CHAPTER 11

Influence of River Flow and Nutrient Loads on Selected Ecosystem Processes
A Synthesis of Chesapeake Bay Data

Walter R. Boynton and W. Michael Kemp

Abstract

In this chapter we assembled and analyzed two data sets, one a discontinuous 22-year time series (1972–1977, 1985–1993) of observations from a single mesohaline site in Chesapeake Bay, and the other, a much shorter time series from that site plus similar sites in four bay tributaries. For all locations, the data set includes measurements of river flow, nutrient-loading rate, phytoplankton primary production rates and biomass, water-column nutrient concentrations, and sediment-water exchanges of ammonium. In addition, data on sedimentation rates of chlorophyll a and bottom-water dissolved oxygen concentrations were analyzed at one site.

We examined a series of hypotheses concerning the influence of river flow and nutrient loading on these variables toward the goal of understanding underlying mechanisms. Significant relationships to flow and associated nutrient loads were found for all variables, some being stronger than others. In most cases, the influence of flow was found to extend over relatively short time periods (months to 2 years) and there were temporal lags between flow events and ecosystem responses on time scales of weeks to months. Results of analyses based on the time series from one location and on comparative analyses of data from five different sites were qualitatively similar; in this system it was not necessary to invoke comparative analyses to capture a large enough signal in forcing and response to observe interpretable patterns. Analyses generally indicated that relationships proximal to flow or nutrient loading rate were stronger (for example, nutrient load versus water-column nutrient mass) than those more removed from the direct influence of flow or nutrient load (for example, flow versus sediment nutrient releases).