The influence of marine benthic habitat data on systematic conservation planning:

Rottnest Island as a case study

By

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Declaration

I declare that the information contained in this thesis is the result of my own research unless otherwise cited.

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Abstract

The need for mechanisms to protect, maintain and restore global marine biodiversity has been globally recognised. Systematic conservation planning algorithms, such as MARXAN, are now a preferred solution for designing marine protected areas (MPAs) that achieve conservation targets while minimising the socio-economic impacts. While MARXAN is widely used for marine conservation planning, there has been little research into the effects that the quality of benthic habitat data have on the outcome of the planning process. This study investigates the effects that habitat data of differing thematic and spatial resolutions have on the design and efficiency of a MPA at Rottnest Island, Western Australia.

Rottnest Island is surrounded by relatively shallow water and seagrass, *Ecklonia, Sargassum*, algal turf, rocky platforms and sand comprise the dominant habitat types. Benthic habitat data derived from Geoscan and Quickbird multispectral, and HyVista hyperspectral sensors were used. Spatial resolution varied from 2.4 - 5 m pixels, and thematic resolution from four to six habitat classes. In combination with prominent biodiversity features and human usage patterns, the influence of the three habitat datasets on planning outcomes was compared. MARXAN analysis was conducted on each habitat map using 50x50 m planning units, with $30x10^3$ repetitions, and $2x10^6$ iterations per repetition. A conservation target of 30% for all habitat types was used.

Site selection frequencies were similar for the three habitat maps, although the selection of core planning units differed. Multispectral data consistently gave better results, with cheaper, smaller and more efficient MPAs. Finer spatial resolution and increased thematic complexity are preferable for conservation planning, and gave more efficient designs. Hyperspectral data offered no obvious advantage in the MARXAN analysis.

In addition to comparing the outputs from MARXAN, the existing Rottnest Island Authority sanctuary zones were analysed to assess their effectiveness in achieving conservation targets. The current sanctuary zones did not meet the targets set in this study. Benthic rugosity was combined with the Quickbird habitat map to determine the additional area required to meet conservation targets. Improved sanctuary zones required 37-42% of the Rottnest Island marine reserve to meet the conservation targets set in this study.

This work is of relevance as much of Australia's coastal waters require conservation efforts, and the procurement of benthic habitat data are an expensive component of MPA planning. This study has shown that cheaper multispectral data may be used to map benthic habitats for biodiversity surrogacy in future conservation planning exercises.

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