

## Report: The ecological role of the turtles of the Murray River

### Abstract

This project aimed at understanding if and how turtles contribute to the maintenance of water quality in the Murray River by consuming carrion. Specifically, we assessed whether turtles eat dead carp carrion, and how quickly, at four wetland sites near Murray Bridge, SA. We trapped all three species of turtles at our four sites, with the majority being short-necked turtles (*Emydura macquarii*). At our four sites, we introduced 160 dead carp, half accessible and half not accessible to turtles. The carp accessible to turtles had a significantly higher daily weight loss compared to the non-accessible carp, particularly in sites with the highest turtle catch per unit effort. This study clarifies the role of freshwater turtles, and particularly of *Emydura macquarii*, as important scavengers in their ecosystem.

### Introduction

There are three species of freshwater turtle that inhabit the Murray River: the broad-shelled turtle (*Chelodina expansa*), the Eastern long-necked turtle (*C. longicollis*) and the Murray River short-necked turtle (*Emydura macquarii*). All these three species consume carrion, particularly *E. macquarii*. Forty years ago, it was estimated that these turtles consumed possibly a few hundred tonnes of carrion per day (Thompson, 1983), which would have been crucial for the prevention of water eutrophication as well as to improve the resiliency of the food web. Vertebrate scavengers are very useful for recycling and redistributing energy, by feeding at lower levels of the food chain and making it available to smaller detritivores, as well as by dispersing nutrients from decaying organisms into the environment with their movement (Barton *et al.*, 2013). By scavenging, the turtles of the Murray River may be providing several extremely valuable ecosystem services, such as regulating services (carcass removal) and supporting services (nutrient cycling; Alcamo *et al.*, 2005).

In 2011, a 91% decline in *C. longicollis* catch per unit effort was reported, and a 69% decline for *E. macquarii* (Chessman, 2011). Due to these declines of turtles in the Murray River, it is central to understand what will happen to the river ecosystem if this fundamental group of vertebrates becomes locally extinct. In view of the extensive human-induced stresses to the Murray River, a deeper understanding of the factors which help stabilise food webs and maintain ecosystem health, such as through carrion consumption and cycling, is invaluable to appreciate the effects of changes to any of these crucial components, and to devise strategic interventions accordingly (Beasley *et al.*, 2015).

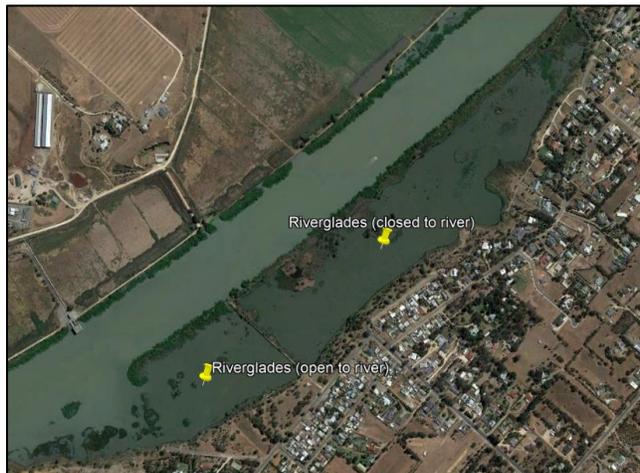
Additionally, the role of freshwater turtles within the invasive European carp (*Cyprinus carpio*) control plan currently under assessment has not yet been considered or investigated. Indeed, the Australian Government has announced the possible release of a carp virus, which will cause a mass die-off of these fish and subsequently increase greatly the amount of carrion in the Murray River. The clean-up process after this mass carp mortality is still unclear, and therefore it would be extremely useful to know if this operation will benefit from the turtles' scavenging habits, or even need them, to prevent a degradation of the water quality.

This field project addressed two specific research questions: (i) do turtles eat dead carp? And, if yes, (ii) is the decomposition rate of carp carrion that is accessible to turtles greater than the decomposition of carp carrion that is not accessible to turtles?

## Materials & Methods

### Study sites

We conducted this study from February to April 2018 at two wetland complexes, Riverglades and Paiwalla, at each of which we selected two study sites (Fig. 1). At each wetland complex we selected a site that was mostly disconnected from the Murray River (Riverglades North, Paiwalla) and one that was directly connected to it (Paiwalla North, Riverglades South).



**Figure 1.** The four study sites.

## Turtle trapping

To estimate if turtles prey upon carp, we first had to estimate how many turtles are living in the wetlands, and which species of turtles inhabit them. We conducted three trapping sessions, one per month. Each trapping session lasted for three consecutive days at each site, during which we deployed 8 baited fyke and/or cathedral traps. The traps were checked twice per day. All trapped turtles were identified, weighed, sexed when possible, and marked with individual shell notchings.

## Carp carcass deployment

We deployed carp carcasses at least 50 m away from each other. Half of the carp carcasses were placed inside a plastic box with no lid (accessible to turtles). The other half of the carcasses were placed in boxes covered by mesh, making the carp inaccessible to turtles (Figure 2). The carp were fixed to the boxes with cable ties, and the boxes were kept submerged by a brick. The carp carcasses were distributed among the first sites and deployed in two 10-day rounds, the first one comprising 74 carp and the second round 86 carp. After deployment, the carp were weighed every day with digital scales.



**Figure 2.** Non-accessible carp box (left) and accessible carp box (right), ready for deployment.

We monitored bird activity at each site during the days the carp carcasses were in the water to ascertain there was no bird eating the dead fish.

## Data analysis

We computed a GLM in RStudio to assess the effect of turtle catch per unit effort and the accessibility to turtles of the carp carcasses to the daily weight loss of the carp.

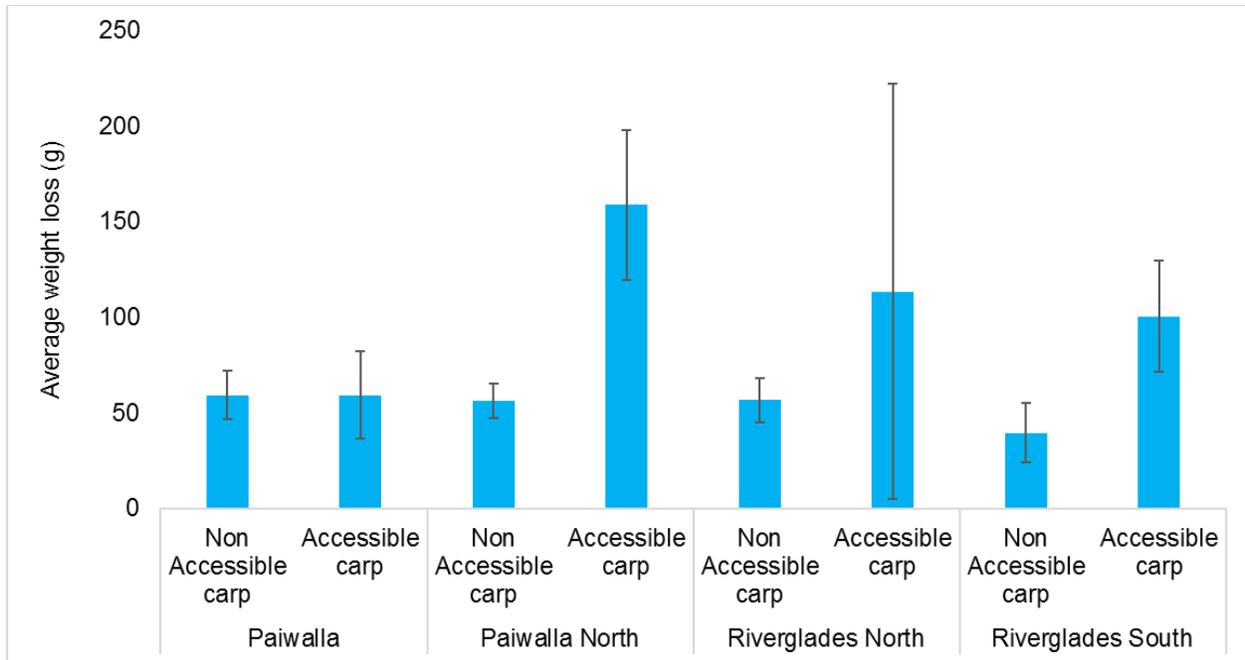
## Results

Over the three trapping sessions, we caught 162 turtles in total. The most commonly trapped turtles were *E. macquarii*, and the sites with most turtles (and therefore greatest catch per unit effort – or CPUE) were Paiwalla North and Riverglades South, the two sites directly connected with the River Murray (Table 1).

**Table 1.** Total turtle catches at each site

		Paiwalla	Paiwalla North	Riverglades North	Riverglades South	Total
<b><i>C. expansa</i></b>	Total	0	3	1	12	16
	Adult ♀	0	2	0	5	7
	Adult ♂	0	1	1	3	5
	Juvenile	0	0	0	4	4
<b><i>C. longicollis</i></b>	Total	7	6	23	21	57
	Adult	6	4	22	21	53
	Juvenile	1	2	1	0	4
<b><i>E. macquarii</i></b>	Total	6	39	5	39	89
	Adult ♀	0	16	1	15	32
	Adult ♂	0	23	0	15	38
	Juvenile	6	0	4	9	19
<b>Total</b>	<b>13</b>	<b>48</b>	<b>29</b>	<b>72</b>	<b>162</b>	

There was no detectable difference in average weight loss between non-accessible carp and accessible carp at the sites separated from the River Murray (and with lowest turtle CPUE). However, there was a great difference at Paiwalla North and Riverglades South, despite a large standard deviation in this last site (Figure 3).

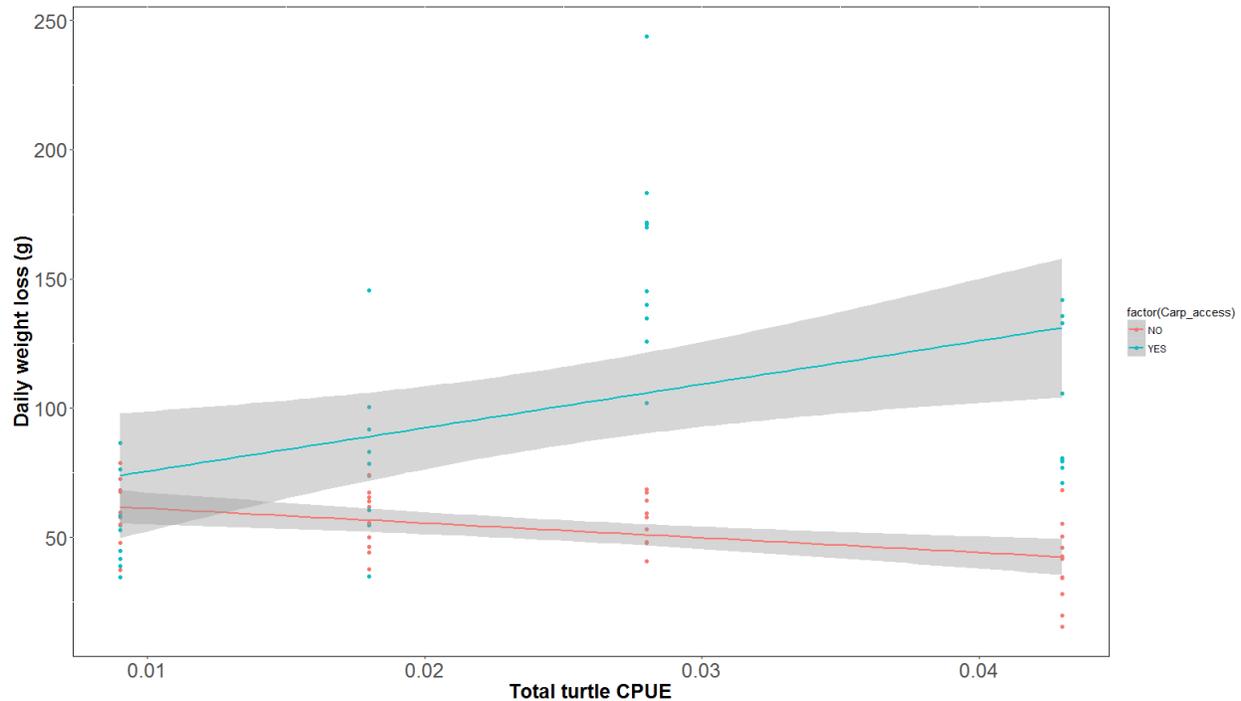


**Figure 3.** Average weight loss per day (g) compared between accessible and non-accessible carp carcasses. The differences are greatest in sites directly open to the river Murray (Paiwalla North and Riverglades South). Error bars represent standard deviation.

Carp accessibility to turtles and turtle CPUE had a significant effect on carp carrion daily weight loss ( $p < 0.001$ ; Table 2). The greater the turtle CPUE, the greater the daily weight loss of accessible carp carrion. If the carp carrion was not accessible to turtles, CPUE had no effect (Figure 4). No bird predation of dead carp was detected at any of the sites.

**Table 2.** GLM showing a significant association between carp carrion daily weight loss and CPUE, initial weight of the carp, and its accessibility to turtles.

	Df	Deviance	Resid. Df	Resid. Dev	F	Pr(>F)
Total CPUE	1	2448	76	137361	2.874	0.094
Carp accessibility (Y/N)	1	44060	75	93302	51.72	<0.001
Initial weight (g)	1	16316	74	76986	19.15	<0.001
Total CPUE * Carp accessibility	1	11323	73	65662	13.29	<0.001
Total CPUE * Initial weight	1	2709	72	62953	3.180	0.079
Carp accessibility * Initial weight	1	2467	71	60486	2.896	0.094



**Figure 4.** With increasing turtle catch per unit effort there is an increase in dead carp daily weight loss, when the carp is accessible (blue line) to turtles and not covered by mesh (red line).

## Discussion

According to our study, freshwater turtles contribute to carp carcass removal from the Murray River and associated wetlands. Indeed, a greater turtle catch per unit effort was significantly associated with a greater weight loss of the carp carcasses that were accessible to turtles (Fig. 4). This study underlines the importance to conserve freshwater turtles for two main reasons. Firstly, after the Murray River water flow became highly regulated, the alteration of flooding regimes might have had an impact into lowering productivity in downstream floodplains and rivers (Nilsson *et al.*, 2005). Therefore, the presence of vertebrate scavengers has the potential to redistribute nutrients along this system, making the energy from fish carcasses more available to invertebrates and other small decomposers, maintaining a stable food web despite disturbances. Secondly, since its establishment in the Murray River system in the 1960's, European carp have become the most abundant fish in these waters (Kohen *et al.*, 2000). In the last few years, the Australian Government has been funding research on the possible introduction of a virus (Cyprinid herpesvirus 3) to kill carp. Our study suggests that freshwater turtles consume carp carcasses, and their consumption makes the disappearance of the carcasses quicker than natural decomposition. Therefore, turtles may play a role in the clean up after the virus is released. Nevertheless, our turtle CPUE was very low compared to historical catch (Parmenter, 1976; Thompson, 1983). Therefore, turtles may have a significant impact consuming large amounts dead carp only in areas where their abundance is very high.

Finally, conservation efforts are recommended as the disappearance of these animals from the Murray River could have severe consequences on the water quality of this system, and has possibly started to have some already.

## References

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## Relevant photos and maps



We selected two study sites in Paiwalla and two at Riverglades.



A broad-shelled turtle *Chelodina expansa*.



A short-necked turtle *Emydura macquarii*.



An Eastern long-necked turtle *C. longicollis*.



A cathedral trap.



A fyke trap.