

CARBON STORAGE IN TIDAL WETLANDS OF SOUTHEAST AUSTRALIA

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree. I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

Date: 27th January 2017

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PREFACE

THESIS BY PUBLICATION

This is a thesis by publication. Consequently, there will be some repetition and redundancy of text particularly in the introductory, methods and reference sections of the various chapters. Chapters are formatted according to the final publication format of the relevant journal for chapters which have already been accepted for publication (Chapters 2 and 5) or in the format required under submission for review for chapters yet to be published (Chapters 3 and 4). The introductory (Chapter 1) and conclusion (Chapter 6) chapters are not currently intended for separate publication and are therefore presented in a generic format.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS		ii
PREFACE		iv
LIST OF TABLES		vi
LIST OF FIGURES		viii
ABSTRACT		xi
CHAPTER ONE	INTRODUCTION AND RESEARCH RATIONALE	1
CHAPTER TWO	SEDIMENTARY FACTORS ARE KEY PREDICTORS OF CARBON STORAGE IN SE AUSTRALIAN SALT MARSHES	31
CHAPTER THREE	SEDIMENT AND CARBON ACCUMULATION VARY AMONG VEGETATION ASSEMBLAGES IN A COASTAL SALT MARSH	49
CHAPTER FOUR	GEOCHEMICAL ANALYSES REVEAL THE IMPORTANCE OF ENVIRONMENTAL HISTORY FOR BLUE CARBON SEQUESTRATION	81
CHAPTER FIVE	SEVENTY YEARS OF CONTINUOUS ENCROACHMENT SUBSTANTIALLY INCREASES ‘BLUE CARBON’ CAPACITY AS MANGROVES REPLACE INTERTIDAL SALT MARSHES	115
CHAPTER SIX	CONCLUSIONS AND RECOMMENDATIONS	136

LIST OF TABLES

CHAPTER ONE

Table 1. Distribution of blue C habitats (saltmarsh, mangrove, seagrass) along the NSW coast of SE Australia.	7
Table 2. Published biomass estimates for temperate Australian saltmarsh and mangrove species.	10
Table 3. Literature values of belowground C stock, bulk surface accretion rates and C accumulation rates reported for saltmarsh and mangrove ecosystems globally and within SE Australia.	17

CHAPTER TWO

Table 1. Estuary and study site information.	36
Table 2. Estimated marginal means of organic carbon density and C:N calculated by Generalised Linear Models.	40

CHAPTER THREE

Table 1. Summary of sediment measure techniques; mean and standard error values for feldspar marker horizon (MH), vial and filter bulk sediment measures; mean and standard error of C deposition rates; and contributions of C3 and C4 vegetation to deposition among vegetation assemblages	70
Table 2. Results of ^{13}C NMR, $\delta^{13}\text{C}$ and elemental (C:N) analyses for each component of three saltmarsh plant assemblage, plus other potential sources.	71
Table S1. Elevation data (mean \pm standard error) for each of five replicate plots in each vegetation assemblage.	76
Table S2. Elemental composition and C:N ratio for organic component of unidentified residues collected on filter papers.	77

CHAPTER FOUR

Table 1. Bulk sediment and carbon accumulation rates for surface sediments and C store for entire core profiles for each of the four study sites.	92
Table 2. Details of samples subjected to radiocarbon dating.	94

CHAPTER FIVE

Table 1 Summary of regression analyses for aboveground biomass and total belowground C store (0–100 cm).	123
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Table S1. Summary of estimated elevation of field sampling locations and depth and intensity of magnetic susceptibility within sediment core.	129
Table S2. Summary of Generalised Linear Model results for Georges River aboveground biomass, total belowground C store (0–100 cm) and depth intervals.	131
Table S3. Summary of Generalised Linear Model results for Towra Point aboveground biomass, total belowground C store (0–100 cm) and depth intervals.	132

LIST OF FIGURES

CHAPTER ONE

- Figure 1. Global distribution of tidal salt marsh abundance by marine ecoregion (Hoekstra & Molnar, 2010) (A) and mangrove forest distribution (Giri et al., 2011) (B). 4
- Figure 2. Idealised sediment distributions of the three main estuary types estuary in New South Wales 6
- Figure 3. Schematic diagram of common C and surface accumulation parameters. 13
- Figure 4. Conceptual diagram of potential influences on saltmarsh C dynamics in fluvial delta and marine tidal delta geomorphic zones. 20

CHAPTER TWO

- Figure 1. Location of the nine study estuaries along the New South Wales coast of southeast Australia. 35
- Figure 2. Mean depth integrated (0–100 cm) carbon (C) stocks (bars) and mean C density of individual depth intervals (squares) for fluvial and marine sites of the nine study estuaries. 39
- Figure 3. Classification and regression tree (CART) of carbon (C) density in New South Wales saltmarsh sediments. 40
- Figure 4. Boxplots of carbon density according to sediment grain type among surface (0–20 cm) (A), mid (20–50 cm) (B) and deep (50–100 cm) (C) sediments. 41
- Figure 5. C and N isotope values for all sediment samples according to depositional setting (fluvial; marine) and sediment core depth (0–20 cm; 20–50 cm; 50–100 cm). 42
- Figure S1. Scatterplots of carbon stocks and location, chemistry and biological variables. 48

CHAPTER THREE

- Figure 1. Location of experimental plots within Weeney Bay saltmarsh of Towra Point Nature Reserve (A), located along the southern shoreline of Botany Bay (B) in southeast Australia (C). 72
- Figure 2. Surface accretion above feldspar marker horizons. 73
- Figure 3. Mean mass of autochthonous litter, allochthonous litter and mineral matter / organic residue retained on filters at end of 6d deployment during December neap (A), December spring (B), January neap (C) and January spring (D) tidal periods. 74

Figure 4. Principal component analysis of MIR spectra with the proportion of variance explained by each component is given in parentheses (A); spectral loading plots for PC1 (B) and PC2 (C).	75
Figure S1. Scatterplots of bulk material retained within vials against the surface elevation of the study plot each vial was located within.	78
Figure S2. Scatterplots of bulk material retained on filters against the surface elevation of the study plot each filter was located within	79
Figure S3. Daily rainfall (mm) records before, during and after filter and vial installation periods.	80

CHAPTER FOUR

Figure 1. Location of study estuaries along the New South Wales coast of SE Australia (A); location of WAP-M and WAP-F in Wapengo Lagoon (B); and location of POR-M and POR-F in the Port Stephens estuary (C).	86
Figure 2. WAP-M (A) and WAP-F (B) core profiles derived from ITRAX core scanning, depth interval, and region of interest (ROI) sampling	93
Figure 3. POR-M (A) and POR-F (B) core profiles derived from ITRAX core scanning, depth interval, and region of interest (ROI) sampling.	99
Figure 4. Proportional (%) contributions of six biomolecule groups to organic C in ROIs located throughout the depth range of each of the four study cores.	100
Figure S1. ¹³ C NMR spectra for each of the regions of interest (ROIs) sampled down four saltmarsh cores	112
Figure S2. Supported and unsupported ²¹⁰ Pb Activity profiles for Wapengo marine (WAP-M) and Wapengo fluvial (WAP-F) cores.	113
Figure S3. Supported and unsupported ²¹⁰ Pb Activity profiles for Port Stephens marine (POR-M) and Port Stephens fluvial (POR-F) cores.	114

CHAPTER FIVE

Figure. 1 Maps of the study region (starred) within Australia (a); the Georges River/Botany Bay estuary with Georges River National Park (GR) and Towra Point Nature Reserve (TP) study sites labelled (b) Georges River (c) and Towra Point (d) study sites with core locations labelled and marked by diamonds	119
Figure. 2 Mean aboveground biomass by vegetation component across the chronosequence at Georges River (a) and Towra Point (b).	121
Figure. 3 Mean belowground carbon store (0–100 cm depth) within each vegetation community category at Georges River (a) and Towra Point (b).	122

Figure. 4 Belowground carbon (C) density (g C cm^{-3}) for Georges River (closed circle) and Towra Point (open circle) for each sampled depth section across the >70 years chronosequence	122
Figure. 5 Downcore profiles of sediment mass accumulation rate, magnetic susceptibility and carbon (C) content (%) of the core chosen for detailed analysis - GR 58–70 years core 3.	124
Figure. S1. Georges River core #3 unsupported ^{210}Pb activity profile and calculated CRS model sediment ages.	133
Figure. S2. Magnetic susceptibility profiles for each sediment core collected at Georges River.	134
Figure. S3. Mean monthly sea level at nearby Fort Denison for the entire study period (1943–2013) and within Botany Bay (data available from 1981).	135

CHAPTER SIX

Figure 1 - Conceptual diagram of carbon dynamics of 261 mangrove encroachment into saltmarsh.	146
Figure 2 – Accommodating for more C sequestration under rising sea levels.	155

ABSTRACT

Saltmarshes and mangroves are among the most productive and most at risk ecosystems to the impacts of human activity and climate change, globally. Along with seagrasses, these coastal vegetated ecosystems have been termed ‘blue carbon’ habitats due to their capacity to accumulate and store C. Consequently, there is interest in the processes which govern C accumulation and storage in these ecosystems and their potential to mitigate climatic change. While previous research has indicated high C stocks and accumulation in saltmarshes, there is substantial spatial variability in saltmarsh C. An understanding of the factors behind this variability is required to better inform regional and global C management. Within the study region of southeast (SE) Australia, this thesis therefore aims to: quantify and characterise saltmarsh C stocks; determine the role of geomorphic and vegetation factors in C accumulation and storage; assess variations in quantity and character of C with sediment depth and in relation to environmental change.

Analysis of sediment cores collected from 18 sites revealed mean (\pm SE) belowground C stocks of $164.45 \pm 8.74 \text{ Mg C ha}^{-1}$, comparable to global values. Stocks were more than two times higher in fluvial ($226.09 \pm 12.37 \text{ Mg C ha}^{-1}$) relative to marine (104.54 ± 7.11) geomorphic sites, but did not vary between the saltmarsh vegetation structures tested.

Vegetation type, however, was determined to play an important role in surface accumulation with mid- (19 month) and short-term (6 d) measures showing faster C accumulation in upper marsh rush saltmarsh relative to both succulent and grass lower marsh assemblages.

Additionally, the encroachment of saltmarsh by high biomass mangrove trees and shrubs was shown to bring about substantial increases in C storage in both biomass and belowground C stocks. While there were general trends of decreasing C content with sediment profile depths, this was not always the case. The preservation of deep mangrove roots (in both contemporary

saltmarsh areas as well as areas currently under mangrove encroachment) and/or remnant stable C sources (including char) were both responsible for peaks in C density down profile.

This thesis improves our understanding of the processes influencing coastal wetland C storage, with implications for the prioritisation of planning policies and on-ground activities which aim to maximise the benefits from wetland protection and restoration. Such initiatives have the potential to increase overall C storage, thereby presenting a negative feedback to global warming, while also presenting other ecosystem service benefits.