Sea Level History and Environmental Change in a Long Island Salt Marsh

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The threat of an acceleration in the rate of sea level rise, due to global climate change, is a prominent geological problem confronting Long Island. Increased sea level rise may result in increased coastal flooding, shoreline erosion, property damage and ecosystem degredation. Despite recent scientific attention, there is an insufficient understanding of the potential magnitudes of these impacts. Far less understanding among the general public exists as to the correct engineering, political, and social responses to future sea level rise. The purpose of this study is to review recent research on sea level rise in the New York region and to present new data suggesting how sea level rise has affected two salt marsh ecosystems.

There is general agreement that the rate of relative sea level rise in the New York region approximates 2-3mm/yr over the last 150 years. The bulk of this data comes from tide gauges, of which the Battery record is among longest record in the country (about 150 years old). The two principal components of this trend are an eustatic increase in ocean volume and an isostatic adjustment of the North American plate after the last ice age (Gornitz et al. 2001, Gornitz 1995). Recent (150 yr.b.p.) sea level rise rates appear to exceed historic (2000 yr.b.p.) sea level rise rates in this region (Varekamp and Thomas 1998, Gornitz et al. 2001). Recent work has documented the destruction of south shore marshes, in a manner that is consistent with accelerated sea level rise. This work used aerial photography to document shrinking of marsh islands, widening of tidal creeks and flooding of marsh surface in Jamaica Bay (Hartig et al. 2002), and near Shinenecok inlet (Fallon and Mushacke 1996).

This study reports new data, using salt marsh foraminifera as paleoenvironmental indicators of marsh changes in the very recent past (eg to ~1850). Our methods are similar to those applied by Varekamp and Thomas (1992) and Scott and Medioli (1980). The method relies on the fact that a few species of agglutinated foraminifera live in distinct zones in salt marshes. This zonation is driven by primarily hydroperiod, the proportion of time a marsh spends exposed/flooded. The microbial community serves as a proxy for position relative to a tidal datum- *ie* sea level. Changes in the microbial community in a core are therefore a proxy for change in the position of the marsh surface relative to that tidal datum- *ergo* sea level changes.
We took surface samples at various marsh elevations and noted the foraminiferal community to calibrate our data. We took replicate core samples and measured water content, loss on ignition, excess ^{210}Pb, and foraminifera at 1-2 cm intervals. Foraminifera samples were preserved in alcohol, and then sieved to extract the 63-500um size fraction. A series of established rules governed the counting of foraminfera to ensure random sampling. The age of the marsh layer was estimated using a model that assumes a constant flux of a natural clock- ^{210}Pb (Bricker-Urso et al.1989). The position of each layer relative to sea level was calculated by means of a transfer

function. This function assumes that the elevation of the marsh surface at a point in history can be calculated from our knowledge of present day distributions, which are derived from our surface samples. By calculating the change in marsh elevation over time we can estimated sea level rise rates. Since our marshes are quite close to the Battery tide gauge, we can judge how accurately this method tracks sea level changes. The advantages, as well of the limitations of this method will be discussed.

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