The influence of marine benthic habitat data on systematic conservation planning: Rottnest Island as a case study

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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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Contents

1 Introduction .................................................................................................................. 1
  1.1 Marine systematic conservation planning ................................................................. 4
    1.1.1 Size of MPAs ........................................................................................................... 4
    1.1.2 Social and economic implications ........................................................................... 6
    1.1.3 Target setting ......................................................................................................... 6
  1.2 Conservation planning software .................................................................................. 7
  1.3 Remotely-sensed data and habitat mapping .............................................................. 8
  1.4 Project rationale and aims ......................................................................................... 10

2 Methods ..................................................................................................................... 12
  2.1 Study site .................................................................................................................... 12
  2.2 Data sets for MARXAN analysis .................................................................................. 14
    2.2.1 Benthic habitat data ............................................................................................... 14
    2.2.2 Species distribution data ....................................................................................... 19
    2.2.3 Development of a cost layer ................................................................................ 20
  2.3 MARXAN analysis ..................................................................................................... 22
  2.4 Implementation of MARXAN ..................................................................................... 24
  2.5 Iterative improvement of existing sanctuaries ............................................................. 26
  2.6 Univariate statistical analysis ..................................................................................... 27
    2.6.1 Comparing habitat maps ....................................................................................... 28
    2.6.2 Iterative improvement of existing sanctuaries ....................................................... 28

3 Results ......................................................................................................................... 29
  3.1 Quickbird habitat map classification ........................................................................... 29
    3.1.1 Habitat map comparison ....................................................................................... 31
    3.1.2 Species distribution data ....................................................................................... 36
    3.1.3 Cost layer development ......................................................................................... 36
  3.2 MARXAN analysis ..................................................................................................... 37
    3.2.1 Summed solution .................................................................................................... 37
    3.2.2 Output variables .................................................................................................... 40
  3.3 Target analysis ......................................................................................................... 43
3.4 Efficiency of the existing sanctuaries .................................................45
3.5 Bathymetry data .................................................................................46
3.6 Iterative improvement of existing sanctuaries ........................................49

4 Discussion ..............................................................................................53
  4.1 Quickbird habitat map creation ...............................................................53
  4.2 Multispectral vs. hyperspectral data for biodiversity surrogacy ....................54
  4.3 Influence of thematic and spatial resolution on MARXAN solutions ................56
  4.4 Efficiency of existing sanctuaries .............................................................58

5 Conclusions ..............................................................................................60

References ....................................................................................................62

Appendix A – Training sites used for the classification of habitats using Quickbird multispectral satellite imagery ........................................................................69

Appendix B – Human use data provided by the Rottnest Island Authority ............72

Appendix C – Flowchart depicting the methodology used to develop MARXAN input files from raw biodiversity and human use data ......................................................74

Appendix D – Flowchart depicting the methodology used to develop MARXAN input files from raw biodiversity, bathymetry and human use data for the improvement of existing sanctuary zones ..........................................................76
List of Figures

Figure 1  Existing Rottnest Island marine reserve, showing sanctuary, recreational and general use zones.................................................................13

Figure 2  The Quickbird four-band composite image of Rottnest Island (17 July 2005), with the existing marine reserve boundary indicated in white.........................16

Figure 3  Illustrated example of the methods used to validate the Quickbird habitat map, using groundtruthing data obtained from Harvey (2009). Each grid cell represents a pixel of the classified habitat map for the Rottnest Island marine reserve. ..................................................................18

Figure 4  Diagrammatic example of the MARXAN process indicating the input data required, and output data given by MARXAN.........................................................23

Figure 5  Extent of habitat and bathymetry data used as a biodiversity surrogate. .....27

Figure 6  Four-class habitat map derived from Quickbird multispectral imagery for the Rottnest Island marine reserve. .................................................................30

Figure 7  Validation data used to ground truth the habitat map created using the Quickbird data. Grey area indicates the extent of the habitat map. Data points have been enlarged for illustrative purposes. Data source: Harvey (2009).........31

Figure 8  Rottnest Island marine reserve habitat map derived from HyMap hyperspectral data (Harvey 2009). .................................................................32

Figure 9  Rottnest Island marine reserve habitat map derived from Geoscan multispectral imagery (DEP 1996). .................................................................32

Figure 10 Percentage composition of each habitat type in the three habitat maps of the Rottnest Island marine reserve used for this study. .................................34

Figure 11 Enlarged section of Thompson Bay, at the eastern end of Rottnest Island, showing mooring scars detected by the Quickbird (top), HyMap (middle), but not the Geoscan (bottom) habitat maps .............................................35

Figure 12 Bird and pinniped distribution data for the Rottnest Island marine reserve...36

Figure 13 Normalised costs for the Rottnest Island marine reserve. Costs are an amalgamation of social and economic cost, and scaled from 0 to 1. Inserts show localised areas of higher cost as a result of shore based fishing, jetties, and snorkelling areas.................................................................36

Figure 14 Summed solutions of planning units for the Quickbird habitat map. Values range from 0-95%. Inserts indicate areas of most noticeable difference..........38

Figure 15 Summed solutions of planning units for the HyMap habitat map. Values range from 0-99%. Inserts indicate areas of most noticeable difference. ............39

Figure 16 Summed solutions of planning units for the Geoscan habitat map. Values range from 0-99%. Inserts indicate areas of most noticeable difference. ......39
Figure 17  Mean number of planning units (± standard error) in each significant selection frequency range for the three compared habitat maps.

Figure 18  Mean reserve cost (± standard error) for MPAs designed by the three habitat maps, based upon the lowest scoring 30% of runs.

Figure 19  Mean number of planning units (± standard error) used for the MPAs designed by the three habitat maps, based upon the lowest scoring 30% of runs.

Figure 20  Mean objective function score values (± standard error) for MPAs designed using the three habitat maps, based upon the lowest scoring 30% of runs.

Figure 21  Mean boundary length (± standard error) for MPAs designed using the three habitat maps, based upon the lowest scoring 30% of runs.

Figure 22  Mean target achievement (± standard error) for the three best reserve solutions using the Quickbird habitat map. Red line indicates the target has been reached.

Figure 23  Mean target achievement (± standard error) for the three best reserve solutions using the HyMap habitat map. Red line indicates the target has been reached.

Figure 24  Mean target achievement (± standard error) for the three best reserve solutions using the Geoscan habitat map. Red line indicates the target has been reached.

Figure 25  Target achievement for the existing marine sanctuaries. The Quickbird habitat map was used as a biodiversity surrogate, with habitats outside this area representing deeper, unmapped areas of the marine reserve. Red line indicates the target required.

Figure 26  Reclassified depths used as a biodiversity surrogate for areas of the Rottnest Island marine reserve beyond the extent of the Quickbird habitat map.

Figure 27  Aspect used as a biodiversity surrogate for areas of the Rottnest Island marine reserve beyond the extent of the Quickbird habitat map.

Figure 28  Slope used as a biodiversity surrogate for areas of the Rottnest Island marine reserve beyond the extent of the Quickbird habitat map.

Figure 29  Summed solution MARXAN output for the 10% target improved sanctuary zones.

Figure 30  Summed solution MARXAN output for the 20% target improved sanctuary zones.

Figure 31  Summed solution MARXAN output for the 30% target improved sanctuary zones.

Figure 32  Target achievement for the 10, 20 and 30% target sanctuary zone improvement designs.
List of Tables

Table 1  Definitions of the IUCN protected area management categories. Source: Dudley (2008) ................................................................. 2

Table 2  Western Australia MPA framework. Compiled from RIA (2009), DEC (2011b) and DoF (2011). DEC – Department of Environment and Conservation, RIA – Rottnest Island Authority, DoF – Department of Fisheries. ......................... 3

Table 3  Summary of datasets and sources used for this study. Data were split into two broad categories, biodiversity data and cost data. ..................................15

Table 4  Cost layers used to represent the various social and economic activities occurring within the Rottnest Island marine reserve. Cost values are unit-less, and range from 0 (no cost) to 100. ..................................................21

Table 5  Default names and descriptions for input files used in the MARXAN analysis for this project. Adapted from Game and Grantham (2008). .........................23

Table 6  Conservation feature targets used for the MARXAN analysis. ..........................25

Table 7  Error matrix for the Quickbird habitat map of Rottnest Island marine reserve. No reference points were recorded in the ‘intertidal’ habitat classification. .....29

Table 8  Comparison of the attributes of the three habitat maps of Rottnest Island marine reserve used for this study .............................................................33

Table 9  A comparison of existing sanctuary zones compared to MPAs designed using the three habitat maps. .................................................................46

Table 10 Comparison of the lowest scoring 30% of runs for 10%, 20% and 30% target sanctuary designs, with the existing sanctuaries locked in to the final design.49