

## Internal Nutrient Cycling in Florida Bay: Denitrification, Nitrogen Fixation and the Role of Microalgae

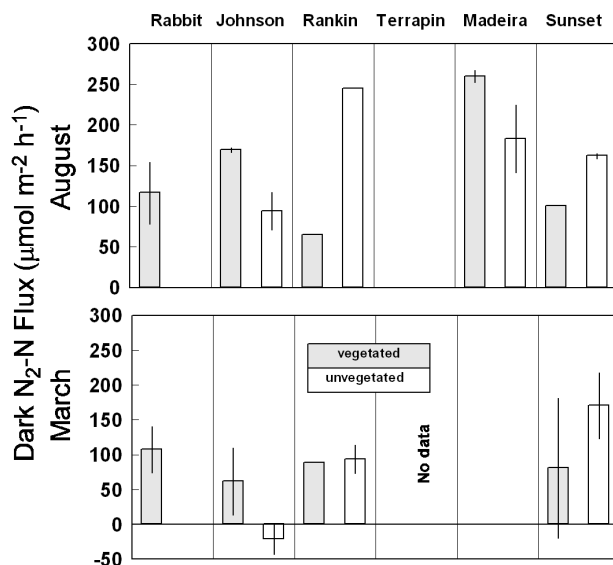
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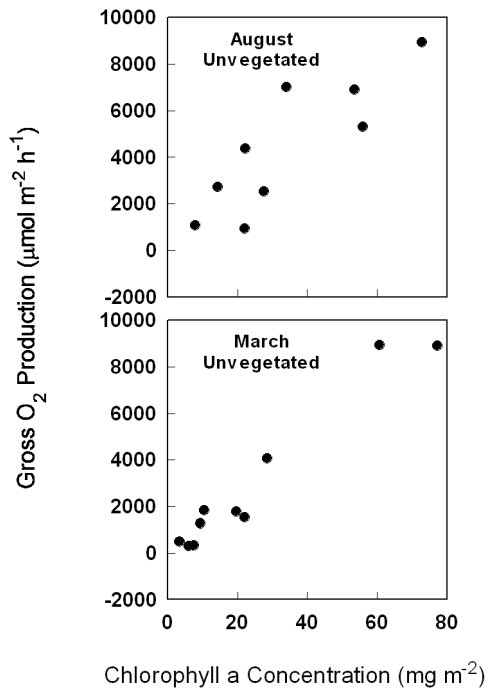
Understanding of the impacts of restoration on biogeochemical processes and primary production in Florida Bay requires information on both external inputs of nutrients and internal cycling processes. Benthic nutrient recycling and primary production are particularly important in shallow systems such as Florida Bay, and these processes tend to regulate the exchange of nutrients and gases between the sediment and the water column. We have measured sediment-water exchanges using core incubations to determine the fluxes of  $\text{NH}_4^+$ ,  $\text{NO}_3^-$ , soluble reactive P,  $\text{N}_2$ -N,  $\text{O}_2$ , DOC and DON. In addition, we have made estimates of N and P burial, nitrification, and N and P uptake by seagrasses and benthic microalgae.

Measured rates of denitrification (dark  $\text{N}_2$  flux) were much higher than would be expected based on reported N loading rates to Florida Bay. In our first surveys, rates averaged  $127 \pm 87 \mu\text{mol m}^{-2} \text{h}^{-1}$  in August and  $65 \pm 82 \mu\text{mol m}^{-2} \text{h}^{-1}$  in March for all Bay sites. These rates are similar to values estimated for sediments in Chesapeake Bay and other eutrophic estuaries. We speculate that such high rates may be common in shallow tropical ecosystems like

Florida Bay often characterized by severely limited phosphorus availability. Estimates of N fixation (gross  $\text{N}_2$  fluxes in light) were large enough to balance denitrification in summer months. Ammonium fluxes across the sediment-water interface were much smaller, and generally directed into the sediments in the light and from the sediments in dark. We measured relative high biomass levels and photosynthetic rates for benthic microalgal communities at most Florida Bay sites.



Strong correlations between benthic chlorophyll-*a* and solute fluxes across the sediment water interface further suggest the importance of microphytobenthos. Estimated N budgets indicate that benthic algal uptake of N is one of the most important processes regulating N pools. Even in Rankin Bay, a major site of seagrass die-back, little ammonium and no nitrate escape from sediments to overlying water. Benthic algal assimilation and N<sub>2</sub> flux dominate the budget at this site. The absence of correlations between benthic community photosynthesis and respiration, however, suggest that benthic algae are not the only important sources of organic matter fueling benthic respiration.



Nitrogen assimilation by the dominant seagrass, *Thalassia testudinum*, is an important term in the overall N budgets of the Bay. Seagrass uptake is, however, far more important in healthy beds like that at Rabbit Key than at dieback sites. Large pools of nitrogen are tied up in seagrass biomass, particularly for healthy beds. Seagrass nitrogen pools are sufficient to support measured rates of denitrification for more than three years at healthy sites. Although our current research in Florida Bay is addressing indirect effects of seagrasses on N cycling, the present study design was not geared to measure N fluxes in sediments with seagrass roots.

Our ongoing work is 1) refining our budget estimates for different Florida Bay basins, 2) examining the role of DOC and DON sediment-water exchange on N and C cycling, 3) experimentally examining the controls of sediment N fixation and 4) comparing biogeochemical gradients along bank to basin transects in healthy seagrass beds and in areas experiencing die-back..

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