

Alex Chuman
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A Sensitivity Analysis of Bristol Harbor: Circulation and Sediment Patterns

ABSTRACT:

Bristol Harbor, a small harbor located in Narragansett Bay, was examined to determine sediment characteristics, susceptibility to low dissolved oxygen, and sensitivity of circulation and flushing to atmospheric conditions. Sediment results indicated that the harbor has low carbon: nitrogen values, demonstrating marine origin of the organic matter. Sediment concentrations of a number of metals (Cr, Pb, Cu, Ni, and Zn) exceeded the NOAA Toxic Effect Range Low (ERL) guidelines, but were below Toxic Effects Range Median (ERM) levels. Both organic matter and metals were positively correlated with higher percentage of fine grained sediment. A survey of dissolved oxygen on August 29, 2008 showed the western margin of Bristol Harbor was hypoxic, but the eastern and southern sections of the harbor were not, suggesting that circulation may play a role in the location of hypoxia. Circulation patterns within the harbor are particularly sensitive to southwesterly wind events, as indicated by changes in the temperature, salinity, and velocity and direction of currents. During these events, net flow into the harbor occurs in the east followed by outflow in the west, and wind forcing overpowers any tidal forcing. The innermost harbor is also observed to be more static when facing heavy winds. These results are consistent with a previous modeling study (Rogers 2008), which indicated significant flushing of the harbor may only occur during these southwesterly winds events. Findings suggest that the combination of hypoxia and elevated metal concentrations in the sediment could result in toxic conditions for benthic organisms in the harbor, and retention of metals and hypoxia may increase if the circulation and flushing in the harbor are disrupted by development.