

2008

Confronting the challenges of tidal flat conservation: spatial patterns and human impacts in a marine protected area in southern NSW, Australia

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**Confronting the challenges of tidal flat conservation:
spatial patterns and human impacts in a Marine
Protected Area in southern NSW, Australia.**

A thesis submitted in fulfilment of the requirements for the award of the degree

DOCTOR OF PHILOSOPHY

from

UNIVERSITY OF WOLLONGONG

By

Pia Carmen Winberg, Bachelor of Science (Honours)

INSTITUTE FOR CONSERVATION BIOLOGY

SCHOOL OF BIOLOGICAL SCIENCES

2008

CERTIFICATION

I, Pia Carmen Winberg, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy, in the Institute for Conservation Biology, School of Biological Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution. All work conducted for this dissertation was conducted under the NSW Marine Parks Permit JBMP 2004/018 Research Authority 2003/011 and the NSW DPI Research Permit P03/0062.

Pia Winberg

14th April 2008.

DEDICATION

I dedicate this thesis to people that make my life most meaningful,
my daughters Saskia and Felicia and my lifetime partner Anders.

I also want to dedicate my efforts to the memory of my sister, Eva Maria, for whom I
will try to make the most of my time here on this wonderful planet.

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ABSTRACT:

One of the solutions that has been advocated to reduce anthropogenic impacts in the marine environment, is the concept of a global representative network of Marine Protected Areas (MPAs). The concept seeks to address both conservation and natural resource (eg. fisheries) management, and in Australia, the introduction of MPAs is guided by comprehensive, adequate and representative (CAR) principles. At a local scale however, we face the challenge of identifying areas that collectively fulfil the goals of MPAs when we don't have enough ecological information. This is due in part to limited knowledge, but is also a result of poor translation of knowledge into the applied realm of management. Consequently, effective MPAs are difficult to plan and balance against diverse stakeholder needs in a political climate. Therefore, it is recognised that ecological science must play an integral part in the development of effective MPAs. In this study, I used MPA zoning in NSW, Australia, as a large scale experiment, to test the effect of no-take zone protection in tidal flat habitat, and also to assess whether the conservation management decisions achieved the MPA goal of representativeness for tidal flat habitat. As bait-harvesting practices for the crustacean *Trypaea australiensis* (callinassidae) would cease following the zoning of a marine protected area, I sought to address four key aims. First, to describe relevant spatial patterns of tidal flat biodiversity, to assess the representativeness of the tidal flat in a bioregional context, to determine what the impact of bait harvesting was as a structuring process, and finally to determine the effectiveness of no-take zoning for tidal flat habitat and the potential for recovery of the assemblage.

I used a hierarchy of spatially nested scales to sample and test the spatial patterns of tidal flat faunal assemblages, and to determine if the macrofaunal diversity of the protected tidal flat was representative of other tidal flats in the bioregion.

This study documents the first recovery trajectory for tidal flat assemblages in a marine protected area. There was an increase in abundance and homogeneity of smaller, less mobile, suspension and deposit feeding species. In contrast, some of the more mobile, predatory and or scavenging species decreased in abundance. This assemblage shift has the potential for further trophic or functional effects beyond the boundaries of the tidal flat, which are discussed, and thus provides important guidance for future research.

I also found that macrofaunal assemblages were patchily distributed, being most heterogeneous at the scale of 100s m within the tidal flat. For planning and management this implies that whole habitat is required in no-take zones, in order to encompass the full range of macrofaunal diversity in the habitat.

In addition to the key findings, the methods used in this study extended asymmetrical ANOVA to incorporate temporally and spatially asymmetrical factors simultaneously. This extension increases the power and thereby the sensitivity of univariate analysis, to detect environmental change for MPA or impact studies. In addition, data manipulations (taxonomic resolution, assemblage sub-sets and data transformations) demonstrated some dramatic effects on the interpretation of biological pattern.

This study demonstrate the opportunity of using MPA management decisions as a basis on which to test ecological predictions, as well as provide outcomes that can be applied to adaptive planning and management for MPA goals.

ACKNOWLEDGEMENTS

I am totally indebted to the guidance of my primary supervisor, Andy Davis, who has shown me how to balance seriousness with not so seriousness and drink proper coffee. Of importance was your guidance through discussions on a broad range of issues and your generosity with time, but primarily you got me to the point. Thank you also for your belief in that I could achieve this goal and your flexibility in understanding when I was constantly dragged off course with new ideas or sideline projects.

I would also like to express my enormous gratitude to my co-supervisor, Alan Jones at the Australian Museum, whose guidance on important issues was essential to my research; and equally to Anna Murray who provided patient guidance in teaching me about the fascinating world of invertebrates (thank you also for enjoyable food and wine in the big smoke). Thank you to the Australian Museum for providing this support.

Of special significance to this project was the in kind and financial support provided by the Jervis Bay Marine Park. I would particularly like to thank the staff both old and new; Tim, Fran, Leigh, Mark, Robyn, Sue, Ozzie, Julian and Graham. Tim set me on a path of digging in the mud and provided some valuable time and enjoyable moments. In turn I recruited Fran to the mud and I hope to enjoy your wonderful company in future mud projects. Julian was instrumental in saving my frozen samples during a black-out (thus fulfilling the technical glitch requirement of a PhD project). You've taught me what I know about boats Mark and Ozzie (not much but don't take it personally), and thank you to Leigh for providing me with extra-curricula research opportunities.

Further thanks go to staff at the University of Wollongong who provided advice and resources for the project. Thank you Ken Russell at the School of Mathematics and Applied Statistics, Jeff Wright and Mari Dwarthe at the School of Biological Sciences, and John Marthick and Brian Jones at GeoSciences.

Other scientific advice was received gratefully from numerous sources including Tom Trinski, Roger Springthorpe and Jim Lowry at the Australian Museum, Graham Edgar (University of Tasmania), Alan Jordan and Rodney James (NSW Marine Parks Authority), Marti J, Anderson (University of Auckland), Bob Clarke (Plymouth Marine Laboratories), Terry Hughes (James Cook University), Alistair Robertson (University of Western Australia), Tony Underwood (Sydney University) and Hugh Possingham (Queensland University).

Fieldworkers Penny, Barbara, Sally and Alex let me spread the joy of mud to others in the world, and made field days much more enjoyable. Especially thanks to Penny for friendship, inspiration and support, and to Alex for hours in the lab.

Further financial support was gratefully received from the Joyce Vickery Research Fund of the Linnean Society of NSW. Other friendly people and places helped along the way; Barry Russell at Shoalhaven City Council and Darryl Halls (LPI) for GIS base station data, Booderee National Park and the Bay of Plenty and Public Transport Union holiday parks for access to field sites.

Finally, thanks to my daughters who have had a PhD candidate as a mother for most of their lives, and who adopted the quirky art of putting worms in jars. Together with the man of my dreams, Anders, you have got me through this milestone – thank you