Single Beam Acoustic Seabed Classification in Coral Reef Environments

Background

Coral reef habitats that cannot be mapped with optical techniques are both extensive and ecologically important. For example, over 55% of the Florida Keys National Marine Sanctuary (about 1540 square nautical miles) has not been mapped due to water depth or clarity limitations.

Acoustic mapping systems are the natural solution to mapping optically deep water, and inexpensive commercial single beam seabed mapping systems are available. Several studies have used commercial single beam systems to map coral reefs, but basic questions about what substrates can be reliably distinguished and how consistent classification schemes are in different areas have not been systematically explored. With funding from the Office of Naval Research and NOAA’s Coral Reef Task force, we have used one commercial system, the Quester Tangent Series V (QTCV) to begin answering such questions.

QTCV datasets from the Florida Keys, USA, the Bahamas, and Navassa Island reveal that rock and sediment are almost always reliably distinguished and that sediment grain size and high seabed relief are other factors captured by classification results.

Application: Stratifying Fish Census Effort

Navassa Island is the only portion of the Caribbean Islands National Wildlife Refuge that includes jurisdiction over marine habitats. A statistically rigorous census of organisms such as corals, fishes, conch, and lobster was not possible on early expeditions to Navassa because no map of the benthic habitats existed. Single beam acoustic data acquired in 2004 provided the basis for a habitat map of the shelf for depths between 15 and 60 m (Fig. 1).

The benthic habitat map produced from this survey is now being used by the Caribbean Fishery Management Council to assess Essential Fish Habitat in the development of the legally mandated Fishery Management Plan for Navassa.
Application: Reef Fish Spawning Aggregations

Fish spawning aggregations (FSAs) are a vital part of the life cycle of many reef fishes. In many cases, however, a lack of knowledge of the location of FSAs prohibits protection and effective management of these sites. In January 1998, for example, an aggregation of over 100 black groupers (*Mycteroperca bonaci*) was documented less than 100 m seaward of a no-take reserve that had been established just 6 months earlier around Carysfort Reef, in the Florida Keys, USA. The proximity of this aggregation to the protected area was particularly unfortunate because even though fishing pressure is eliminated within no-take reserves, fishing intensity is often concentrated along no-take reserve borders.

The objective of this study was to determine if reef fish spawning aggregation (FSA) sites in the upper Florida Keys were characterized by similar geomorphology. The QTCV was used to map known historical FSA sites. Results showed that drowned, margin-parallel, rocky ridges, known locally as outlier reefs, were found in proximity to all the mapped FSA sites. In particular, three conditions related to the specific configuration of these outlier reefs were observed to create a "signature" of the geomorphological features likely to attract FSAs in the upper Keys.

From a management perspective, the results of these surveys indicate the potential benefit of employing single beam acoustics for reconnaissance in deep water when considering the placement of protected areas.

From a research perspective, the results of these surveys suggest that drowned shelf-edge reef habitat should be considered as potentially viable for attracting FSAs.

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**Figure 2:** Acoustic survey at Carysfort Reef, FL, USA. Left: The QTCV equipment is portable and easily mounted on almost any vessel. Here it was used on a 25 foot NOAA outboard. The equipment consists of an echosounder, an amplifier and computer to record data (purple box) and a transducer, here mounted on a pole with a GPS antenna (yellow box). Center: Track lines at Carysfort reef extended from 5 m to 30 m depths at 100 m spacing and 5 m to 60 m depths at 400 m spacing along 6 km of the shelf margin. Here the track lines are displayed over an IKONOS satellite image. Right: Oblique 3-D view of the bathymetry with classified track lines draped on top. The black grouper aggregation occurred along a steep part of the shelf edge, inshore of three drowned reefs at 30, 36, and 50 m. The SPA border is the boundary of the no-take protected area.

**References:**
See [http://www.rsmas.miami.edu/personal/agleason/results_acoustic.html](http://www.rsmas.miami.edu/personal/agleason/results_acoustic.html) for additional references and PDF files.