Assessing the Capacity of Restored Salt Marshes to Process Nitrogen and Phosphorus

Avesh Khemraj, Mitchell Choon, Christopher Andrade - Baruch College Now
Xiang Lin and Chester Zarnoch - Natural Sciences, Baruch College
Christopher Girgenti, Daniel Molinaro, Beryl Kahn - Randall’s Island Park Alliance

Introduction:
Salt marshes serve an important role of filtration that removes toxic chemicals, fertilizers, and other contaminants. Salt marshes may also filter nitrogen (N) and phosphorus (P) that is harmful to ecosystems.

Inputs of excess N and P increased growth of algae which eventually die and create ‘dead zones.’ These zones are deprived of oxygen and do not allow for sustained aquatic life. Often termed eutrophication. Excess N can also degrade salt marshes (Deegan et al. 2012).

Salt marshes may help reduce N and P in ecosystems (Davis et al. 2004) but it's unclear if restored marshes can provide this function.

Research Questions
1) Do restored salt marshes retain nutrients better than unrestored habitat?
2) How do restored salt marshes and unrestored habitat process nutrients under nitrogen-enriched conditions, such as a storm event?

Methods:
We brought the cores back to Baruch College and set up continuous-flow core incubations.

Water samples were taken from each core for two days to analyze the N and P processing.

After the 2nd day of sampling we used a potassium nitrate solution to enrich the cores with NO₃⁻. The enrichment doubled the nitrate concentration of the water flowing through the cores. We collected water samples 24 h later.

All nutrient samples were measured spectrophotometrically using a Seal Autoanalyzer and a DO was measured with a YSI Pro20 dissolved oxygen probe.

After completing the incubations we collected sediment samples from each core to measure marsh belowground biomass, sediment organic matter, and chlorophyll-a content.

Results: The effect of N enrichment

Little Hell Gate marsh

The NO₃⁻ enrichment resulted in the Little Hell Gate marsh habitat shifting from a NO₃⁻ sink to a source.

Bronx Kill marsh

The NO₃⁻ enrichment resulted in the Bronx Kill marsh habitat shifting from a NO₂⁻ sink to a source.

Discussion:

Question 1) Restored marsh vs. unrestored habitat

The total dissolved inorganic N (DIN) flux suggest that the Little Hell Gate marsh is a significant sink for DIN while the other sediment habitats are a source of DIN to the ecosystem.

The magnitude and direction of the DIN flux at each of the study sites.

Different restored marshes may not function equally. The Little Hell Gate marsh appears to retain more dissolved inorganic N than the Bronx Kill marsh. This could be due to a number of factors including hydrodynamics, water chemistry, and oxygen conditions.

Question 2) The effect of N enrichment

Under simulated storm conditions, the sediment can shift to becoming e a source of nutrients instead of a sink. There seems to be a threshold where the sites are unable to process all of the nutrients.

Conclusions:
The ability of restored salt marshes to reduce N availability in ecosystems may depend on marsh site and environmental conditions (e.g. NO₃⁻ exposure).

All sediment sampled at Randall Island appear to be a source of P. This may be due to sediment oxygen conditions and P demand by primary producers.

References: