Habitat characterization for deep-sea coral reef communities in Roatán, Honduras

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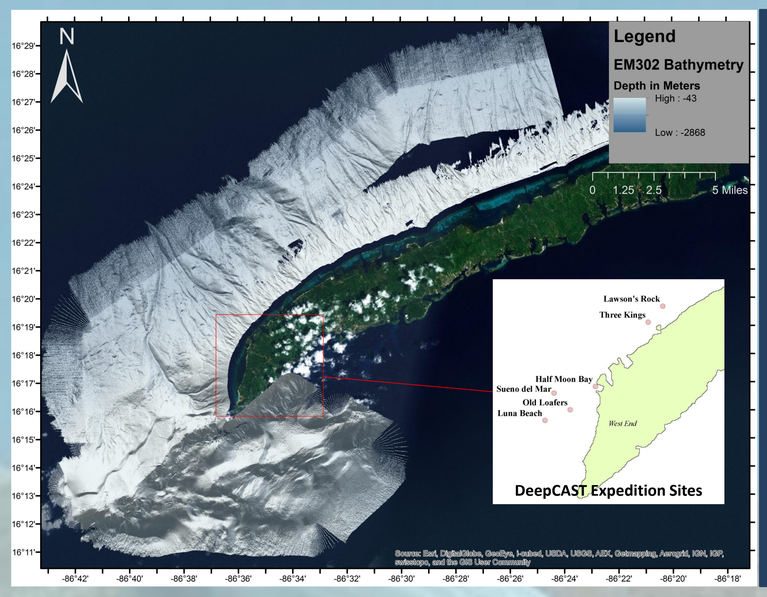
ABSTRACT:

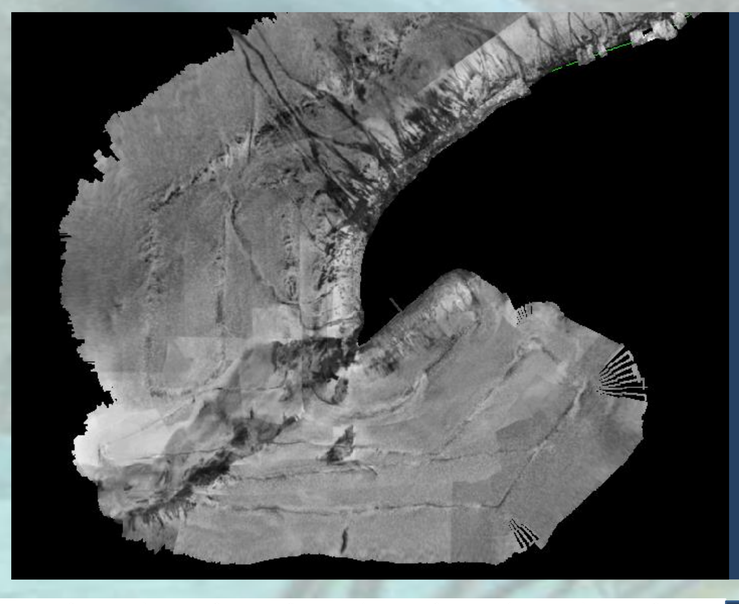
Roatán, Honduras is located along the southern end of the Meso-American Reef. The biodiversity of deep-sea coral communities and their association with hard bottom has been documented. However, the deep-sea ecosystem remains poorly explored. In July of 2013, the R/V *Falkor* mapped much of Roatán's coastline using Kongsberg EM302 and EM710 multibeam echosounders. These data were processed in CARIS HIPS/SIPS to generate 10 meter resolution bathymetry and QPS-Fledermaus to generate backscatter for habitat characterization. Once processed, the surfaces were imported into ArcGIS to examine several key habitat features, including slope and substrate character.

The data revealed a series of canyon and spur and groove features along a 25 km distance on the steep north face of the island. Deep-sea habitats (<200 meters depth) were found to occur within one kilometer of the shoreline. These basaltic slopes transition to more gradual slopes from northeast to southwest. Most notably, the geomorphology suggests considerable hard bottom habitat for deep-sea corals and sponges adjacent to, but outside, the existing Sandy Bay-West End Marine Protected Area. This unsupervised habitat characterization will be ground-truthed using ROV and submersible video in 2014 to further understand and conserve Roatán's deep-sea coral communities.



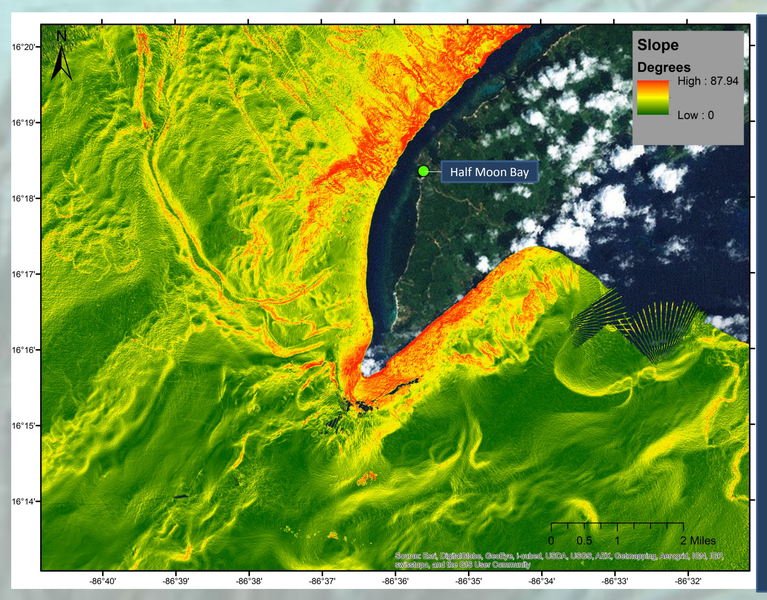
BATHYMETRY:

There is a steep fore-reef which extends without major interruption down to approximately 3000 meters depth. The continental margin is characterized by a series of ridges that run along the northern face of the island. James and Ginsberg (1979) theorize that the breaks in the slope are tectonic in origin and represent the raised fault blocks (horsts) bounded by depressed blocks (grabens). Of interest, Roatán is adjacent to the Maya Mountains of Belize and Guatemala, and in line with an oceanic transform boundary of the Caribbean tectonic plate.



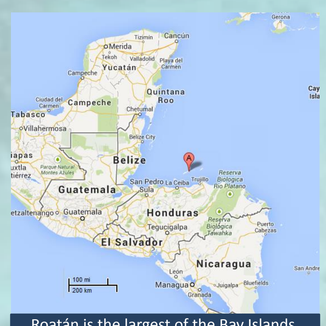
BACKSCATTER:

This map is an unsupervised statistical classification of backscatter intensity (in decibels). As a result, many objective classification algorithms cannot produce reliable results without ground-truthed calibration values. Thus, this study will employ a tertile (three class) classification in order to clearly distinguish between high intensity (rocky surface, i.e. basalt), low intensity (soft sediment, i.e. sand), and intermediate intensity returns (gravel, mud, coral rubble, etc.). This continuous backscatter map clearly distinguishes the crests of the rocky ridges extending from the fore-reef, and also indicates potential rocky habitat off the western coast.

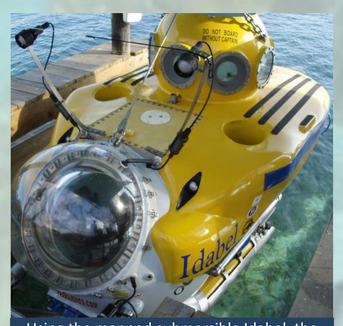


SLOPE:

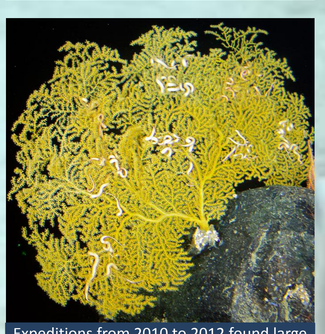
Although bathymetry and backscatter represent primary data layers collected directly by the Kongsberg multibeam echosounders, secondary data layers may also shed light on the habitat. Slope, aspect, curvature (slope of slope), rugosity (ratio of surface area to planar area) all may be derived from bathymetry. This slope map clearly shows the brow and steep wall (reaching nearly 90 degree slopes in some regions) of the proximal fore-reef , with the slope tapering off with distance from the coast. In the northern portion of the map, the steep slopes of ridges are visible, as well as flat surfaces in Roatán's southern coastal fore-slope.



Roatán is the largest of the Bay Islands, located off the coast of Honduras, and within the Meso-American Barrier Reef.

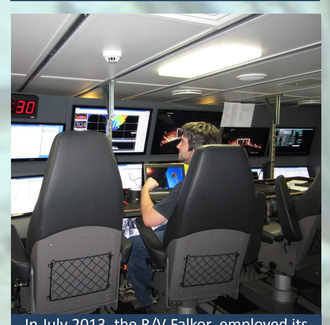


Using the manned submersible Idabel, the DeepCAST expeditions set out to document Roatan's deep-sea coral diversity.



Expeditions from 2010 to 2012 found large sea fans, including this Paramuricea, as well as Lophelia and others.

However, these expeditions also discovered anthropogenic impacts including trash and rusting metal debris.



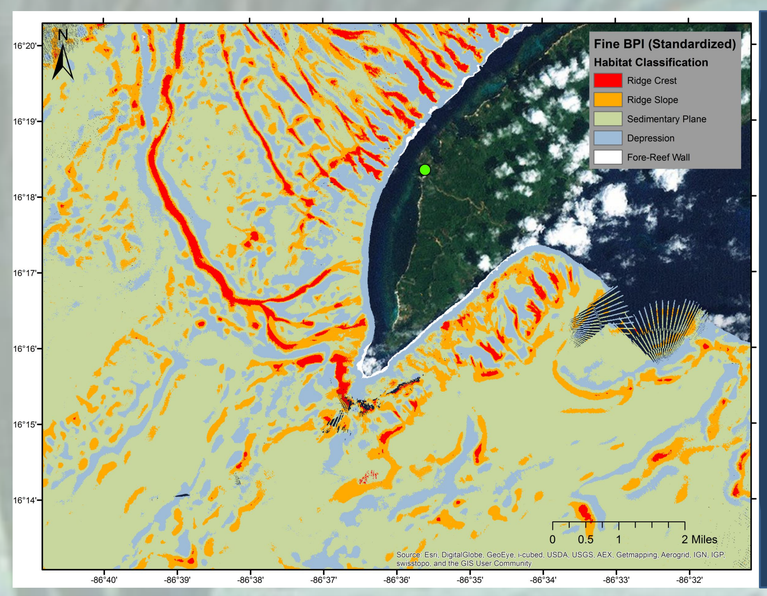
In July 2013, the R/V Falkor employed its Kongsberg EM302 and EM710 MBES to map roughly 650 km^2 of coastal seafloor.

This research seeks to create geomorphic characterization of Roatán's seafloor for later use in a predictive habitat model.

METHODS:

Multibeam bathymetry was collected via the R/V Falkor's Kongsberg EM302 and EM710 multibeam echosounders and processed using CARIS HIPS and SIPS generate cleaned 10m resolution CUBE bathymetry surfaces. The raw lines were also processed using QPS FMGT to produce 10m resolution backscatter surfaces.

Bathymetry and backscatter surfaces were imported into ESRI ArcGIS 10.1 and analyzed using a combination of ArcGIS Spatial Analyst and the Benthic Terrain Modeler toolbox (Wright et al. 2013). The model was run to generate layers for slope, aspect, bathymetric position index (BPI).



BATHYMETRIC POSITION INDEX:

Bathymetric Position Index (BPI) compares the depth and slope values of a single point against the depth and slope values of neighboring points within a grid. A quintile-based classification is presented here, with corals expected to be found along the fore-reef wall, and on ridge crests and slopes.

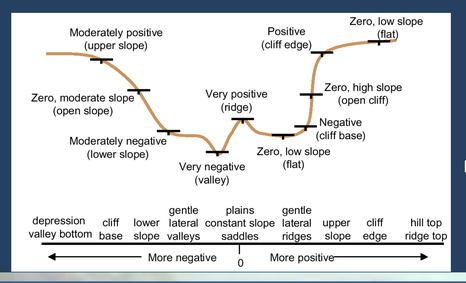


Figure from Wright 2001.

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