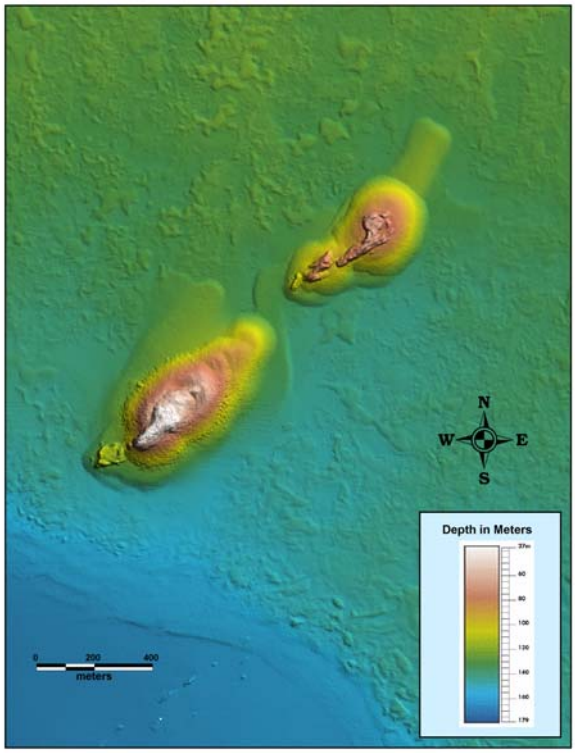
GEOHAB

Marine Geological and Biological Habitat Mapping

Ninth International Symposium
29 April – 2 May, 2008
Sitka, Alaska, USA

Deep Benthic Habitats and High Seas Marine Protected Areas



Alaska Department of Fish and Game
Region 1
Commercial Fisheries

Circum-Pacific Council

University of Alaska Fairbanks
School of Fisheries and Ocean Science
Global Undersea Research Unit

EXHIBITORS

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GeoHab (Marine Geological and Biological Habitat Mapping) was established in 2001 to bring together scientists from around the world working on the development of new thematic maps linking acoustic mapping and geological sampling to marine biology in a Geographical Information System environment to underpin sustainable ocean management. GeoHab is an international forum which meets annually and is designed to:

- maintain awareness of technological developments and survey standards
- identify existing metadata sources relevant to marine habitat mapping
- develop new thematic maps useful for fisheries management, biodiversity management, and the assessment of future Marine Protected Areas (MPAs)
- encourage standardization of maps through the creation of a habitat mapping glossary and building links to marine mapping agencies worldwide
- apply and evaluate habitat classification systems using real-world examples

All information concerning GeoHab is available on www.geohab.org

Welcome to Sitka and the 9th GEOHAB meeting!

Welcome to our beautiful town of Sitka and welcome to GEOHAB 2008! On behalf of the Alaska Department of Fish and Game (ADF&G), the University of Fairbanks, School of Fisheries & Ocean Sciences Global Undersea Research Unit (GURU) and the Circum-Pacific Council (CPC) we would like to welcome you to the Ninth International GEOHAB Conference here in Sitka, Alaska. We are excited about the productive work done in the Gulf of Alaska using habitat mapping to inform fisheries management. We have mapped some of our most important fishing grounds and from this work have furthered our knowledge and made new discoveries. But just as important are the alliances we have made with researchers in other parts of the globe. These relationships keep us from focusing solely on our own "backyard" and keep us aware of our global oceans and their importance and fragility.

It is our pleasure to host this meeting bringing together scientists from all parts of the world to share information regarding the mapping of our oceans, the connection between biology and geology, and the importance of global policies for oceanic awareness. We hope that you enjoy your stay in Sitka and that you come away enlivened and informed!

Hosts:
Cleo Brylinsky, Alaska Department of Fish and Game
Dr. Jennifer Reynolds, University of Alaska Global Undersea Research Unit
Circum-Pacific Council

Organizing Committee
Cleo Brylinsky, Alaska Department of Fish and Game
Dr. Gary Greene, Moss Landing Marine Laboratories and Tombolo Institute
Dr. Jennifer Reynolds, University of Alaska Global Undersea Research Unit
Dr. Vaughn Barrie, Geological Survey of Canada
Dr. Brian Todd, Geological Survey of Canada

If you need anything during the meeting find Tory O'Connell or call her at (907) 738-4000

GeoHab 2008
Agenda

Monday, 28 April 2008

18:30-20:30 p.m.	Registration, no host bar, poster set-up Harrigan Centennial Hall

Tuesday, 29 April 2008

7:30 a.m.	Registration
8:30	Welcoming Remarks
8:45	**Session One: Coldwater Coral and Sponge Habitats-The Use of Proxies for Habitat Prediction** ***Session Chairs: Gary Greene, Moss Landing Marine Laboratories and Kim Picard, Geological Survey of Canada***
	Presentations:
8:50	Habitat Investigations Within the SEA 1, 4 and 7 Areas of the UK Continental Shelf. Cold Water Reefs and Sponge Habitats. ***Ola Oskarsson****, Kerry Howell, Colin Jacobs, Olof Nilsson, Nils Ingvarsson and Heather Stewart*
9:10	Structural Sponge Communities of the Faroe-Shetland Channel, N.E. Atlantic: Preliminary Observations. ***Kerry L. Howell****, Jaime S. Davies, David J Hughes, Bhavani E. Narayanaswamy*
9:30	Seamounts, Deep-sea Corals, and Fisheries on the High Seas: What Can We Do With Almost No Data? ***Malcolm Clark****, Derek Tittensor, and Alex Rogers*
9:50	Sponge Reefs in the Georgia and Queen Charlotte Basins, British Columbia, Canada: a widespread, readily mapped and sensitive benthic habitat. *K. W. Conway,* ***J. V. Barrie*** *and G.E. Schlagintwiet*
10:10-10:40	COFFEE BREAK
10:40	Geological Basis of Large Gorgonian Coral Habitat in Atlantic Canada. ***Evan N. Edinger****, Owen A. Sherwook, Kent Gilkinson and Vonda E. Wareham*

11:00	Use of Video Classification Techniques to Describe and map Sponge Reef Habitat on the Continental Shelf of British Columbia, Canada. ***S. E. Cook**, Kim Conway and Vaughn Barrie*
11:20	Explorations of Cold-water Coral-Habitat Relationships on Cordell Bank, CA Using Submersible Visual Data and Multibeam Sonar Data. ***Lisa Etherington** and Pamela van der Leeden*
11:40	Predicting Suitable Habitat for Deep-sea Coral Reefs in British Columbia. ***Jessica L. Finney**, E.J. Gregr and S. Patton*
12:00-13:30	LUNCH
13:30	New Discoveries of Coral Reefs in the Hola Trench Off Norway, Highlighting Challenges in Coral Reef Prediction. ***Pål Buhl-Mortensen**, Lene Buhl-Mortensen and Margaret Dolan*
13:50	Holy Coral! Is that what I think it is? Adventures in Vague Locations, Extrapolations, & Mis-identification. ***John V. Olson***
14:10	**Session Two: Fish or Invertebrate Associations with Habitat** ***Session Chair: Margaret Dolan, Geological Survey of Norway***
14:15	Geology as a Surrogate to Ecology – Is this Possible? Examples from Alaska. ***H. Gary Greene**, Cleo K. Brylinsky, Victoria M. O'Connell, Jennifer Reynolds, Sean Rooney and Jon Heifetz*
14:35	Modeling Rockfish Distributions Using Hydroacoustics and High Resolution Bathymetry. ***Dan Urban***
14:55-15:25	COFFEE BREAK
15:25	Construction of a Habitat Map for Heceta Bank, Oregon, USA for Use in Estimates of Groundfish Assemblages on the Bank. ***Julia E. R. Clemons**, W. Waldo Wakefield, Curt E. Whitmire, Robert W. Embley, Brian N. Tissot, Susan G. Merle, Chris Goldfinger and Christopher G. Romsos*
15:45	Spatial Patterns of Macrobenthic Communities in a Swedish Fjord as Derived From Opportunistic Video Data. ***Genoveva Gonzalez Mirelis**, Mats Lindegarth, Per Bergström, Lisbeth Jonsson and Tomas Lundälv*
16:05	A Multi-Scale Analysis of Demersal Fishes and their Associated Habitats on a Gulf of Alaska Fishing Ground. ***Sean C. Rooney**,*

	Jennifer R. Reynolds, Brenda L. Norcross, Jonathan Heifetz and H. Gary Greene
16:25	Sea Scallop Habitat in the Gulf of Maine. ***Brian J. Todd**, Stephen J. Smith and Vladimir E. Kostylev*
16:50	Marine Habitat Mapping in the Gilbert Bay Marine Protected Area, Labrador, Canada. ***Evan N. Edinger**, Alison Copeland, Trevor Bell, Rodolphe Devillers, Phillippe LeBlanc and Joseph Wroblewski*
17:10	Closing remarks
18:30-20:30	**Poster Session Reception and refreshments hosted by Fugro-Pelagos Centennial Hall**

Wednesday 30 April 2008

8:30	Announcements
8:40	**Session Three: Broad-scale Habitat Mapping in Territorial Waters** ***Session Chair: Dan Urban, National Marine Fisheries Service (NOAA)***
8:45	Mapping and Lithologic Interpretation of the Territorial Sea, Oregon. ***Chris Goldfinger**, M. Agapito, C. Romsos, T. Haddad, K. Karageorge and R. Dana*
9:05	Surficial Seabed Characteristics of the United States: Focus on Alaska. ***Jane A. Reid**, Mark Zimmermann, Adam Jackson, S. Jeffress Williams, Matthew A. Arsenault and Chris Jenkins*
9:25	Sea-Floor Character Maps for the California State Waters Mapping Program. ***Guy R. Cochrane***
9:45	Mapping Rocky Reefs in the Central English Channel: A Case Study Using Nested Surveys and Broadscale Acoustic Proxies. ***Roger Coggan**, Markus Diesing, and Koen Vanstaen*
10:05-10:35	COFFEE BREAK
10:35	Prediction of Australia's Benthic Marine Habitat Diversity Using Seascapes: A National Map. *Andrew D. Heap, **Scott L. Nichol** and Tanya Whiteway*

10:55	Biological Relevance of Benthic Marine Landscapes and Seabed Topographic Features in the Archipelago Sea (Baltic Sea) – Distribution of Seabed Topographic Features in the Archipelago Sea, the Baltic Sea – An Approach to Pinpoint Geodiversity Hotspots. ***Anu Reijonen*** *and A. T. Kotilainen*
11:15	Implications for Management Uses. ***Anna-Leena Nöjd****, Anu Reijonen, Heta Rousi and Aarno Kotilainen*
11:35	Implementing Canada's National Marine Mapping Strategy. ***R. A. Pickrill***
11:55-13:30	LUNCH
13:30	Seascapes – A Framework For Nature Type Classification in the Lofoten-Barents Sea Region, Arctic Norway. ***Terje Thorsnes****, Margaret Dolan, Valérie Bellec, Dag Ottesen, Reidulv Bøe and* Pål *Buhl-Mortensen*
13:50	**Session Four: Engaging the Public** ***Session Chair: Heather Stewart, British Geological Survey***
13:55	Sitka Sound and Beyond – Serving Up 40,000 km of Coastal Habitat Mapping & Imagery. ***Jodi Harney****, John Harper, Steve Lewis, Mandy Lindeberg, K. Kosti, Sue Saupe and Mary Morris*
14:15	Revealing Sidney's Bottom – Seabed Habitat Mapping for the Community of Sidney, BC. ***John R. Harper****, Brian D. Bornhold, Sheri Ward, Sarah Cook and William C. Austin*
14:35	From Rubber Boots to ROV's: Exploring Marine Benthic Habitats Across the Gulf of Maine Biodiversity Discovery Corridor. ***Peter Lawton***
14:55- 15:25	COFFEE BREAK
15:25	Data Discovery, Access and Distribution Pathways of the Pacific Coast Ocean Observing System (PACOOS): An Ecosystem Observing Tool for the California Current. ***Chris Romsos****, Elizabeth Clarke, Chris Goldfinger, Waldo Wakefield and Robert Gref*
15:45	Design and Implementation of an Open-source-WebGIS for the Sea Floor of the North and the Baltic Sea. ***R. Pesch****, W. Schröder, A. Unruh and L. Vetter*

16:05	Production of Marine Information Overlays (MIOs) for Marine Environmental Protection. ***Cameron McLeay*** *and Dr. Lee Alexander*
16:25	Closing remarks
17:30-20:00	**BBQ out at Halibut Point Recreation Area, buses leave from the Centennial Hall at 17:30**

Thursday 1 May 2008

8:30	Announcements
8:40	**Session Five: Deep Water Benthic Habitats and High Seas MPAs** ***Session Chair: Jim Baichtal, U.S. Forest Service***
8:45	Substrate Mapping of Bogoslof Volcano, Alaska for a Natural Experiment on Invertebrate Colonization. ***Jennifer Reynolds*** *and Mark Zimmermann*
9:05	Diverse Habitats on Intraoceanic Island Arc Submarine Volcanos of the Mariana Arc, Western Pacific. ***Robert Embley****, William Chadwick, Jr., Susan Merle, Verena Tunnicliffe, John Dower and S. Kim. Juniper*
9:25	Global Ocean Conservation Priorities for Benthic Ecosystems Identified by GIS Analysis of Multiple Spatial Data Layers. ***Peter T. Harris*** *and Tanya Whiteway*
9:45	Challenges and Rewards of ROV- Based High-Resolution Habitat Mapping in Deep-Sea Canyons Offshore Portugal. ***Veerle A. I. Huvenne****, Douglas G. Masson, Abigail Pattenden, Paul A. Tyler and Peter J. Mason*
10:05- 10:35	COFFEE BREAK
10:35	GIS Based Identification of Chemoautotrophic Communities, Mud Flows and Biogeochemical Habitats at Hakon Mosby Mud Volcano. ***Kerstin Jerosch****, Michael Schlüter, Jean-Paul Foucher and Anne-Gaille Allais*
10:55	Surveying Deep-Water Habitats on the UK Shelf Edge to Inform MPA Selection. ***Neil Golding****, Heather Stewart, Jaime Davies,*

	Janine Guinan, Kerry Howell, Emma Verling and Viv Blyth-Skyrme
11:15	Predicting the Distribution of Annex 1 Reef Habitat – Results From the MESH SW Canyons Survey, UK. ***Heather Stewart**, Jaime Davies, Janine Guinan, Kerry Howell and Emma Verling*
11:35	The Global Seafloor Atlas Project: Seafloor Geomorphology as Benthic Habitat. ***Elaine Baker**, Peter Harris and Tina Schoolmeester*
11:55- 13:30	LUNCH
	Session Six: Developing and Testing Classification Methods ***Session Chair: Peter Lawton, DFO, St. Andrews, New Brunswick***
13:30	Refinement and Application of the Coastal and Marine Ecological Classification Standard. ***Rebecca Allee**, D. Bamford, M. Finkbeiner, K. Goodin and C. Madden*
13:50	Assessing the Robustness of a Morphometric Classification Model to Help Predict Australia's Benthic Marine Habitat Diversity. ***Vanessa Lucieer**, Hugh Pederson, Neville Barrett and Colin Buxton*
14:10	Spatial Modelling and Multivariate Prediction of Seabed Nature Types in the MAREANO Regional Mapping Programme. ***Margaret F. J. Dolan**, Valérie Bellec, Pål Buhl-Mortensen, Lene Buhl-Mortensen, Terje Thorsnes and Reidulv Bøe*
14:30	Identifying Errors That Occur When Applying Drop Video Techniques for Marine Phytobenthos Surveys. ***Jan Ekebom** and Mats Westerbom*
14:50- 15:20	COFFEE BREAK
15:20	An Ecological Classification of Benthic Habitat in Pacific Canadian Shelf Waters. ***Edward J. Gregr** and Glen Jamieson*
15:40	Characterising Rock from Thin Sediment and its Significance in Mapping Habitat. ***J. W. Ceri James***
16:00	Assumptions Behind Geological Proxies in Benthic Habitat Mapping. ***Vladimir E. Kostylev***

16:20	Backscatter Angular Dependence as a Quantitative Tool for Seafloor Substrate Characterization. Application to Cook Strait, New Zealand. ***Geoffroy Lamarche**, Xavier Lurton, Anne-Laure Verdier and Jean-Marie Augustin*
17:00	Closing remarks

Friday 2 May 2008

Field Trips: Meet at Harbor Dock Shelter Adjacent to Harrigan Centennial Hall
Geology: meet at 9 AM (plan on 4 hours)

Wildlife: meet at 9:30 AM (plan on 3 hours)

Poster Presentations

Integrating terrestrial, freshwater and marine processes in a preliminary classification of coastal ecological units in southeastern Alaska: A hierarchical framework and exploratory analysis. David Albert, K Koski, Zach Ferdana, and Jim Baichtal

Paleogeography of the Late Pliestocene and Quaternary Coastlines of Southeast Alaska and Their Potential Archaeological Significance. J.F. Baichtal, R.J. Carlson, and S.J. Crockford

Utility of existing single-beam 'Digital Survey Bathymetry' for identifying potential Marine Protected Areas. Roger Coggan, Markus Diesing, and Koen Vanstaen

Epifauna and infauna associated with shallow cold seeps and carbonate mounds in Hecate Strait, British Columbia, Canada S.E. Cook and J.V. Barrie

Biological communities of the South West approaches (UK) Jaime Davies**,** Kerry Howell, Heather Stewart, Janine Guinan, Emma Verling and Neil Golding

Geology meets biology: mapping and prediction of seabed nature types in the MAREANO regional mapping programme. Margaret F.J. Dolan, Valérie Bellec, Pål Buhl-Mortensen, Lene Buhl-Mortensen, Terje Thorsnes, and Reidulv Bøe

A comparison of the habitat structure and ecology associated with cold water coral reefs at the Mingulay Reef Complex (Outer Hebrides) and the Sula Ridge Reef Complex (Norway) Sophie L. Green, Veerle A.I. Huvenne, Andrew Davies, Veit Hühnerbach, J. Murray Roberts and Andre Freiwald

Using models to predict deep-sea cold-water coral habitats: case studies from the Irish continental slope. Janine C. Guinan, and Margaret F.J. Dolan

High-resolution acoustic mapping of Mediterranean Deep Coral areas. C. Lo Iacono, E. Gràcia, C. Orejas, J.J. Dañobeitia, A. Gori, and J.M. Gili

Application of nonlinear seismics in the study of the seagrasses. The case of *Posidonia oceanica* (Mediterranean Sea) C. Lo Iacono, E. Gràcia, M.Á. Mateo, and JJ. Dañobeitia

Development of a benthic habitat methodology for establishing Rockfish Conservation Areas(RCAs) in British Columbia. L. Lacko, K.L. Yamanaka, and G. Logan

Estimation of global meiofauna and macrofauna biomass. A. Peters-Mason, J. Guinotte, R. Watson, and D. Pauly

Benthic Habitat Map of the US/Canada transboundary region of Georgia Basin
Kim Picard, Charles Endris, H. Gary Greene and J. Vaughn Barrie

Spatial patterns of nearshore subtidal communities in southeast Alaska linked to habitat and environmental variability Jodi L. Pirtle, Jennifer R. Reynolds, and Ginny L. Eckert.

Prediction of Suitable Rockfish Habitat. Jennifer Stahl, Dave Carlile, and Cleo Brylinsky

Predictive modeling of coral and sponge distribution in the central Aleutian Islands
Doug Woodby, Dave Carlile, and Lee Hulbert

Abstracts

Oral and Poster Presentations

(alphabetical by first author)

Integrating terrestrial, freshwater and marine processes in a preliminary classification of coastal ecological units in southeastern Alaska: A hierarchical framework and exploratory analysis

David Albert, The Nature Conservancy; K Koski, The Nature Conservancy; Zach Ferdana, The Nature Conservancy; Jim Baichtal, USFS Tongass National Forest, dalbert@tnc.org

Complex interactions among terrestrial, freshwater and marine environments exemplify coastal ecosystems in southeastern Alaska. Our objective was to construct a GIS database to characterize coarse-scale ecological processes and develop a preliminary classification of estuarine systems. To describe the nested nature and spatial complexity of these systems, we developed a six-tiered, hierarchical framework that includes (1) marine ecoregions, (2) coastal basins, (3) sub-basins, (4) coastal watersheds, (5) shoreline units and where available (6) across-shore tidal zones and biobands. In addition, a database of individual estuary features was developed that links individual stream systems with shoreline and nearshore habitat features, and also nests within upper levels of the hierarchy. Additional attributes in the database include terrestrial landforms, freshwater fluvial processes, shoreline substrate, wave exposure, intertidal and nearshore vegetation, marine basin geometry and estimated tidal volume. We conducted a series of exploratory analyses to provide a coarse-scale characterization of estuarine systems that may be considered as a working hypothesis to be tested as finer-scale data on physical and biological processes become available.

Refinement and Application of the Coastal and Marine Ecological Classification Standard

R. Allee, National Oceanic and Atmospheric Administration
D. Bamford, National Oceanic and Atmospheric Administration
M. Finkbeiner, National Oceanic and Atmospheric Administration
K. Goodin, NatureServe
C. Madden, South Florida Water Management District
becky.allee@noaa.gov

The Coastal and Marine Ecological Classification Standard (CMECS) was first introduced in 2004 as the first nationally applicable habitat classification system developed for the United States. CMECS was conceptually designed to allow coastal and marine habitat managers access to data and information on the physical structure and associated biodiversity of the vast array of habitats found in U.S. coastal and marine waters. Over the years, the hierarchical structure of CMECS has been evaluated and refined to improve its applicability to mapping applications and provide the analytical opportunities requested by coastal managers. The scope of this classification standard extends upstream and landward to where ocean derived salts measure less than 0.5‰ during the period of average annual low flow to the deep ocean. This encompasses estuaries, wetlands, rivers, shorelines, islands, the intertidal zone, the entire benthic zone, and the entire water column from the coast to the deep ocean. The standard is hierarchical, extending spatially and conceptually from systems, which are units of large scale, to specific biological assemblages of a very small scale. CMECS Version III addresses the needs expressed by the habitat mapping community, provides better alignment for seamless integration with the U.S. National wetland classification system and the National Vegetation Classification Standard and retains the original intent of the system to provide a common terminology and classification approach to assess the biodiversity of the habitats. This presentation will provide an overview of CMECS Version III and present classified results for various habitat types as derived from several data sources.

Paleogeography of the Late Pliestocene and Quaternary Coastlines of Southeast Alaska and Their Potential Archaeological Significance

Baichtal, J.F., Geologist, U.S. Forest Service, Tongass National Forest, jfbaichtal@fs.fed.us
Carlson, R.J., Archaeologist, U.S. Forest Service, Tongass National Forest, rcarlson@fs.fed.us
Crockford, S.J., Archaeozoologist, Pacific Identifications, Inc., British Columbia, Canada, sjcrock@shaw.ca

An extensive literature search and years of field reconnaissance have resulted in a dataset of over 300 shell-bearing raised marine deposits throughout Southeast Alaska. It includes site location, elevation, and description when available, and over 170 radiocarbon dates beginning at 14,380 B.P. Interpretation of this data gives insight on the timing and complexity of isostatic crustal adjustments that resulted from glaciation and deglaciation, eustatic sea level change, and subsequent tectonic uplift. Digital bathymetry data of varying resolutions across the region, analysis of marine cores, and geomorphic interpretations from the finding of fish habitat studies on the shelf and its margins were utilized in the paleogeographic modeling. Comparisons with the paleogeographic modeling of the Queen Charlotte Islands/Hecate Strait region of British Columbia suggest a similar response to ice loading during the Last Glacial Maximum (LGM) resulting in a forebulge to the west of the ice front adjacent to Prince of Wales, Baranof, and Chichagof Islands in the Alexander Archipelago. The Alexander forebulge would have created a much larger land mass than previously modeled, providing a nearly ice-free coastal plain available for plants, animals and human occupation as early as 13,500 B.P. This now submerged landform may have provided a refugium for flora and fauna for re-colonizing the islands after the LGM and an explanation for the absence of coastal archaeological sites prior to 10,000 B.P. This interpretation of the paleogeography is preliminary at this time. The extent and timing of the forbulge can only be inferred and estimated from this data. Additional surface sampling, imaging and modeling of the outer coast shelf, and analysis of sediment cores from across the shelf is needed to better define the relationships between the timing and extent glaciation, forbulge development, and the rate of sea level rise. Furthermore, analysis of selected shell-bearing raised marine deposits in southern Southeast Alaska ranging in age from 8170 to 9400 YBP suggest a warmer and dryer climate in the region. The presence of charcoal and the bones of Pacific sardine may be an indicator of a warmer and dryer climate following the end of the Younger Dryas from 10000 to 8000 YBP. This evidence combined with ongoing pollen research in Southeast suggests that this may have been a time of relatively dry climate as well, which would favor the occurrence of wildfires, either natural or man-caused.

The Global Seafloor Atlas Project: Seafloor Geomorphology as Benthic Habitat

Elaine Baker[a], Peter T. Harris[b], Tina Schoolmeester[a]

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Through the efforts of GeoHab together with other marine researchers around the world, knowledge of the geomorphology of the seafloor has improved markedly over the past 10 years. Using multibeam sonar, the morphology of submarine features such as seamounts, canyons, mud volcanoes and spreading ridges has been revealed in unprecedented detail. In particular, case studies are now available for a range of seabed features where detailed bathymetric images have been combined with seabed video and sampling to yield an integrated picture of the benthic communities that are associated with different types of habitat. A picture is emerging that shows patterns of different communities that are consistently associated with certain geomorphic features in combination with other physical environmental variables.

The objective of the atlas project is to contribute to the conservation of marine biodiversity by utilising geomorphological data to identify and characterise global marine benthic habitats. Linking these habitats to marine ecosystems provides a mechanism for mapping the ecological geography of the ocean floor. The goal of the project is to produce an atlas of marine geomorphology that can be used to support the identification of a representative system of Marine Protected Areas - especially in the high seas area where there is currently a scarcity of data and information.

It is envisaged that the atlas will present a collection of up-to-date summaries of the benthic communities that are associated with different types of geomorphic features that have been described from the ocean. The atlas would contain an introductory summary chapter giving an overview of global ocean geomorphology, followed by contributions from a range of authors that combine descriptions of biological community-geomorphic feature associations, illustrated by state-of-the-art imagery of the seabed produced by acoustic and other technologies. The atlas should be inclusive wherever possible and so the number and titles of chapters could be adjusted to suite the material submitted.

The development of a methodology for the atlas has been included as a component of the UNEP project "Development of the Methodology Arrangements for the GEF and Transboundary Waters Assessment Programme (TWAP)". The objective of this project is to *develop the methodologies for conducting a global assessment of transboundary river, lake, and groundwater basins, Large Marine Ecosystems, and ocean areas for GEF purposes and to catalyse a partnership and arrangements for conducting such a global assessment.*

New discoveries of coral reefs in the Hola trench off Norway, highlighting challenges in coral reef prediction

Pål Buhl-Mortensen, Lene Buhl-Mortensen, Margaret Dolan

Reliable predictions of spatial cold-water coral reef occurrence would be a useful tool for the management of deep coastal and offshore areas. Several studies have indicated that the distribution of cold-water coral reefs is correlated with rough topography and slopes exceeding a certain critical angle. In this study we show that this is not always the case. The Norwegian seabed mapping program MAREANO covers areas off northern Norway. Two case study areas within the MAREANO mapping area are used to investigate the potential to predict coral reef occurrence based on multibeam bathymetry, backscatter and topographic variables. Both areas are located within trenches crossing the continental shelf, but have completely different topography. At the Malangen study site the reefs occur on a ridge crossing the trench separating Malangsgrunnen from Fugløybanken, whereas within the Hola area, the reefs occur within the deeper parts of the trench on a relatively level seabed. The reefs of the two sites differ markedly in shape: the Malangen reefs are relatively circular with summits of living corals, wheras the Hola reefs are elongated with a living upcurrent front. The topography of the seabed has no influence on the corals in itself, but influences the environment by modifying the hydrodynamic setting. Currents accelerate over peaks and ridges, and provide environments for enhanced food encounter. At other locations the topography may induce hydrodynamic patterns concentrating food particles. In the Hola area the reefs occur at the side of the trench where the currents flow from the coast towards the shelfbreak. The currents are strong, and local production at the shelf may have increased the nutrient content of the water. Within the range of the coral's temperature and salinity tolerance the combination of hard bottom substrates for coral larvae settlement and relevant food transport rates are probably more important than the topography *per se*.

Seamounts, deep-sea corals, and fisheries on the High Seas: what can we do with almost no data?

Malcolm Clark[1], Derek Tittensor, Alex Rogers

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Seamounts are widespread features of the world's underwater topography, and may number 10s of thousands in the Pacific Ocean. They can support high biodiversity and unique biological communities. They are often highly productive, and bottom trawl fisheries target deepwater commercial fish species such as orange roughy, oreos, alfonsino, pelagic armourhead and redfishes. However, seamount habitat is ecologically vulnerable to such exploitation.

In this talk we present results of recent studies by CenSeam (the Census of Marine Life programme on seamounts) that examine the relationships between seamounts, deepwater corals, and fisheries. The known distribution of stony corals worldwide is related to their physical environment, and then applied to potential seamount locations derived from satellite altimetry to estimate the likelihood of the seamount having suitable conditions for corals. Habitat suitability is then related to the distribution and depth ranges of deepwater trawl fisheries to assess their vulnerability.

The North Pacific has a broad band of predicted habitat for stony corals at depths down to 250m, which becomes more restricted with depth. Habitat suitability in the South Pacific is more widespread through the 750m to 1250m depth range. This makes deeper seamounts in the South more vulnerable to fisheries targeting orange roughy and oreos, while the North Pacific seamounts are mainly at depths for species like alfonsino, pelagic armourhead and some of the shallower *Sebastes* spp. Careful management is required for all these seamount fisheries to avoid overexploitation of the fish stocks, and associated damaging effects of trawling on the coral habitat.

Construction of a habitat map for Heceta Bank, Oregon, USA for use in estimates of groundfish assemblages on the bank

Julia E. R. Clemons[1], W. Waldo Wakefield[1], Curt E. Whitmire[1], Robert W. Embley[2], Brian N. Tissot[3], Susan G. Merle[4], Chris Goldfinger[5], Christopher G. Romsos[5]

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3Program in Environmental Science, Washington State University, Vancouver
4Cooperative Institute for Marine Resources Studies, Oregon State University
5Active Tectonics and Seafloor Mapping Lab, Oregon State University

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Heceta Bank, (offshore Oregon), is one of the largest rocky banks along the US west coast and contains a diverse array of habitats supporting numerous species of commercially important groundfish, including a diverse assemblage of rockfishes (*Sebastes* sp.). In 1998 we collected high-resolution bathymetry and backscatter imagery of the bank using a *Simrad* EM 300 multibeam echo sounder, and returned in 2000 and 2001 to conduct strip transect video surveys of habitat, fish, and invertebrates using the remotely operated vehicle *ROPOS*. These *in situ* data have been analyzed for fish habitat relationships. One of the critical elements of this project was to create the first comprehensive lithological habitat map of the bank. Polygons of uniform habitat were constructed by analyzing the image data (bathymetry, backscatter, topographic position index and slope) and reconciling with the video data. Habitat areas identified include: high relief ridge sediment complex, heavily eroded ridge complex, pinnacle, boulder/cobble, and unconsolidated sediment (mud and sand). This map, combined with the fish observations made in the ROV video, may be used as a tool to extrapolate groundfish abundances for the entire bank and adjacent areas surveyed by dive transects.

Sea-Floor Character Maps for the California State Waters Mapping Program

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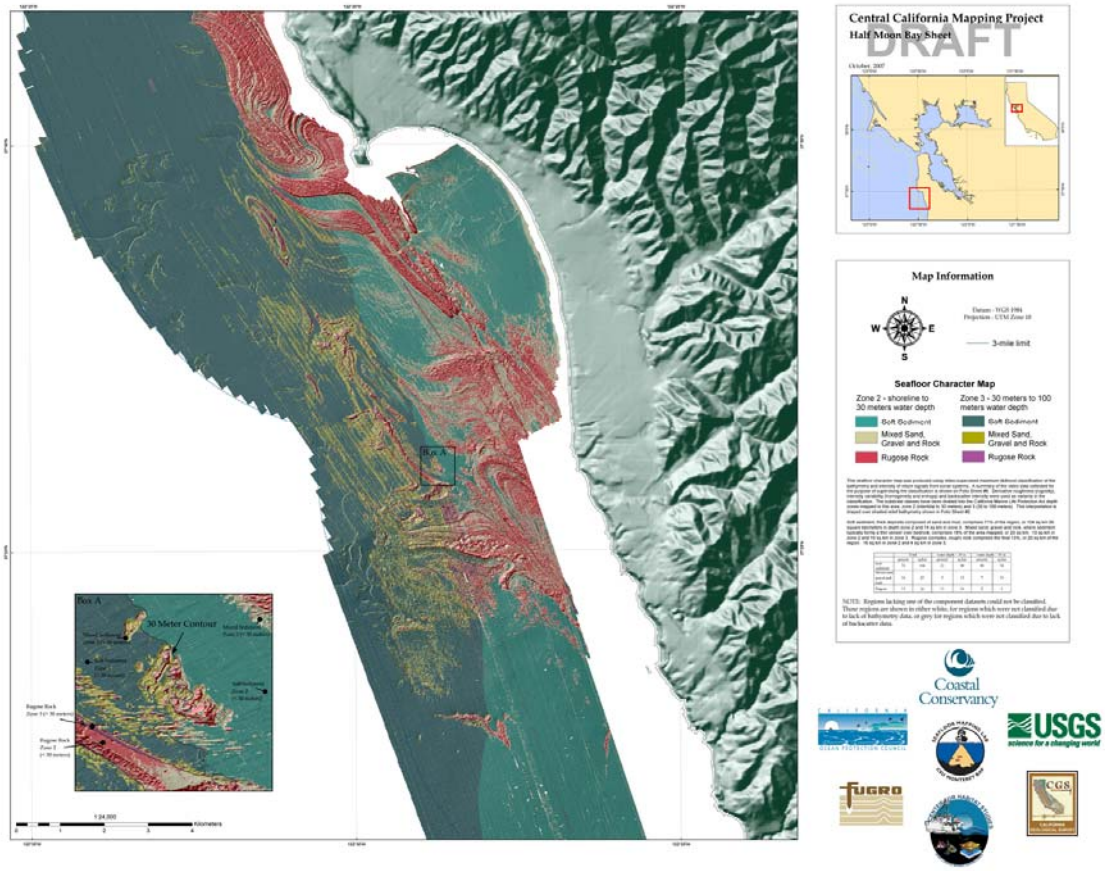

A new raster map product has been produced to describe benthic habitat as part of the California State Waters Mapping Program which will be called a sea-floor character map. The map resolution is 2 meters, identical to that of the multibeam-sonar data from which it is derived, and preserves the gradational qualities of the substrate in a marine environment unlike map products based on delineated polygonal regions. Each pixel is given a value, through a sea-floor video supervised numerical classification that combines information about bottom hardness, rugosity, slope, and depth into a single raster of classes based on current standards used in California fisheries management. Both the raster GIS layer, and a digital map (shown in figure) will be published as part of an online publication that will include other digital maps and associated GIS layers. The digital map folio will include imagery derived from the multibeam-sonar data, bottom-video imagery and observations, sediment thickness isopachs, sub-bottom geology from seismics, surficial geology units and structure, and multi-attribute habitat polygons.

Utility of existing single-beam 'Digital Survey Bathymetry' for identifying potential Marine Protected Areas

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This poster demonstrates two topographic images of the central English Channel, derived primarily from single beam acoustic data, known as 'Digital Survey Bathymetry' (DSB). Each image covers an area about 100 x 50 km (70 x 30 miles), and reveals remarkable detail of the surface expression of the underlying geology and the erosion and transport features that give shape to the current-day seabed.

Such images are particularly useful in broadscale habitat mapping, allowing seabed interpretation on a regional scale and providing confidence in delineating (mapping) the different seabed facies. This confidence can be critical to effective management.

We have used these images to complement site-specific surveys designed to locate and characterise rocky reef habitats, which will soon be afforded a measure of protection under the EU Habitats Directive. The DSB helped us to accurately delineate areas of the seabed containing rocky reefs, providing an important evidence-base in the process of designating Marine Protected Areas.

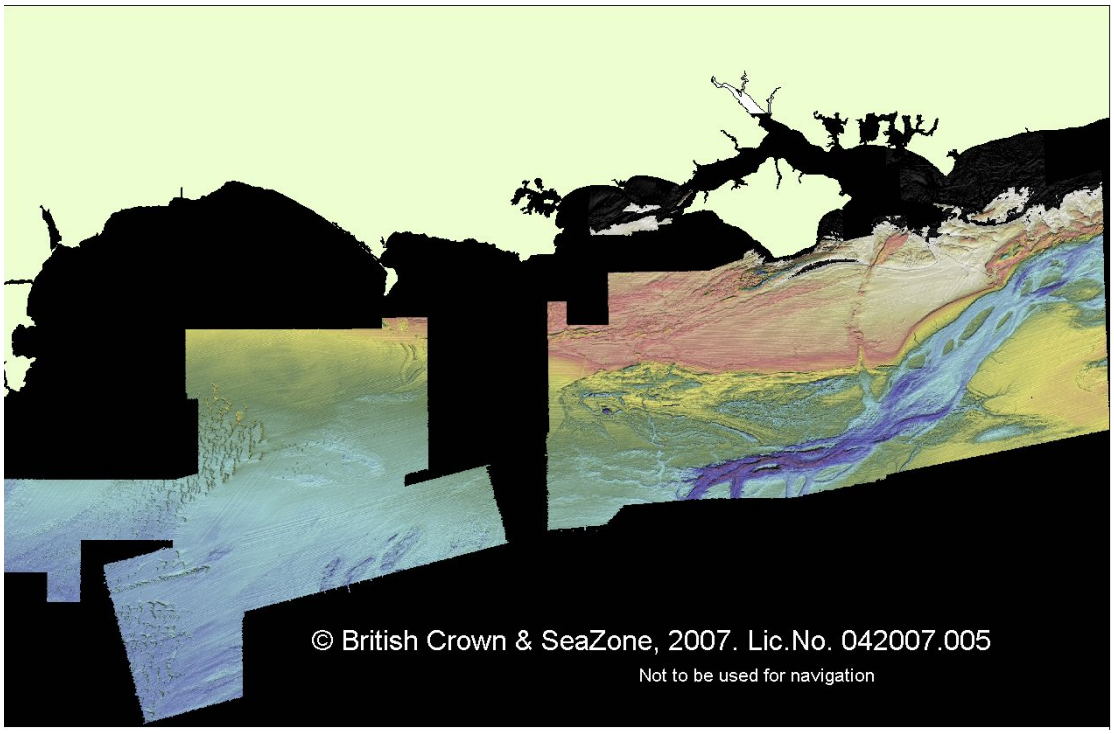

Figure 1. Seabed topography in the central English Channel, as determined from Digital Survey Bathymetry based on single-beam acoustic data.

Mapping Rocky Reefs in the Central English Channel: a case study using nested surveys and broadscale acoustic proxies

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The EU Habitats Directive requires member nations to protect a representative proportion of certain marine habitats that occur within their waters. Rocky reefs are one of seven habitats listed for special consideration, but in UK waters they are not well mapped. Without knowing the location and extent of rock outcropping at the seabed surface, it is difficult to establish what constitutes a 'representative proportion' of the UK's rocky reefs.

This paper reports on a search for rocky reefs in the central English Channel. We surveyed two areas where rock was indicated on seabed sediment charts. In one area we found hardly any rock at the seabed surface. In the other we found outcrops over a far more extensive area than expected. The reefs were characterised using a combination of acoustic surveys (multibeam and sidescan sonar) and underwater video and photography. Large sponges were a feature at sites > 50 m depth.

Digital Survey Bathymetry (SeaZone Solutions Ltd.) of the central English Channel provides a fascinating insight into the complex topography of the area (Figure 1). Drawn mainly from single-beam acoustic surveys, it places our multibeam surveys and geological knowledge in a wider spatial context and allows us to delineate a reef area in the order of 1,000 sq km (about twice the size of the Isle of Wight).

Our study demonstrates the considerable potential benefits that existing broadscale topographic data can bring to seabed mapping at the regional scale, by using seabed character as a proxy for habitats identified during site-specific surveys. The resolution and extent of the resulting maps are well aligned with the information needs of regional management and implementing policy objectives of the Habitats Directive.

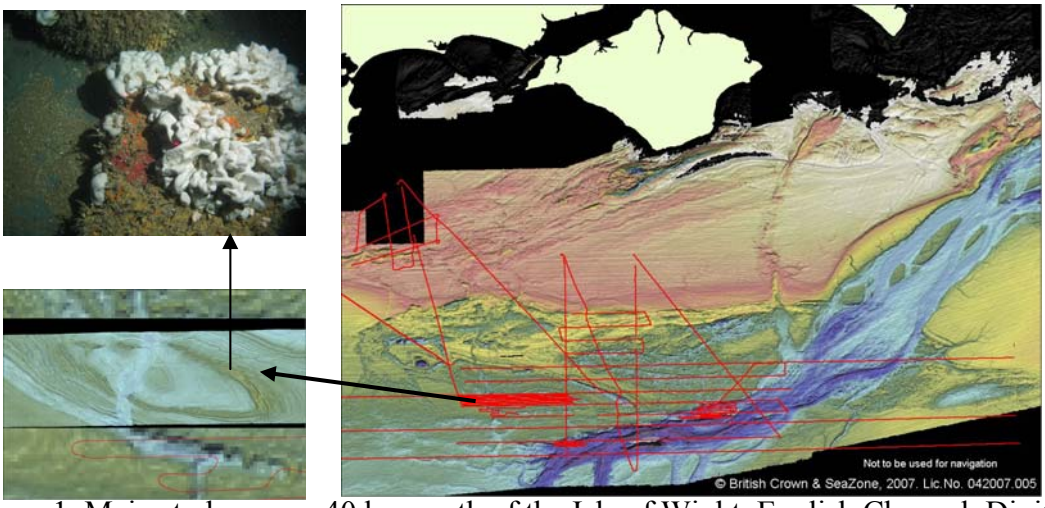

Figure 1. Main study area, ~40 km south of the Isle of Wight, English Channel. Digital Survey Bathymetry (DSB) overlain with initial acoustic survey track. Insets show multibeam detail overlaying DBS, and photo of sponge covered rock outcrop.

Sponge reefs in the Georgia and Queen Charlotte Basins, British Columbia, Canada: a widespread, readily mapped and sensitive benthic habitat

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Hexactinellid sponge reefs are commonly found on the western Canadian margin during multibeam surveys in two geographically separate basins where seafloor mapping is ongoing. These reefs develop as a result of framework reef construction by rigid skeleton sponges of the Order Hexactinosida and the trapping by sponges of suspended sediments entrained in bottom currents over centuries or millenia. Previous geological surveys documented four very large, contiguous areas of sponge reefs forming large complexes in the Queen Charlotte Basin (QCB) where reefs are up to 21 m in height and hundreds of km^2 in area. However, ongoing surveys are discovering smaller areas of reefs as inner shelf areas, such as Agassiz Bank, are mapped. These reefs are found as discontinuous clusters of reef mounds along the eastern edge of the QCB indicating that a belt or zone of sponge reefs may exist bordering the eastern QCB, approximately centered on the 200 m isobath, where ice-contact glacial units remain unburied by recent sediments. This zone of potential sponge reef habitat is approximately 300 km in length.

New reefs have been found on glacial promontories in the Georgia Basin (GB) including several locations in Howe Sound and on Ajax Bank. Multibeam bathymetry and backscatter surveys have proved an effective mapping tool in delimiting sponge reefs and also in discriminating between different types of sponge communities such as flat lying sponge spicule mats, found off Parksville, BC and the more commonly observed framework constructed reef mounds. In certain cases discrimination between living reefs, which show undulatory and non-reflective surfaces, and dead reefs, where more reflective and planar surfaces are observed, may be possible. These new discoveries suggest that far from being an anomaly found only in certain locations of the BC margin, sponge reefs form a widespread habitat type on the seafloor in deep shelf and also inshore locations, and thus represent an important, long term habitat for other species on the western Canadian margin. In many areas these reefs have been impacted by mobile fishing gear with resultant loss of benthic habitat complexity. Mapping of these and other sensitive habitat types will permit more effective fisheries management and will enhance the overall decision making framework for ocean management.

Epifauna and infauna associated with shallow cold seeps and carbonate mounds in Hecate Strait, British Columbia, Canada

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Hydrocarbon seeps with carbonate mounds are present at 130m depth in Hecate Strait, on the continental shelf of British Columbia, Canada. The community associated with these cold seeps has both infaunal and epifaunal components. The epifauna was surveyed using a Phantom ROV and the video was classified using a georeferenced spreadsheet with all organisms enumerated and identified to the lowest taxonomic level possible. All taxa were relatively common species found on the continental shelf, although some, such as the Oregon triton (*Fusitriton oregonensis*) were in unusually high abundance for a habitat dominated by soft substrate. These taxa were apparently attracted by the presence of hard substrate in an otherwise soft seabed environment, especially those sessile organisms, such as giant plumose anemones (*Metridium giganteum*) and encrusting sponges that require hard substrate for attachment. No evidence could be found that linked the presence of any epifauna to the presence of hydrocarbons. The infauna at one of the carbonate mounds was sampled using an IKU grab, including a portion of the mound itself. Infaunal biomass was low and was dominated by bivalves, including the gutless bivalve *Solemya reidi*, which harbour sulphide-reducing bacteria and are found in hypoxic environments.

Another major characteristic of these cold seeps is the presence of significant shell debris accumulated near the carbonate mounds. It was originally suggested that this indicated a significant infaunal clam community; however, further analysis shows that this shell debris must have been transported from other areas of the continental shelf. Under normal oceanographic conditions these carbonate shells would dissolve into the water column. That the shells are persisting in the vicinity of the carbonate mounds suggests that the chemistry of the near-seabed water has been altered, possibly due to the presence of the hydrocarbon seepage.

Use of video classification techniques to describe and map sponge reef habitat on the continental shelf of British Columbia, Canada

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Glass sponge reef complexes have been mapped using multibeam swath bathymetry in the Queen Charlotte Basin (QCB) and Georgia Basin (GB) on the continental shelf of British Columbia, Canada. These reefs are complex habitats and are host to a diverse array of fauna. They have been shown to play a role as nursery habitats for commercially important rockfish species (*Sebastes* spp.). The reef complexes can be easily damaged, especially by fishing techniques that contact the seabed such as bottom trawling. From compiled submersible and ROV dives, as well as geophysical survey data and groundfish trawl distribution data it is estimated that about 50% of the known reefs in the QCB have been impacted by bottom trawling. It is unknown if heavily trawled reef areas recover. In most cases the status of the reef complexes (damaged or undamaged) and their associated megafaunal community cannot yet be described using acoustic mapping techniques, so Remotely Operated Vehicles (ROV) have been employed to conduct visual surveys of many of the reefs. Depending on the classification methodology the video can be used to qualitatively or quantitatively describe the fish and invertebrate community of each reef complex.

Analysis of the video taken at reef complexes in the GB indicate that four out of seven surveyed reefs have been mechanically damaged and consist mainly of large areas of scattered dead sponge skeleton fragments and few live reef-building sponges. Relative abundance of the fish and invertebrate megafauna associated with the reefs was also assessed. To determine if reef status impacts the associated community, two adjacent reefs, one damaged and one undamaged, were compared. Higher taxonomic richness, and higher abundance and greater variety of rockfish, both adult and juvenile, were recorded on the undamaged reef. These results are compared with a quantitative analysis of video data from a newly discovered sponge reef off Malcolm Island using a structured, georeferenced database. This information was mapped over the multibeam bathymetry of the reef to allow analysis of the spatial patterns in the distribution of fauna. The strengths and weaknesses of both qualitative and quantitative assessment techniques for the sponge reefs are discussed, and their utility for habitat mapping.

Semi-Automated Classification of Acoustic & Optical Remotely Sensed Imagery in the U.S. Caribbean

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Benthic habitat mapping supports ecosystem-based management objectives by contributing to the development of detailed species utilization models linking physical habitats with biological information. Marine habitats deeper than 30 meters have been successfully characterized by conducting heads-up digitizing of acoustic and optical remotely sensed imagery. These resulting maps, however, are subjective and ultimately irreproducible because they depend on the accuracy and interpretation of the person that is digitizing. Here we semi-automate the seafloor feature extraction and classification process using high-resolution MBES and LiDAR data as well as underwater images collected off the coast of western Puerto Rico. Alternative approaches were used to identify and extract seafloor features at relevant spatial and thematic scales. The accuracy of these mid to deep-water benthic habitat maps were validated using georeferenced underwater imagery. The ability to quickly and objectively create benthic habitat maps would allow scientists and resource managers to better quantify and assess the changing health of mid to deep-water coral reef ecosystems.

Biological communities of the South West approaches (UK)

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Habitat mapping is the process by which seafloor geological characteristics are integrated with biological information. It can have an important role in sustainable ecosystem-based management of the marine environment, and aid in the selection and management of marine protected areas.
A survey of the canyons on the continental slope south west of the UK was carried out by the RV Celtic Explorer in the summer of 2007. This survey was undertaken as part of the Mapping European Seabed Habitats (MESH) project. The aim of the survey was to identify and map areas of sensitive reef habitat (Annex I reef habitat).

High resolution multibeam and video ground truthing data were obtained from three canyons on the UK continental margin. Multibeam bathymetry and backscatter response were interpreted in terms of topography and broad scale lithology, and ground truthing sites chosen. 44 camera tows were undertaken across the sample area. A drop-frame camera system (stills and video) was used to visually sample the benthic faunal communities and their associated seabed habitat. Images were taken along the tow to provide quadrat-like samples for quantitative analysis of the benthos and representation of the different habitats encountered.

Quantitative analysis of the images were undertaken, all organisms >1cm were enumerated and identified to the lowest taxonomic level. In addition, images were classified on the basis of substrate type using a combination of Wentworth and Folk scales. Biological data were analysed using PRIMER 6. Cluster analysis with group averaged linkage was performed on square root transformed Bray-Curtis similarity matrix using species count and percentage cover data to identify ecologically coherent benthic communities. Thirteen biotopes (biological communities and associated physical habitat) were identified from combined analysis of biological and physical data. Video footage was reviewed and classified according to newly defined biotope. Each tow was coded with the representative biotopes observed and mapped using ArcGIS. Mapped video tow data was combined with classified acoustic data and habitat maps produced. The spatial distribution of biotopes within the canyons is discussed.

Geology meets biology: mapping and prediction of seabed nature types in the MAREANO regional mapping programme

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MAREANO is a regional programme which includes mapping of surficial geology and benthic habitats, or nature types, in the southern Barents Sea, northern Norway. It is a cooperative venture between several institutions with the Geological Survey of Norway, the Institute of Marine Research and the Norwegian Hydrographic Office as major partners.

Mapping of seabed nature types is an important activity in regional mapping programmes like MAREANO and one which lies at the interface between geology and biology. Interpreted maps provide multidisciplinary information which can be essential for the sustainable management of seabed resources.

We provide a summary of ongoing research related to mapping and prediction seabed nature types including mapping of surficial geology, benthic fauna and interpretation of seabed processes. Case studies from the MAREANO area are presented to give examples of the various areas of research. Highlights and ongoing research themes include:

- The importance of multibeam bathymetry and backscatter data and derived variables in nature type mapping and modelling.
- Integration of biological information and sediment ground-truth data from video observations.
- Multivariate modelling of nature types - the roles of supervised and unsupervised classification.
- Delivering useable map-products - making the transition from paper to web-based mapping, issues related to data, scale and resolution.

Spatial modelling and multivariate prediction of seabed nature types in the MAREANO regional mapping programme

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MAREANO is a regional programme which includes mapping of surficial geology and benthic habitats, or nature types, in the southern Barents Sea, northern Norway. It is a cooperative venture between several institutions with the Geological Survey of Norway, the Institute of Marine Research and the Norwegian Hydrographic Office as major partners. A comprehensive, hierarchical survey strategy has been adopted. Multibeam surveys provide 100% mapping of the seabed bathymetry and backscatter. Targeted seabed sampling is conducted over representative portions of the seabed, but covers a fraction of the total area. Video data provide efficient high-resolution imagery of the sea floor and permit the identification of seabed sediment type (grain size) and the analysis of benthic fauna. These 'ground-truth' data, together with some physical samples and any available historical data provide the basic suite of information from which sediment grain size distribution maps and nature types are developed.

Since they provide full spatial coverage, the multibeam data (bathymetry and derived multi-scale terrain variables, plus backscatter data) provide a good basis for the development of models of the distribution of seabed properties. The data provide basic information related to the seafloor geology which underpins the distribution of benthic habitats or nature types. We summarise current research under the MAREANO project into multivariate segmentation and classification of the seabed using these data in order to map nature types. The roles of supervised and unsupervised classification will discussed, with particular reference to regional mapping and use of classification results in planning ground-truth campaigns.

Addressing issues of scale, we have investigated the use of multibeam data at several resolutions, with derived terrain parameters across a range of spatial scales, in order to find suitable and practical predictor variables for regional mapping of surficial sediments and nature types at scales relevant to management. We compare the results of these automated analyses with 'expert' derived end-product maps and discuss the role of each approach in the context of a regional project like MAREANO, which focuses on the delivery of web-based maps for a wide range of end-users.

Geological basis of large gorgonian coral habitat in Atlantic Canada

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Deep-sea corals in Atlantic Canada comprise 30+ species of gorgonian, alcyonacean, scleractinian, and antipatharian corals. Most of these corals occur at continental slope depths along the continental margin of Nova Scotia, Newfoundland, Labrador, and Baffin Island. Because most of the longest-lived coral species require specific substrates, surficial geology exerts a primary control on the distribution of the most sensitive deep-sea corals in Atlantic Canada. The geological features that provide coral habitat were observed in-situ from the ROV ROPOS during 2006 and 2007. Broader coral distribution data are derived from DFO trawl surveys and fisheries observer records.

In-situ observations of the surficial geology of coral habitat suggest that upper slope till and till-tongue deposits and margins of submarine fan distributory channels provide hard substrates for deep-sea corals along the upper continental slope. Moraine-derived till provides the primary habitat for corals in the Fundian Channel (1) and the Stone Fence (southwestern margin of the Laurentian Channel, Nova Scotia). Other coral sites with reported stacked tills in Labrador include the Hudson Strait and, probably, the Cartright Saddle. These stacked tills are associated with the locations of principal ice streams during the deglaciation of Atlantic Canada (2). Coral concentrations in the Haddock Channel (Newfoundland) are dominated structurally by the isidid gorgonian *Keratoisis ornata*, and are developed on deep-water till-tongues derived from glaciomarine debris flows. Other coral concentrations in deep water near shelf-crossing troughs along the Newfoundland and Labrador margin, such as sites along the southwest Grand Banks, northeast Newfoundland shelf-edge, and southern-central Labrador sites including Hawke Channel, Hopedale Saddle, and Ogak Saddle, probably have a similar geological basis.

Large gorgonian coral habitats in the Sable Gully consist primarily of eroded friable Tertiary mudstone, and are dominated by *Keratoisis ornata*, *Primnoa resedaeformis*, and *Paragorgia arborea*. In the upper reaches of the Gully, boulders of crystalline basement rock were observed, with abundant coral growth on them. Shear strength of the mudstone appears to limit size, shape, and species composition of deep-sea corals in many parts of The Gully.
Multibeam bathymetry and backscatter data have been collected for the Fundian Channel, Sable Gully, Stone Fence, and Halibut & Haddock Channels. Further *in-situ* observations of remaining deep-sea coral concentrations in Newfoundland and Labrador waters will be coupled with multibeam sonar and 3.5 kHz sub-bottom profiling.

(1) Scott, 2003, GSA NE Section, Abstracts with Program 35(3): 27.
(2) Shaw et al. 2006, *Quaternary Science Reviews* 25: 2059-2081.

Marine habitat mapping in the Gilbert Bay Marine Protected Area, Labrador, Canada

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The Gilbert Bay Marine Protected Area in southeastern Labrador, Canada, comprises approximately 60 km^2 of fjord and related habitats. This MPA was designated to protect a genetically distinct resident population of Atlantic cod (*Gadus morhua*), the Golden Cod. The management plan for the MPA allows scallop dragging and limited fishing for species other than cod in approximately ½ of the bay. Substrates and marine habitats throughout the bay were mapped using multibeam sonar – derived bathymetry and backscatter, and slope derived from bathymetry, and ground-truthed using drop video and grab samples. Shallow portions of the bay not covered by multibeam were mapped using GPS-single-beam-sonar, drop video, low-speed towed video, and grab samples, with manual interpolation between survey lines. Faunal composition of substrates was compared using multidimensional scaling, analysis of similarity, and similarity percentage analysis in PRIMER, with video data and grab data considered separately. Six substrate classes were identified that had uniquely identifying combinations of depth, backscatter intensity, and slope based on multibeam sonar. The substrate classes were: muddy-gravel, sandy-gravel, coralline-algal-encrusted gravel, gravelly-sandy-mud, gravelly-mud, and mud. Two additional gravelly substrates were identified based on video: nearshore gravel, and current-swept gravel, but the current-swept gravel did not have unique acoustic characteristics. Bedrock wall substrates were rare, being replaced by coarse, steeply-sloping talus accumulations. Moraine-derived sills, submerged eskers and other glacial features largely control substrate distributions within the bay.
Highest biodiversity was found in the coralline-algal-encrusted gravel substrates. This substrate class included rhodoliths formed by branching *Lithothamnion glaciale* as well as thin to thick crusts of the encrusting coralline red algae *Clathromorphum* sp.on coarse gravel. Species composition of biota on this substrate class was statistically distinct from all other substrates. Gravelly substrates all had similar faunal composition, with the exception of the sponge-rich current-swept gravel, which also contained the soft coral *Gersemia rubiformis*, and the shallow ice-scoured gravel, which was distinct due to its low diversity and prominence of *Mytilus edulis*. Faunal composition of muddy substrates was statistically indistinguishable. The number of mappable habitats was lower than the number of substrate types.
Marine habitat mapping combined with the current management plan for the MPA shows that more than ½ of the highly sensitive coralline-algal-based habitat is now protected from fishing activity, but remaining areas of coralline-algal habitat are impacted by scallop dredging. Similarly, most, but not all, of the areas with highest habitat diversity are already protected from fishing activities.

Identifying errors that occur when applying drop video techniques for marine phytobenthos surveys

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Abstract
Underwater video surveys have in recent years become a popular method for carrying out marine phytobenthos surveys (inventories of marine benthic macroscopic vegetation). Video surveys make it possible to identify e.g. the seafloor geology, geomorphology, habitats and sessile macroscopic species. The results from video surveys have wide applications ranging from marine ecological research to marine spatial planning which can apply survey maps for planning and management of marine protected area and for sustainable planning of human activities. In recent years the ecosystem approach to management of human activities has been emphasize by the Convention on Biological Diversity as well as the European Union which further underline the importance to acknowledge the marine biota in sea use planning. The spatial plans for marine areas will have a great socio-economic impact that last for a very long time. Consequently, the availability of good biological datasets of high quality becomes crucial for successful marine spatial planning. This study identifies errors that occur when applying drop video techniques for underwater surveys of marine vegetation. The study is based on large datasets from the northern Baltic Sea as well as published papers. Consequences of the identified errors on marine spatial planning are discussed.

Diverse Habitats on Intraoceanic Island Arc Submarine Volcanoes of the Mariana Arc, Western Pacific

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At least 30,000 seamounts have been constructed on the ocean floor over the past 175 million years by submarine volcanic processes. The majority of these are composed of basaltic lavas associated with Mid-Ocean Ridge, hotspot or mid-plate volcanism. A subset of seamounts submarine arc volcanos, which are located within the intraoceanic subduction zones of the western Pacific and Atlantic oceans. Although there are fewer than 1000 of these volcanoes their geologic framework is fundamentally different than other seamounts. The primary differences are: (1) diverse lava types, (2) high amounts of magmatic gases which produce more explosive fragmental eruptions, and (3) long-term volcanic and hydrothermal activity. The volcanic and hydrothermal activity commonly occurs at much shallower water depth (<1000 m) than that that occurring on the Mid-Ocean Ridge (almost entirely >2000 m). Three basic types of seafloor habitat are found on these volcanoes; 1) effusive lava flows, (2) fragmental slopes and (3) hydrothermal vents. A 2001-2004 systematic sidescan and multibeam survey of the Mariana Arc provides a basic habitat map of about 50 of these volcanoes and ROV dives on 14 of them provide a preliminary habitat assessment. Lava outcrops on the summits and flanks of the volcanos provide habitat for a diverse benthic taxa. The coarse-grained volcaniclastic deposits have sparse larger sessile taxa although erosion by mass-wasting processes can expose semi-lithified clastic substrata that support fixed benthos. Many of these volcanoes are hydrothermally active (20 out of 50 in the Mariana arc) and support chemosynthetic communities marked by a high diversity between volcanoes and relatively low diversity on individual volcanos. The chemosynthetic communities have evolved in extreme physical and chemical conditions, including those adapted to long-term volcanic activity and low pH induced by high concentrations of CO_2 and Sulfur species. Because the summits of these volcanos are often in shallow depth, many have overlap between photosynthetic and chemosynthesis. In summary, the submarine volcanos of the intraoceanic island arcs comprise a unique suite of open-ocean habitats found nowhere else on Earth.

Explorations of cold-water coral-habitat relationships on Cordell Bank, CA using submersible visual data and multibeam sonar data

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This work represents an exploratory analysis of *in situ* data collected with the Delta submersible on the prominent geological feature of Cordell Bank by relating stylasterid coral (*Stylaster californicus*) presence to various seafloor features, as measured by multibeam acoustic sampling. It has been recognized that *in situ* observational data can provide critical information in understanding deep, cold-water coral distribution patterns and habitat associations. These data coupled with fine-scale seafloor mapping provide robust assessments of habitat relationships and allow predictions of species occurrence.

Cordell Bank is situated on the edge of the continental shelf of California and rises from 130m to within 35m of the surface. The Bank contains diverse habitats including high relief rock, flat bedrock pavement, boulders, mixed cobble and sand, sand ripples, and mud. Multibeam acoustic data of Cordell Bank were collected and bathymetric products were created by California State University-Monterey Bay, while substrate analyses were conducted by CSUMB in collaboration with U.S. Geological Survey. These data indicate that 29% of the bank is composed of hard substrates, 48% is mixed substrates, and 23% is soft substrates. The majority (74%) of Cordell Bank is comprised of sloping (1-30°) habitats, while areas with a slope of <1° make up 25% of the Bank, and steeply sloping (30-60°) and vertical (60-90°) habitats make up a very small proportion of the Bank.

Extensive video coverage in representative habitats of the Bank allow for comprehensive assessment of coral distribution and habitat associations. Coral presence is modeled as a function of various habitat features, including depth, slope, rugosity, aspect, topographic position index (tpi), and substrate using data generated from multibeam acoustic sampling. Results indicate that corals are not widely distributed across the Bank, but instead are found in limited habitat types, particularly shallow, hard, high sloping areas. These results provide important information for understanding fine-scale habitat associations of corals and provide the foundation for monitoring these communities. In addition, these habitat models aid in our ability to make informed management decisions regarding these sensitive and diverse communities within a national marine sanctuary.

Predicting suitable habitat for deep-sea coral reefs in British Columbia

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Deep-sea coral reefs provide valuable habitat for fish and other organisms but are highly susceptible anthropogenic threats. The most serious threats are posed by benthic fisheries, most notably bottom trawling, and other human activities that disturb the seafloor. Recent surveys of deep-sea coral reefs suggest that they have been damaged or destroyed in virtually all parts of the world. To date, most deep-sea corals in Canada are unprotected. There is a particularly pressing need to develop a conservation strategy for deep-sea corals in British Columbia (BC), but it is not a simple task. Relatively little coral research has been conducted in BC, and the distribution of deep-sea reefs remains largely unknown. The vast majority of sightings are derived from bycatch data from the trawl fishery. These data are recorded on a taxonomically coarse scale as the on-board observers are poorly trained in coral identification. Furthermore, these data only provide information on the locations of previously damaged corals. Determining the distribution of deep-sea corals and identifying pristine coral aggregations is a crucial first step in establishing effective ocean management strategies to protect these rare and valuable habitats. This study makes a significant contribution toward addressing these information gaps by compiling known locations of corals and using predictive habitat modeling techniques to map locations of potentially suitable coral habitat along the BC coast. Suitable habitat will then be used as a proxy for potential coral locations in previously unsampled areas in BC. The results of this study will be useful in guiding future research and conservation efforts.

Mapping and Lithologic Interpretation of the Territorial Sea, Oregon

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On September 18, 2006, the Governors of California, Oregon and Washington signed the "West Coast Governors' Agreement on Ocean Health". One of the seven priority areas identified in the agreement is the expansion of ocean and scientific information. Additionally, Oregon's Ocean Policy Advisory Council (OPAC) in its public workshop held in July 16-17, 2007 proposed seafloor mapping as part of its action plan to expand ocean and coastal scientific information in preparation to establishing marine reserves in Oregon. Moreover, previous high-resolution mapping efforts in Oregon's territorial sea have mapped only five percent of state waters. In response to this, the Active Tectonics and Seafloor Mapping Laboratory (ATSML) at Oregon State University (OSU) College of Oceanic and Atmospheric Sciences (COAS) initiated mapping of the territorial sea using various thematic GIS layers.

Recently, approximately 11,000 bottom sample labels from National Oceanographic Surveys (NOS) hydrographic smooth sheets in Oregon were digitized. This newly discovered dataset of sample points added a significant amount of information to the previously available 305 bottom samples used to characterize the sedimentary lithology of the territorial sea. These data were collected by the Coast and Geodetic Survey using leadlines and traditional navigation methods, and extend from the late 1800's to the modern. CGS surveys during that period were more explorational than the purely safety of navigation surveys that NOS performs today, and thus broad areas of coastline between ports were sampled. We collected these data from "smooth sheets", interim mapping sheets on which field data were compiled. High resolution scans of these sheets were rectified, and the data were captured using heads-up digitizing. Navigation using bearings and horizontal sextant angles was surprisingly good where we could compare the position of offshore rocks to modern data, and typical maximum errors in these cases were ~ 50m. While not ideal by modern standards, the sheer volume of available sample data have made it possible to construct a preliminary Surficial Geologic Habitat (SGH) map for the Oregon Territorial Sea. In addition to the lithologic point layer, this mapping work uses many other updated thematic GIS layers to interpret the extent of lithologic points such as kelp points and polygon layers, (interpreted as proxies for rocky substrate), exposed rock polygons digitized from 0.5 meter resolution aerial photos, the onshore Oregon digital geologic map, and a TIN model derived from NOS soundings. Rugosity of the TIN layer was considered in the interpretation, along with lithology and the kelp proxy to create the lithologic map. The new inshore map was then merged with the current regional habitat map of the US west coast.

We expect this mapping effort to provide the most detailed surficial geologic interpretation of territorial sea to date. It will also provide a new map product that can be used during the nomination and evaluation process for marine reserves as well as in the overall reserve design process for Oregon.

Surveying deep-water habitats on the UK shelf edge to inform MPA selection

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A survey of submarine canyons in the South-West Approaches areas of the UK Continental Shelf edge was undertaken in June 2007 as part of the MESH (Mapping European Seabed Habitats) project. This collaborative survey involved the Joint Nature Conservation Committee, the Marine Institute, the British Geological Survey and the University of Plymouth. Starting at around 200m water depth, the canyons plummet to the abyssal plain over 4,000m below. Previous work (Graham *et al*, 2001[1]) has indicated the occurrence of 'potential reef' in the area surveyed, as defined by Annex I of the EC Habitats Directive[2]. Habitats listed in Annex I of the Directive are considered to be under threat in the European Union because they are in danger of disappearance or have a restricted range in Europe.

The survey successfully acquired high resolution multibeam and sub-bottom profiler data (GeoHAB abstract Stewart *et al*, 2008) as well as drop-camera data (digital video and stills). A variety of deep-water habitats were observed. The canyon interfluves, or canyon tops, were dominated by mixed substrata and 'historic' coral mounds. Living cold water coral reef communities were observed on the flanks of the canyons between 800m and 900m water depth. Significant anthropogenic impacts were observed with the camera drop-frame. Evidence of fishing activity (discarded nets and lines) and rubbish was observed across the survey area. Plastic bags were also observed wrapped around the reef structure.

Information provided by surveys such as this can help inform MPA selection. For MPAs designated under the EC Habitats Directive, a number of selection criteria should be met. In addition, such information gathered should confirm that the area hosts the Annex I habitat, enables the identification of the specific Annex I habitat sub-type and provides a picture of the biological community present on the Annex I feature.

[1] Graham C, Campbell E, Cavill J, Gillespie E & Williams R (2001) JNCC Marine Habitats GIS Version 3: its structure and content. British Geological Survey Commissioned Report, CR/01/238, 45 pp.
[2] The Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and wild fauna and flora) came into legal force in June 1994.

A comparison of the habitat structure and ecology associated with cold water coral reefs at the Mingulay Reef Complex (Outer Hebrides) and the Sula Ridge Reef Complex (Norway)

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The existence of cold water corals has been identified in a range of latitudinal, hydrodynamic and bathymetric settings. This study involved the application of side scan sonar data and camera footage from a Remotely Operated Vehicle and a manned submersible to establish the similarity of two relatively shallow (~150 – 320 m) aphotic reefs, one at Mingulay in the Outer Hebrides, off Scotland, the other the Sula Ridge Reef Complex on the Norwegian margin.

Combination of the video data and side scan sonar using ArcGIS suggests similar habitat structure at these sites with a characteristic pattern of homogeneous background sediment overlain by coral rubble and topped with dead and living coral framework, dominantely *Lophelia pertusa*. Similar proportions of each habitat type were recorded within comparable mapped areas at the 2 sites. Ecological assessment also suggests analogous distinctive ecological assemblages may be associated with the individual habitat types recorded at both sites. A tentative estimation of the biodiversity showed that the diversity at the Sula Ridge Reef Complex may be higher than that recorded at Mingulay. However, the relative difference between species richness on and off the coral framework appears lower than expected. This may partly be the result of the limited quality of some of the video data, and of the simplicity of the methodology applied.

Anthropogenic activities can have detrimental impact on cold water coral reefs. Trawling, oil exploration and ocean acidification are all potentially destructive. However, video footage studied in this project did not contain evidence for physical destruction. This led to the suggestion that wider scale studies with a regular sampling period are needed to fully assess impacts. The importance of finding indicators for ecosystem stress, such as key species, was also noted in order to optimise management of cold water coral reef ecosystems.

Geology as a Surrogate to Ecology – Is this Possible?
Examples from Alaska

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Using geology to define and map seafloor conditions that in turn are used to characterize potential marine benthic habitats is becoming a common method in trying to define ecosystems over broad areas of the ocean. With the rapid decline in fisheries worldwide and the intense pressure to establish Marine Protected Areas (MPAs) in an attempt to arrest, or even reverse, this decline, scientists and managers alike are struggling to establish methodologies and standards to map habitats that accurately reflect the existing ecosystems. Driving this effort is the use of modern technology such as acoustic Multibeam Ecosounder (MBES) systems, which can produce high-resolution images of the seafloor over large areas in fairly rapid time. Therefore, the inclination is to map the seafloor geomorphology, lithology, and structure in such a fashion that these can be defined as potential habitats that may represent a particular ecosystem.

The inherent problem with trying to define habitats based on remotely sensed acoustical geophysical data is that only the physical conditions of the seafloor are obtained and the other components (temperature, currents, nutrients, etc.) that comprise a habitat are not readily available. Some of these components can be interpreted from the physical data, but generally the biological and chemical information is lacking. Therefore, certain assumptions are included in any geological surrogate that is produced for a particular ecosystem. In addition, the problems of false heterogeneity and false homogeneity play a role in using geological surrogates as predictors of potential habitats. To overcome such problems it is important to statistically groundtruth the interpreted potential habitats in many areas, a procedure that has been done in the characterization of rockfish habitats in Alaska. Potential marine benthic habitat maps produced in Alaska for the management of demersal groundfish are based on geologically interpreted MBES and side-scan sonar data and groundtruthed using the submersible *Delta*, which were used to determine the quantity and quality of commercially targeted groundfish habitat. Although these maps are not perfect and may not characterize the diversity of habitats in Alaska waters, they do provide a base upon which ecosystem-based habitat characterization can be built once the biology is better known. It will be shown that geological surrogates for groundfish fisheries in Alaska are useful predictors of habitat types and that the surrogates can be used elsewhere.

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An ecological classification of benthic habitat in Pacific Canadian shelf waters

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The classification of habitat depends on the correct translation of physical characteristics into measures of habitat suitability. Southwood's (1977) definition of the habitat template was initially proposed for classifying the landscape. The habitat template is intended to group life history traits of species according to their functional role with respect to Disturbance and Adversity, the two axes that define the template. The approach was applied to benthic marine habitat in Atlantic Canada. Kostylev et al. (2005) showed that the template, when divided into four quadrants, was significantly correlated with species diversity. We applied the method to Pacific Canadian waters and, based on available physical data, developed local definitions of Disturbance and Adversity. We assessed how the resulting classification (Figure 1) corresponded to distributions of a number of species including corals, sponges, and commercially important bottom fish. We also explored how the use of discrete categories (i.e., four quadrants) created from the continuous classification influenced the identified biological relationships. The ecological classification of benthic habitat on Canada's west coast shelf will support ecosystem management efforts by providing a representative view of available habitat, and a means of estimating species diversity and community structure. Our results advance our understanding of Canada's Pacific coast, and represent a novel, ecosystem-based approach to marine classification.

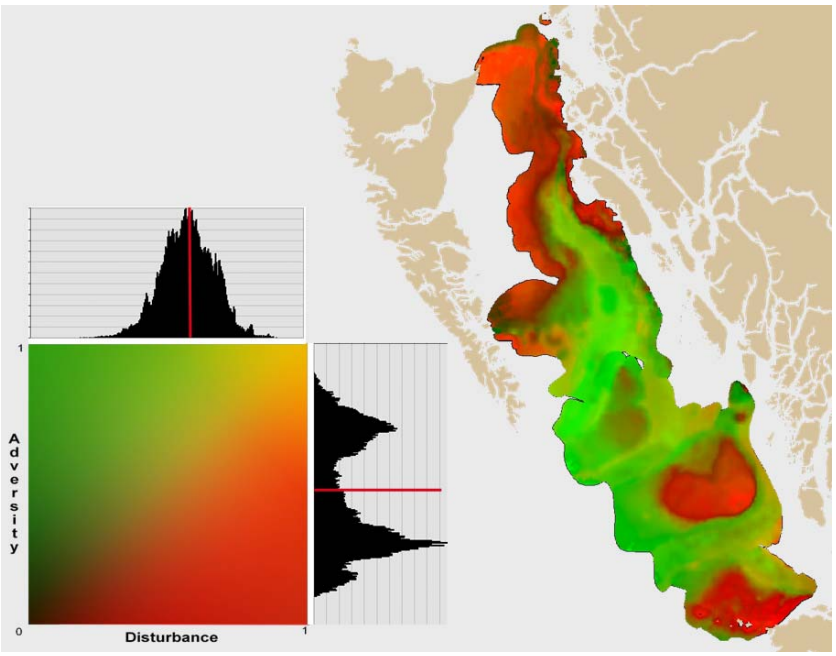

Figure 1: Habitat template for British Columbia shelf waters. Graphs show the distribution of the 500x500 m^2 grid cells across the Adversity and Disturbance axes. Red lines show how the continuous distribution is divided into four quadrats.

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Using models to predict deep-sea cold-water coral habitats: case studies from the Irish continental slope

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Cold-water corals are an important and fragile component of the benthic habitat in the northeast Atlantic Ocean, and the scleractinian corals *Lophelia pertusa* and *Madrepora oculata* occur frequently along the Irish continental margin. Following the Irish National Seabed Survey (INSS), multibeam data provide bathymetric mapping of Ireland's entire offshore territory. The occurrence of corals, however, has only been documented over a fraction of this area. Remotely Operated Vehicle (ROV) surveys conducted at several sites of particular scientific interest, including carbonate mounds, have provided much valuable data on coral biology, associated fauna and reef-related sedimentary processes, but such surveys are by nature limited in their extent. The true distribution of the corals remains largely unknown, yet this information is required for sustainable management. Predictive modelling of coral distribution may help to bridge this gap, but models must be based on sound science, and appropriate methodologies.

As a precursor to developing predictive models for the distribution of cold-water corals, we used quantitative methods to investigate the relationships between observed coral distribution and terrain attributes (e.g., slope, aspect, rugosity, and bathymetric position index) derived from multibeam bathymetry data. We demonstrate a method for estimating deep-water coral percentage cover from ROV-based video footage, using data from two carbonate mound provinces on the Irish margin.

Two methods for modelling coral habitat suitability have been assessed: 1) Genetic Algorithm for Rule-set Production (GARP), and 2) Ecological Niche Factor Analysis (ENFA). Models of suitable coral habitat distribution were developed across a range of spatial scales. Our results provide insights into the usefulness of these modelling techniques and highlight several issues relating to the input data. GARP was used to predict cold-water coral habitat in deep water, beyond the extent of existing samples. Its predictive ability at local and regional scales was examined, as was the relative importance of multi-scale predictor variables including terrain and oceanographic parameters. ENFA was used to provide comparisons with the GARP models and gave additional insight on the predictor variables. ENFA was also used in a detailed study to predict locally suitable coral habitat on a single carbonate mound in relation to terrain variables derived from ROV-based multibeam data.

Sitka Sound and Beyond - Serving Up 40,000 km of Coastal Habitat Mapping & Imagery

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The ShoreZone coastal habitat mapping system was developed in the early 1980s and has been widely applied in the Pacific Northwest, including the entire 40,000 km of British Columbia coastline and 5,000km of the Washington coastline. ShoreZone mapping in Alaska began in 2001 and presently encompasses 40,000 km of shoreline in the Gulf of Alaska, including the xxx km of Sitka Sound. The Gulf Alaska shoreline mapping is expected to be complete in 2010 which will result in a 100,000 km contiguous dataset (Columbia River to the Bering Sea).

A priority of the Alaska ShoreZone program has been to make both the imagery and data widely accessible. At present, the 40,000 km of low-tide imagery is provided via two ArcIMS websites[3], which reflect the evolution of data delivery. The websites allow users to "fly" most of the Gulf of Alaska shoreline. Benthic habitat characterization is displayed through a variety of themes, including: mapped *physical attributes* (e.g., substrate type, morphology), mapped *biological attributes* (e.g., wetlands, eelgrass, canopy kelps) and mapped *man-made features* (e.g., docks, piers, seawalls) and some derived data layers (e.g., wave exposure, habitat type, oil spill residence). Visibility of the websites has been enhanced not only by presentations at professional meetings but also numerous community presentations (e.g., Kodiak, Homer, Anchorage, Cordova, Ketchikan) as well as interviews with community newspapers (e.g., *Sitka Sentinel*) and radio stations (e.g., Sitka *Raven Radio*). A specialized school curriculum was developed to use the web-based Alaska ShoreZone dataset in high school science programs (e.g., Homer).

[3] http://www.coastalaska.net/; http://www.fakr.noaa.gov/maps/szintro.htm

Revealing Sidney's Bottom – **Seabed Habitat Mapping for the Community of Sidney, BC**

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ABSTRACT

Nearshore habitat mapping was conducted off the waterfront of Sidney, British Columbia in support of community planning initiatives. The survey area extended from the intertidal zone to depths of approximately 10m and involved classification of 0.8 km^2 of seabed along the shoreline of Sidney. Side-scan sonar with 100% overlap was used to delineate seabed sediment texture and man-made features on the seabed. Video imagery was acquired using towed video (the Seabed Imaging and Mapping System or SIMS); the video survey grid resulted in imagery of approximately 2% of the project site. Approximately 35,000 video images were classified for biology, geology and man-made artifacts using the SIMS classification system. Seabed habitat units were defined based on (a) the acoustically-defined substrate units (from side-scan) and (b) the biotic assemblage present in each unit. The five biophysical habitat units mapped are: (1) sand-pebble with *eelgrass*, (2) intertidal and nearshore rock with *rockweed* & *bladed kelps*, (3) sand-pebble with *filamentous red algae*, (4) rocky reefs with *large bladed kelp* and (5) dense clay with *piddock clams*. The use of combined substrate and biota as the habitat descriptor provides a good index of the habitat structure and ecological function.

As part of a 2007 Oceans Day event, the Sidney Marine Ecology Centre planned a *Revealing Sidney's Bottom* event to publicly present the habitat maps. In the weeks preceding Oceans Day, the recreational diving community and local whale watching operators were engaged to help identify unresolved targets on the seabed. A newly opened, waterfront hotel hosted the event as part of their opening promotions. Over 150 people, including the mayor and council, attended the presentations with a standing-room only crowd. In addition to the presentation of habitat mapping information, local divers presented pictures of the seabed and biota, and the Canadian Hydrographic Service formally released a new chart of the area, which included the location of a shipwreck that was found during the survey.

The Sidney's Bottom event was designed to reach and engage people who are seldom exposed to seabed mapping information including, recreational divers and boaters, school children, the mayor and council and local residents, who were just curious as to what the seabed looks like. The diversity of information presented (maps, habitat visualizations, videography, historical photos of the waterfront, new charts, diver photos and projected microscope images) contributed to the "engagement" of the community.

Global ocean conservation priorities for benthic ecosystems identified by GIS analysis of multiple spatial data layers

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At GeoHab 2007 in Noumea we presented a global map of seafloor geomorphology and suggested ways it could be used to identify the spatial distribution of broad-scale benthic habitats having high conservation value, namely seamounts and hydrothermal vents. Here we present a new global seabed classification based on the multivariate analysis of bathymetry (depth and seabed slope), sediment thickness, bottom water temperature, bottom water dissolved oxygen and surface primary production. Each of these variables exerts control over the benthic ecology and affects the type of community that might occur in any given location. Multivariate analysis of maps for these 6 variables identifies 11 unique "seascapes" that covers the off-shelf areas of seafloor for the entire globe excluding the Arctic Ocean. The Atlantic, Pacific, Indian and Southern Ocean basins are each characterised by seascapes occurring in different proportions of surface area and there is a broad correspondence between certain seascape assemblages and seabed sediment type and geomorphology. The Arc GIS "focal variety" function was used to carry out an analysis of the seascapes to identify areas having the greatest spatial heterogeneity of seabed types. We suggest such areas of high heterogeneity may be expected to contain the greatest biodiversity within the smallest surface area, which provides useful information for the design of a global network of representative high-seas marine protected areas.

Prediction of Australia's benthic marine habitat diversity using seascapes: a national map

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One of the biggest challenges facing marine scientists is the development of a robust and defensible way to represent potential seabed habitats and ecosystems, based on easily mapped and spatially-abundant biophysical properties. Geoscience Australia is currently developing a statistical approach to integrate multiple spatial biophysical data layers into a single map of seabed habitats or "seascapes" for Australia's marine region. A total of 13 ecologically-meaningful seascapes were defined on the shelf and nine defined for off-shelf areas. Seascapes were delineated most strongly by variations in seabed sedimentology, rugosity and temperature. Seascapes on the shelf divide into two broad latitudinal groups. The northern group are characterised by muddier, warmer environments and shallow water relative to the southern group, which is characterised by sandy, cooler environments. Interestingly, seascapes dominated by gravel occur only on the southern margin. Seascapes off the shelf lack a distinct latitudinal pattern and are more related to seafloor temperature as a function of depth. For deep ocean environments on the southern and western margins, seascapes are principally defined by rugosity and primary production. For other areas, seascape distribution is more complex, with bathymetry and slope emerging as key drivers. Areas where a network of marine protected areas could maximise biodiversity coverage by protecting the maximum seascape heterogeneity are identified using a focal variety analysis in ARCGIS. Future research includes working with Australia's marine biologists to correlate the seascapes with high-resolution biological data.

Structural Sponge Communities of the Faroe-Shetland Channel, N.E. Atlantic: Preliminary observations

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A high resolution multibeam survey of the continental slope NW of the UK was undertaken by *MV Franklin* in September 2006. This was conducted as part of the UK's Department for Trade and Industry's Strategic Environmental Assessment programme and the Department for the Environment, Food and Rural Affairs, through their agency the Joint Nature Conservation Committee, Special Area for Conservation programme. The surveyed areas were ground-truthed using video and stills image cameras mounted on a drop frame. One of the aims of the survey was to locate and investigate the occurrence of structural sponge communities on the UK side of the Faroe-Shetland Channel (FSC).

Structural sponge communities have been recorded from the FSC on both the Faroese and UK sides of the Channel. Their occurrence is thought to be a result of the unique hydrography of this region. On the UK side of the channel the inflowing current, North Atlantic Water, is relatively warm (~7°C) and occupies the upper 500 m. Below the surface water mass there is cooler/fresher water (~0°C) which originates in the Nordic Seas and Arctic Ocean. The water temperature in the Channel is known to fluctuate at depths of 350m – 650 m as a result of internal tides. The incidence of internal waves is thought to result in resuspension of materials leading to increased food supply, which supports the sponge aggregations.

Almost 1500km^2 of seabed was surveyed with 28 video ground-truthing tows and 1800 images obtained. Video data were reviewed and a sub-sample of 260 images quantitatively analysed. Fauna were identified to morphospecies and cluster analysis with group averaged linking was performed on a Bray-Curtis similarity matrix using P/A data to investigate patterns in community structure.

This survey identified structural sponge communities associated with various seafloor features including iceberg plough marks, terrace structures and ditch features. Sponge communities were not visible from multibeam bathymetry or backscatter grided at 15m grid squares. Video observations revealed these communities to be characterised by a high diversity of sponge morphospecies including branched, cup, lamellate, globose, erect and encrusting sponges. Distinct species included bright blue and bright yellow encrusting sponge forms, large white erect sponges with multiple chimney like structures, and Geodid species. The distribution of sponges is patchy with some areas supporting dense growths of large sponges and others areas supporting less dense growths of small and encrusting forms. Cluster analysis of the faunal data suggest that the sponge communities are distinct but related to the surrounding faunal communities. Video and image data suggest these communities are present over a very narrow depth range focused on the 500m contour. Data from this and previous studies, suggest these communities may form a continuous narrow band on the UK continental slope north of the Wyville-Thomson Ridge.

Challenges and rewards of ROV-based high-resolution habitat mapping in deep-sea canyons offshore Portugal

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Deep-sea canyons are major geomorphological and ecological features of the continental margins and slopes, but are still poorly known and understood. They can be hundreds of kilometres long, cut hundreds of meters in the overall slope, and can act as conduits, but just as well as traps for the transport of sediments (and hence of carbon and pollutants) from the shelf to the deep sea. They form major breaks in the slope, causing important effects on the local physical oceanography and ecosystem distribution. Yet insights in the processes and patterns governing deep-sea canyons are only increasing slowly, because the canyons form such a challenging environment to study.

The Nazaré, Setúbal/Lisbon and Cascais canyons offshore Portugal have been studied for a number of years within a range of national and international projects. Overall bathymetry and sidescan sonar (TOBI – 30kHz) maps have been acquired over the area (e.g. Lastras et al., subm.), together with video data and a number of cores. Still, due to the high spatial variability and complicated nature of the terrain, it was necessary to refine the mapping to a much higher resolution in order to understand the local distribution of the different habitats and communities. During spring/summer 2007, the ROV *Isis* was used on board the RV *James Cook* for this objective.

The habitat mapping operations during JC010 included high-resolution multibeam mapping of 4 areas of ca. 0.5 km^2 each using the Simrad SM2000 system (200kHz), video surveying and photographing, the continuous recording of temperature and salinity, and the occasional collection of biological and geological samples. The swath data were processed to 0.5 m resolution grids with the IFREMER software suite *Caraibes*, while overall data integration was carried out within *ArcGIS*. The main challenges related to the work in the deep canyons included uncertainty in terms of navigation, problems with sound velocity and beam-forming of the multibeam system, the turbidity of the water column in certain parts of the canyons, and strong currents and tides, also related to the steepness and irregularity of the terrain.

However, despite those difficulties, the results significantly increase our insight in the morphologies and processes present in deep-sea canyons. Important features such as sharp bends, gullies, steep (to vertical) walls and ledges, which usually are smoothed in large-scale bathymetry grids, are mapped accurately, and at a scale which can be linked directly to the biological communities at the seabed. The results illustrate the tremendous heterogeneity of canyon habitats and the associated ecosystem spatial distribution. The 4 bathymetrical data sets acquired show how a flat-bottomed thalweg incises the canyon axis over several 10s of meters, even at depths of 4300 m. This creates near-vertical to overhanging walls, often the preferred settling grounds for filter feeders such as stalked crinoids, brachiopods, corals etc. On more gentle slopes, sediment transport is evidenced by sediment waves, below the resolution of even TOBI sidescan sonar imagery (which is 6x6m). Terraces are characterised by thick mud deposits, supporting a typical community of deposit-feeders.

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High-resolution acoustic mapping of Mediterranean Deep Coral areas

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Deep Coral areas have been detected and mapped off the Almeria Margin and in the Cap de Creus Canyon, along the western and north-western Mediterranean Sea.
The study has been carried out by means of an integrated geophysical dataset, comprising large-scale (TOBI) and small-scale sidescan sonar systems, swath-bathymetry, TOPAS high-resolution seismics. In the area of Cap de Creus Canyon, acoustic dataset has been ground-truthed with visual images from ROVs and the man submersible JAGO (IFM-GEOMAR).
Amplitude analysis of backscatter images revealed extremely high reflective patches, punctually distributed along some of the volcanic banks in the Almeria Margin (Chella and Pollux Banks) for depths ranging from 230 to 470 m. High reflective patches coincide in the seismic records with areas where carbonate cold water coral mounds occurs (Fig.1). Very high acoustic strength could be related to the roughness of coral colonies or to associated sediments.
Banks of the cold coral *Madrepora oculata* and some isolated colonies of *Lophelia pertusa* have been visually detected along the southern wall of the Cap de Creus Canyon, by 150-300 m depth range. The obtained images offered valuable information for the characterization of the communities (species composition) and abundance of the coral species as well as the conservation stage of them. In both study areas, the position of deep corals banks suggests that the occurrence of strong bottom currents and reduced sedimentary fluxes are environmental factors suitable for their development
The integration of different marine geophysical methods supported by ground-truthing calibrations, allowed to recognize in detail the morphological and sedimentary constrains suitable for the development of deep coral habitats. Furthermore, quantitative analysis of acoustic images could represent a step ahead in the detection of deep coral areas by remote sensing methods.

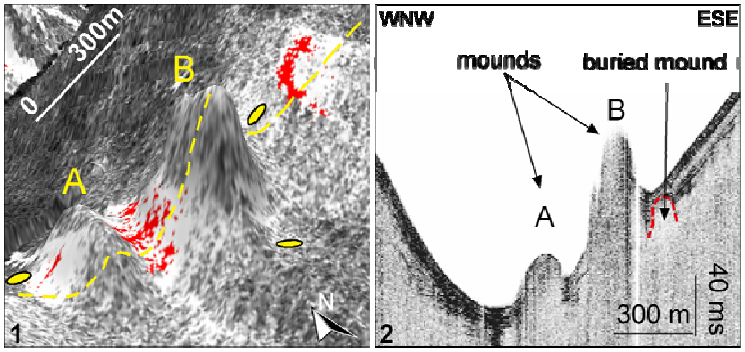

Figure 1. TOBI (1) and correspondent TOPAS records (2) of isolated carbonate mounds at the top of Chella Bank (Almeria Margin). Yellow lines on the TOBI images indicate the track of the TOPAS profile. Yellow dots on the TOBI images indicate sediment sampling points. Red patches in (1) indicate extremely high reflective areas.

Application of nonlinear seismics in the study of the seagrasses. The case of *Posidonia oceanica* (Mediterranean Sea)

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The distribution of the Mediterranean seagrass *Posidonia oceanica* has been widely assessed using acoustic methodologies. However, informations on *P. oceanica* internal structure obtained with seismic methods are still very rare. In the framework of the multidisciplinary project CARBOMED, a seismo-acoustic survey was carried out in Port Lligat Bay (Catalonia, NE Spain) with the aim to assess the volume potentially occupied by *P. oceanica* organic deposits (known as "matte"), detect its internal structure and highlight the morphological and sedimentological characters of the study area. The high content in organic carbon inside the matte makes the *P. oceanica* one of the most extensive coastal reservoirs of $C0_2$, playing a major role in the global ocean carbon cycle.

The high resolution nonlinear parametric echosounder "Innomar SES 2000 compact" was used to acquire 75 seismo-acoustic records. The echosounder was characterized by a primary frequency of 100 kHz and secondary frequency ranging from 5 to 12 kHz. Pulse Repetition Rate was up to 30/sec and the beamwidth of ±1.8°. In most of records it was possible to detect a strong reflector, from 2 to 6 m depth, that was interpreted as the initial substratum where the seagrass established for first time. A core collected on the *P. oceanica* meadow showed the presence of a dense matte for the first tens of centimeters in the subsurface, degrading to sandy sediments with rhizomes and leaf sheaths for a total depth of 6 m. The base of the core presented gravely bioclastic sediments, dated 5616 ± 46 Cal yr BP, and its depth correlates, in a seismic record near the core location, to the reflector interpreted as the base of the *P. oceanica* matte. A first calculation of the potential volume of *P. oceanica* deposits in Port Lligat Bay was estimated in about 220,000 ± 17,400 m^3, resulting in a carbon accumulation of 0.19 tons m^{-2}. Results allow us to conclude that in Port Lligat Bay *P. oceanica* probably developed on gravely sediments, mainly constituted by less fragmented gastropods and bivalves, and probably deposited in a very shallow coastal setting, characterized by moderate hydrodynamic energy. The use of nonlinear seismo-acoustic technologies proved to be a powerful non-destructive method for highlighting the settling of coastal seagrasses and accurately estimating the potential size of the carbon sink represented by the organic debris buried under *P. oceanica* meadows.

Characterising rock from thin sediment and its significance in mapping habitat

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In areas where rock is at or close to the sea bed surface, the thickness, extent and grain size of sediment cover can be a greater control on habitat than the underlying or surrounding rock. However, experience with using a suite of geophysical survey methodologies simultaneously including single beam morphology models, multibeam, sidescan sonar and boomer sub-bottom seismics indicates that the results of individual methods when deployed in areas of rock and thin sediment can produce different and seemingly contradictory results in terms of physical morphology and sediment cover.

Ground truth evidence from video and photography can go some way to answering the contradictions particularly with regard to local high resolution detail, for example, with identifying epifauna, sand bedforms, gravel fabric and rock type, but this detail may not always be transferable for interpretation on a small scale across a wider regional perspective. Also this level of surface detail may not always be useful in understanding the relationship between the sea bed and its underlying geology particularly if it is a rock based substrate.

The ease with which rock can be characterised from thin sediment depends on a number of factors including the lithology, structure, bedding, density and hardness of rock. The hydrodynamic regime and mobile sediment availability is also a factor. The scale at which these can be distinguished is important in defining a mapped habitat.

Examples and methodologies adopted in habitat mapping projects in southern UK waters to map areas of rock and thin sediment indicate that a wide variety of survey methodologies are required to provide an adequate basis for robust interpretations.

GIS based identification of chemoautotrophic communities, mud flows, and biogeochemical habitats at Håkon Mosby Mud Volcano

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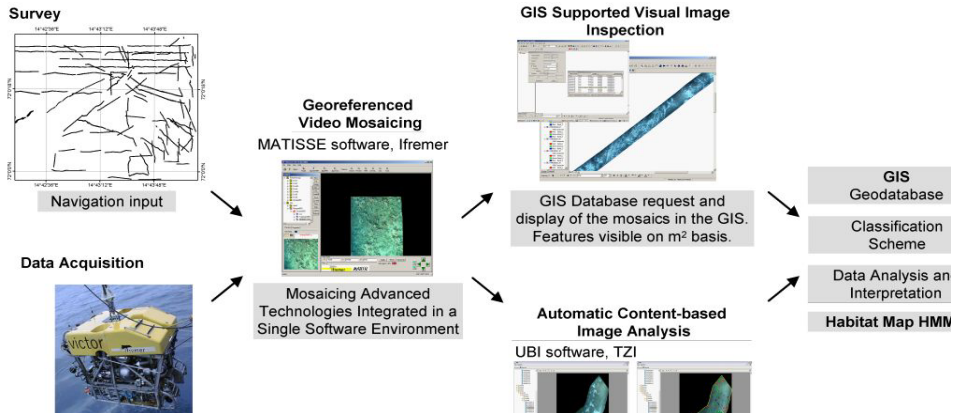
Marine mud volcanoes are significant source locations contributing to the marine methane cycle. Enhanced heat flow, unique chemoautotrophic communities, occurrence of massive gas hydrates and large gas plumes are direct evidences of elevated methane concentrations and the dynamic environment of mud volcanoes. Related to the high concentrations and large inventories of CH_4 in surface sediments only a fraction of the methane is exported to the bottom water. This is mainly due to chemoautotrophic communities oxidizing methane and proving a "microbial filter" reducing CH_4 fluxes. Although these processes were studied for several mud volcanoes still little is known about the spatial pattern and the areas covered by chemoautotrophic communities or by present mud flows.

For this purposes the Håkon Mosby Mud Volcano (HMMV), which is located at the continental slope of the Barents Sea, was studied by several dives with the Remotely Operated Vehicle *Victor6000*. During these dives a high resolution microbathymetric map, with a footprint of 25 x 25 cm and a vertical resolution of better than 10 cm was derived. Furthermore, video streams of the bottom camera was converted into georeferenced mosaics, providing a detailed image about the spatial distribution of seafloor features as bacterial mats, pogonophorans, both indicating methane oxidation, or mud flows. Based on visual inspection of 2310 georeferenced mosaics covering an area of 46160 m², different biogeochemical habitats were identified and quantified on a m²-basis and stored within a geodatabase. By application of GIS based and geostatistical techniques as indicator kriging the distribution of different biogeochemical habitats were quantified and mapped for the entire HMMV.

Considering the flat and hummocky area of HMMV, approximately 16% of the flat centre is nearly void of any benthic communities. This area is considered as a region of high methane discharge into bottom water. An area of 5% located in the south-eastern part, is densely inhabited by *Beggiatoa*. The hummocky outer part is colonised dominantly by pogonophoran tube worms (37.3%) and only occasional by *Beggiatoa.* Source locations and drainage directions for current mud flows were identified by computation of trend surfaces and consideration of temperature data.



Assumptions behind geological proxies in benthic habitat mapping

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Geological mapping of seabed has a great potential for use in predicting spatial patterns of benthic communities and ecosystems. Recent technological advances in acoustic surveys empower scientists to acquire massive information on seabed structure, texture, complexity and subsurface. Benthic habitat maps, based on high-resolution acoustic surveys, often accompanied by limited groundtruthing by cores, grab and optical samples have implicit assumptions on relationships between sampled acoustic signal, seabed morphology, texture and biological derivatives, such as community composition. There are two major groups of assumptions on the path from collecting survey data to creating a map of benthic habitats: First is that we can confidently interpret properties of surficial sediments from remotely-sensed information, and the second – that the derived textural or morphological classes are relevant to seabed ecology. The degree of uncertainty behind these assumptions may render the resulting habitat maps useless. The current understanding of sediment-organism relationships, based mostly on studies of sediment grain size, requires urgent revision. Interaction of sediment and flow as an agent of natural disturbance, together with the effects of benthic organisms on this interaction are in the core of benthos-sediment coupling. Better understanding of drivers behind ecological patterns such as physical processes in benthic boundary layer on a range of spatial scales will allow more efficient use of remote sensing tools and techniques for using geological information as a proxy in benthic ecosystem mapping.

Development of a benthic habitat methodology for establishing Rockfish Conservation Areas (RCAs) in British Columbia

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In April 2007, 164 Rockfish Conservation Areas (RCAs) were implemented as a spatial management tool to protect a portion of the inshore rockfish stocks and promote recovery. These areas were chosen by identifying optimal inshore rockfish habitat and closing a portion of this habitat to all fishing activities. Integral to the selection of these RCAs was the public consultation process as well as the development of various benthic habitat models.

The selection of closed areas began in early 2002, with stakeholders identifying specific areas on charts where known rockfish populations or habitat exist. The process evolved in 2003, when a coastwide inshore rockfish habitat model was developed in a Geographic Information System (GIS) using bathymetric line data from digitized nautical charts and fishery catch and location data. Later, in 2005, new methods to non-subjectively classify benthic habitat zones were developed by using high resolution multibeam bathymetry derivatives (rugosity, slope, and bathymetric position index), and backscatter data in a multivariate spatial analysis.

Backscatter Angular Dependence as a Quantitative Tool for Seafloor Substrate Characterization. Application to Cook Strait, New Zealand

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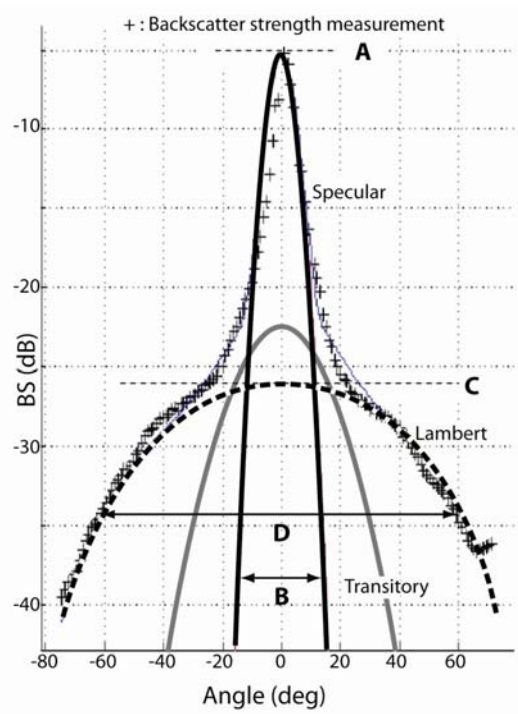
Echo-sounder backscatter intensity is a relative measure of the sound-scattering by the seafloor. Backscatter strength is a function of the seafloor substrate and roughness, i.e. it is associated to both sediment grain size, porosity, and small scale topography. We worked in the sedimentologically and tectonically active Cook Strait, central New Zealand, where a wealth of EM300 (30 kHz) multibeam bathymetry and backscatter data are available, augmented by an extensive geological database (seafloor photographs, sediment and rock samples, and high-resolution seismic profiles). This provides an excellent opportunity to correlate the quantitative processed backscatter signal with distinctive geological, sedimentological and biological environments.

Based on the use of the SonarScope® software from Ifremer, the processing of an 8500 km^2 area in Cook Strait was completed. Subsequently, we modelled the angular dependence of the backscattering strength for a variety of geological substrates and landforms using a functional model commanded by four physically significant parameters, without trying to relate explicitly these parameters with geological or acoustical parameters used classically in these disciplines. The four parameters are associated to the specular echo and the Lambert-like regime, featured in the angular response of the backscatter given by:

$BS(\square) = 10 \log[A.\exp(-\square^2/2B^2) + C. \cos^D \square$

A, the specular maximum amplitude, is high for soft and smooth sediment interfaces; B is given by the angular width of the specular regime and is associated with the average (medium-scale) slope of the seafloor roughness; C, the average backscatter level at oblique incidence, is the offset associated with the classical Lambert's law describing backscattering strength at intermediate angles from rough interfaces; C increases with the seafloor roughness and impedance; D, the angular decrement of the backscatter commanding the variations at grazing angles, is high for soft and smooth sediment interfaces. In the classical Lambert's law, D equals 2. The library of backscatter angular profiles was built for a series of specific location where ground-truthing data provided information on the geology. The four parameters form the basis for operations of seafloor-type recognition. This first library will form a generic reference for further studies.



From Rubber Boots to ROV's: Exploring marine benthic habitats across the Gulf of Maine Biodiversity Discovery Corridor

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The Gulf of Maine Biodiversity Discovery Corridor is a relatively new regional marine science research and outreach initiative. It currently has a significant research emphasis on the integration of marine benthic ecological and marine geological research approaches. The original concept for discovery corridors arose in national meetings on marine biodiveristy science held in Canada in 2003, sponsored by the Centre for Marine Biodiversity (www.marinebiodiversity.ca), the Department of Fisheries and Oceans, and the International Census of Marine Life (www.coml.org).

The Gulf of Maine corridor cuts across a broad swath of the northern Gulf of Maine, covering both Canadian and US waters, extending from the intertidal out to shelf and slope waters, also encompassing part of the New England Seamount Chain. During 2005 and 2006 two offshore research cruises were conducted. In 2005 benthic explorations were conducted to depths of 500m in offshore basins (Jordan, Crowell Basin) and in Northeast Channel using two benthic sampling gears (Campod and Videograb) operated off the Canadian Coast Guard Ship (CCGS) *Hudson.* Based on the success of this first mission, explorations to depths of 2500m occurred in 2006 using a deepwater remotely operated vehicle, ROPOS (www.ropos.com). Further offshore research missions are now being planned for 2009 and 2010.

During 2007 and again in 2008, efforts are underway to mount new coastal research components within the Discovery Corridor. A new North Atlantic node for the international NaGISA program (www.nagisa.coml.org) has been established to explore diversity patterns in intertidal and shallow-subtidal macroalgal-dominated sites in Canada and the US. Additional coastal work is underway to examine relationships between benthic diversity and seabed habitat characteristics using both SCUBA diving and surface-deployed benthic video survey systems.

The Discovery Corridor has proven to be an accessible concept for developing outreach intiatives, engaging the interest of the arts community (print and video/film) and educators. The corridor project is considered a Canadian contribution to the Gulf of Maine Area Program of the Census of Marine Life. Major financial contributors have been the Department of Fisheries and Oceans, the Sloan Foundation, and the Natural Sciences and Engineering Research Council of Canada. Longer-term aims of the initiative are to expand the range of project activities beyond the initial focus on benthic habitats, and thus to create knowledge and vizualizations of corridor as an integrated ocean space.

Assessing the robustness of a morphometric classification model to help predict Australia's benthic marine habitat diversity

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A major challenge facing marine scientists is to develop a robust and defensible way to represent potential seabed habitats and ecosystems based on easily mapped physical properties. In this research we investigate a benthic morphometric classification model to produce a classification of the seafloor to identify features at multiple scales. The results contribute to a larger nation wide research project with the aim to provide an improved understanding of the utility of different marine biophysical variables as surrogates for benthic habitats and patterns for marine biodiversity in Australian waters.
By applying geomorphometry theory developed by terrestrial ecologists, we were able to convert multibeam bathymetric data into models that classify six distinct features of the seabed and provide a quantifiable level of seabed complexity. The resulting classification maps are geo-referenced, high resolution, scale-independent, reproducible and have assigned levels of uncertainty in the classification of features.

The results of this research will improve our understanding of the degree and form of relationships between physical variables and benthic marine biota, and identify the best analysis methods to relate these variables to biological data. We will continue to examine the performance of a number of statistical/mathematical methods for modeling the relationships between biodiversity and the physical environment from multibeam bathymetric surfaces at multiple scales.
Future research includes working with Australia's marine biologists to correlate the morphometric models with high-resolution biological data.

Production of Marine Information Overlays (MIOs) for Marine Environmental Protection

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Marine Information Overlays (MIOs) are supplemental layers of information that are used with shipboard Electronic Chart Display and Information System (ECDIS). Although an Electronic Navigational Chart (ENC) contains necessary information to ensure safety-of-navigation, MIOs provide additional layers of geospatial information associated with hydrograhpic, meteorological, and oceanographic factors, as well as for marine environmental protection. MIOs can exist in a variety of formats including imagery, graphics, gridded and vector data. Currently, most MIOs are based on IHO S-57 vector data format. However, MIOs will soon be developed based on the new IHO S-100 Geospatial Standard and ISO TC211 suite of geospatial standards.

This paper will describe the overall process required to produce MIOs for marine environmental protection. This includes challenges associated with acquiring suitable geospatial data from existing mapping and GIS databases that describe/classify marine and benthic habitats. An explanation will be provided regarding what software tools can be used to convert existing GIS/geospatial databases into IHO S-57 format datasets. Specific mention will be made regarding the importance of producing MIOs of critical benthic habitats such as coral reefs and internationally-designated Particularly Sensitive Sea areas (PSSAs).

A description will be provided regarding the MIO component of the Marine Electronic Highway (MEH) Project in the Straits of Malacca/Singapore. The goal of this International Maritime Organization/World Bank initiative is to strengthen marine resource conservation in one of the world's busiest shipping routes by bringing critical coral, marine protected area (MPA) and other environmental protection-related information to the mariner. The MEH Project involves a number of stakeholders (e.g., mariners, hydrographers, conservationists, scientists, and resource managers) who are interested in both safety-of-navigation and marine environmental conservation.

Spatial patterns of macrobenthic communities in a Swedish Fjord as derived from opportunistic video data

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This paper summarizes research carried out at Tjärnö Marine Biology Laboratory in support of a soon to be established Marine National Park in the Koster Fjord area, off the West coast of Sweden. The main focus of this scientific effort is to develop a spatially-explicit model to predict the distribution of benthic assemblages across the greater Koster Fjord area. The outcomes will aid in the design and future management of the Park. The work presented concerns the documentation of scales of variability of benthic communities with the aim of choosing an appropriate mapping unit that will capture the full range of assemblage diversity effectively at the local scale.
Analysis of Remotely Operated Vehicle (ROV) video footage from seven sites located in and around the fjord has been carried out. This includes over 1200 short video sequences, for which all species of benthic megafauna have been identified to the level of species whenever possible, or lowest taxonomical level otherwise. Mantel autocorrelation has been computed, based on Bray-Curtis similarity of pairs of samples, across the whole range of distances between samples.
Preliminary analyses of the data indicate that samples were significantly correlated (ie, more similar than it would be expected if they had been taken from random locations) at distances below 30 m. When considering only species that live physically attached to the seabed or bedrock, different patterns emerged, where autocorrelation became significant again at distances around 100 m.
In this presentation, these results will be discussed, as well as their implications for sampling effort optimization and scales of analysis to get the best possible maps of assemblage distribution from the available data.

Biological relevance of benthic marine landscapes and seabed topographic features in the Archipelago Sea (Baltic Sea) – implications for management uses

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The Archipelago Sea is a highly heterogeneous mosaic with approximately 40,000 islands and small skerries. The greatly varying seabed topography and substrate is reflected in the biology of the region. A salinity and water clarity gradient from the more enclosed inner archipelago through the outer archipelago to open sea exerts a further influence. The harsh environment has low species diversity, but often high abundances of the dominant species. The mix of freshwater, brackish and marine species is unique to the Northern Baltic Sea region. The area is important for both conservation and commercial purposes. Among other uses, the Archipelago Sea has many important shipping routes and is very popular for both leisure boating and second homes. Most of Finnish fish farming is concentrated in the region, and the area supports both commercial and leisure fisheries. Information on the natural values of the region is essential for planning management, however information available on the distribution of biological communities is largely lacking.

The marine landscape, or seascape, approach has been put forward as a cost effective way to represent the marine environment, and act as a proxy for biological and ecological considerations in management of the marine environment. Landscapes are based on data of the abiotic variables that contribute to the physical habitat of biological communities, such as depth and substrate. In order to be effective proxies the landscapes must be biologically relevant. Information on the level and type of inference that can be drawn from such maps, in relation to biological values, is vital for informed planning and management.

In this study, a part of the EU Interreg IIIB funded BALANCE project, we tested the biological relevance of the benthic marine landscapes and seabed topographic features mapped in the Archipelago Sea. Habitat maps from the same area made utilising the same abiotic data, with the addition of wave exposure, were also tested for comparison. The habitat maps we classified according to level 3 of the European Nature Information Network (EUNIS) marine habitat classification. We were aiming to establish, if the landscapes and abiotic habitats corresponded to any consistent communities, or groups of communities, or species that could be considered indicator species for that landscape or habitat type. We used two datasets, a grab sampled benthic fauna dataset with observations from 1991-2005 and a drop video dataset collected 2004-2006. We used a number of multivariate methods, including NMDS, the multi-response permutation procedure (MRPP) and Indicator Species Analysis. No clear association was found between specific biological communities and a single landscape type. This was to be expected, as landscapes are larger units and will include several different habitats. However, the landscape classes were found to have some power to group species in a meaningful way, with smaller within group differences in species assemblages than between groups. Some classes of each of the classification systems used (benthic marine landscapes, seabed topographic features, level 3 EUNIS habitats) were also found to have on or more significant indicator species.

Holy Coral! Is that what I think it is?
adventures in vague locations, extrapolation, & mis-identification

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The discovery of cold-water coral around the world has garnered a great deal of attention in recent years, both in the scientific and popular literature. In Alaska, over 425,000 nm^2 of seafloor has been closed to bottom trawling since 2006 in an effort to minimize the effects of fishing on habitat, including cold-water corals and sponges. These Essential Fish Habitat (EFH) closure areas were developed with relatively limited habitat information/mapping, instead relying on fisheries catch/bycatch & survey data. An extensive analysis of fishery catch and survey data was performed to delineate open/closed areas, with particular attention paid to coral and sponge bycatch. While these data were not ideal , no other proxy for habitat was available to the analysts. Lessons learned about the spatial accuracy of observed and survey data, techniques used to collect those data, and how those data are processed are presented, and implications of using catch/survey data rather than habitat mapping data is discussed

Habitat investigations within the SEA 1, 4 and 7 areas of the UK continental shelf. Cold water reefs and sponge habitats

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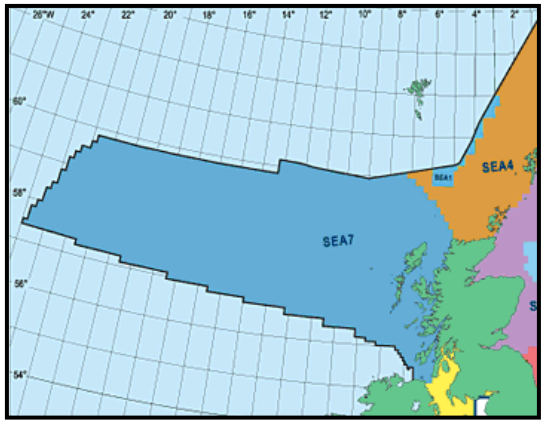

The purpose-built research vessel *MV Franklin,* conducted a 70 day cruise in the North eastern Atlantic during 2006, as a part of the UK Department for Trade and Industry's ((now renamed as Department for Business, Enterprise & Regulatory Reform)) Strategic Environmental Assessment (SEA) programme and the Department for the Environment, Food and Rural Affairs, through the Joint Nature Conservation Committee (JNCC) agency, for their Special Area for Conservation (SAC) programme. The task was to collect multibeam bathymetry and backscatter data as well as photo transects over selected areas of the UK's Continental Shelf that would help refine current models of the benthic topography, habitat and ecology. More than 5000 km^2 was mapped and more than 20 000 digital photos were recorded.

The combination of high-resolution multibeam and backscatter data along with drop camera digital still photographs and video transects proved an efficient tool to find and map habitat areas of interest in the depth region 400-1000m. With the aid of accurate underwater positioning, the camera could be landed with precision on reef structures and sponge fields.

The features of continental shelf off northwest Scotland was formed in large part by glacial scouring and ice-movements, with only recent slight modification by seafloor currents, such that the current surficial sediments are the remnants of material deposited as the ice sheets waxed and waned; there is little present-day sediment input to the area.

Within the Rockall Trough cold water coral reefs were observed which, in general, were associated with rock outcrop, pinnacle and rock terrace (ledge) features. Within the Faeroe Shetland Channel structural sponge communities were observed, which may be present in a continuous band along the continental slope in this basin. The complex hydrology of the FSC has led to the occurrence of an underwater tide pool below 400mwater depth. . Here cold Norwegian Sea Water (~0°C) is trapped in iceberg scours bathed in warm North Atlantic Overflow Water (~°7C) as a result of internal tides.

Design and Implementation of an Open-source-WebGIS for the Sea floor of the North and the Baltic Sea

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The use of web-based geoinformation systems (WebGIS) in natural sciences and engineering is increasing rapidly. Systems designed for the efficient retrieval and the visualisation of empirical (geo-)data or for supporting land use planning and engineering are only two fields of application. Such systems are appropriate vehicles for publishing and illustrating research results, thereby enabling to engage the public in the importance of environmental issues. Furthermore, web-based geoinformation systems may serve to accomplish legally obligated report duties regarding environmental monitoring activities.

We designed and implemented a WebGIS to serve as a query and visualisation tool for marine geoinformation for the North and the Baltic Sea. The WebGIS is realised using Open-Source-software considering standards and specifications for interfaces and handling of geodata determined by the Open Geospatial Consortium (OGC) to ensure interoperability between Web Map and Feature services (WMS/WFS). The software components consist on the Apache HTTP-Server and the UMN Mapserver. The mapserver thereby allows inquiries and analyses on spatial data (raster and vector) as well as generating and visualising maps. The database management system used is PostgreSQL with the spatial extension PostGIS. The Mapbender of CCGIS is used as user interface and for administration of map services.

The geodata that is up to now integrated in the WebGIS-application were mostly collected within the framework of the MarGIS project which was part of the GEOTECHNOLOGIES research focus. Approximately 235000 sample point data on salinity, temperature, silicate, nitrate, and ammonium at the interface Water body / sediment, and on grain size ranges could be made available from the ICES Data Base, the Marine Environmental Data Base (MUDAB) of the German Federal Maritime and Hydrographic Office (BSH) and the German Federal Environmental Agency (FEA) as well as the Institute of Marine Research (IfM, University of Hamburg, Germany). Surface data sets on bathymetry were provided by the Alfred-Wegener-Institute (AWI, Bremerhaven, Germany). Further data that can be visualised and queried by the application consists of raster information on geochemical, biological and sedimentological characteristics of the sea floor of the North Sea. Most of this data had been derived geostatistically and was used to calculate benthic habitat maps that can be used as a spatial reference system for monitoring activities in the North Sea.

The geodata can be visualised using interactive tools like zooming, panning or centering. Data attributes can be screened by spatial as well as by logical queries. Additional GIS functions like intersection and buffering tools are furthermore implemented. Together with statistical functionalities it is possible to interactively select measurement sites for a certain area, for instance a certain habitat type and to compute chosen statistical measures.

Estimation of global meiofauna and macrofauna biomass

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Although numerous local studies exist, global distribution maps of the biomass of benthic invertebrates are lacking, which prevents the incorporation of this group into global ecosystem models. In this study, global distribution maps were generated for meiobenthos (organisms 0.1-1 mm retained on sieves of 30 to 74 µm mesh size, including foraminaferans and nematodes among others) and macrobenthos (organisms 1 mm - 1 cm retained on sieves between 250 and 1000 µm mesh size, such as polychaete worms, crustaceans and mollusks) based on general linear models linking benthos biomass with depth, sea surface and bottom temperature, and surface chlorophyll-*a* using ArcGIS 9.2. Geographic coordinates for point measurements of meiofauna (n=184) and macrofauna (n=140) biomass came from 28 peer review journal articles.

The models for meiofauna and macrofauna accounted for 27% and 42% of the variation in measured biomass values, respectively ($p < 0.0001$). The model, represented in the maps in Figure 1, predicts a total of 2.34 x 10^9 teragrams of meiofauna biomass and 1.07 x 10^7 teragrams macrofauna biomass across the world ocean for an estimated total of 1.3 x 10^{10} teragrams benthic invertebrate meiofauna and macrofauna biomass worldwide.

This study provides a global benchmark for benthic biomass, provides the first estimate of benthic biomass for large-scale trophic models of ecosystems and provides the first step of what could be a continuous exercise in the identification of additional factors impacting the distribution of benthos on a global scale.

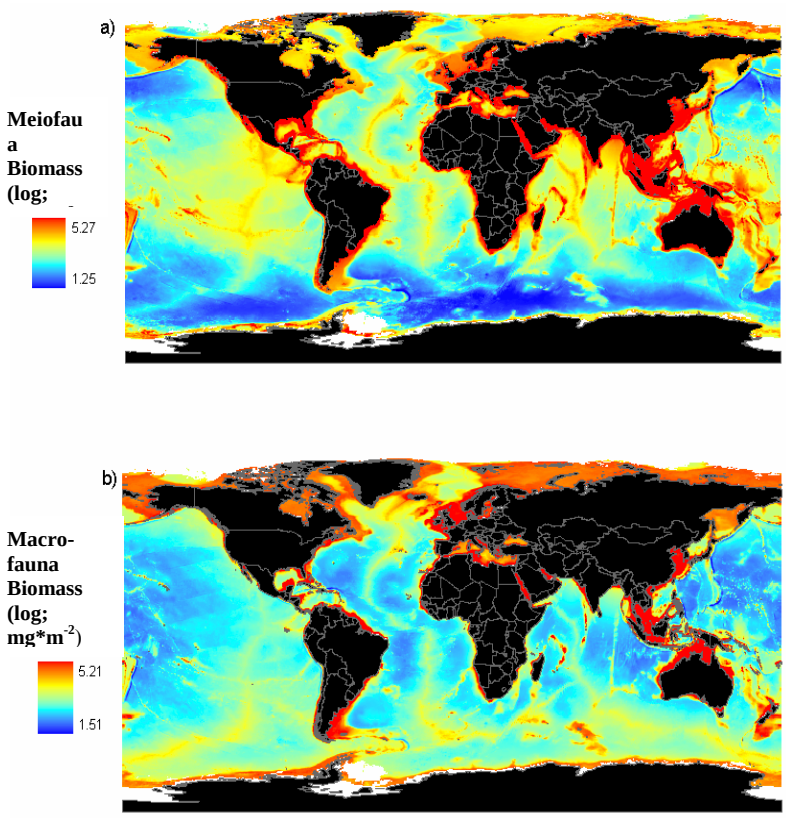

Figure 1. Maps detailing log benthic biomass for meiofauna (a) and macrofauna. White areas of the map are covered by ice for more than six months of the year.

Benthic Habitat Map of the US/Canada transboundary region of Georgia Basin

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A Georgia Basin transboundary collaborative project between Moss Landing Marine Laboratories' Centre for Habitat Studies (Cal, USA) and the Geological Survey of Canada (Natural Resources Canada) has been active for the past seven years to study the inland sea between the San Juan Islands, the southern Gulf Islands, and the southern Strait of Georgia. A near-complete high-resolution multibeam dataset (2 and 5m resolution) has been produced for the area using the Canadian Coast Guard vessels *Vector* and *OtterBay*, which support Simrad EM1002 (95 kHz) and EM3002 (300 kHz) systems respectively. Multibeam sonars collect two types of data: primarily bathymetric data, calculated from beam time-to-return, and the secondarily backscatter strength data, which registers the beam amplitude. The use of both datasets facilitates morphologic and physical characterization of the seafloor, permitting marine geohazard assessments, geological mapping and marine benthic habitat characterisation.

Here we illustrate the results of the US/Canada transboundary habitat mapping project, following the modified Greene et al. (1999 and 2007) habitat scheme. The entire multibeam area was interpreted at a scale of 1:10 000. This method uses codes to describe the marine benthic habitat from a macro environment to a micro environment. Large scale mapping of the high-resolution multibeam dataset has highlighted various benthic habitats, such as subaqueous dunes, current scoured features, muddy flats, and anthropogenically disturbed areas. In combination with GIS systems, these map products are easily adapted to suit the requirements of other science users and seafloor managers.

Implementing Canada's National Marine Mapping Strategy

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With an offshore territory of 4.6 million km^2 Canada faces many challenges in managing offshore lands. In addition under UNCLOS Article 76 Canada could lay claim to substantial additional territory on the Atlantic and Arctic margins. Rapid climate change in the Arctic and sustainable management of the fishery are providing additional stresses to resource management. Government response to these challenges has been to enact new policy (Canada's Oceans Act 1997), to develop new strategies (Canada's Ocean Strategy 2002), leading to realignment of existing research programs (Geoscience for Oceans Management in the NRCan), and to fund new programs such as Canada's Oceans Action Plan, and a 10-year program to support the Canadian UNCLOS claim.

Management of offshore lands has been constrained by a lack of high quality information on marine ecosystems. Seafloor maps are a foundation knowledge base upon which regional management plans are being developed. Over the last three years a national seafloor mapping program has been developed and implemented. In the federal budget of 2005 Canada implemented the Oceans Action Plan, which incorporated a national seafloor mapping program to be delivered by NRCan in partnership with the Canadian Hydrographic Service. Through a series of stakeholder workshops priority areas of national importance have been identified, while a habitat mapping strategy has been developed to optimise program outputs. A new national marine map series has been developed as a foundation to support integrated ocean management. Maps are being produced at scales of 1:50,000 and 1:100,000 with four separate sheets in each area, multibeam bathymetry, backscatter intensity, interpreted geology and benthic habitat; in selected coastal areas maps are produced at 1:10,000. More than 100 maps are currently in production, incorporating approximately 120,000 km^2.

Spatial patterns of nearshore subtidal communities in southeast Alaska linked to habitat and environmental variability

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Spatial patterns of benthic marine biodiversity and community structure reflect the influence of many habitat variables. In the marine intertidal zone of northern British Columbia, species richness and distribution are strongly related to salinity, temperature, and wave exposure at locations with varied ocean or terrestrial influence (Zacharias and Roff 2001). At subtidal depths, such differences also appear to occur between the outer coast and mainland coast of southeast Alaska, which are separated by a complex archipelago of many islands (O'Clair and O'Clair 1998). Our study defines and compares patterns of biogeography, marine community structure, and habitat at shallow (< 20 m) nearshore locations in southeast Alaska near the city of Juneau on the mainland coast, and Sitka on the outer coast.

Sites were surveyed in summer, 2007 using SCUBA to classify seafloor habitats and quantify faunal assemblages and macroalgae. Environmental data were collected using a CTD and subtidal moorings. Major environmental gradients were observed with salinity and temperature between coastal locations. Benthic habitats and associated communities varied among sites and between locations. Patterns of biogeography and community structure are present between the outer coast and mainland coast of southeast Alaska that are explained by benthic habitat and environmental conditions. Our study identifies predictors of marine benthic biodiversity and community structure at locations in southeast Alaska with varied terrestrial and ocean influence. This information will support community classification for future habitat mapping efforts in southeast Alaska.

O'Clair RM, O'Clair CE (1998) Southeast Alaska's Rocky Shores: Animals, 2nd edition Plant Press, Auke Bay, AK

Zacharias MA, Roff JC (2001) Explanations of patterns of intertidal diversity at regional scales. Journal of Biogeography 28:471-483

Surficial seabed characteristics of the United States: Focus on Alaska

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Costly and labor-intensive groundtruthing data, gathered through physical or photographic sampling of the seabed, is a key data type in mapping for habitat, along with bathymetry for depth and slope, backscatter imagery for large-scale bottom type determination, and biota identifications. Information about surficial seabed characteristics is also instrumental in understanding geologic history and processes, sediment transport issues, and the distribution of resources.

The USGS and collaborators are compiling hundreds of groundtruthing reports, site specific to regional, from all areas of U.S. oceans into the usSEABED database (http://walrus.wr.usgs.gov/usseabed); these surficial and subbottom (core) data are unified through the dbSEABED integration program (http://instaar.colorado.edu/~jenkinsc/dbseabed). usSEABED holds numeric point data from both lab analyses and parsed written descriptions to provide the most complete coverage of the seafloor. Data include sampler type, sediment-size percentages, standard statistical parameters, locations of rocks or hard bottom, common geochemical and geophysical parameters, and constituent components of the sediment, such as ash, coral, shells, epi- and infauna, and many others. FGDC-compliant metadata on each source report are given in usSEABED publications to provide links to the original works; see the usSEABED website above for links to the current Atlantic, Gulf, and Pacific coast publications.

We present views of usSEABED in Alaska from data collected by the USGS, NOS, the U.S. Navy, universities, oil companies, and other federal agencies, totaling hundreds of thousands of data points, seek further data and partners for usSEABED, and show examples of usSEABED data usage elsewhere in the country.

For detailed seafloor habitat analysis, groundtruthing data are best combined with high-resolution bathymetry and backscatter imagery; however, usSEABED provides an ongoing data source and data repository and allows for currently unavailable regional estimations of rocky (bedrock and gravel), sandy, and muddy areas to advance the marine science community's understanding of benthic habitats as well as understand seafloor character, processes, and resources.

Distribution of seabed topographic features in the Archipelago Sea, the Baltic Sea – an approach to pinpoint geodiversity hotspots

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The Archipelago Sea is one of the largest archipelagos in the world with over 40 000 islands and islets (larger than ½ ha). It is located in the Baltic Sea off the South-Western coast of Finland. The Archipelago Sea is characterized by shallow average depth (23 m) and land uplift (3-4 mm/year) that is continuously changing the landscape. The seafloor is a mosaic of various substrates. Surface salinity varies from 5 to 7 PSU. Majority of the area is covered by ice each winter. Exposure of the shore, topography and seabed substrates among other environmental parameters vary within small area resulting to an archipelago of heterogeneous natural environments.

Here we describe the identification method and distribution pattern of the Archipelago Sea seabed topographic features (STF). They are marine landscape type developed in BALANCE project (www.balance-eu.org), where the objective was to delineate areas with ecological relevance by their physical parameters. The STF describe geomorphological differences and structures of the seafloor. They were identified by analyzing and modeling existing bathymetry and substrate datasets. The Baltic Sea scale marine landscape analysis (Reijonen et al., submitted) revealed that the Archipelago Sea is highly heterogeneous feature area. Here the purpose was to give insight to what archipelago consists of and major geoprocesses within area. We hypothesize that heterogeneous STF areas correlate with geodiversity hotspots as well as reflect to biodiversity. Biological validation of the STF is presented by Nöjd et al.

Variety of STF was revealed from the Archipelago Sea. Altogether we identified 49 features on the basis of substrate and bathymetry data (16 features if depth zonation is ignored). Basins and different types of mounds (e.g. bedrock mounds) are most typical to the area; together they include over 80 % of the seafloor. We have classified the Archipelago Sea into five diversity categories on the basis of the STF distribution. Study area is revealed largely heterogeneous. In maximum there were 26 different feature types and 80 feature patches inside 1*1 km^2 block. Geodiversity hotspots are located near small islands and close to large ice-marginal formations. Glacial impact combined with crystalline bedrock is noted to lift geodiversity leading to a patchy and fragmented seafloor environment. Active processes, like wave exposure and continuous land uplift, contribute to feature distribution and geodiversity by revealing and remoulding deposits.

Substrate mapping of Bogoslof Volcano, Alaska for a natural experiment on invertebrate colonization

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The focus of benthic substrate mapping has been to improve knowledge of the spatial distribution and health of benthic ecosystems and to aid management of marine resources. Alaska region fisheries include bottom-contact gear, and information is needed on both the impact of such gear and the recovery of benthic ecosystems after disturbance. However, some ecologically significant benthic invertebrates have slow growth rates and life spans on the order of decades to hundreds of years. This makes it difficult to measure rates of recovery from disturbance over an appropriate time period, if a new experiment must be started. Mapping that identifies substrate ages has potential to help constrain the range of possible recovery rates.

Bogoslof Volcano, in the eastern Bering Sea, provides a natural laboratory because lava and tephra from historical eruptions (since 1796) have resurfaced different areas of the seafloor. We report the results of the first stage of our study, multibeam sonar mapping and a preliminary map that is specifically designed to indicate substrate of different ages. Future work is needed to groundtruth the substrate maps and characterize the biological colonization of the substrates. The absolute ages of substrates are to be tested by matching rock sample compositions with those of historical eruptions, i.e., 'geochemical fingerprinting.'

For this study, we collected 100 kHz bathymetry and backscatter data starting at the edge of the summit platform. The survey by Fugro Pelagos, Inc. was conducted with a pole-mounted Reson 8111 during very favorable weather and sea conditions, producing bathymetry data to 800m water depth. The historical record of volcanic eruptions on Bogoslof Island and the shallow submarine summit was compiled by the Alaska Volcano Observatory. A small number of flank vents are observed, but Bogoslof does not have well-developed flank rift zones characteristic of larger submarine volcanoes, confirming that the great majority of volcanic eruptions occur through vents on the summit platform. Most of the volcanic products that end up on the seafloor are volcanic clasts of various sizes, rather than intact lava flows. The submarine slopes to 750m depth are dominated by downslope transport of volcanic debris and erosion of underlying volcanic deposits into knife-edge ridges. Younger volcaniclastic debris blankets the seafloor between these ridges and is expected to include the products of historical eruptions. Time periods for rapid erosion of these eruptive products and debris transport off of the summit platform can also be estimated from historical records. Two Phantom ROV dives were conducted on the upper slopes of Bogoslof (90-230m) in 1995 (R. Brodeur, NOAA/NMFS, pers. comm), on sites predicted to be surfaced by eruptive products from the 1883 eruption of Fire Island and from the 1927 lava dome on Bogoslof. The dive videos show clear differences in substrate and invertebrate colonization between the two sites.

DATA DISCOVERY, ACCESS, AND DISTRIBUTION PATHWAYS OF THE PACIFIC COAST OCEAN OBSERVING SYSTEM (PACOOS): AN ECOSYSTEM OBSERVING TOOL FOR THE CALIFORNIA CURRENT

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The Integrated Ocean Observing System (IOOS) is a national program designed to provide quality controlled ocean data and information as products and services for decision makers. Federal, State, Academic, and Private partnerships are developed within IOOS providing access to data historically within the domain of separate agencies, offices and programs. The system is integrated in that it efficiently links observational nodes through a data communications and management subsystem to data analysis and modeling nodes.

Recognizing the need to develop an ocean observing system covering the entire California Current Ecosystem (CCE), NOAA and its partners are establishing the Pacific Coast Ocean Observing System (PaCOOS) as a west coast observing ecosystem "backbone" for IOOS. In 2004 a partnership was developed between NOAA Fisheries NWFSC and the Active Tectonics and Seafloor Mapping Lab at Oregon State University to organize a collection of marine geological and fisheries products (spatial datasets) and make them discoverable, viewable, connectable, and downloadable to end users who cover the widest range of technological capability.

Under IOOS, the Data Management and Communications Subsystem (DMAC) is a set of standards developed to promote the flow of information from observational to analysis nodes of a distributed network. At the PaCOOS Marine Habitat Portal, we implement the base data transport standards of the DMAC with servers and services allowing distributed computer applications to share information. However, implementing the DMAC standards alone does not of itself add much value to our collection other than connectivity. To make the collection useful and applicable to real world problems fisheries managers and scientists face in our region we're developing a highly functional map viewer, query system, and data discovery portal.

This presentation will give a live demonstration of the PaCOOS Marine Habitat Server and Portal focusing on: Navigation, Spatial Queries, Data Discovery and Extraction. Examples will also be presented for using client side software such as a GIS to make connections to the underlying database (SDE and OPeNDAP) and web services (WFS and Image Service). We hope to convey through live demonstration the breadth of capabilities and possibilities that web services such as the PaCOOS Marine Habitat Server bring to marine managers.

A Multi-Scale Analysis of Demersal Fishes and their Associated Habitats on a Gulf of Alaska Fishing Ground

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The continental shelf and upper slope of the Gulf of Alaska support a diverse and commercially important community of demersal fishes. In Alaska, very few areas of the continental shelf and slope where major fisheries occur have been adequately described using geophysical and biological data. We selected a site on Albatross Bank, south of Kodiak Island to conduct such a study. Using the research submersible *Delta* in combination with acoustically derived habitat maps, we examined fish community distribution and abundance patterns in relation to seafloor substrate type, rugosity and water depth. These associations were examined across three spatial scales: broad, ranging from a kilometer to tens of kilometers in size; intermediate, ranging in size from several kilometers down to tens of meters; and fine, ranging in size from meters down to centimeters.

Twenty-two video strip transects were conduct on Albatross Bank from 1999 to 2005. Dive locations were selected with reference to the habitat maps in order to maximize the variety of habitats sampled and ground truth the maps. Dive transects were approximately two meters wide, and covered a total of 37.5 linear kilometers. Surveyed depths ranged from 10-360 m. A total of 18,475 video frames (3,531 containing fish) representing 100% coverage were analyzed. Fish taxa and abundance were recorded; a total of 5,762 fish were counted from 33 taxa. Rockfishes (*Sebastidae*) accounted for 69% of observed fish. Habitat was described in terms of depth, primary substrate (>50%), secondary substrate (>20%), and rugosity.

Fish community distribution patterns were found to be largely correlated with depth. This held true across all three spatial scales. Fish community distribution patterns were less well defined when they were examined in relationship to substrate type and rugosity. Habitat associations of individual fish species were also examined. While depth was found to have a strong influence on species distribution, substrate type and rugosity were also found to be important factors. Notably, the scale at which that these factors were relevant varied by fish species. Some of the observed fish-habitat associations occurred at the scale of the habitat maps; others occurred as scales that were finer than the resolution of the habitat maps. In the future the challenge will be to identify and incorporate the relevant factors into new habitat maps in order to improve their utility in indentifying fish-habitat associations at the community level.

Prediction of Suitable Rockfish Habitat

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Yelloweye rockfish, *Sebastes ruberrimus*, the target species for the demersal shelf rockfish (DSR) longline fishery in Southeast Alaska, is long-lived (O'Connell and Funk 1986), late maturing (O'Connell and Fujioka 1991), and highly residential (O'Connell 1991). These life history characteristics result in a species that is extremely vulnerable to over harvest. The Alaska Department of Fish and Game (ADF&G) sets the total allowable catch for yelloweye to no greater than 2% of the exploitable biomass; biomass is estimated from density, average weight, and habitat area (O'Connell et al 2001). The estimated area of rockfish habitat is the factor of interest for this study. Rockfish habitat is delineated by a combination of multi-year DSR fishery logbook data and acoustic (multibeam and/or sidescan sonar) survey data. We consider acoustic survey data a better predictor of rockfish habitat than logbook fishery data, so in areas where acoustic survey data is available, we use it instead of fishery data. However, in some locations only high resolution bathymetry in the presence or absence of fishery data is available. The purpose of this project is to determine if we can improve our estimate of available rockfish habitat by using bathymetry without backscatter data to predict suitable yelloweye habitat. A model to predict yelloweye habitat was produced using a multivariate regression with catch per unit effort (CPUE) data from the directed commercial fishery for yelloweye rockfish, depth and other characteristics derived from bathymetry, such as slope, rugosity and bathymetric position index. The model performance was tested by comparing the predicted and actual CPUE values for single year fishery datasets using a Pearson's correlation coefficient. The model was inefficient at predicting CPUE for the single year datasets as suggested by the weak associations between the predicted and observed CPUE. We will explore additional methods to produce more effective models, for example, we will use less restrictive Generalized Linear Models. We will also explore models that incorporate presence/absence values for yelloweye instead of CPUE. Model performance will be tested by comparing our predicted yelloweye habitat to areas delineated as rocky habitat from the interpretation of backscatter from one multibeam survey performed at Cape Ommaney.

Predicting the distribution of Annex 1 reef habitat – Results from the MESH SW Canyons survey, UK

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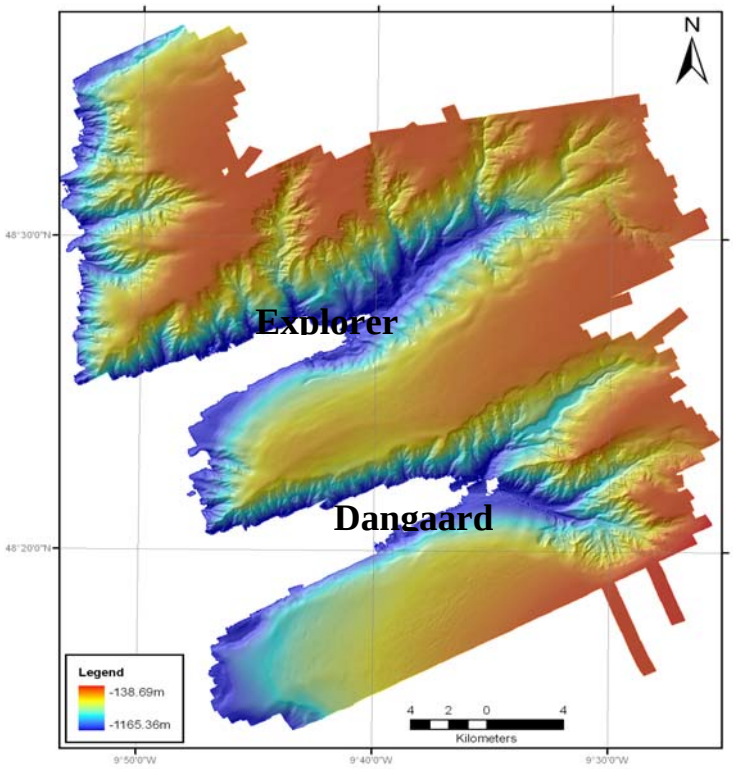
A survey of the SW Approaches (north-eastern Atlantic margin) was carried out in June 2007 as part of the Mapping European Seabed Habitats (MESH) project. The cruise not only mapped the variable morphology of the Dangaard and Explorer Canyons (Explorer Canyon first named here) of the SW Approaches area, but also investigated the biological communities within the canyon system to provide data to allow the subsequent assessment of potential Annex I reef habitat against the interpretation of Annex I reef according to the EU Habitats directive. The cruise was a thorough test for the recently completed MESH Guidance Framework www.searchmesh.net/Default.aspx?page=1616. The work programme was highly successful with 1106km^2 of multibeam data acquired (Figure 1), 44 photographic "ground truthing" sites and approximately 320 line km of sub-bottom data collected.

The Celtic Margin is characterised by a highly dissected, incised continental slope interspersed with smooth interfluves of un-eroded continental shelf. The Explorer and Dangaard Canyons were incised in the Pleistocene during episodic sea level low stands. There is no evidence to suggest that canyon cutting continues today although active retrogressive headwall erosion has occurred since the last glacial maximum. Sediment infilling is observed on selected upper slope channels while mass wasting processes (gullying and landsliding) on the lower canyon's walls are contributing to sediment deposition at the lower canyon slope and floor. The data revealed a sea-bed composition of predominantly gravel and gravelly sediments in water depths <500m, with muddy sediments dominating in water depths of >500m. Boulders and bedrock were only observed to crop out on the canyons flanks and floors.

The interpretation of the sea-bed composition and determining past and present sea-bed processes provided a framework on which the biological analysis could be based. Thirteen biotopes were described from the canyons, and of these six are proposed as new EUNIS (European Nature Information System) habitat types. Bedrock supporting reef-like fauna was observed in all canyons. Biogenic reef, reef rubble and bedrock reef were all observed within the area of study although stony reef was not observed. Cold water coral (*Lophelia pertusa*) reef was observed at the seaward entrance to, and within Explorer Canyon associated with areas of sediment covered and exposed bedrock on the canyon flanks. In addition, areas of reef rubble were observed on the sea floor in the vicinity of intact reef within the canyon but more commonly on the interfluves of Dangaard Canyon.

Predicting distribution 1 reef habitat from the SW Canyons UK (page 2)



the of Annex – Results MESH survey,

Figure 1. Multibeam data collected as part of MESH survey 01-07-01.

Data presented were acquired during a collaborative survey involving the Joint Nature Conservation Committee, the Marine Institute, the British Geological Survey and the University of Plymouth. Defra Natural Environment Group Science Division (CRO 361) made a significant financial contribution to this work. This work contributes to the MESH project (www.searchmesh.net) that receives European Regional Development Funding through the INTERREG IIIb Community Initiative (www.nweurope.org).

A Web-Based GIS For Assisting Public Outreach, Regulatory and Management Processes In The Sustainable Development of Marine Aggregate Resources

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This paper describes an advanced web based Geographic Information System (GIS) that has been developed as part of the Irish Sea Marine Aggregates Initiative (IMAGIN). This prototype Decision Support System (DSS) has been designed to facilitate access to spatial information that will be required to facilitate key outreach, regulatory and marine spatial management processes. It also serves as a highly accessible means to publicly promote and disseminate the scientific findings of the project by means of an intuitive but sophisticated user interface. By providing appropriate public access and supporting decision making processes associated with the sustainable development of marine aggregates, including strategic environmental assessments, (SEA, EIA), Risk Assessment (RA) and also in the wider context of Marine Spatial Planning (MSP), the system enables a comprehensive and more holistic view of a complex marine environment. It also promotes transparent and flexible access to integrated geological and biological data, derived data products such as facies, habitat and fishery maps, and comprehensive metadata. This paper presents an initial overview of the IMAGIN project as a thematic context for the subsequent sections in which key features of the survey data types; the database and design and function of the web based GIS are described. We conclude that our approach based on adherence to international quality standards, robust open source functional elements assembled in a modular architecture provides an appropriate, sound, and highly flexible technical foundation for a tool that can support public access, dissemination and future decision making processes in the development of this important marine resource.

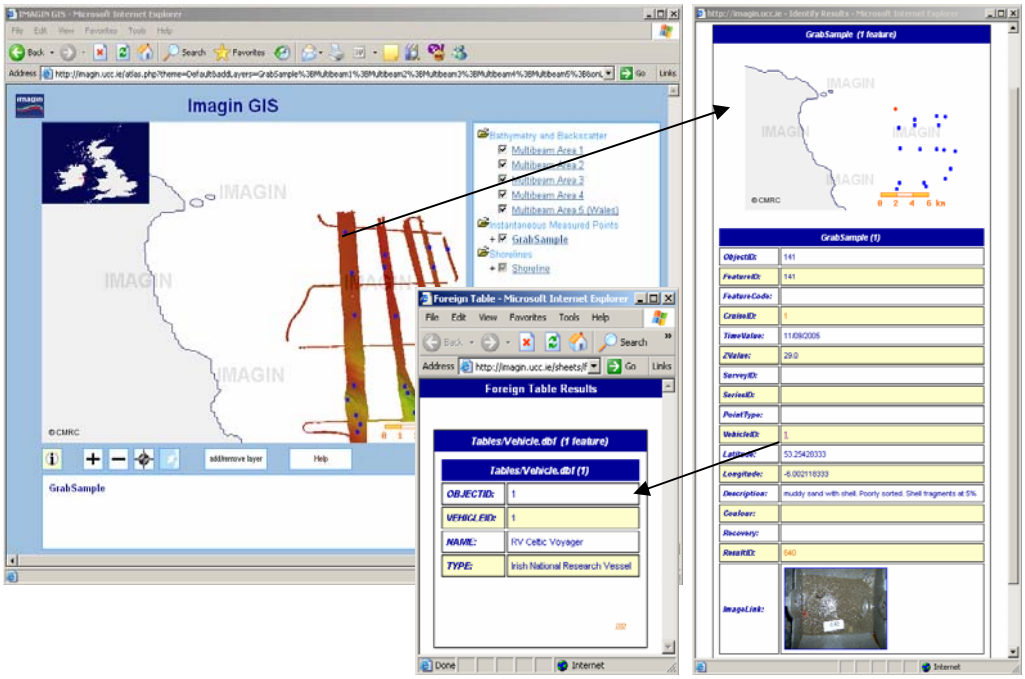

Figure 1. IMAGIN Prototype Decision Support System's Graphical User Interface

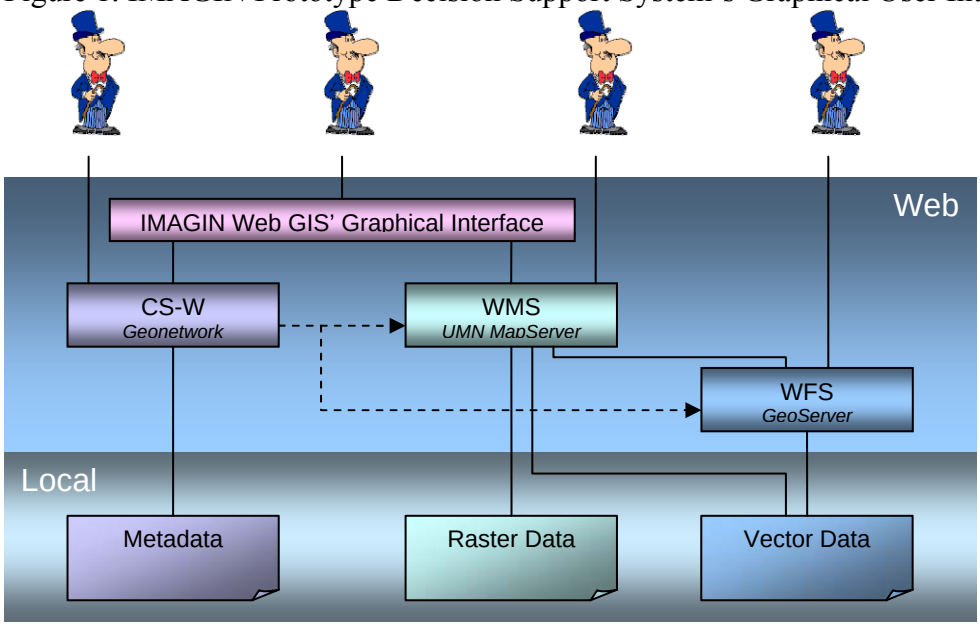

Figure 2. IMAGIN Web DSS Architecture: An OGC service-oriented Architecture that uses the OGC Web Feature Service (WFS) for delivering vector data, the OGC Catalogue Service for the Web (CS-W) for delivering metadata, and the OGC Web Map Service (WMS) for delivering image maps

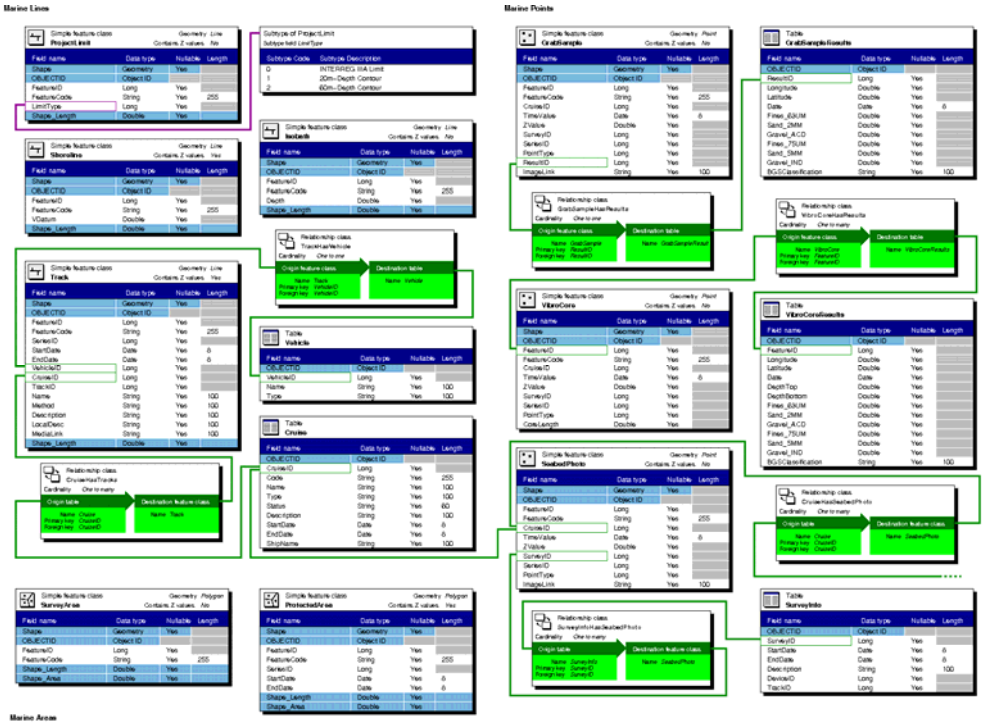

Figure 3. IMAGIN Data Model based on Arc Marine

Seascapes – a framework for nature type classification in the Lofoten-Barents Sea region, Arctic Norway

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Identification and documentation of vulnerable nature types is a primary objective for the multidisciplinary MAREANO program, in order to support the overarching goal of mapping and monitoring of the biological diversity. We are currently testing the application of the seascapes as a framework for the nature type classification in the Lofoten-Barents Sea region, Arctic Norway. This is based partly on the experiences from USA and Canada, from the European EUNIS system, the MESH and BALANCE projects, and on a new nature type classification scheme currently being developed.

The terms "seascape" or "marine landscapes" have been used in different meanings, but commonly indicates focus on the fundamental environmental conditions that influence ecological patterns and processes. The scale may vary, but commonly implies a regional rather than local scale. In some schemes, the term "landscape" is at a hierarchical level above that of nature types or habitats.

The Lofoten-Barents Sea region is part of a passive margin, highly diverse in terms of physiographic settings, and with continental shelf, continental slope and abyssal plains as the main elements. The water depths range from less than 100 water depth at the banks, to in excess of 2500 meters at the abyssal plains.
The shelf/slope/abyssal plain configuration is rooted in the Caledonian Orogeny more than 400 million years ago, with late Mesozoic extensional tectonics, Tertiary seafloor spreading and Quaternary glaciations giving rise to the present large scale morphology.

The shelf has water depths ranging from 50 to 400 meters. Both the morphology and seabed sediments bears witness of extensive glacial processes. The most common seabed sediment is moraine, locally overlain by thin traction current sediments or lag deposits. Iceberg ploughmarks In the southwestern part of the Barents Sea, the shelf is extremely narrow, down to 10 kilometers. In this area, broad banks are separated by narrow glacial troughs, hosting basins with finegrained sediments. On the banks, sand and gravel dominate, witnessing strong currents action.

The shelf edge is sharp, and in many places modified by submarine slumping. The current position of the edge is due to the extensive "bulldozing" by the ice sheets during the last glaciations. The continental slope extends from c. 400 meters to c. 2200 meters. Submarine slides are found extensively on the slope. In some places, the backwall of slides form a characteristic stair-like morphology One large, and several smaller canyons also occur along the slope, in the southwestern part of the Barents Sea. Further north, extensive submarine fans are found on the slope.

The high geodiversity in the Lofoten-Barents Sea region with its wide range of seascapes and associated nature types supports a high biodiversity. A better understanding of the links between seascapes, nature types and ecosystems is in progress, and will underpin the efforts to provide knowledge based decision support for ecosystem based ocean management.

Sea scallop habitat in the Gulf of Maine

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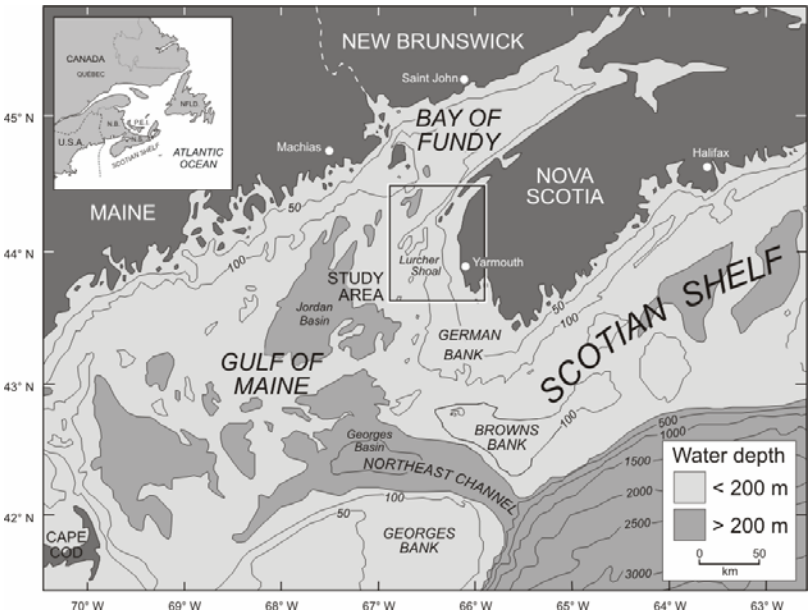
The sea scallop (*Placopecten magellanicus*) population in the Gulf of Maine off southwest Nova Scotia, Canada, supports a multimillion dollar commercial fishery. This resource is managed by the Government of Canada in cooperation with fishing groups. An interdisciplinary study is ongoing to improve the understanding of sea scallop habitat–specifically the relationship between sea scallop distribution, oceanographic conditions, sea floor geomorphology and surficial geology. The study results will be used to improve sea scallop management in the Gulf of Maine and to reduce the impact of scallop fishing on other important commercial species, like American lobster (*Homarus americanus*), and on seabed habitats.

In the study area of Lurcher Shoal (see map below), the population of sea scallops has been traditionally assessed as one stock. However, the 1996-2007 spatial distribution of commercial sea scallop catch rates, and distribution of survey catches of commercial size animals and recruits, suggests the presence of an inshore population (within 30 km of shore) and an offshore population. The two populations may be associated with the oceanographic regime across the shoal or different characteristics of the sea floor. Recently-acquired single-beam sonar bathymetric data in the Gulf of Maine indicate that the sea floor geomorphology associated with the inshore sea scallop population is relatively smooth. For the offshore population, the sea floor topography is irregular (on the scale of hundreds of metres to a kilometre). Future sea floor investigations of the sea scallop habitat study will encompass geophysical and geological grountruthing integrated with towed-video observations of scallop habitat. These large-scale observations will be extrapolated to underpin a regional habitat map of the Gulf of Maine.



Modeling rockfish distributions using hydroacoustics and high resolution bathymetry

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Advances in multibeam hydroacoustics have allowed mapping of the marine bottom terrain with increasingly high resolution. At the same time advances in fisheries acoustics have made it possible to plot individual fish in three dimensional space. When a fish species has an affinity for certain bottom structures, the high resolution bathymetry can be used to predict where fish will be located and then these predictions can be used to more efficiently plan hydroacoustic surveys.

Our study took place in the Shumagin Islands in the western Gulf of Alaska. This area is prime habitat for black rockfish, *Sebastes melanops*, which is a semi-pelagic, schooling species known to be associated with rocky outcroppings and pinnacles. They present a good acoustic target and in their typical loose aggregates, individual fish can be relatively easily distinguished. The NOAA Pacific Hydrographic Branch has surveyed the Shumagin Islands in recent years using multibeam and lidar equipment and so it was possible to acquire high resolution bathymetry at nominal cost.

The author, in collaboration with the Alaska Department of Fish and Game, used a Biosonics DTX split-beam echosounder (reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA) to conduct 3 acoustic surveys in an area, Mountain Point, where black rockfish were known to occur and where bathymetry was available. Parallel transects were run with a spacing of 50 meters. The Biosonics files were processed using Sonardata Echoview software's fish tracking module. The bathymetry was analyzed using the Benthic Terrain Modeler (BTM) tools for ArcGIS 9.1. Values were calculated for slope, roughness, and position relative to the surrounding terrain (e.g. ridges, pinnacles, shallow depressions). The position characteristic is known as a bathymetric position index (BPI) which has positive values when a location has a higher elevation than its surroundings. Locations with values greater than one positive standard deviation from the mean were identified and the distances from these locations needed to include all black rockfish from each survey replicate were determined. While there was broad overlap in the locations with strong positive values for slope, roughness, and BPI, they did not totally overlap and different distances were needed to include all the black rockfish for each of the bottom terrain characteristics.

We then evaluated these bathymetry/fish associations in 3 other areas where we had information that black rockfish occurred, as well as in a large area where we had no information. The model of fish locations was highly successful in predicting where black rockfish would be located.

Predictive modeling of coral and sponge distribution in the central Aleutian Islands

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Logistic regression models were used to predict the probability of presence/absence for deep-sea corals and sponges in the central Aleutian Islands from 50 to 3000 m depth. Explanatory variables included depth, slope, and rugosity. Models were evaluated based on a cross validation procedure. Models of occurrence north of the Aleutian chain were more successful than models for areas to the south of the chain. Model success was related to prevalence of the taxonomic group. Based on the predictive model, there are large swaths of sea floor below 200 m with potential coral garden habitat (highly diverse coral and sponge communities), particularly north of the Aleutian Islands arc and in Amchitka Pass.

Attention Students

GeoHab would like to begin a tradition of funding one or two students per year to attend GeoHab. This scholarship would cover airfare, lodging and registration for GeoHab 2009.

Our hope is to extend this opportunity with preference to any student in attendance at GeoHab 2008 in Sitka. Students who were not in attendance at GeoHab 2008 are also encouraged to apply. In order to be considered you must be prepared to present your work either in poster form or as an oral presentation at the next meeting, GeoHab 2009, to be held in Bergen, Norway.

If you are interested in applying for this scholarship please fill out an application. An application form follows. Applications can also be obtained from the GeoHab website http://geohab.org/ or here at the meeting, just ask Cleo Brylinsky for more information.

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Please send this form and any attachments to: Cleo Brylinsky by February 28, 2009 to be considered for this scholarship. Thanks and Good Luck!

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