LS96-080

THE IMPACTS OF EXTERNAL NUTRIENT SOURCES ON MARINE PHYTOPLANKTON IN AN EASTERN SHORE SEA-SIDE ESTUARY

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A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirement for the Degree of

DOCTOR OF PHILOSOPHY

OCEANOGRAPHY

OLD DOMINION UNIVERSITY
DECEMBER 1999

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ABSTRACT

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The Eastern Shore of Virginia (Greens Creek) as well as a large portion of the North Atlantic coastline is characterized by estuarine systems not dominated by large river systems. Instead, small freshwater creeks influence many coastal systems yet little information has been documented on their ecological significance. The focus of this research is to identify the biogeochemical and physical interactions within an estuarine water-column and understand the importance of freshwater sources in governing phytoplankton production. The hypothesis of this research is that increases in external nutrient loading into Greens Creek will not result in an increase in primary production. The reasons behind this are due to the light limitation of photosynthesis and high tidal exchange rates, removing phytoplankton, in this creek system.

Nutrient concentrations, species composition and nutrient loading rates for reservoir discharge, groundwater and precipitation will be presented. In addition, a rainfall related runoff model was also incorporated into this research to assess the indirect impacts of atmospheric deposition.

This research shows that a total of $1.80(*10^7)$ moles DIN yr^{-1} and $1.72(*10^5)$ moles P yr^{-1} are input to Greens Creek via freshwater sources annually. The continuous freshwater discharge from the reservoir spillway accounts for the majority of the total freshwater DIN (97.5%) and P (97.2%) inputs into Greens Creek. Groundwater discharge and rainfall are believed to be of substantial significance only on shorter time scales. Nutrient data from all input sources indicates that NO_3^- is the dominant form of DIN input to the creek with NH_4^+ and NO_2^- being of less significance.

Evidence shows that Greens Creek phytoplankton are light-limited in the turbid nutrient-rich waters of the upper and mid-reaches of the creek. However, as water becomes clearer downstream in the lower more saline reaches phytoplankton production increases and nutrient concentrations become low. Recharging tides characterized by high tidal energy break down the freshwater stratification and create a well-mixed water-column. This well-mixed environment drastically dilutes nutrient concentrations thus limiting phytoplankton growth. Daily production was strongly correlated with ambient nitrate concentrations and inversely correlated with salinity, emphasizing the importance of freshwater inputs as a nutrient source in this system.

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