Preliminary Seabed Mapping of Oyster Bay, NY for the Potential Impacts of Hydraulic Shellfish Dredging

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Hydraulic shellfish dredging (HSD) is a controversial method of shellfishing that has been used to fish for *Mercenaria mercenaria* in Oyster Bay Harbor (OBH), NY on the north shore of Long Island, NY, for at least the past thirty years on seabed leased from the Town of Oyster Bay. Using HSD in OBH has engendered much public discussion about the sustainability of the fishery, and one question is whether fine sediments suspended when the dredge is being used are being transported and deposited outside the leased area. The thirty-year lease expires in 2024 and new information is needed by stakeholders as the future of the fishery is being discussed. NY State Senator James Gaughran provided funding for a study of the seabed of OBH and the adjacent Cold Spring Harbor to inform stakeholders of the effects of HSD, the state of the seabed, and how that informs shellfish management practices. A detailed study of the seabed in OBH was undertaken using multibeam sonar techniques during June and July of 2022 to provide some of the needed detailed information on the seabed so that the fishery can be properly managed. In addition to characterizing the modern seafloor, the 2022 results can be compared to a similar data set collected by SoMAS in 2004 and a bathymetry survey done by NOAA in 1990.

An acoustic multifrequency (200/300/400 kHz) multibeam sonar was employed in a survey aboard the R/V Pritchard to measure the bathymetry and acoustic backscatter of the seabed. Forty-nine sediment grab samples and four short cores were taken to ground truth backscatter and inform of depositional processes. The bathymetry and acoustic backscatter were visualized during the survey using Kongsberg Seafloor Information System 5 and reprocessed for mapping using UNB Swath Ed programs. The backscatter, bathymetry, and sediment samples were mapped in ESRI ArcGIS Pro. The survey effort resulted in nearly 100% of the seabed in OBH being imaged, about 12 km^2.

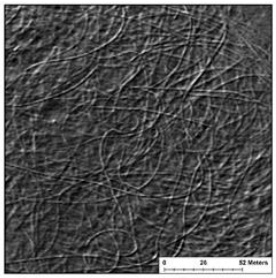
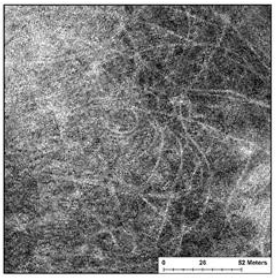
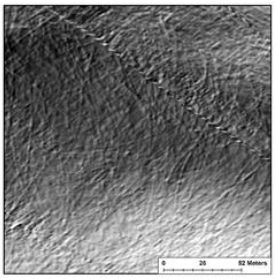
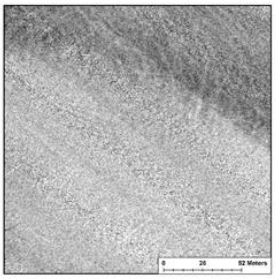
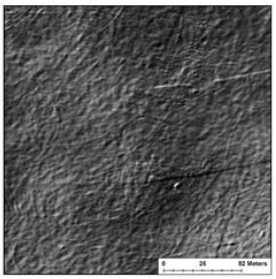
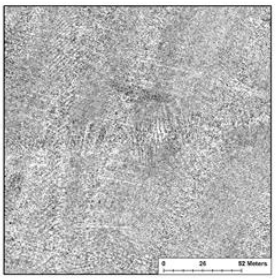
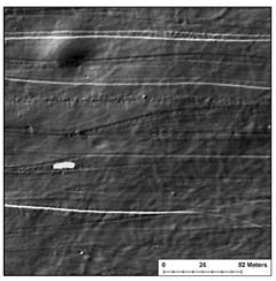
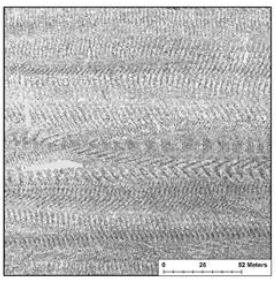
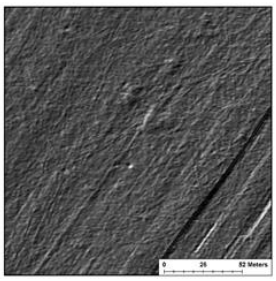
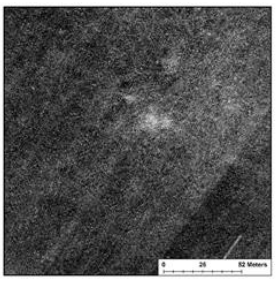
The HSD technique creates distinct grooves in the seabed; these grooves were found throughout the leased seabed. Shellfish in different parts of OBH are harvested in different years since clams that are about three years old bring the highest market price. Also, sediment transport processes and biological activity are expected to smooth the grooves over time although the time scale of the smoothing is not known. The acoustic data allows for the classification of the apparent freshness of dredge tracks (Table 1) in different parts of OBH and the apparent freshness appears to change with time since dredging, the dredging method used, the sediment properties, and the current strength. The multiple controls on apparent freshness can be demonstrated. For example, in an area of recent dredging where there is sandy/gravely sediment and strong tidal currents, one set of dredge tracks does not appear very fresh and instead appears smoothed.

Of the 49 grab samples, 37 had clay/silt-dominant matrices, 12 had sand-dominant matrices, and 29 contained shellfish, shells, shell fragments, or shell hash. Samples with finer sediment and

less shell appear to be more commonly found in areas of low backscatter while areas with coarser sediment and more shell appear to be more commonly found in areas of high backscatter. The area of low backscatter appears to have grown in extent between the multibeam survey in 2004 and the multibeam survey in 2022 suggesting that the area of fine-grained sediment in OBH has grown in the last two decades. However, a detailed comparison between samples collected in 2004 by Cerrato and Holt (2008) and the 2022 samples has not yet been done.

The grain size distribution of the 2004 grab samples will be more accurately determined using wet sieving, a settling column, and a Mastersizer 2000 for the gravel, sand, and clay/silt fractions. Grain size parameters will be correlated by multiple regression to absolute backscatter intensity (dB) at the three different frequencies for ground truthing. These parameters will include mean and median grain size, coarse sediment and shell fraction, and sorting. Seabed features like bedforms, bioturbation, and vegetation will be mapped in ArcGIS Pro if visible in the backscatter and bathymetry because they can alter backscatter intensity too.

Table 1. Categorization of dredge track by freshness, or as linear depressions produced by clam raking.

Bathymetry (Hillshade)	Backscatter	Category and Description
		**Fresh:** Over ~0.3 m deep Tightly packed and overlapping Clearly visible in both backscatter and hillshade
		**Less Fresh:** ~0.1 to 0.3 m deep Packed and overlapping Visible in both backscatter and hillshade
		**Not Fresh:** Less than ~0.1 m deep Packed or spaced Hardly visible in backscatter and visible in hillshade
		**Nearly Filled:** Less than ~0.1 m deep Spaced or alone Invisible in backscatter and hardly visible in hillshade
		**Linear Depressions:** Less than ~0.3 m deep Narrower, straighter, and shorter than dredge tracks Outside the FMF leased seabed

References

Cerrato, R.M., and Holt, L., 2008, North Shore Bays Benthic Mapping, Groundtruth Studies: final report to NY Department of Environmental Conservation MRSC Special Report 135, 184 p.