New Jersey's Shallow Coastal Estuaries: Water Quality and Other Environmental Conditions

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Mullica River-Great Bay (MR-GB) is a shallow coastal plain estuary that lies entirely within the boundaries of the Jacques Cousteau National Estuarine Research Reserve. Located approximately 15 km north of Atlantic City in southern New Jersey, MR-GB is one of the most pristine and least disturbed estuaries in the northeastern corridor of the United States. The estuarine system covers an area of 56 km^2, and the Mullica River drainage basin, an area of 1474 km^2. The Mullica River, with a mean depth of ~5 m, has a mean discharge rate of ~28 m^3s^{-1}. Great Bay has a roughly circular shape, being ~8 km long, 6 km wide, and 2.5 m deep at mean low water. Water exchange with the coastal ocean occurs through Little Egg Inlet. The concentrations and dynamics of major nutrients (i.e., dissolved inorganic and dissolved organic nitrogen and phosphorus) have been characterized in detailed studies conducted along a 42-km stretch of the estuary. These studies have shown that the upper estuary and mid-estuary serve as net sinks for the nutrients, whereas the lower estuary serves as a net source for nearshore ocean waters. YSI 6-series dataloggers are deployed at four permanent monitoring sites along the estuary at Lower Bank, Chestnut Neck, Buoy 139, and Buoy 126. These dataloggers have generated a long-term database on a series of water quality parameters (i.e., water temperature, salinity, pH, dissolved oxygen, turbidity, and depth) recorded at 15-minute intervals year-round. Meteorological parameters (i.e., air temperature, wind speed and direction, barometric pressure, relative humidity, precipitation, and photosynthetically active radiation) are measured at a permanent Campbell weather station site at the Richard Stockton College Marine Field Station. Aside from physicochemical data collected on the system over many years, numerous research projects have been conducted over the years on plankton, benthic communities, bottom sediments and habitats, as well as finfish and shellfish in the estuary.

The Barnegat Bay-Little Egg Harbor (BB-LEH) Estuary, in contrast to the MR-GB Estuary, is subject to multiple anthropogenic impacts from an expanding population in the adjoining coastal watershed. Eutrophication poses the most serious threat to the long-term health and function of the estuary, impacting essential habitats (e.g., seagrass and shellfish beds) as well as finfish nursery areas. Nutrient and organic carbon loading in this shallow, lagoon-type estuary has been linked to an array of cascading environmental problems such as increased micro- and macroalgal growth, harmful algal blooms (HABs), bacterial and viral pathogens, high turbidity, low dissolved oxygen values, altered benthic invertebrate communities, and impacted harvestable fisheries. The net insidious effect of progressive eutrophication is the permanent alteration of biotic communities in the system. The BB-LEH Estuary, including waters within the boundaries of the Jacques Cousteau National Estuarine Research Reserve, is classified as

a highly eutrophic system based on application of NOAA's National Estuarine Eutrophication Assessment Model and Nixon's Trophic Classification. Because it is shallow, poorly flushed, and bordered by highly developed watershed areas, the estuary is particularly susceptible to nutrient loading. Most of this load (~54%) derives from surface water inflow, but substantial fractions also originate from atmospheric deposition (~34%), and direct groundwater discharges (~12%). Other adverse effects on these bays include nonpoint source inputs of chemical contaminants, as well as the physical alteration of habitat due to bulkheading, diking and ditching, dredging, and lagoon construction. Power-plant (Oyster Creek Nuclear Generating Station), point-source impacts (i.e., biocidal releases, thermal discharges, impingement, and entrainment) increase mortality of estuarine and marine organisms in Barnegat Bay. Human activities in watershed areas, notably deforestation and infrastructure development, partition and disrupt habitats while also degrading water quality and altering biotic communities. Ongoing land development raises turbidity and siltation levels in tributaries of the estuary, creating benthic shading problems. Management actions, including the purchase of open space, improved stormwater controls, fertilizer controls, and smart development must be implemented as a holistic management approach to remediate some of the aforementioned insidious effects and restore vital estuary functions.