Sediment nitrogen cycling and phytoplankton nutrient limitation in an urbanizing estuary

PRESENTER:
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BACKGROUND:

- Eutrophication is degrading water quality and ecological integrity in coastal systems
- The Guana Estuary, located in NE Florida is experiencing increased nitrogen (N) loading due to upstream development
- Understanding nutrient loading impacts to water column sediment biogeochemical processes is imperative for proper watershed management of urbanizing estuaries

OBJECTIVE:

- **To measure sediment nutrient fluxes and phytoplankton responses to elevated nutrients**

Figure 1. Sampling sites going from the Northern site Mickler's Weir (low salinity) to the Southern site River North (high salinity) .

METHODS:

Benthic Nutrient Flux (Fig. 2, 4, 6)

1. Collected 16 sediment cores (n=4) from four sites along a salinity gradient in March & July 2022
2. Measured sediment net N_2 fluxes, sediment oxygen demand (SOD) and nutrient fluxes: NOx, NH_4, PO_4^{3-} under ambient and nitrogen enriched water conditions during the continuous flow incubation

Figure 2. Sampling sediment cores using a coring pole at the Lake South site.

Nutrient Limitation Bioassay (Fig. 3, 5, 7-11)

1. 24 1-Liter Cubitainers were filled from four sites in June & September 2022
2. Six nutrient treatments added (n=4) to Cubitainers, then incubated for 2.5 days at the water's surface
3. Measured chlorophyll a and nutrients: NOx, NH_4, PO_4^{3-}

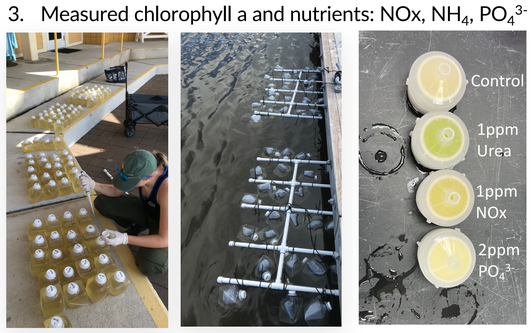

Figure 3. Cubitainers filled from each site, dosed with different nutrient treatments and then deployed together to incubate for 2.5 days.

RESULTS

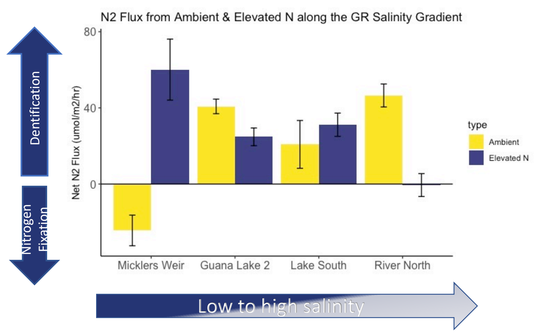

Figure 4. Net N_2 fluxes from the four sites along the Guana Estuary salinity gradient.

Nutrient assimilation in the **Guana Estuary** is high, but assimilation outpaces **denitrification**, limiting permanent N removal in the system.

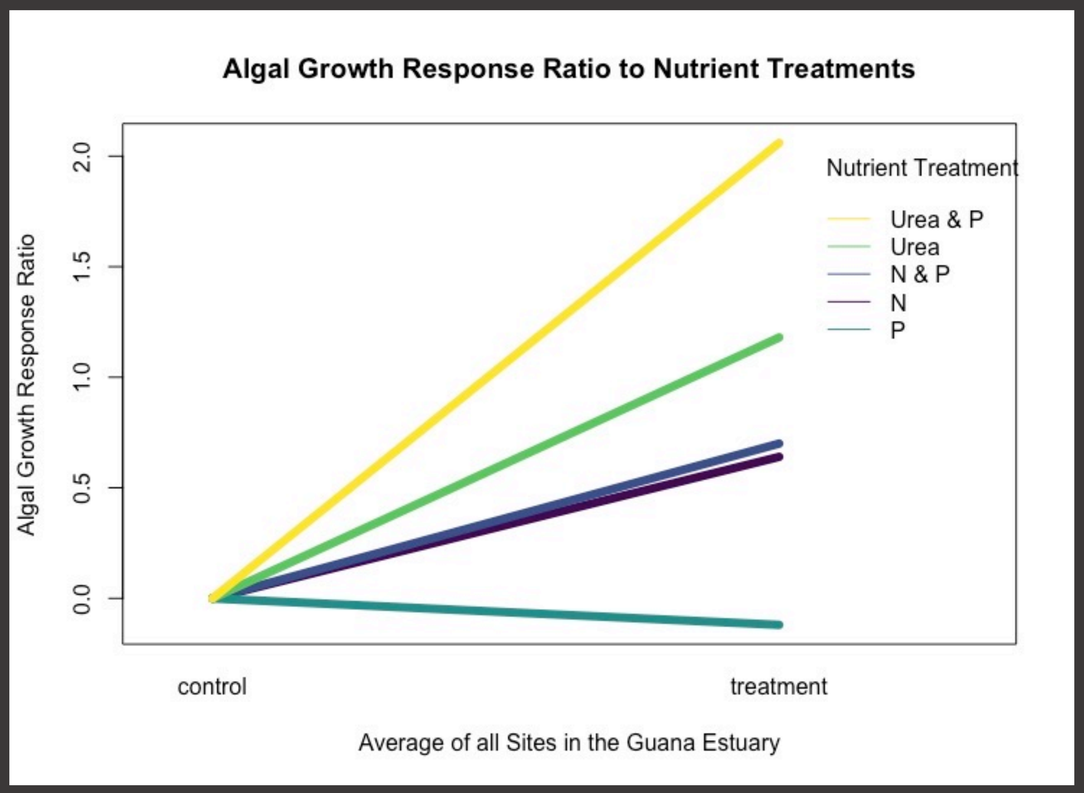

Figure 5. Phytoplankton growth response ratios for all nutrient treatments averaged from all four sites of the Guana Estuary.

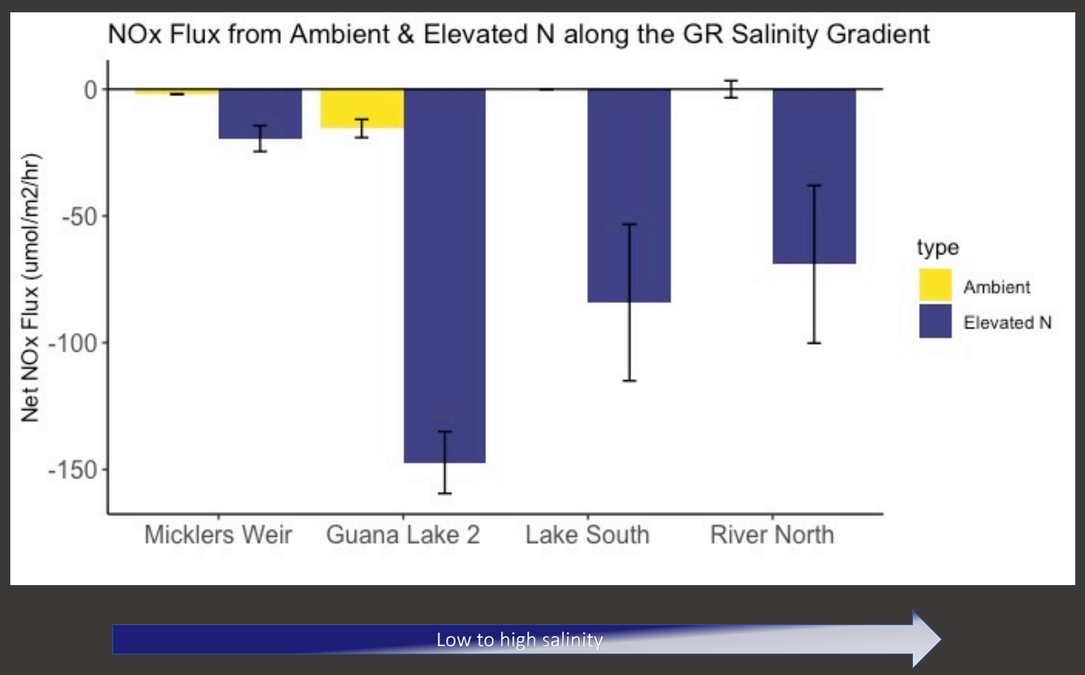

Figure 6. Net NOx fluxes measured from sediment cores under ambient and elevated N water conditions from continuous flow incubation.

RESULTS:

- Net denitrification did not have a high response to elevated nitrogen additions but had high rates of net denitrification, except Mickler's Weir which had net nitrogen fixation and was the lowest salinity site (Fig. 4.)
- Elevated nitrate additions in overlying water caused high rates of NOx and NH_4 assimilation (Fig. 6)
- The magnitude of nutrient limitation was highest in the Urea & P treatments at all sites (Fig. 7)
- Nitrogen is the limiting nutrient, which is expected for estuarine systems, but more analysis will be conducted

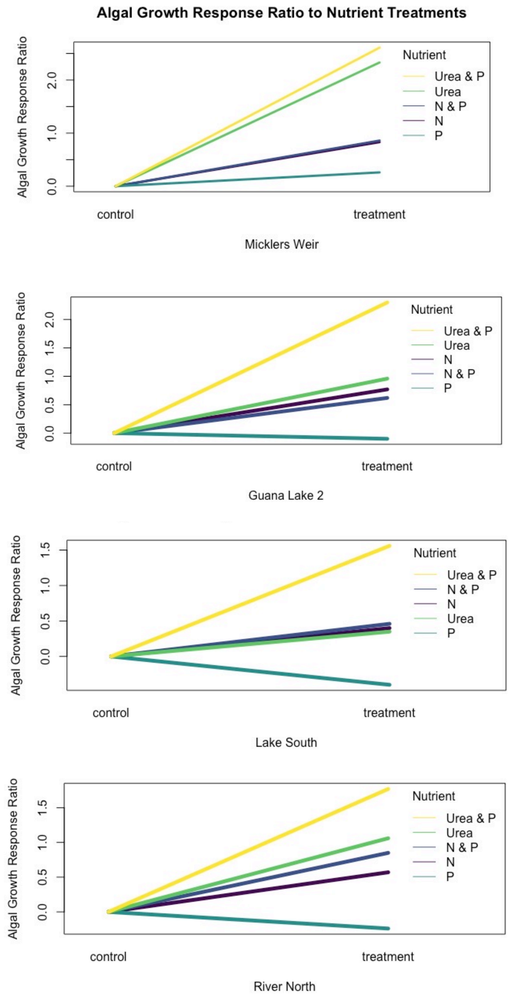

Figure 7. Algal growth response ratios calculated from chlorophyll-a for each site along a salinity gradient of the Guana Estuary.

CONCLUSION:

- **The Guana Estuary is poised for N additions, but sediment denitrification cannot keep up, therefore upstream urbanization could impact water quality by increasing the severity and occurrence of algal blooms**
- **Guana estuary structure and function seem to be strongly affected by anthropogenic pressures**

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