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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

Pia C. Winberg Dr
University of Wollongong, pia@uow.edu.au

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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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 to 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.

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