DETERMINING THE LIMITING NUTRIENT OF HAB BIOMASS IN BRANCHPORT CREEK, NEW JERSEY

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Inorganic nitrogen limits the phytoplankton bloom biomass in Branchport Creek, NJ.

Introduction

Harmful algal blooms (HABs) are experienced worldwide, exacerbated by nutrient pollution and climate change. These blooms contribute to deoxygenation and can release toxins that lead to fish kills and public health issues. They can also cause damages both environmentally (fish kills) and economically (lake, beach, and fish closures). Branchport Creek in the Shrewsbury River, NJ, has been known for its polluted waters and periodic fish kills, but little has been done to characterize the HABs that presumably occur here. The goal of this study is to determine the nutrient causing increased levels of phytoplankton in Brachport Creek.

Methodology

- Stations were sampled in Sandy Hook Bay, the Navesink River, and the Shrewsbury River including a special focus in Branchport Creek
- Chemical and biological parameters were measured *in situ* (salinity, temperature, oxygen, pH, turbidity, chlorophyll, and light transparency)
- A 20L carboy was filled with station BP3 water filtered with a 200 µm mesh to remove micrograzers
- *In vitro*, chlorophyll *a* was extracted using acetone
- Bioassays were performed:
  - 24 1L cubitainers were filled with 0.8L of station BP3 water
  - Chlorophyll *a was* measured from three randomly selected cubitainers (extracted with acetone and measured with a handheld cyanofluor at T_0)
  - In replicates of three, including a control, the following nutrients were added: nitrate (N), phosphate (P), ammonia (Am), N+P, N+Am, Am+P, and N+Am+P
  - Cubitainers were placed in a 25°C incubator for 3-4 days
  - Chlorophyll *a was* again measured via extractions and cyanofluor for each cubitainer (T_F)
  - ANOVA analysis was completed using IBM SPSS Statistics Software
    - Post Hoc tests were completed with Bonferroni using $\alpha < 0.01$
  - Dissolved inorganic nutrients were measured by YSI photometer

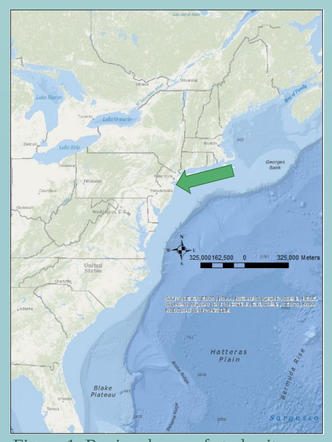


Figure 1: Regional map of study site.

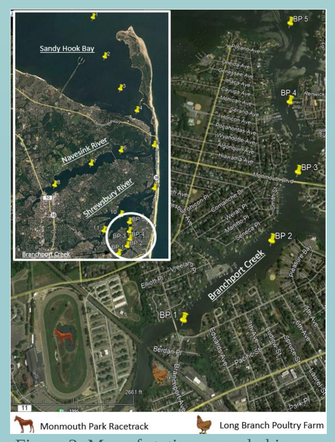


Figure 2: Map of stations sampled in Branchport Creek along with stations in Sandy Hook Bay, the Navesink and Shrewsbury River

Branchport Creek, NJ History:

August 2006: Extremely high levels of bacterial pollution was reported

- Levels were 1,000 times higher than the acceptable limit (104 colonies of enterococci/ 100 mL) which would ensure human health (known for years but only now addressed)
- All public access points had posted signs in excess warning people to avoid any contact with the polluted waters, and were monitored by Marine Police
- Monmouth Park Racetrack was identified as the most likely source of pollution, finding issues with the Two Rivers Sewage Treatment Plant's pipelines (which carried the manure and runoff from the racetrack). As bad as the pollution was, pipeline inspection was postponed until after racing season in mid-September.

May 2009

- A proposal was unveiled to construct a 4-acre detention basin (vegetated detention basin that will have the ability to hold 7.8 million gallons of water and feature 2.7 acres of constructed wetlands), a pump station, and a series of draining piping to reduce the contaminated runoff to virtually zero.
- This four-year, 22 million dollars plan to prevent pollution of Branchport Creek was paid for by the NJSEA (New Jersey Sports Exposition Authority)

April 2012

- Inspection was completed by Water Compliance and Enforcement and the point source was terminated

Summer 2019

- HABs, anoxia and fish kills persist and have become 'normal' for the area

Figure 3: Sign warning to avoid contact with polluted Branchport Creek water.

Figure 4: Fish kill (Atlantic menhaden) observed on Branchport Creek.

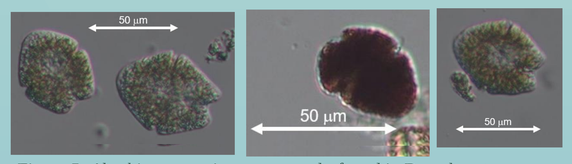


Figure 5: *Akashiwo sanguinea*: commonly found in Branchport Creek. This dinoflagellate is known for causing fish kills.

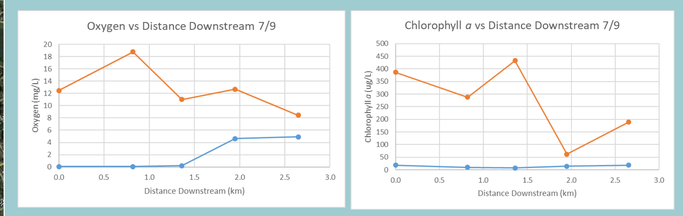
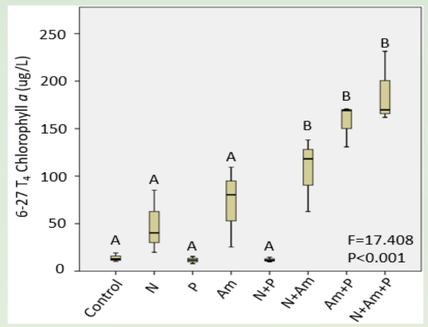
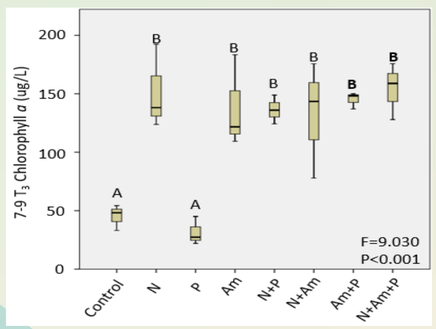
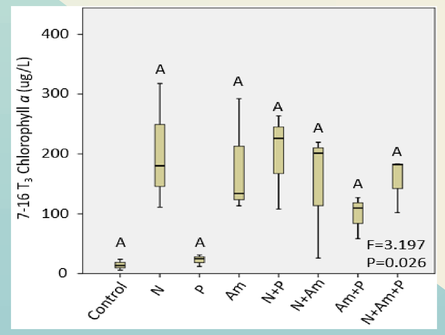


Figure 6: Graphs show the difference in surface water and bottom water in Branchport Creek. The surface water is filled with blooms of phytoplankton while the bottom water is anoxic: the farther upstream, the worse the conditions.

Results







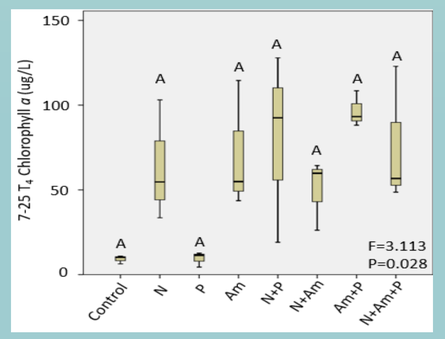


Figure 7: Boxplots show the comparison of chlorophyll *a* from the control to each treatment at the bioassay endpoint (T_F). Superscripts show (A) no statistically significant differences between the control and the treatment or (B) a statistically significant difference between the control and the treatment.

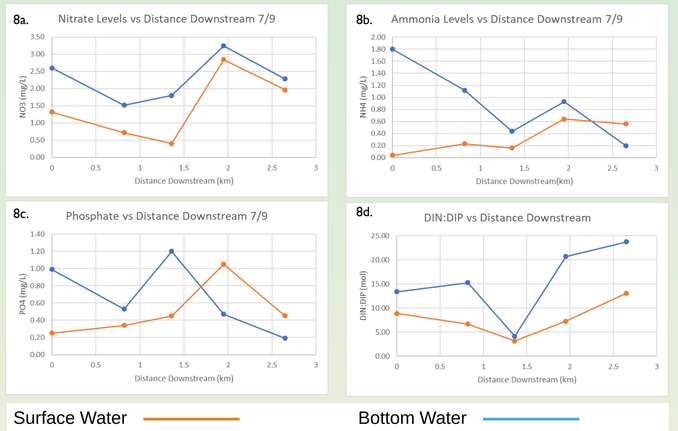


Figure 8: Inorganic nutrients in Branchport Creek in surface and bottom waters (July 2019). 8a, 8b, and 8c show the individual nutrients from upstream to downstream. 8d shows the ratio of nitrogen to phosphorous (16:1 being the ideal ratio for phytoplankton growth). DIN:DIP lower than 16 suggests potential nitrogen limitation, in agreement with bioassay results.

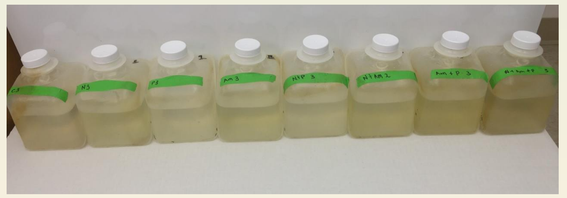


Figure 9: Picture of bioassay at the end of incubation period. Visible difference can be seen throughout the treatments.

CONCLUSIONS

- Nitrate and ammonia addition results in significantly high growth ($p<0.05$) when compared to the control (7/9)
- Phosphate addition resulted in no difference when compared to the control
- Inorganic nitrogen limits phytoplankton growth in Branchport Creek

Future Work

- Target sources of nitrate and phosphate in Branchport Creek
- Use this source to determine management practices for the polluted waters of Branchport Creek

Acknowledgements

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