling in either direction. Nets were set during the afternoon and removed at dawn the following day. Nets were checked at regular intervals during the night to remove captured platypuses and bycatch, and to repair holes caused by rakali (water rats, *Hydromys chrysogaster*). Net sites were selected with water depth and flow appropriate to the size of the nets and with suitable banks so that the wings could effectively block the entire channel.

Two live-trapping surveys were undertaken in the lower Werribee River during 2022/23. One survey was conducted through the Werribee township (Werribee) overnight on 24th February 2022 with fyke nets deployed at six sites (12 trap nights, Figure 1). Survey sites were consistent with previous surveys to maintain consistency and provide comparable CPUE data. A second exploratory survey was undertaken in the reaches between Melton Reservoir and Cobbledicks Ford (Mt Cottrell) on 8th March 2023 with nets deployed at five sites (10 trap nights, Figure 2). There is very little empirical data on platypuses in this area due to limited access, lack of suitable sites to deploy nets, and highly variable flows due to water releases from the Melton Reservoir for irrigation. This was an opportunity to gather some new data in this area as the Werribee region was to be surveyed as part of the Melbourne water Urban Platypus Program again from autumn 2023. Members from the Werribee River Association assisted with the surveys and helped facilitate access to private land.

BYCATCH IDENTIFICATION

All non-platypus bycatch were identified to species level (where possible) using relevant field guides (Allen *et al.* 2002; Cogger 1992; Menkhorst and Knight 2004). Rakali were either observed, captured or their presence was inferred by the occurrence of holes in nets. When captured, rakali frequently chew holes through fyke nets in order to escape (J. Griffiths pers. obs.). Presence of rakali stated below usually indicate holes observed in nets and therefore are more an indication of activity rather than absolute numbers.

DATA ANALYSIS

To generate spatial and temporal trends on platypus populations, captures per unit effort (CPUE) is typically used as an index of abundance as there is currently no reliable way of estimating absolute numbers for platypuses. Standard capture-mark-recapture models are unsuited to platypus data due to overall low captures, low recapture rates, and apparent differential catchability of individuals (Grant 1992b; Connolly and Obendorf 1998; Bethge 2002; Griffiths *et al.* 2013). To calculate CPUE, the number of individual platypuses captured in a survey period is standardised by the survey effort (number of nets deployed). This standardisation allows comparison of capture rates across waterways, catchments and survey periods.

Although widely accepted as a measure of relative abundance, CPUE is undoubtedly a coarse index of abundance for platypuses. The usefulness and limitations of CPUE as an index of abundance for platypuses has been discussed elsewhere (Griffiths and Weeks 2011) and recently Griffiths *et al*. (2020) identified several biological and environmental factors that contribute to some of the variability observed, independent of actual abundance. Importantly, CPUE can be highly variable between surveys and such data must be interpreted carefully with repeat surveys required to give a true indication of the current status of a population. Nevertheless, CPUE can be useful as a broad indicator of population trajectories with long term datasets. Historical CPUE was derived from previous reports for WRivA and Melbourne Water.

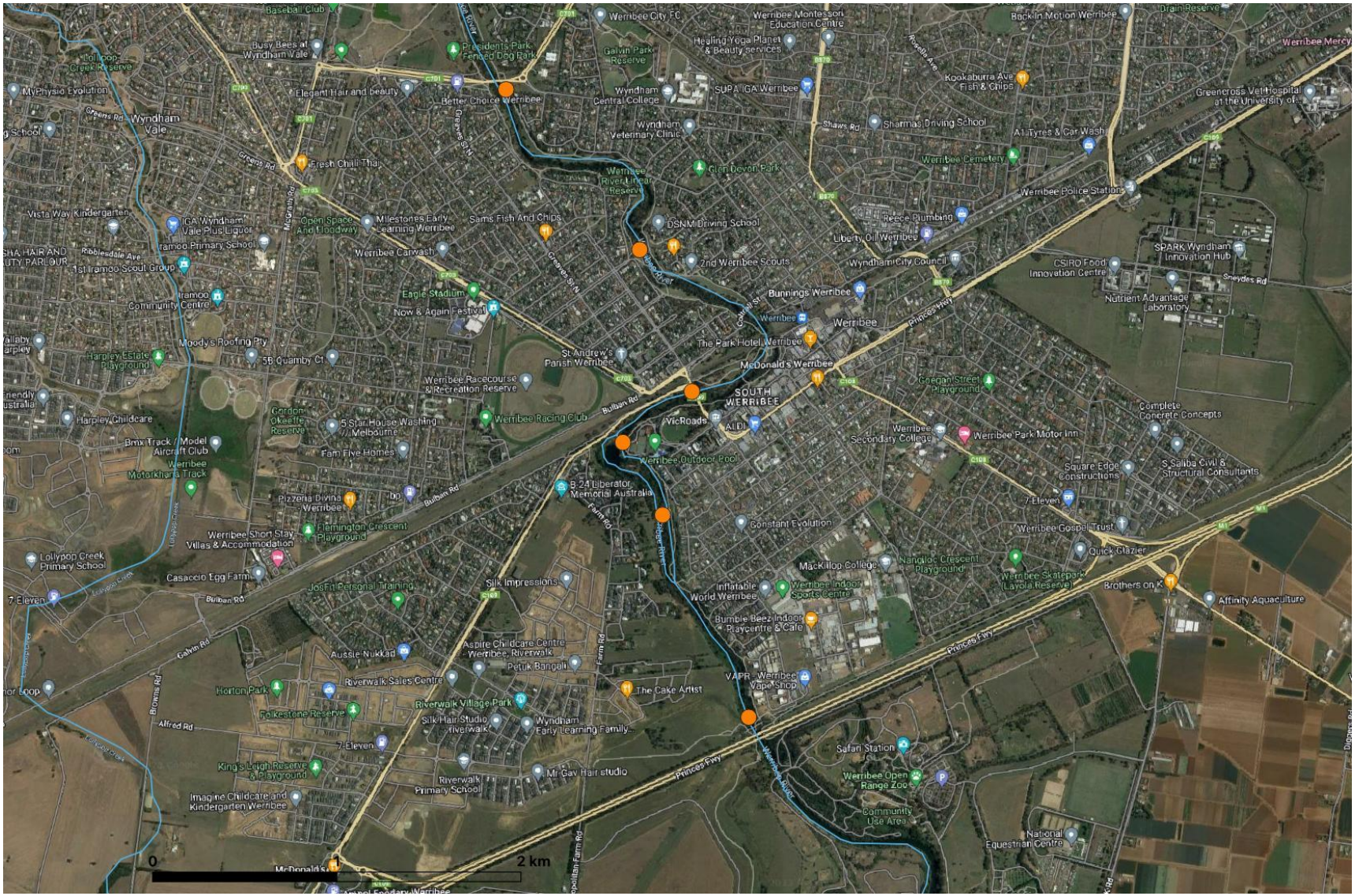

Figure 1. Location of platypus live-trapping survey sites at Werribee.

Figure 2. Location of platypus live-trapping survey sites at Mt Cottrell.

Results

No platypuses were captured from 12 trap nights (6 sites) in Werribee in February 2022 (CPUE = 0.00). While disappointing, this result is not entirely unexpected and continues the trend of low CPUE in recent years (Figure 3) although there have been some encouraging recent results (see Discussion). This survey may also have been somewhat impacted by another trapping survey conducted shortly before as platypuses are known to avoid nets for a period following capture (Griffiths *et al.* 2013).

Bycatch included rakali (2), short-finned eels (3), tupong (1), goldfish (1), long-necked turtles (2), pacific black ducks (9), and chestnut teals (2)(Appendix 1).

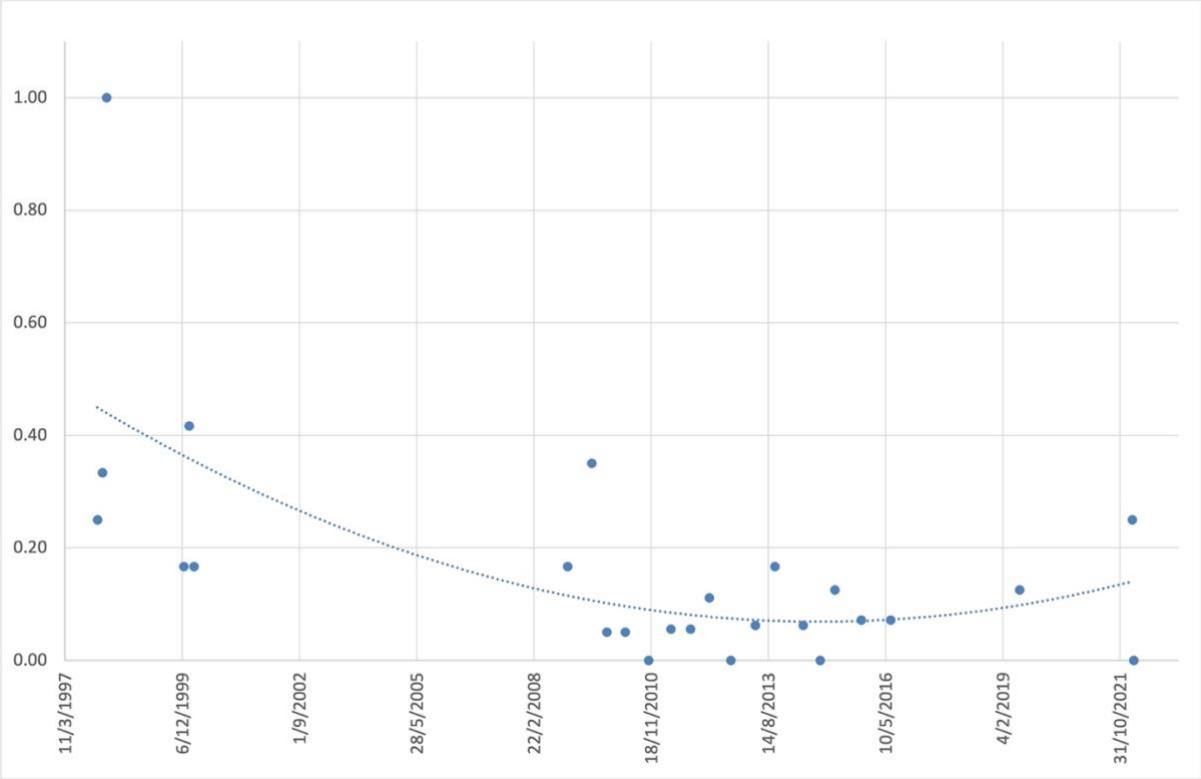

Figure 3. CPUE history of all platypus live-trapping surveys undertaken at Werribee, including those for WRivA and Melbourne Water by Australian Platypus Conservancy (1997-99), Cesar Australia (2008-2022), and Ecology Australia (2022). Trend line is a 2nd order polynomial.

No platypuses were captured from 10 trap nights (5 sites) in Mt Cottrell in March 2023.

Bycatch included rakali (1), short-finned eel (1), roach (1), carp (1), pacific black ducks (6), and Australian wood ducks (2)(Appendix 1).

Discussion

Live trapping surveys have been undertaken at Werribee since 1997 with 25 surveys completed during the 25 year period (Williams and Serena 1998; Williams 2000; Griffiths, Maino, *et al.* 2020; Serena *et al.* 2022). CPUE has declined significantly over that period (Figure 3), which coincides with impacts of the Millennium Drought as well as increasing urbanisation. Very low CPUE was recorded from 2009 to 2016, including very few captures of juveniles, indicating a very small population with low reproductive output. This is supported by population genetic analyses in 2017 using Next Generation Sequencing that calculated an effective population size of 16 individuals and reduced genetic diversity – a key indicator of population resilience and adaptive potential (Griffiths *et al.* 2018). In addition, the recovery of this population since the end of the drought has not been as pronounced as other populations around Melbourne (Griffiths *et al.* 2018).

Estimates of abundance using CPUE from platypus surveys are notoriously variable, largely due to the relatively low numbers of captures each survey, as well as other factors that can influence capture rates (e.g. season, flow rates; Griffiths *et al.* 2020). For this reason, it is not realistic to make conclusions about a local population from a single survey. Griffiths *et al*. (2016) created an index of abundance based on a minimum of four surveys undertaken over a five year period to provide a robust estimate of "current abundance" and enable meaningful spatial and temporal comparisons. Based on this index, using the results from the three surveys undertaken in the lower Werribee from 2019-2022, the average CPUE is 0.125, with current abundance appropriately categorised as Low. Although this estimate doesn't meet the minimum requirement of four surveys, a small population size is supported by both population genetics analyses and eDNA survey results, suggesting it is an accurate representation. This highlights the vulnerable nature of platypuses in this area, but some recent results have been encouraging with the long-term trend in CPUE first stabilising at a low level, then starting to head upwards, indicating the population is recovering following a long-term decline. Results from a recent survey are particularly encouraging (Serena *et al.* 2022) with three individuals captured, including a juvenile, and the highest CPUE since 2009. Therefore, we expect average CPUE to increase over future surveys if suitable conditions persist, likely related to improved flows (Griffiths *et al.* 2019). Further monitoring in the Werribee area being undertaken during 2023 as part of the Melbourne Water Urban Platypus Program will help understand the current status more comprehensively.

There have been limited live-trapping surveys throughout the Mt Cottrell area due to limited access to sites, the occurrence of deep pools that are unsuitable to deploy fyke nets, and highly variable flows from on-demand releases of water from Melton Reservoir for irrigation. Surveys in spring 2013 at limited sites (two and three respectively) also failed to record any platypuses (Kelly *et al.* 2014). Anecdotal sightings of platypuses (www.platypusSPOT.org, www.ala.org.au) suggest the species does occur in the reaches of the Werribee River between Melton Reservoir and Werribee Diversion Weir but these survey results, although limited, indicate a low density population. There is insufficient data to infer any historical trends in abundance or the current population trajectory.

Environmental DNA (eDNA) techniques are now routinely used to survey for aquatic fauna by detecting traces of the target species DNA in water samples to infer the species' presence or absence (McColl-Gausden *et al.* 2019). The simplicity of collecting water samples and relatively low costs of analysis has enabled systematic surveys to be implemented over much greater spatial or

temporal scales than has been feasible with traditional techniques (e.g. Griffiths, McColl-Gausden, *et al.* 2020; McColl-Gausden 2022). Importantly, direct comparisons with traditional techniques across a variety of species have demonstrated eDNA techniques to have significantly higher sensitivity to detect species presence(Biggs *et al.* 2015; Smart *et al.* 2015; Thomsen *et al.* 2012; Valentini *et al.* 2016), including platypuses (Lugg *et al.* 2018) enabling effective detection at low densities. Surveys for platypuses using eDNA have been undertaken in the lower Werribee River since 2016 by both trained ecologists (Griffiths *et al.* 2017, 2018) and citizen scientists (Melbourne Water unpublished data). The number of sites sampled during each survey is relatively low and location of sites variable between surveys, meaning rigorous comparisons between survey periods are not possible.

Nevertheless, detections of platypuses have been recorded on at least one occasion at sites throughout the lower Werribee River from Melton Reservoir to around the Bluestone Ford near Werribee Mansion (Figure 4). The hotspot appears to be at the most downstream reaches of this distribution (Bungies Hole to Bluestone Ford), corresponding with the locations of recent captures. However, low site occupancy (proportion of positive sites) within each survey period and inconsistency of detections at sites with repeat surveys across years demonstrate platypuses are not distributed homogenously through the area and do not occur in all areas at all times. This is consistent with a low density population of a highly mobile species and supports the conclusions from live-trapping surveys.

There is a small resident population of platypuses in the lower Werribee River. Abundance may be slightly higher downstream of Werribee Diversion Weir (i.e. through Werribee township) than upstream. The population is at low abundance after a long term decline over the last 25 years although there are some good signs of recovery in recent years. The population should still be considered highly vulnerable due to its low abundance and isolation. Although the diversion weir may somewhat inhibit free movement along the river, it is unlikely to form an effective barrier for platypuses and we can assume individuals up and downstream of the weir form a single population. However, it is highly likely that platypuses in the lower Werribee are isolated from the nearest population in the Bacchus Marsh/Werribee Gorge region (middle Werribee) by Melton Reservoir. Previous genetic analysis (Griffiths *et al.* 2018) had insufficient samples from the middle Werribee population (n = 2) to ascertain gene flow between populations but with an apparent recovery in both populations (including 4 individuals captured near Bacchus Marsh in early 2022; Serena *et al.* 2022), collection of tissue samples for genetic analysis should be a key objective for any live-trapping programs in the area. Re-establishing a connection and gene flow between these populations would improve the resilience and long-term conservation outcomes of both populations.

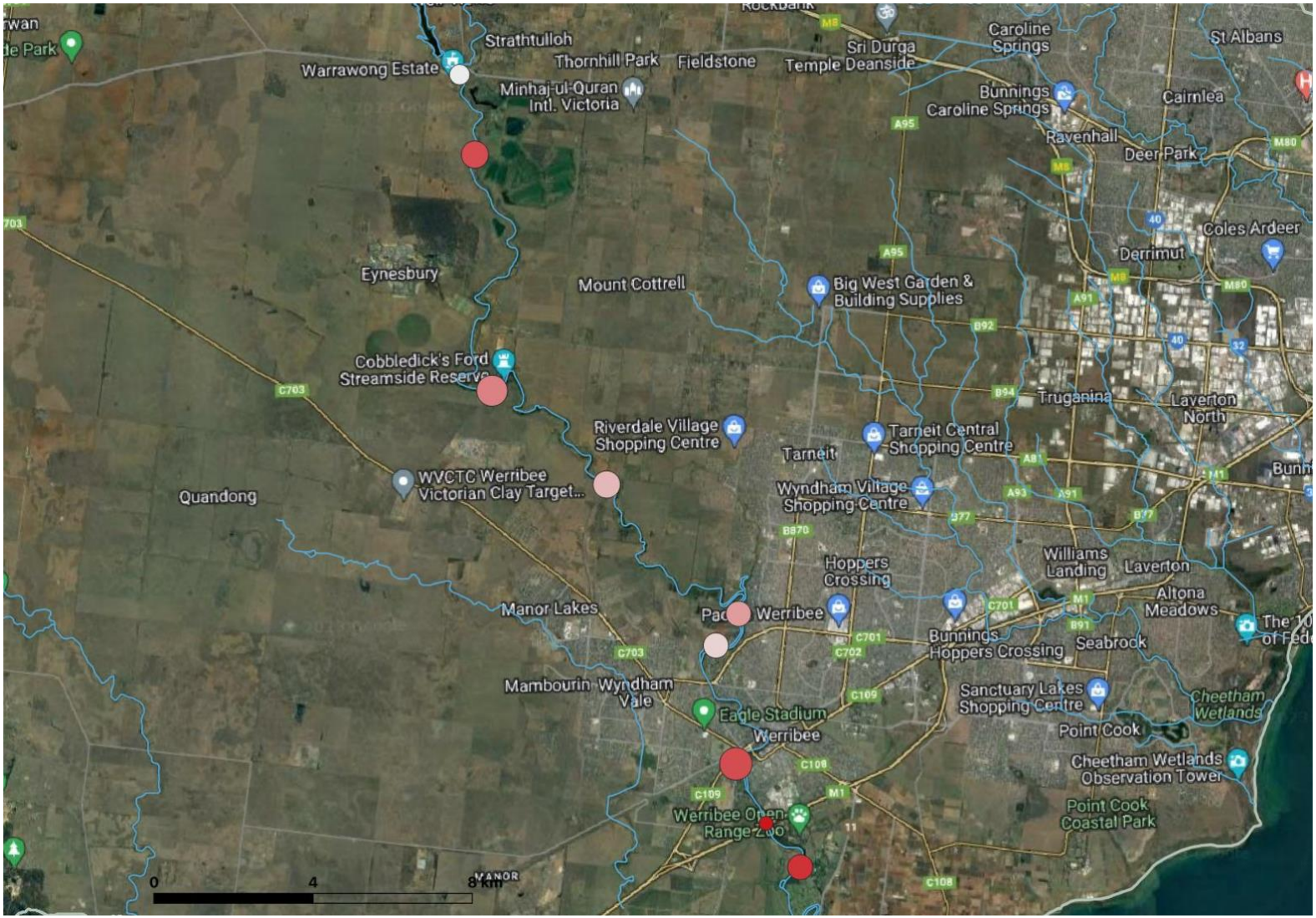

Figure 4. Summary of repeated eDNA surveys in the lower Werribee River between 2016 and 2021. Colour intensity represents proportion of positive detections at each site (0.0-1.0, mean 0.51) with marker size representing the number of surveys undertaken throughout the period (1-9, mean 4.3).

References

Allen G. R., Midgley S. H. & Allen M. (2002) *Field guide to the freshwater fishes of Australia*. West Australian Museum, Perth.

Bethge P. (2002) *Energetics and foraging behaviour of the platypus Ornithorhynchus anatinus*. University of Tasmania. [online].

Biggs J., Ewald N., Valentini A. *et al.* (2015) Using eDNA to develop a national citizen science-based monitoring programme for the great crested newt (*Triturus cristatus*). *Biol. Conserv.* doi: 10.1016/j.biocon.2014.11.029. [online].

Bino G., Kingsford R. T. & Wintle B. A. (2020) A stitch in time – Synergistic impacts to platypus metapopulation extinction risk. *Biol. Conserv.* **242** , 108399. [online].

Cogger H. G. (1992) *Reptiles and amphibians of Australia*. Chatswood, NSW.

Connolly J. H. & Obendorf D. L. (1998) Distribution, captures and physical characteristics of the platypus (*Ornithorhynchus anatinus*) in Tasmania. *Aust. Mammal.*

Grant T. R. (1992a) Historical and current distribution of the platypus, *Ornithorhynchus anatinus*, in Australia. In: *Platypus and Echidnas* (ed M. L. Augee) pp. 232–254 Royal Zoological Society of New South Wales.

Grant T. R. (1992b) Captures, movements and dispersal of platypus, Ornithorhynchus anatinus, in the Shoalhaven river, New South Wales, with evaluation of capture and marking techniques. In: *Platypus and Echidnas* (ed M. L. Augee) pp. 255–262 Royal Zoological Society of New South Wales. [online].

Grant T. R. & Temple-Smith P. D. (1998) Field biology of the platypus (*Ornithorhynchus anatinus*): historical and current perspectives. *Philos. Trans. R. Soc. London Ser. B-Biological Sci.* **353** , 1081–1091.

Grant T. R. & Temple-Smith P. D. (2003) Conservation of the platypus, *Ornithorhynchus anatinus*: Threats and challenges. *Aquat. Ecosyst. Heal. Manag.* **6** , 5–18.

Griffiths J., Kelly T. & Weeks A. (2013) Net-avoidance behaviour in platypuses. *Aust. Mammal.* **35** , 245–247.

Griffiths J., Maino J., Tingley R. & Weeks A. (2020) *Distribution and relative abundance of platypuses in the greater Melbourne area: survey results 2018-20 (Report for Melbourne Water)*. **cesar**, Parkville, VIC.

Griffiths J., Maino J. & Weeks A. (2019) *Identifying key flow variables and quantifying their impact on platypus populations (Report to Melbourne Water)*. **cesar**, Parkville, VIC.

Griffiths J., McColl-Gausden E. F., Connelly F. & Weeks A. (2020) *Assessing the impacts of the 2019/20 bushfires on platypus populations in south eastern Australia*. Cesar Australia, Parkville, VIC.

Griffiths J., van Rooyen A., Song S. & Weeks A. (2018) *Distribution and relative abundance of platypuses in the greater Melbourne area : MWUPP 2013-18*. **cesar**, Parkville, VIC.

Griffiths J., van Rooyen A. & Weeks A. (2016) *Distribution and relative abundance of platypuses in the greater Melbourne area: survey results 2015/16. (Report to Melbourne Water)*. **cesar**, Parkville.

Griffiths J., van Rooyen A. & Weeks A. (2017) *Using eDNA to assess the current distribution of platypuses in the greater Melbourne area (Report to Melbourne Water)*. **cesar**, Parkville, VIC.

Griffiths J. & Weeks A. (2011) *Temporal patterns in abundance of platypus populations in Melbourne's catchments (Report to Melbourne Water)*. **cesar**, Parkville, VIC.

Griffiths J. & Weeks A. (2018) *Platypus Strategic Management Plan for Melbourne ' s Catchments (Report to Melbourne Water).* **cesar**, Parkville, VIC.

Kelly T., Griffiths J. & Weeks A. (2014) *Platypuses in the lower Werribee River: survey results spring 2013. Report to Whyndham City Council*. **cesar**, Parkville, VIC.

Lugg W. H., Griffiths J., van Rooyen A. R., Weeks A. R. & Tingley R. (2018) Optimal survey designs for environmental DNA sampling. *Methods Ecol. Evol.* **9** , 1049–1059.

McColl-Gausden E. F. (2022) *Environmental DNA sampling as a tool for monitoring freshwater vertebrates*. PhD thesis, The University of Melbourne.

McColl-Gausden E. F., Weeks A. R. & Tingley R. (2019) A field ecologist's guide to environmental DNA sampling in freshwater environments. *Aust. Zool.* doi: 10.7882/az.2019.025.

Menkhorst P. & Knight F. (2004) *A field guide to the mammals of Australia*. Oxford University Press, Melbourne.

Serena M. (1994) Use of time and space by platypus (*Ornithorhynchus anatinus*: Monotremata) along a Victorian stream . *J. Zool.* **232** , 117–131.

Serena M., Bloink C. & Williams G. (2022) *Results of platypus survey work in the Werribee River at Bacchus Marsh and Werribee township: summer 2022. Report to Bacchus Marsh Platypus Alliance and Werribee River Association*. Ecology Australia Pty Ltd, Fairfield, Victoria.

Smart A. S., Tingley R., Weeks A. R., Van Rooyen A. R. & McCarthy M. A. (2015) Environmental DNA sampling is more sensitive than a traditional survey technique for detecting an aquatic invader. *Ecol. Appl.* **25** , 1944–1952.

Thomsen P. F., Kielgast J., Iversen L. L. *et al.* (2012) Monitoring endangered freshwater biodiversity using environmental DNA. *Mol. Ecol.* **21** , 2565–2573.

Valentini A., Taberlet P., Miaud C. *et al.* (2016) Next-generation monitoring of aquatic biodiversity using environmental DNA metabarcoding. *Mol. Ecol.* **25** , 929–942.

Weeks A., van Rooyen A., Griffiths J. & Tingley R. (2015) *Determining the effectiveness of eDNA for monitoring platypuses (Report to Melbourne Water)*. cesar, Parkville.

Williams G. A. (2000) *Distribution and population density of platypus in the Werribee River near Werribee township: results of live-trapping surveys December 1999 - March 2000. (Report to Werribee River Association)*. Australian Platypus Conservancy, Whittlesea.

Williams G. A. & Serena M. (1998) *Distribution and population density of platypus in the Werribee River near Werribee township. (Report to Werribee River Association)*. Australian Platypus

Conservancy, Whittlesea.

Appendix 1. Summary of bycatch during fyke net surveys in the lower Werribee River.

Site ID	Latitude	Longitude	Date	Platypus	Rakali	Short-fin eel	Roach	Carp	Tupong	Goldfish	Long-neck turtle	Ducks
WER01	-37.919	144.657	24/2/2022	0		1						
WER04	-37.909	144.652	24/2/2022	0	1	1						1
WER06	-37.9054	144.6497	24/2/2022	0		1					2	10
WER07	-37.903	144.654	24/2/2022	0	1					1		
WER10	-37.896	144.651	24/2/2022	0					1			
WER11	-37.888	144.643	24/2/2022	0								
WER14d	-37.8169	144.5869	8/3/2023	0								
WER14g	-37.7942	144.5882	8/3/2023	0								1
WER14h	-37.7917	144.5897	8/3/2023	0								1
WER14i	-37.7806	144.5875	8/3/2023	0	1							6
WER14j	-37.7607	144.57939	8/3/2023	0		1	1	1				