Side-Scan Sonar Study of Port Jefferson Harbor, Long Island, New York

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INTRODUCTION

A side-scan sonar survey was undertaken in Port Jefferson Harbor to help understand bottom morphology in this productive shell fish area. The bottom sonar image also provides some insights into sediment transport pathways within the harbor. Bottom morphology is surprisingly complex in this harbor as a result of past sand mining activity.

METHODS

A Klein 595 dual-frequency side-scan sonar (operating at 100 kHz and 500 kHz) was used to map bottom morphology in the harbor. The side-scan sonar data was tape recorded on an 8-channel analog tape recorder for subsequent processing, and the survey vessel was navigated to ca. 1 meter using a microwave navigation system. Water depth was also recorded along track for most of the survey. Side-scan sonar data were collected for all of the northern portion of the harbor, but for less than half of the southern part of the harbor. Our studies focused on the northern portion because that is where most of the shell fishing occurs. Surveying in the southern portion of the harbor was also limited by the presence of many moorings and time constraints.

The side-scan sonar data were replayed in the lab and digitized by computer, and the digitized sonar records were processed to created a mosaic of the 100 kHz sonar data allowing bottom morphology to be visualized for much of the harbor. Sonar processing included decimation through median filter and shading corrections. No slant-range correction was applied to the data because of the extremely rugged bottom topography and/or shallow depth in most of the study area. The sonar mosaic was printed at a large scale and compared with the charted bathymetry of Port Jefferson Harbor. While only the 100 kHz sonar data was used to create the sonar mosaic, both the 100 kHz and 500 kHz sonar data were studied in interpreting the sonar data (Figure 1). The primary sonar data set, collected in August, 1992, was supplemented by a single side-scan sonar record collected in August, 1989.

BOTTOM MORPHOLOGY

A number of distinctive zones can be delineated in Port Jefferson Harbor on the basis of side-scan sonar patterns and reflectivity. These zones represent variations in sediment type and morphology.

The most striking feature on the side-scan sonar records is an irregular system of pits and ridges that is best developed in the northern part of the harbor. The pits are up to about 10 m deep, and sediments in the bottoms of the pits are weakly reflective at both 100 kHz and 500 kHz while the tops of the ridges have water depths of only 2 to 3 m and are very reflective at both sonar frequencies. We interpret the weakly reflective sediments in the pits to be fine-grained sediments and the very reflective sediments on the ridges to be coarse. These pits and ridges were apparently formed during sand-mining activities which took place in the harbor up through the 1940s.

A similar, pit-like pattern exists on side-scan sonar records from several areas in the northern portion of the harbor: an irregular network of higher-reflectivity on a background of lower reflectivity. However, the bed in these areas is somewhat flatter. This somewhat modified pit pattern also appears to have its origin in sand-mining activities, but the flatter floor suggests either smoothing by currents, more complete removal of dredged materials, or subsequent sediment deposition.

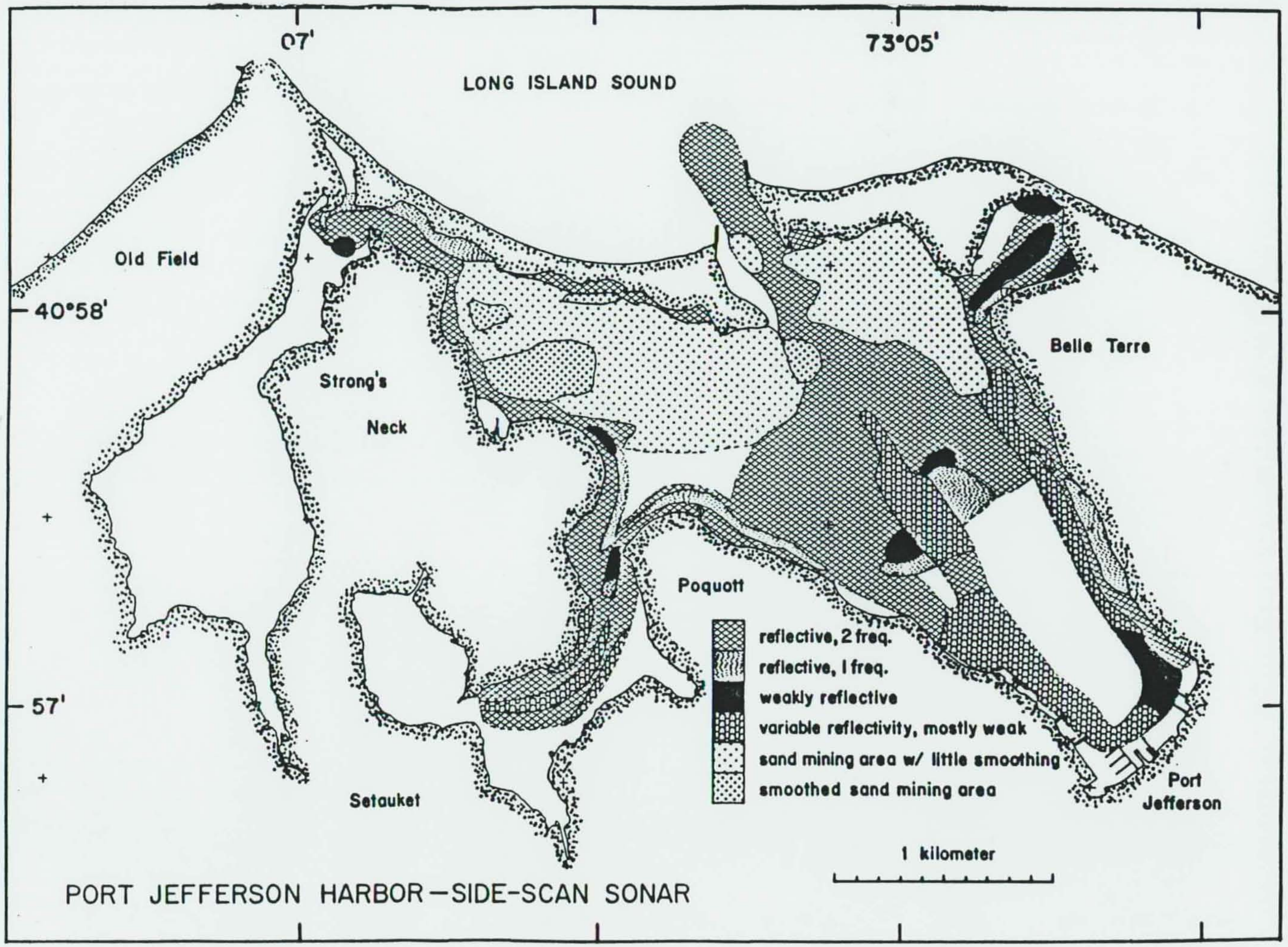
The pit-like pattern becomes progressively smoothed towards the south, and the pattern is not observed south of about latitude 40°57.5' N. The smoothing suggests active sediment movement or deposition in the area. The high reflectivity sediments in the entrance channel and the central portion of the harbor are sand-sized. Much of the southern part of the harbor is characterized by a smooth, low-reflectivity bed, although there are changes in the relative reflectivity of the 100 kHz and 500 kHz signals that may be related to sediment grain size. Sediments within this southern area are generally fine grained.

Naturally-created features within the harbor include lineations in the southern end of the dredged channel, probably furrows created by bottom current flow, a very reflective nearshore terrace on the southeastern side of the harbor that may be a wave-cut terrace, and a prominent sand ridge on the western side of the main channel. This prominent sand ridge, which is exposed at low tide, appears to be fed by sediments transported from the eroding bluffs of Strongs Neck to the west and of Poquott to the south.

CONCLUSIONS

A systematic side-scan sonar survey of Port Jefferson Harbor shows a complex bottom morphology much of the harbor that appears to be a remnant of past sand mining, and these pits may be filling as they trap fine-grained sediments. Sonar patterns in other parts of the harbor show the effects of sediment transport in smoothing the sea bed. The kind of detailed knowledge of the bed provided by this kind of study is essential to proper management of the coastal environment.

Figure 1: Summary of side-scan sonar records collected in Port Jefferson Harbor in August, 1992. The harbor bed has been classified based on the presence and character of pits related to sand mining and on the relative reflectivity of the bed at 100 kHz and 500 kHz. We expect that more reflective sediments are coarser and less reflective sediments are finer, and this interpretation is consistent with available sediment size data. The overall pattern is consistent with deposition of finer-grained sediments at the southern end of the harbor. The bed in the northern end of the harbor is dominated by pits created by sand mining, and some of the mined sea bed has been smoothed by sediment transport and/or more recent deposition.



samples was measured in the lab with the K-620A miniature permeameter. The measured value of hydraulic conductivity could then be used in the Hazen method equation to calculate a local value for the Hazen coefficient. This coefficient can then be used to calculate the hydraulic conductivity for other samples local to the measured sample site.

The additional time involved in measuring samples in the lab is will be balanced by the improved accuracy of hydraulic conductivity values derived through the Hazen equation. Further measurements of conductivity will be used to establish the range over which measured coefficients will remain reliable. Establishing a grid of coefficient values for Long Island will provide a basis for testing theories regarding the effect of hydrological behavior on the development of ecosystems.