INTERACTIVE EFFECTS OF LOCAL AND GLOBAL STRESSORS ON SOFT SEDIMENT COMMUNITIES OF SOUTHEAST AUSTRALIAN ESTUARIES

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Contents

List of tables....vi
List of figures....ix
Summary....1
Statement of sources declaration....3
Contributors....4
Acknowledgments....6
1. General introduction....9
1.1 Estuarine ecosystems and their value....9
1.2 Predicting the impacts of global climate change on estuaries....10
1.2.1 Potential impacts....10
1.2.2 Investigation methods....11
1.3 Impacts of coastal development on estuarine ecosystems....13
1.4 Climate change adaptation of coastal ecosystems: preparing estuaries for future climate....14
1.5 Interacting effects of coastal development and climate change on southeast Australian estuaries....16
1.6 This thesis....17
1.7 References....19
2. Direct and indirect effects of tidal elevation on eelgrass decomposition....33
Abstract....35
Introduction....35
Material and methods....36
Study sites....36
Shoreline profiling....37
Variation in *Zostera muelleri* foliar material....37
Litter-bag experiment....38
Data analysis....39
Results....39
Shoreline profiling....39
Variation in *Zostera muelleri* foliar materia....39
Litter-bag experiment....39
Discussion....40
Literature cited....43

3. Effects of tidal inundation on benthic macrofauna associated withthe eelgrass *Zostera muelleri* 45
3.1 Abstract 46
3.2 Introduction 47
3.3 Material and methods 49
3.3.1 Field surveys 49
3.3.2 Field experiment 52
3.4 Results 55
3.4.1 *Zostera muelleri* biomass and associated macrofaunal community 55
3.4.2 Effect of root structure of *Z. muelleri* on the infauna along the shore gradient 65
3.5 Discussion 74
3.6 References 79
4. Spatial variation in estuarine macrofaunal communities across a latitudinal gradient and with respect to diffuse nutrient loading 87
4.1 Abstract 88
4.2 Introduction 89
4.3 Material and methods 92
4.3.1 Study sites and sampling design 92
4.3.2 Macrofauna and sediment properties methods 92
4.3.3 Statistical analysis 97
4.4 Results 98
4.5 Discussion 111
4.6 References 115
5. Effects of increased nutrient loading on the assimilation of organic matter by two benthic consumers across a latitudinal gradient 125
5.1 Abstract 126
5.2 Introduction 128
5.3 Material and methods 131
5.3.1 Study sites and sampling design 131
5.3.2 Sampling and processing of food sources and invertebrates for $\delta^{13}C$, $\delta^{15}N$, and N content analyses 135
5.3.3 Sediment chlorophyll-*a* and organic matter content 137
5.3.4 Statistical analysis 138
5.4 Results 139

5.4.1 N content and $\delta^{15}N$ signature of mangrove and eelgrass in relation to nutrient enrichment and availability and latitude 139
5.4.2 Spatial variability of invertebrate carbon assimilation in relation to nutrient enrichment and availability and latitude 142
5.5 Discussion 147
5.6 References 151
6. General conclusions 161
6.1 Impact of local and global stressors 161
6.2 Potential impacts of sea level rise on seagrass systems 162
6.3 Context dependent effects of nutrient pollution and climate setting on estuarine macrofauna 164
6.4 Utility of correlative studies using natural gradients: advantages and limitations 165
6.5 Preparing Australian estuaries for climate change 167
6.6 References 169

List of tables

Table 1 (Chapter 2) Two-way PERMANOVAs testing for spatial variation in leaf traits of *Zostera muelleri* among high intertidal, low intertidal and subtidal depths (Depth, D), and among three study sites (Site, S). (*a*-*e*): *n* = 10; (*f*-*i*): *n* = 5. *p*-values in bold are significant at $\alpha = 0.05$. 40

Table 2 (Chapter 2) The decay rate (*k*) and half-life of *Z. muelleri* litter collected from low intertidal (Int) and subtidal (Subt) sources, and deployed at high intertidal, low intertidal and subtidal depths at Careel Bay. Estimates of decay rate and half-life were derived separately for each treatment using linear regression analysis between time and $\ln(x_0/x_t)$, where x_0 is the amount of litter at the beginning of the experiment and x_t is the amount of litter after time *t* (in days). The y-intercept (i.e. dry weight at t= 0) was forced through 100 %. All regressions were significant at $\alpha = 0.001$. n = 25. 40

Table 3. 1 Analyses (ANOVAs for univariate data; PERMANOVAs for multivariate community data) testing for differences in above- and below-ground *Zostera muelleri* biomass, epi- and infauna assemblage structure, epi- and infauna abundance and taxon richness, abundance of discriminating macrobenthic species among sites (3 levels, random) and depths (3 levels, fixed: subtidal, low intertidal, high intertidal). n = 10. The results of SNK tests are presented in Fig. 3.2 for *Z. muelleri* biomass, in Fig.3.4 for the epi- and infaunal abundance and taxon richness and in Fig. 3.5 for discriminating species. 57

Table 3.2 Analyses (ANOVAs for univariate data; PERMANOVAs for multivariate community data) testing for differences in assemblage structure, macrofauna abundance and

taxon richness, sediment organic matter content, and abundance of discriminating macrobenthic species among depths (2 levels, fixed: intertidal and subtidal) and habitat treatments (4 levels, fixed: bare sediment, intertidal and subtidal artificial *Z. muelleri* units, and natural *Z. muelleri*) at the end of the manipulative experiment. n = 6. The results of SNK tests are presented in Fig. 6 for macrofaunal abundance and taxon richness, in Fig. 7 for discriminating species and in Fig. 8 for sediment organic matter content. 66

Table 4.1 Physical and chemical attributes and mean values of sediment characteristics (mean ± SE, n = 6 for median grain size, sorting and silt/clay content, n = 12 for organic matter [OM] content) for the 16 estuaries surveyed. Abbreviations: TN flux = flux of total nitrogen, TN ratio = ratio of total nitrogen loading pre-European settlement to present. 94

Table 4.2 Results of multivariate multiple regression analyses (distLM) run using data from: (a) all estuaries, (b) estuaries with a median sediment grain size of < 250 μm and (c) estuaries with a median grain size of > 250 μm. Prop. = the proportion of variance in the macrofaunal community structure explained by each environmental variable. Prop. BEST = the proportion of variance explained by the variables selected as the key environmental drivers using the BEST procedure (AICc selection criterion). Significant ($p < 0.05$) predictor variables are in bold. Macrofaunal data were log(x + 1) transformed prior to analysis. Abbreviations: TN flux = flux of total nitrogen, TN ratio = ratio of total nitrogen loading pre-European settlement to present. 100

Table 4.3 R^2 values of the regression analyses between predictor environmental variables and univariate community descriptors for estuaries with a median sediment grain size of < 250 μm

(low MGS) and estuaries with a median grain size of > 250 μm (high MGS). Significant (p < 0.05) predictor variables are in bold. TN ratio = ratio of total nitrogen loading pre-European settlement to present. 108

Table 4.4 R^2 values of the regression analyses between abundance of macrofaunal taxa and predictor environmental variables for estuaries with a median sediment grain size of < 250 μm (low MGS) and estuaries with a median grain size of > 250 μm (high MGS). Significant (p < 0.05) predictor variables are in bold. TN ratio = ratio of total nitrogen loading pre-European settlement to present. 108

Table 5.1 Physical and chemical attributes, mean chlorophyll-*a* and sediment organic matter [OM] content (mean ± SE, n = 5) for the 12 estuaries surveyed. Abbreviations: TN flux = flux of total nitrogen, TN ratio = ratio of total nitrogen loading pre-European settlement to present, Chl-*a* = sediment chlorophyll-*a* content, pres = present and sampled, NF = plant not found at the time of sampling. 133

Table 5.2 Results of multivariate multiple regression analyses (DistLM) testing for correlation between changes in the average relative contribution of producers to the resources assimilated by consumers and each of the predictor variables. Prop. = the proportion of variance explained by each variable. TN ratio = ratio of total nitrogen loading pre-European settlement to present. Significant (p < 0.05) predictor variables are in bold. 144

List of figures

Fig. 1 (Chapter 2) Mean (+ 1 SE) values of *Zostera muelleri* leaf traits within high intertidal (H; white bars), low intertidal (L; striped bars) and subtidal (S; grey bars) elevations at Careel Bay (CB), Pretty Beach (PB) and Budgewoi Lake (BL). Letters denote significant (at α = 0.05) within-site differences among depths (post-hoc tests for significant PERMAONVA analyses; Table 1). (*a*-*e*): n = 10; (*f*-*i*): n = 5. 41

Fig. 2 (Chapter 2) Mean (± SE) percent of initial litter weight remaining in bags deployed at high intertidal, low intertidal and subtidal elevations, on each of five sampling occasions. Litter sources were pooled because there was no significant difference in the decomposition of litter sourced from low intertidal or subtidal plants (PERMANOVA, $p_{perm} > 0.05$). n = 10. 42

Fig. 3.1 Diagram of artificial *Zostera* rhizomes. The length of the main strand was 1.63 m for the low and 3.08 m for the high density artificial *Zostera* rhizomes. The rope was laid in a horizontal plane 30-50 mm below the surface of the sediment. 54

Fig. 3.2 Mean (+ 1 SE) dry weight of *Zostera muelleri* (per m^2), at high intertidal, low intertidal and subtidal elevations of three study sites (CB, Careel Bay; PB, Pretty Beach; BL, Budgewoi Lake). n = 10. Letters indicate significant differences between depths, within sites (SNK tests, $p < 0.05$). 56

Fig. 3.3 Non-metric MDS ordinations showing variation in epifaunal and infaunal communities among high intertidal (crosses), low intertidal (triangles) and subtidal (squares) elevations of three study sites (CB, Careel Bay; PB, Pretty Beach; BL, Budgewoi Lake). Points represent centroids for the average community present at each depth of each site. n = 10. Letters indicate significant differences between depths, within sites (SNK tests, $p < 0.05$). 60

Fig. 3.4 Mean (+ 1 SE) total abundance and taxon richness of epi- and infauna within *Zostera muelleri* beds at high intertidal, low intertidal and subtidal elevations of three study sites (CB, Careel Bay; PB, Pretty Beach; BL, Budgewoi Lake). n = 10. Letters indicate significant differences between depths, within sites (SNK tests, $p < 0.05$). 62

Fig. 3.5 Mean (+ 1 SE) abundance of discriminating epi- (*Nassarius burchardii* gastropod) and infaunal (opheliids and *Notomastus* sp. polychaetes) macrobenthic taxa collected in *Zostera muelleri* at three fixed depths. n = 10. Letters indicate significant difference between depths, within sites (SNK tests, $p < 0.05$). 64

Fig. 3.6 Non-metric MDS ordination of macrofaunal assemblages sampled in control (C), low density (LD) and high density(HD) artificial *Zostera* and natural *Zostera muelleri* plots (N) at low interidal (empty triangle) and subtidal (solid triangle) depths at the end of the manipulative experiment. Points represent treatment centroids. n = 6. 68

Fig. 3.7 Mean (+ 1 SE) (a) total abundance and (b) taxon richness of macrofauna (including *Mysella* sp.), (c) number of *Mysella* sp. and (d) total abundance of macrofauna excluding *Mysella* sp. in plots of bare sediment (control), low density (LD) and high density (HD) artificial *Zostera* rhizomes (AZR) and natural *Zostera muelleri*, at intertidal and subtidal depths, at the end of the manipulative experiment. n = 6. Letters indicate significant differences among treatments within depths (SNK tests, $p < 0.05$). 69

Fig. 3.8 Mean (+ 1 SE) abundance of discriminating macrobenthic taxa collected from plots of bare sediment (control), low density (LD) and high density (HD) artificial *Zostera* rhizomes (AZR) and natural *Zostera muelleri*, at intertidal and subtidal depths, at the end of the manipulative experiment. n = 6. Letters indicate significant differences among treatments within depths (SNK tests, $p < 0.05$). 71

Fig. 3.9 Mean (+ 1 SE) sediment organic matter content (%) at the end of the manipulative experiment in plots of bare sediment (control), low density (LD) and high density (HD) artificial *Zostera* rhizome (AZR) and natural *Zostera muelleri*, at low intertidal and subtidal depths. Letters indicate significant differences among treatments within depths (SNK tests, $p < 0.05$). 73

Figure 4.1 Map showing the location of surveyed estuaries along the New South Wales (Australia) coastline. 96

Figure 4.2 PCA (Principal component analysis) plot of environmental the 11 environmental variables, excluding longitude, of Table 1 (transformed and normalised). Dots represent sites within each of estuaries. Vectors show the two-dimensional (PC1 and PC2) correlation

structure among the environmental variables (% of variance explained = 52.4). Abbreviations: catch a = catchment area, dist a = % of disturbed area of the catchment, est a = estuary area, Flushing t = flushing time, lat = latitude, median = median sediment grain size, OM = sediment organic matter, silt/clay = % sediment silt/clay content, sorting = sediment sorting, TN flux = flux of total nitrogen, TN ratio = ratio of total nitrogen loading pre-European settlement to present. 99

Figure 4.3 dbRDA plots representing the reduced model of the macrofaunal community structure grouped by taxa and its relationship to a) environmental variables and b) taxa significantly correlated with db-RDA axes (multiple correlation > 0.30). Points omitted in plot b for clarity. See Fig. 2 for abbreviations. 102

Figure 4.4 dbRDA plots representing the reduced model of the macrofaunal community structure of estuaries with a median sediment grain size of < 250 μm (a, b) and estuaries with a median grain size of > 250 μm (c, d) and its relationship with environmental variables (a, c) and taxa significantly correlated with db-RDA axes (b, d) (multiple correlation > 0.30). Points omitted in plot b and d for clarity. See figure 2 for abbreviations. 105

Figure 4.5 Linear regression between latitude, total nitrogen (TN) ratio (i.e. ratio of total nitrogen loading pre-European settlement to present), % of sediment silt/clay content and the mean number of individuals and taxa per core in each site. Empty and full circles represents low and high median sediment grain size estuaries, respectively. 109

Figure 4.6 Linear regression between latitude, total nitrogen (TN) ratio (i.e. ratio of total nitrogen loading pre-European settlement to present), % of sediment silt/clay content and the mean number of individuals of the taxa that mostly correlated with the variability in environmental variables (see Fig. 4.4). 110

Fig. 5.1 Map showing the location of surveyed estuaries sampled along the New South Wales coast, Australia. 134

Fig. 5.2 Linear regression between latitude and the %N content and the $\delta^{15}N$ signature of *Zostera muelleri* and *Avicennia marina* leaves. Empty and full circles represent low and high total nitrogen to estuary respectively..... 140

Fig. 5.3. Linear regression between total nitrogen (TN) loading to estuary and the %N content and the $\delta^{15}N$ signature of *Zostera muelleri* and *Avicennia marina* leaves. Note that TN loading is plotted on a log scale. 141

Fig. 5.4 $\delta^{13}C$ and $\delta^{15}N$ (mean ± SE) of potential organic matter sources (seston, microphytobenthos [MPB], *Avicennia marina* and *Zostera muelleri*) and benthic consumers *Pyrazus ebeninus* and *Nephtys australiensis* in all the estuaries. Values showed are not corrected for fractionation. 143

Fig. 5.5 Linear regression between latitude and the % contribution of potential organic matter sources for *Pyrazus ebeninus*. 145

Fig. 5.6 Relationship between latitude and the % contribution of potential organic matter sources for *Nephtys australiensis*. 146

Summary

Estuaries are highly productive and provide valuable ecosystem services and fisheries resources. They are, however, also the sites of human population centres, and are consequently under growing pressure from multiple stressors introduced by coastal development. These stressors may act interactively to affect estuarine biodiversity and functioning. They may also modify the response of coastal systems or their resilience to climate change. In this thesis I considered two of the major threats to estuarine ecosystems: coastal urbanization and nutrient pollution and how they may exacerbate and interact with the effects of global stressors associated with climate change.

Artificial structures, such as sea-walls, are a common feature of urbanized coastal areas. Their presence can impede the landward migration of the coastline caused by sea level rise, resulting in a reduction of the intertidal area. I assessed what the ramifications of a reduction in intertidal area might be for 1) the quality and decomposition of seagrass detritus, an important resource for macroinvertebrates, and 2) the macroinvertebrate communities supported by live seagrass. Results indicated that tidal elevation influenced seagrass decomposition directly, by changing the decomposition environment, rather than inducing changes in detrital quality. Tidal elevation also influenced seagrass-dwelling macroinvertebrates both as a direct effect of changes in depth and an indirect effect of changes in seagrass morphology. Hence, a reduction in intertidal area is likely to have sizeable ecological ramifications for tidal flat communities dependent on seagrass resources.

Warming is anticipated to enhance the susceptibility of estuaries to eutrophication by increasing metabolic rates of oxygen consumption, and by increasing the stratification of waterways. I assessed how climatic setting modifies the relationship between diffuse nutrient pollution and invertebrate assemblage composition and their carbon and nitrogen sources, sampling 16 estuaries, receiving varying levels of nutrient pollution, across a 7° gradient in latitude. Overall, macrofaunal communities were only weakly correlated with nutrient enrichment and this relationship was dependent on sediment grain-size, rather than climatic

setting. The nitrogen content of mangrove and seagrass increased with latitude and this pattern was weakly, but significantly, correlated with a shift in the proportion of food sources assimilated by a detritivorous gastropod, but not by a predatory polychaete. Consequently, it appears that present rates of diffuse nutrient loading to oligotrophic southeast Australian estuaries may be insufficient to cause persistent degradation of benthic sediments, although the possibility for localized eutrophication caused by point nutrient sources remains. Future studies should determine threshold nutrient loadings at which environmental deterioration starts to be seen.

In summary, this thesis has enhanced our understanding of when and where two consequences of coastal development, coastal armoring and nutrient enrichment, will have greatest impacts on estuarine tidal flat communities. In doing so, it will assist managers in ascertaining when, where and how to expend limited resources to best sustain estuarine biodiversity and its important functions.

Statement of Sources Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or at any other University or institution. This thesis contains only original material. Any additional help received during the preparation of this work has been indicated in the ‘Contributors’ section.

Signature

_____

Contributors

This thesis contains material that has been submitted or prepared for publication as follows:

Chapter 1: General introduction

I have done the literature review and writing of this chapter with constructive feedback and suggestions from my supervisor Melanie Bishop.

Chapter 2: Direct and indirect effects of tidal elevation on eelgrass decomposition

Authors: Andrea Nicastro, Yusuke Onoda, Melanie Bishop

This paper has been published on *Marine Ecology Progress Series* on June 2012.

My contribution to the research paper: Concept = 60%, Data collection = 95%, Analysis = 95%, Writing = 70%, Total = 80%.

I received constructive help in statistical analyses and editorial assistance with the writing from my supervisor Melanie Bishop and co-author Yusuke Onoda and help in the statistical analyses from my co-supervisor Joshua Madin.

I presented this paper at two conferences:

1. Ecological Society of Germany, Giessen, Germany. August 2010.
2. The Australian Marine Science Association Annual Conference, Fremantle, Western Australia, Australia. July 2011.

Chapter 3: Effects of increased nutrient loading on estuarine macrofauna across a latitudinal gradient.

Authors: Andrea Nicastro, Melanie Bishop

This paper has been submitted to *Estuarine, Coastal and Shelf Science* on the 14th of March 2012 and it is currently under review.

My contribution to the research paper: Concept = 50%, Data collection = 100%, Analysis = 100%, Writing = 70%, Total = 80%.

I received constructive help in the experimental design of the manipulative experiment, statistical analyses and writing from my supervisor and co-author Melanie Bishop.

Chapter 4: Effects of increased nutrient loading on estuarine macrofauna across a latitudinal gradient.

Authors: Andrea Nicastro, Melanie Bishop

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I received constructive help in the experimental design, statistical analyses and writing from my supervisor and co-author Melanie Bishop.

Chapter 5: Direct and indirect effects of increased nutrient loading on benthic trophic relationships across a latitudinal gradient

Authors: Andrea Nicastro, Ka-Man Lee, Melanie Bishop

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Chapter 6: General Discussion

I have done the literature review and writing of this chapter with constructive feedback and suggestions from my supervisor Melanie Bishop.

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