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Great South Bay beyond Sailors Haven Marina, Fire Island National Seashore

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Organic and Inorganic Nitrogen in Coastal Groundwater: A Potential Link to Great South Bay Brown Tides?

Coastal groundwater discharge (including submarine groundwater discharge) is often an important and even dominant pathway for nitrogen transport from land to sea. Sources for increasing nitrogen inputs to landscapes and estuaries of Long Island include 1) wastewater disposal; 2) fertilizer application to crops, lawns, and other turf; and 3) atmospheric deposition of nitrogen, due in part to combustion of fuels for electricity, transportation, home heating, and industry. Nitrogen typically controls the growth of algae in coastal waters, and thus increasing the rate of nitrogen supply to estuaries and bays, including Great South Bay, stimulates algal blooms. The resulting increase in production of algal organic matter, referred to as "eutrophication," leads to a host of changes in the ecosystem, including low dissolved oxygen conditions and changes in the assemblage of living organisms. Of particular concern in Great South Bay are harmful blooms, referred to as brown tides, of the algae *Aureococcus anophagefferens*. In past studies it has been shown that brown tide blooms are stimulated by inputs of only particular chemical forms of nitrogen (Taylor and others, 2006). Results suggest that nitrogen in the forms of ammonium and organic nitrogen stimulates brown tide blooms, while nitrogen occurring as nitrate stimulates other types of algal blooms. Thus, to manage nitrogen inputs and the ecology of Great South Bay, improved understanding is required of not only the sources and magnitudes of nitrogen inputs, but also of the controls on the chemical forms of nitrogen.

In Great South Bay, it has been estimated that about 65% of the freshwater discharge from Long Island occurs as coastal groundwater discharge, with the remainder occurring through river discharge (Monti and Scorca, 2003). In addition to fresh groundwater, coastal groundwater discharge commonly includes substantial quantities of saline and brackish groundwater, carrying nitrogen from marine sediment sources. To better understand the role of groundwater in eutrophication of the bay, we intensively sampled and analyzed groundwater along the bay shore of Patchogue. Results showed that nitrogen concentrations in fresh groundwater at the shoreline were closely related to human population density on the adjacent landscape, and were on average very high relative to concentrations we have measured at a range of sites along the U.S. east coast. Comparison to groundwater nitrogen concentrations in locations where wastewater inputs have been reduced by sewering suggests that sewering of the Great South Bay watershed would dramatically reduce groundwater nitrogen loading. Even in sewered watersheds, however, nitrogen loads carried by groundwater from densely populated landscapes are still quite high, due to continued inputs from fertilizer applications and atmospheric deposition. The nitrogen in both fresh and saline groundwater along the Patchogue shore was primarily in the form of ammonium and organic nitrogen, and was nearly devoid of nitrate. If the Patchogue site is representative of substantial portions of the Long Island Great South Bay coast, it may be that coastal groundwater discharge plays an important role in stimulating brown tides.