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Variation in Nitrogen Isotope Ratios of Eelgrass to Detect Trends in Estuarine Nutrient Status

The Challenge: Seagrasses are productive and important components of shallow coastal waters, and they have suffered extensive declines worldwide. Because seagrasses are directly in the path of watershed nutrient inputs, a major cause of habitat loss is coastal development and consequent water quality degradation. Improved approaches for detecting threats of nutrient enrichment are paramount to seagrass conservation.

The Science: Nitrogen isotope ratios ($\delta^{15}N$) of seagrasses reflect primarily the isotopic composition of N sources. Wastewater-derived N is enriched in ^{15}N relative to natural pools, so the $\delta^{15}N$ of estuarine seagrasses is frequently correlated with the percent contribution of wastewater to N loads. Therefore, seagrass $\delta^{15}N$ is often proposed as an indicator of incipient eutrophication. To date, however, evidence linking seagrass $\delta^{15}N$ to wastewater input has been based on spatial variation in macrophyte isotopic signatures among watersheds; corroboration associated with temporal changes in estuarine nutrient status is lacking. We measured trends in $\delta^{15}N$ of eelgrass in a groundwater-fed estuary (Pleasant Bay, MA, within Cape Cod National Seashore) associated with a change in estuarine nutrient status from 2003 to 2015. During this period a new inlet formed in the barrier beach separating Pleasant Bay from the ocean, resulting in increased flushing rates and reductions in estuarine N concentrations. The long-term pattern in eelgrass $\delta^{15}N$ showed increasing values prior to inlet formation and decreasing values thereafter.

The Future: Our time-series data suggest that eelgrass $\delta^{15}N$ is a reliable indicator of estuarine nutrient status. However, it's important to note that in Pleasant Bay, the decrease in percent wastewater of estuarine N corresponded to increased flushing rather than decreased N load per se. Therefore, patterns in the N isotopic composition of seagrasses must consider hydrodynamics in interpreting eutrophication processes.

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