2017

# The effects of inorganic nitrogen and phosphorus enrichment on herbaceous species growth of the Kimages Creek wetland (VA)

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## Introduction and Objective

Dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) infiltrate waterways through fertilizer application, urban stormwater runoff, and sewer infrastructure leaks. As surrounding waterbodies experience increased DIN and DIP inputs, wetlands can experience corresponding nutrient enrichment. Vegetation uses DIN and DIP for structural growth, color, and seed production. Changes in DIN and DIP availability can influence species distribution due to differences in photosynthetic rates, root morphology and structure, and tissue type.

DIP and DIN inputs are projected to increase 15-30% and 30-60% in the next fifty years[1]. It is of interest to examine plant growth characteristics within this nutrient enrichment projection as well as nutrient enrichment from a potential 100-year projection to analyze future species composition responses within a freshwater tidal marsh.

## Study Site

The study site is within the recently restored, 70-acre tidal freshwater marsh of Kimages Creek; a semidiurnal tidal tributary of the James River located in the Coastal Plain of Virginia within the VCU Rice Rivers Center.


## Methods

**Plots**

- Fifteen, one-meter squared plots, divided across five levels of fertilization: control, low, medium, high, very high (Figure 1)
- Pore water sampler (10 cm depth) in the middle of each plot

**Fertilization and Sampling**

- Fertilize plots monthly in accordance to projected 50 year and 100 year nutrient increases with inorganic nitrogen (IN) and inorganic phosphorus (IP), May 2016 to October 2017 (Figure 2)
- Collect pore water samples at beginning, middle, and end of growing season and measure DIN and DIP concentrations
- Monthly, record percent coverage of each species and measure growth characteristics
  - Growth characteristics include plant height, leaf width, leaf length, leaf number, and base diameter
- Statistically analyze plant characteristics of species in plots that were abundantly present using ANOVA followed by Tukey's multiple comparison test. Species that grew in patchy patterns were not analyzed
- Statistically analyze pore water nutrients using a one way ANOVA

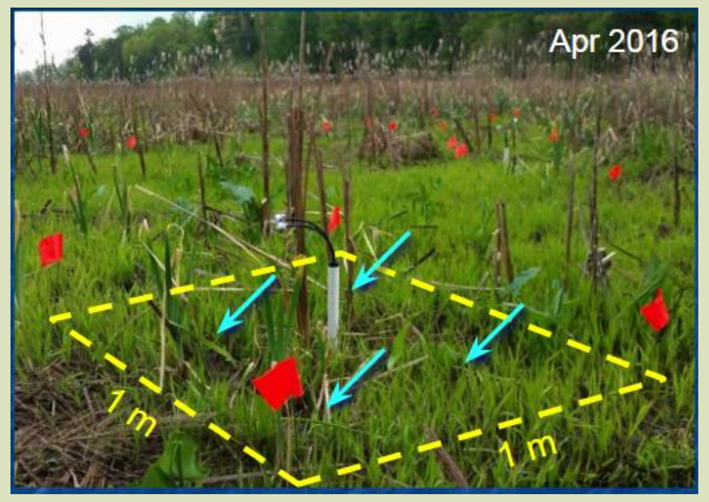


*Figure 1: Blue arrows indicate fertilization points*

| Enrichment Category | (g IN m-2 m-1) Added IN | (g IP m-2 m-1) Added IP |
|---|---|---|
| Control | 0 | 0 |
| Low | 1.52 | 0.04 |
| Medium | 3.03 | 0.07 |
| High | 4.55 | 0.11 |
| Very high | 6.06 | 0.14 |

*Figure 2: Fertilization amounts in grams per month based on 50 and 100 year enrichment projections*

## Results

- Significant differences in leaf width for the very high nutrient category for months June through September and the high nutrient category for months June through August compared to the control for both *Sagittaria latifolia* (broadleaf arrowhead) and *Leersia oryzoides* (rice cutgrass) (Figures 4 and 6)
- Significant differences in plant height for the very high nutrient category for months June through August compared to the control for *Sagittaria latifolia* (Figure 5)
- Significant differences in plant height for both the very high and high nutrient category for months June through August compared to the control for *Leersia oryzoides* (Figure 7)
- No significant differences in leaf width or plant height of *Typha* species (cattail) compared to the control
- No significant difference in pore water DIN or DIP concentration among different nutrient categories
- No significant changes in species richness with fertilization during first sampling season
  - average of 4.5 species per plot
- No significant changes in percent species coverage with fertilization
- *Pontederia cordata* (pickerelweed) and *Peltandra virginica* (green arrow arum) were not present evenly enough among plots to run analysis in the first season

## Results cont.

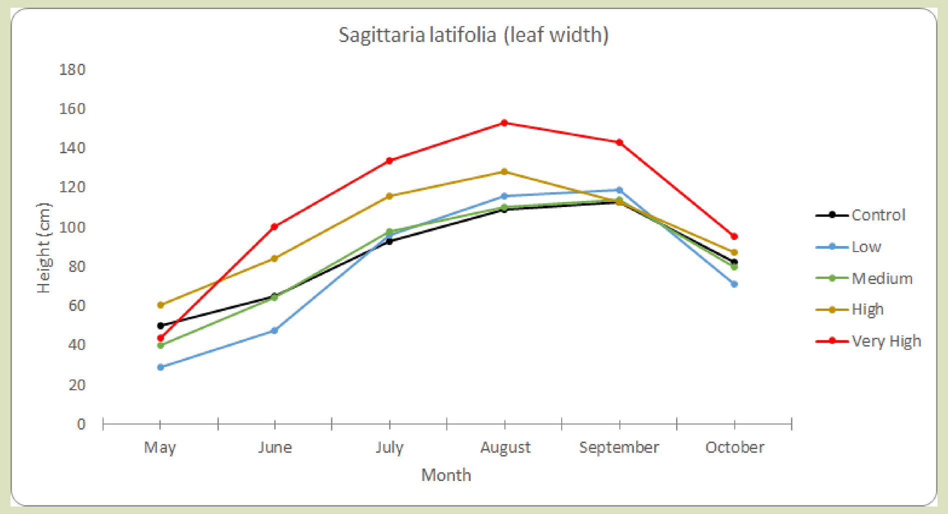


*Figure 4: Sagittaria latifolia had larger leaf width for the high and very high fertilization levels throughout much of summer compared to the control. Error bars omitted for clarity.*

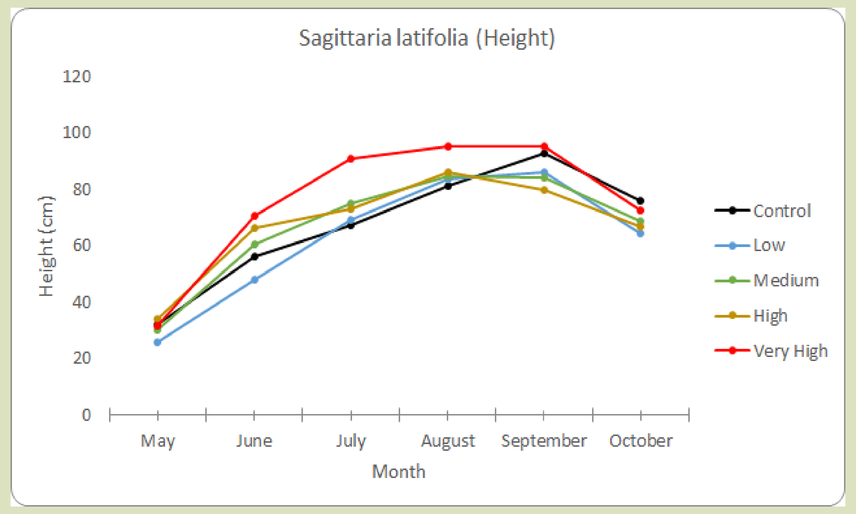


*Figure 5: Sagittaria latifolia had higher stem stalks for the very high fertilization level during mid-summer compared to the control. Error bars omitted for clarity.*

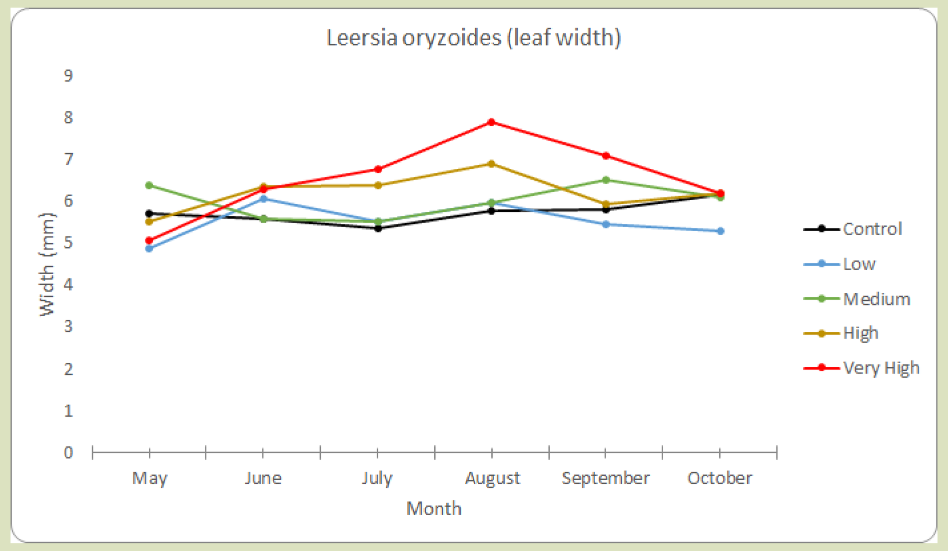


*Figure 6: Leersia oryzoides had larger leaf width for the high and very high fertilization levels during mid-summer compared to the control. Error bars omitted for clarity.*

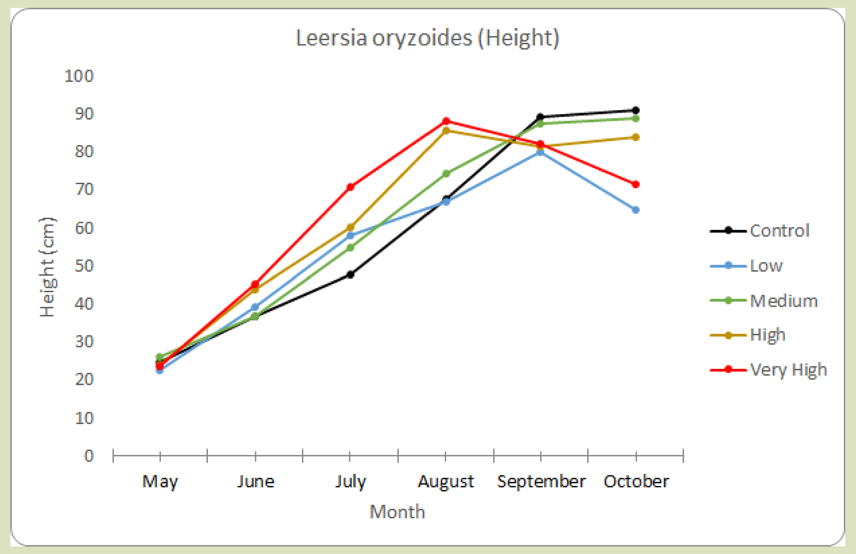


*Figure 7: Leersia oryzoides had higher stem stalks for the high and very high fertilization levels during mid-summer compared to the control. Error bars omitted for clarity.*

## Conclusions and Discussion

- Some species including *Leersia oryzoides* and *Sagittaria latifolia* may grow taller with wider leaves with projected 100-year DIN and DIP enrichments ("high" and "very high" levels).
- Based on the first season of data, it seems there will not be any significant effects in plant characteristics for the projected 50-year fertilization enrichment ("low" and "medium" levels)
- *Typha* species' insignificant response could be due to unexplainable deaths of the species among all plots.
- Since most species within the plots are perennial plants, it make take more than one year for plants to respond to changes in nutrient availability
- A second season of sampling will be conducted in the Summer of 2017 to further analyze hydrophytic herbaceous growth trends in the tidal freshwater marsh.

## Acknowledgments and Citations

We would like to thank Virginia Commonwealth University, William M. Lee for pore water nutrient analysis, Jennifer M. Ciminelli for data support, Dr. Catherine Viverette for grant support, and Russell Sprouse, Ryan Falkowski, Anne Barbot, and Beau Whelan for excellent help as field sampling volunteers.

[1] Mikolaj, P., Kardel, I., Gielczewski.M, Marcinkowski, P., and Okruszko, T. "Climate Change and Agricultural Development: Adapting Polish Agriculture to Reduce Future Nutrient Loads in a Coastal Watershed." *AMBIO.* (2013) Vol 43 pp 644-660.

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