Eutrophication and Partial Recovery of a Shallow Embayment of the Tidal Potomac River

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Enhanced nutrient loading has resulted in widespread eutrophication of inland and coastal waterbodies. Shallow water macrophyte communities in many locations have been displaced by phytoplankton dominated systems. The tidal freshwater portion of the Potomac River received extensive loads of wastewater nutrients through much of the 20th century culminating in major blooms of cyanbacteria and almost total loss of submersed aquatic vegetation (SAV). Beginning in the late 1970's, loads of the limiting nutrient phosphorus underwent dramatic reductions which decreased loadings by more than 98% by the early 1980's. Long-term trends in water quality, phytoplankton, and SAV in Gunston Cove, a shallow embayment of the tidal freshwater Potomac River receiving treated wastewater, have been monitored on a consistent semimonthly basis since 1983. Additional monitoring data is available for periods back to the mid 1960's allowing construction of a data record spanning the time from intense loading and eutrophication through the nutrient load reductions of the late 1970's and early 1980's and continuing to the present.

Response to nutrient loading was not immediate, partially because even at reduced levels nutrients were not really limiting. But following a substantial lag period, nutrient concentrations and phytoplankton populations began a steady decline and water clarity has demonstrated marked improvement. After remaining constant at about 40 cm for nearly two decades, average summer Secchi depth has increased to over 70 cm. In September 2009 Secchi depth exceeded 100 cm for the first time in the study. In the same period, average summer chlorophyll a declined from 100 ug/L to about 40 ug/L. In recent years SAV has spread over larger portions of the embayment consistent with model predictions of macrophyte recovery. The state of the Cove could now be characterized as partially recovered, with SAV returning to shallower inner areas of the cove, but not able to successfully colonize the somewhat deeper mid to outer cove. Results demonstrate the role of time lags in ecosystem response and the importance of long-term monitoring in understanding ecosystem recovery.

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