Multiple methods, maps, and management applications: purpose made maps in support of Ocean Management

Craig J. Brown McGregor GeoScience Ltd.

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McGregor GeoScience Limited

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Outline

- Introduction
 - Review of benthic habitat mapping: Brown et al (2011)
 - Strategies for map production
- Case study area and data sets
 - Study Area: German Bank and SFA 29
 - Multibeam and derived data layers
- Methods, maps and applications (examples)
 - "Benthoscape" map
 - Scallop habitat suitability map
- Summary



Benthic habitat mapping: Review



predict biological patterns on the seafloor (in a continuous or discontinuous manner)".

Brown et al. (2011) Benthic Habitat Mapping: A review of progress towards improved understanding of the spatial ecology of the seafloor using acoustic techniques. *Estuarine Coastal and Shelf Science* 92 (3): 502-520



Introduction



Brown et al. (2011) Benthic Habitat Mapping: A review of progress towards improved understanding of the spatial ecology of the seafloor using acoustic techniques. *Estuarine Coastal and Shelf Science* 92 (3): 502-520



Introduction

Published Habitat Mapping Studies: Acoustic technique



Brown et al. (2011) Benthic Habitat Mapping: A review of progress towards improved understanding of the spatial ecology of the seafloor using acoustic techniques. *Estuarine Coastal and Shelf Science* 92 (3): 502-520



Technological developments:

Bathymetry and backscatter – the advantage of multibeam sonar







Strategy 2: Assemble first, predict later TOP DOWN (unsupervised)



Strategy 3: Predict first, assemble later BOTTOM UP (supervised)



Brown et al. (2011) Benthic Habitat Mapping: A review of progress towards improved understanding of the spatial ecology of the seafloor using acoustic techniques. *Estuarine Coastal and Shelf Science* 92 (3): 502-520



Introduction

Published Habitat Mapping Studies: Strategies



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The Benthoscape Approach



Working definition of the term "<u>Benthoscape</u>": "The minimum mapping unit (grain) at which distinctive bio-physical characteristics can be identified and objectively delineated based on continuous, remotely sensed environmental data sets from a study area".



Case Study Area





Multibeam data



Data collection:

- MBES data collected 1997-2003 over 5320 km² of German Bank
- Simrad EM1000 and Simrad EM1002
- Bathymetry and backscatter processed
- Sub-bottom, sidescan, grab, core and seafloor video/stills (for geological interpretation)



Strategy 2: Application of multispectral (objective) segmentation methods



Methods:

CLUSTER (unsupervised method) based on 6 layers:

- Bathymetry
- Slope
- Curvature
- Q1
- Q2
- Q3

Multidimensional segmentation based on standard techniques used to classify multi-spectral satellite imagery.



Strategy 2: Application of multispectral (objective) segmentation methods



Brown et al. (2012) Multiple methods, maps, and management applications: Purpose made seafloor maps in support of ocean management. *Journal of Sea Resaerch* (72): 1-13. doi:10.1016/j.seares.2012.04.009



Strategy 2: Application of multispectral (objective) segmentation methods



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Ground-truthing

Towcam survey 9-21 September 2010









Strategy 2: Application of multispectral (objective) segmentation methods



Total of 3190 geo-referenced seafloor photographs classified into 5 "benthoscape" classes:

- Reef
- Glacial Till
- Silt/Mud
- Silt with bed forms
- Sand with bed forms



Strategy 2: Application of multispectral (objective) segmentation methods



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Strategy 2: Application of multispectral (objective) segmentation methods

	Segmented class							
	5+6	1+3+9+13	2+4+7+8+ 15	10+11+14	12	Row total (no. images)	Producer accuracy (%)	Errors Omission(%)
Reef	304	275	26	9	12	626	48.6	51.4
Glacial Till	196	980	268	7	13	1464	66.9	33.1
Silt/Mud	13	84	726	18	0	841	86.3	13.7
Silt/bed forms	0	0	16	194	0	210	92.4	7.6
Sand/bed forms	3	3	2	17	24	49	49	51
Grand Total (No. of pixels)	516	1342	1038	245	49	3190		
User accuracy (%)	58.9	73	69.9	79.2	49	Overall Accuracy = 70%		



Scallop Habitat Map

Strategy 3: Species-specific habitat maps. Application of SDM methods

SPECIES DISTRIBUTIONS





Environmental (physical) data layers Continuous coverage (geomorphological and/or oceanographic)



Methods:

Species Distribution Modelling: Maximum Entropy

- Bathymetry
- Backscatter
- Slope
- Aspect
- Curvature
- Q1
- Q2
- Q3
- BPI (3 scales)

Training data = 3813 scallop records from 55 stations

Validation data = 1003 scallop records from 20 survey



Scallop Habitat Map

Strategy 3: Species-specific habitat maps. Application of SDM methods



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Scallop Habitat Map

Strategy 3: Species-specific habitat maps. Application of SDM methods





Summary

- The same primary data set (MBES bathymetry and backscatter) can form the building blocks for production of a number of thematic maps to support a number of ocean management objectives
- Multiple-maps approach as opposed to a "one-map-fits-all" approach
- Objective segmentation methods are starting to show tremendous promise for map production – use of methods created for terrestrial applications
- SDM techniques appropriate for species-specific map production (but success likely limited to the life-history characteristics of the target species)
- Move toward incorporation of spatial information in ocean management – Commercial application of the "Benthoscape" approach...

McGregor GeoScience

- Established in 1973
- New Ownership April 2007
- Seafloor mapping specialists -Hydrographic, Geophysics, Geotechnical Services and Environmental Surveys
- Multidisciplinary team of surveyors, geologists, oceanographers and biologists
- Provide marine survey, mapping and science services to a wide range of clients











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