01st August 2018 Claudia Santori

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, a*s 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
C. expansa	Total	0	3	1	12	16
	Adult ♀	0	2	0	5	7
	Adult ♂	0	1	1	3	5
	Juvenile	0	0	0	4	4
C. longicollis	Total	7	6	23	21	57
	Adult	6	4	22	21	53
	Juvenile	1	2	1	0	4
E. macquarii	Total	6	39	5	39	89
	Adult ♀	0	16	1	15	32
	Adult ♂	0	23	0	15	38
	Juvenile	6	0	4	9	19
Total		13	48	29	72	162

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).

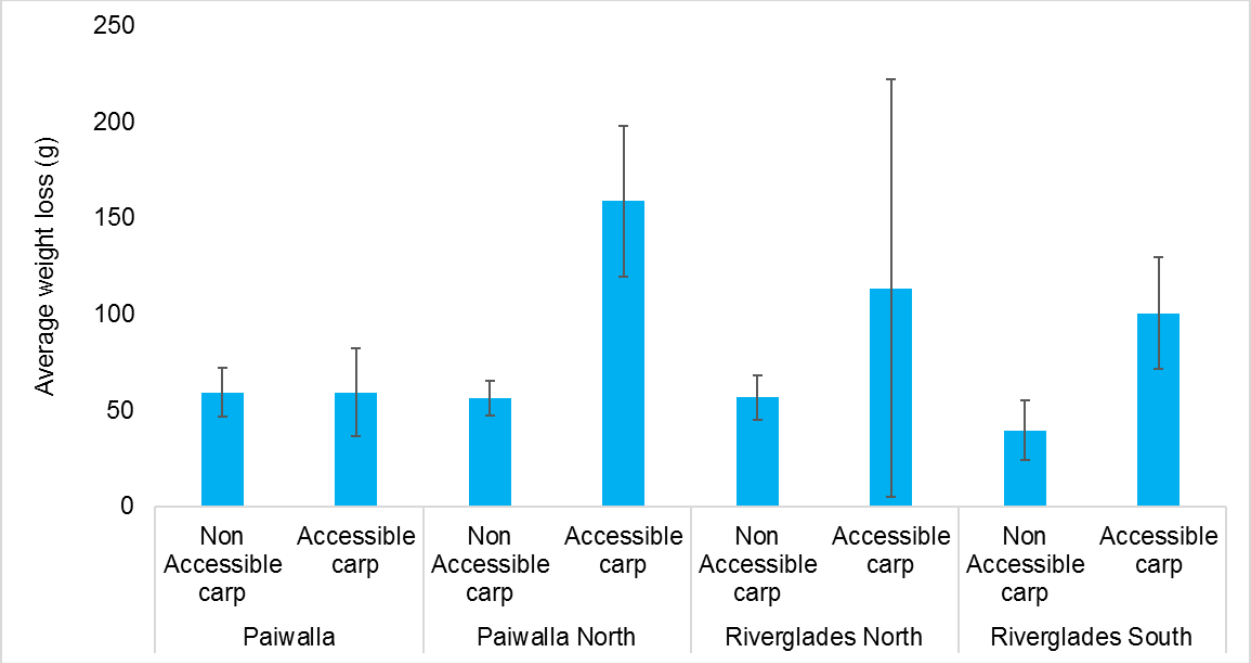

Figure 3. Average weight loss per day (g) compared between accessible and non-accessible carp carcasses. The differences are greatest in sites directly open to the river Murray (Paiwalla North and Riverglades South. Error bars represent standard deviation.

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

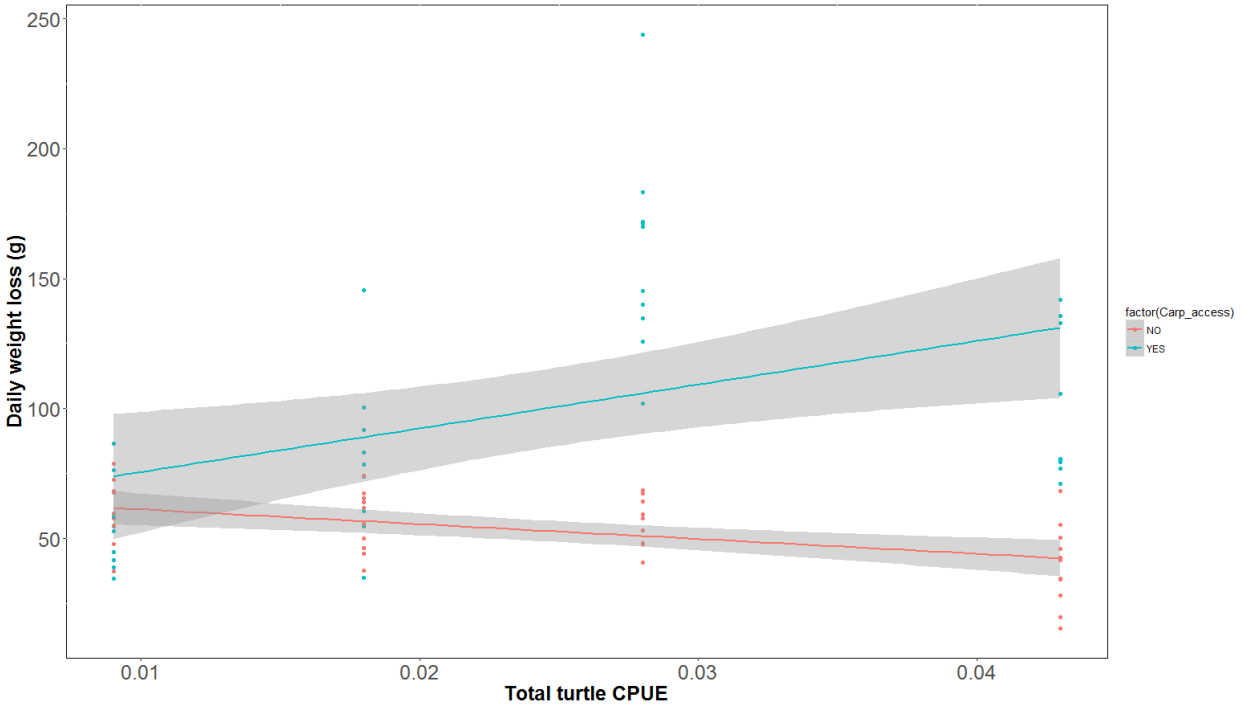

Figure 4. With increasing turtle catch per unit effort there is an increase in dead carp daily weight loss, when the carp is accessible (blue line) to turtles and not covered by mesh (red line).

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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Thompson, M.B., 1993. Hypothetical considerations of the biomass of chelid tortoises in the River Murray and the possible influences of predation by the introduced fox. In: Herpetology in Australia. Eds: D. Lunney.

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.

THIS ATTACHMENT IS ONLY TO BE COMPLETED AT END OF FUNDING AND RETURNED TO THE NATURE FOUNDATION SA INC.

NATURE FOUNDATION SA INC. Project Funding Expenditure Breakdown

NAME: **Claudia Santori**

ORGANISATION: **University of Sydney**

PROJECT NAME: **The ecological role and ecosystem service provision of the Murray River Turtles**

AMOUNT OF GRANT FROM NATURE FOUNDATION SA: $ 3000

DATE	ACTIVITY	EXPENDITURE AMOUNT
	Travel Expenditure (Car rental)	3000
	Accommodation	NA
	Salaries	NA
	Equipment Purchased	NA
	Short description of item	NA
	Consumables	
	Organisation Levy	NA
	Scientific analysis	NA
	Report Production	NA
	Miscellaneous Expenditure	
		$ 3000

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Nature Foundation SA
Media Report

Congratulations on receiving a grant from NFSA. The Foundation believes that your proposed research will be of real benefit in the conservation of South Australian wildlife.

Research is important in conservation, but so is letting people know what has been discovered. That communication is crucial to the success of the Foundation, which depends on public support to raise funds for wildlife research.

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In order to help us in our dealings with the media, **at the same time as you return your formal project report** would you please return the following information about yourself and your project to:

Research Coordinator
Nature Foundation SA
32 Holden St, Hindmarsh SA 5007
Email: *NatureFoundationSA@nfsa.org.au*

---------- ***For Media*** ----------

Name of Researcher (include Title) *Miss Claudia Santori*

Title of Research Project *The ecological role and ecosystem service provision of the Murray River turtles*

Name of your Institution (eg University, Museum etc) *The University of Sydney*

For Media contact. Phone *0478745197* ***email*** *claudia.santori@sydney.edu.au*

In approximately 100 words suitable for a general audience, describe the aim and point of your project.

In the light of recent dramatic declines in freshwater turtles in South Australia, it is important to understand the ecological role of the scavenging habits of these turtles. This field experiment was aimed at clarifying the ecological role of turtles in their ecosystem, and at understanding what will happen to the waters of the river and associated wetlands if this fundamental group of vertebrates disappears. During this project, we assessed if and how turtles contribute to the maintenance of a healthy ecosystem though carp carrion consumption. The questions we addressed were: do turtles eat carp carrion? If yes, does the decomposition rate of carp carrion which is accessible to turtles differ from the one of carp carrion which is not accessible to turtles?

In approximately 150 words suitable for a general audience, summarise the results of your project.

I conducted this study from February to April 2018 at two wetland complexes, Riverglades and Paiwalla. At each wetland complex I selected a site that was separated from the Murray River (Riverglades North, Paiwalla) and one that was directly connected to it (Paiwalla North, Riverglades South). A total of 162 turtles were trapped throughout the study: 89 Murray River turtles (*Emydura macquarii*), 16 broad shelled turtles (*Chelodina expansa*) and 57 long necked turtles (*C. longicollis*). I trapped more turtles at the sites directly connected to the river compared to the more isolated sites. I then introduced to the four sites 160 carp carcasses either accessible or not accessible to turtles. Our analysis shows that there was a significant difference in weight loss between the carp carrion accessible to turtles compared to the non-accessible carcasses, and this difference was greater at sites with the higher numbers of turtles (especially of Murray River turtles *E. macquarii*). This indicates that turtles eat dead carp, and they make carcasses disappear faster than they would naturally decompose without turtles.

List as dot points some of the most interesting points about your work.

1 *Turtles eat dead carp in the water, and can consume it quite quickly.*

2 *I trapped just over 160 turtles in 36 days of intensive trapping. This number is unfortunately much lower compared to how many turtles we would have found a few decades ago.*

3 *I found quite a big difference in turtle numbers among my study sites. Turtles were in the highest numbers in sites directly connected to the Murray River.*

4 *During my study I trapped two hatchlings of E. macquarii, which is a great sign that some are making it to the water alive despite heavy fox depredation of turtle nests in the area.*

In your own words, what was the most /exciting thing about this work?

"I think this project tells a clear story and supports the importance of freshwater turtles in their ecosystem, due to their key role as vertebrate scavengers. Not much is known about freshwater turtles' role in their ecosystem, nor about the consequences of their recent, dramatic decline along the Murray River. This study is the first step to understanding the positive impact they have in the waters they live in, as well as supporting their value as providers of important ecosystem services. This knowledge will hopefully prioritise and support their conservation."

Please attach and describe (caption) 3 or 4 original coloured photographs of good quality that you could supply to complement an article on your research and which can be used by the media with an acknowledgement of the photographer but without payment or copyright infringement.

1 Claudia Santori checking a fyke trap for turtles in Paiwalla North. Photo by: Tom Burd.

2 Carp carcass box deployed at Riverglades. Photo by: Claudia Santori.

3 Juvenile Murray River turtle Emydura macquarii trapped at the wetland of Paiwalla. Photo by: Claudia Santori.