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Soil and Water Science
Research Brief

University of Florida Institute of Food and Agricultural Sciences

Temporal and spatial variability of nutrient fluxes from sediment in the Lower Saint Johns River Estuary

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Eutrophication refers to nutrient pollution of a body of water. Eutrophication of Florida's lakes, rivers, and estuaries is a result of decades of agricultural, industrial, and urban point and non point source nutrient loading. A large amount of nutrients in fresh and estuarine waters can result in a variety of ecological responses such as algal blooms, decreased dissolved oxygen levels and fish kills due to the low oxygen levels in the water.

The 1972 Clean Water Act required states to identify impaired water bodies and establish total maximum daily loads (TMDLs). The St. Johns River Water Management District is mandated to set TMDLs for nutrients in the Lower St. Johns River (LSJR).

The LSJR is considered to be the northern 101 mi portion of the SJR from the mouth of the Ocklawaha River in Putnam County to the inlet at the Atlantic Ocean in Duval County (Figure 1). The LSJR is an elongated, shallow, estuarine river. It is unique among rivers in FL, characterized as a black water river, meaning it has a shallow zone of light penetration but high productivity (Demort and Bowman, 1985).

Release of nutrients such as phosphorus (P) and nitrogen (N) from the sediment must be considered as an important contribution to the total nutrient load to the river when determining TMDLs. The objectives of this study were to determine nutrient (N and P) flux out of the sediment and to calculate the annual internal loading of nutrients from the sediment to the water column. Internal loading results when nutrients from the sediment are introduced into the water column.

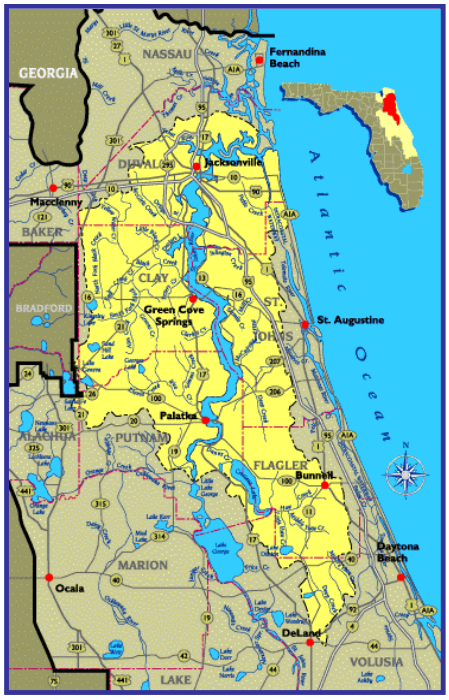
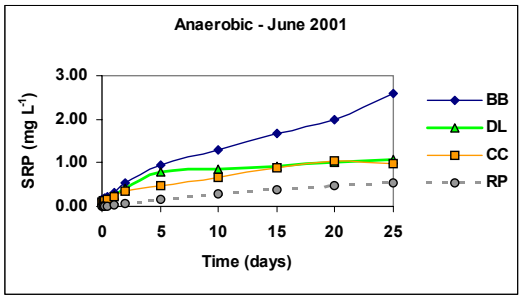


Figure 1. The Lower St. Johns River Basin is in yellow with the river running through the middle of it.

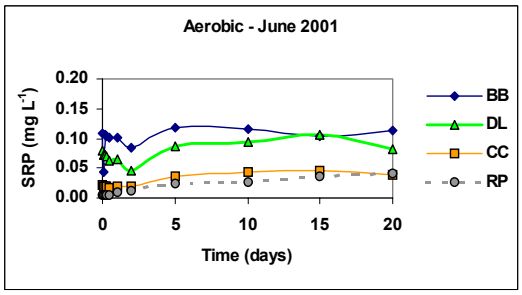
Sediments were collected from 36 stations throughout the river. Sediments in the northern portion of the river had higher concentrations of P, iron, aluminum, and magnesium than the southern portion of the river. This is likely a result of urban land use in the Jacksonville metropolitan

area versus the less intensive agricultural land use in the southern region of the river.

A laboratory experiment monitoring nutrient levels for 30 days in cores taken from the LSJR was used to measure the flux of nutrients from the sediments to the water column. Phosphorus fluxes ranged from 0.04 to 8.13 mg m^2 d^{-1} and N fluxes ranged from 13.1 to 28.8 m^2 d^{-1}. Flux rates were forty times higher under anaerobic (absence of oxygen) conditions than under aerobic conditions (presence of oxygen) (Figure 2). This is an importance difference as the river can undergo periods of low oxygen during the year.



(a) Anaerobic P concentrations.



(b) Aerobic P concentrations.

Figure 2. Change in LSJR (a) anaerobic and (b) aerobic water column P concentrations over time

The average annual internal load of P was 405 Metric Tons yr^{-1}, one fourth of the total P load to the LSJR (Figure 3). The average annual internal load of N was determined to be 2,555 Metric Tons yr^{-1}, one third of the total N load to the LSJR estuary (Figure 4).

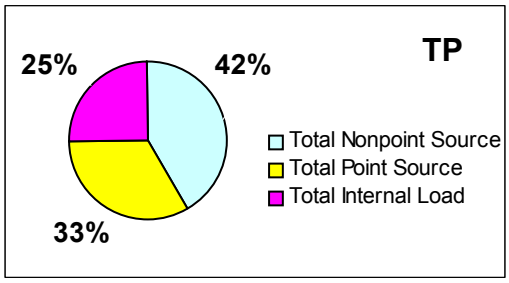


Figure 3. Contribution of internal P, from the sediment to the water column, on the total nutrient loading to the Lower St. Johns River Estuary.

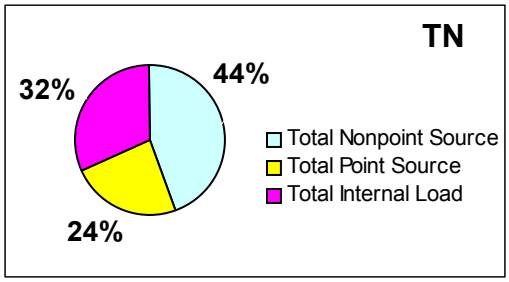


Figure 4. Contribution of internal N, from the sediment to the water column, on the total nutrient loading to the Lower St. Johns River Estuary.

Results from this study suggest the contribution of internal loading (nutrients from the sediment) is a major component of the LSJR estuarine nutrient budget. This load will likely decrease as external loading (nutrients from agricultural and urban runoff, industrial and domestic wastewater discharge, etc.) is decreased over time, resulting in fewer anaerobic events, thereby improving the water quality of the Lower St. Johns River Estuary.

References: Demort, C. L. and R. D. Bowman. 1985. Seasonal cycles of phytoplankton populations and total chlorophyll of the Lower St. Johns River estuary, Florida. Florida Scientist 48:96-107.

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