The South Texas Banks (STBs) are a rare hard bottom feature of the Gulf of Mexico (GOM) colonized by a community of deep water corals whose multi-species, high-density assemblages provide structurally complex habitat and significant ecosystem services. The depth of the banks, a persistent nepheloid layer, and strong currents have hindered efforts to collect quantitative data on what inhabits the rocky outcrops and relic coralgal reefs. The STBs were under consideration as a candidate for Marine Protected Area (MPA) status in 2008, but there was not enough information available to support this conservation action. Using a remotely operated vehicle, video data from 5 banks were collected in order to characterize the benthic communities. Community structure analyses show significant differences in benthic community composition between the two southern and the three northern banks surveyed. Also, by correlating the benthic communities’ data with terrain patterns from multibeam sonar images, a habitat suitability model was created to predict the probability of presence of important coral species. This work significantly reduces the cost, time and effort in characterizing the banks, which is key to ensuring that these habitats are protected. The ability to create habitat suitability maps and discern biodiversity of the South Texas Banks from multibeam SONAR images will aid future marine protection efforts in the Northwestern GOM.