Application of multibeam sonar technology for benthic habitat mapping in Newfoundland and Labrador

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In this paper we describe an approach to benthic habitat mapping by supervised classification of multibeam sonar-derived data, with examples from coastal Labrador. Benthic habitat is a combination of seabed substrate and its associated biotic components. In our habitat mapping approach we assume that substrate controls the distribution of benthic biota, a relationship which has been established for nearshore and continental shelf environments elsewhere, and that substrate can be accurately mapped using acoustic seabed data acquired from multibeam sonar surveys. Multibeam data comprise both bathymetric and backscatter intensity values; the former provides information on water depth, slope angle, and general basin physiography, while the latter largely depends on seabed properties, such as texture and roughness and the occurrence of structure-forming biota. Multibeam data are ground-truthed using drop-video camera transects and benthic grab samples, with both video and grab sample data for each ground-truth point.

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Once multibeam sonar and ground-truth data have been acquired and processed, our classification procedure involves the following steps: (1) identify unique substrate classes from grab-samples and video images; (2) use Exploratory Data Analysis (EDA) to examine the distribution of multibeam sonar-derived depth, slope and backscatter values for sampled stations in each substrate class; (3) from the EDA results, generate supervised classification rules for substrate mapping of multibeam coverage; (4) define habitats by determining which substrate classes have statistically unique biological assemblages; (5) establish statistically determined characteristic taxa for each habitat class; and (6) use a Geographic Information System (GIS) to execute the classification rules for each pixel in the gridded multibeam dataset and run accuracy and ambiguity tests on the mapped substrate and habitat classes. Accuracy maps are based on ground-truth data withheld from the initial classification procedure, while ambiguity maps determine the extent to which pixels were assigned multiple classes and the class associations. Parts of this procedure have been automated in a software tool developed as an extension to ArcGIS 9.2 to allow faster production of the substrate maps and the assessment of their accuracy.

Two case studies illustrate our mapping approach and highlight a range of applications in varied coastal settings. Nunatsiavut Nuluak is a research network that addresses Inuit concerns about the effects of climate change, modernization ,and contaminants on fiord-based marine ecosystems in northern Labrador. Our marine mapping component involved a baseline inventory and comparative assessment of benthic habitats in Nachvak and Saglek fiords; the former represents a pristine ecosystem adjacent to the Torngat Mountains National Park, whereas the latter has been exposed to a historical source of PCB contamination. Gilbert Bay is a Marine Protected Area (MPA) in southeastern Labrador, designated to protect a genetically unique population of Atlantic cod. The ecosystem-based management plan for the MPA requires information on benthic habitats for cod and other species to make scientifically defensible management decisions and establish monitoring protocols.

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