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The Nitrate Project: An Analysis of Algal Growth

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ISCI 121 Entering Research II; Faculty Mentor: Melissa Rhoten



Research Question

How do nitrates and phosphates affect algal growth?

Introduction

- The **Chesapeake Bay**, an important coastal body of water, is a watershed that spans thousands of miles ranging from Maryland to New York.¹
- With the effects of runoff from urban areas and farms, the Chesapeake Bay has been experiencing harsh backlash from **nutrient pollution**.²
- The **nitrate (NO₃⁻)** and **phosphate (PO₄³⁻)** ions are two components that comprise nutrient pollution. Elevated levels of both of these ions are known to contribute to the Bay's poor water quality, which leads to a lack of biodiversity and algal blooms.
- The main reason why algal blooms are so harmful is that the sea grasses and the algae compete for resources such as oxygen and space.³

Methods

- Algae samples were set up using the schemes shown in Tables 1 and 2.
- Flasks were loosely covered with Parafilm and placed on a light cart equipped with lighting emitting 80-90 foot-candles while incubating at 27°C. Following two weeks with observations made in between weeks, the algae were isolated using vacuum filtration and set aside to dry overnight.
- Samples were weighed with their corresponding filter paper and dried bacteria before having their masses recorded. This was then used to calculate the growth of the *Anabaena* cyanobacteria.

Table 1. Nitrate (NO₃⁻) Treatment Levels

mL of algae	mL of 100 ppm KNO ₃	mL of spring water	[NO ₃ ⁻] (ppm)
10	0	20	0
10	1	19	27.3
10	5	15	40.7
10	10	10	57.3
10	15	5	74
10	20	0	90.7



Figure 1. Photo of *Anabaena* cyanobacteria



Figure 3. Photo of the mixtures at 1 week.

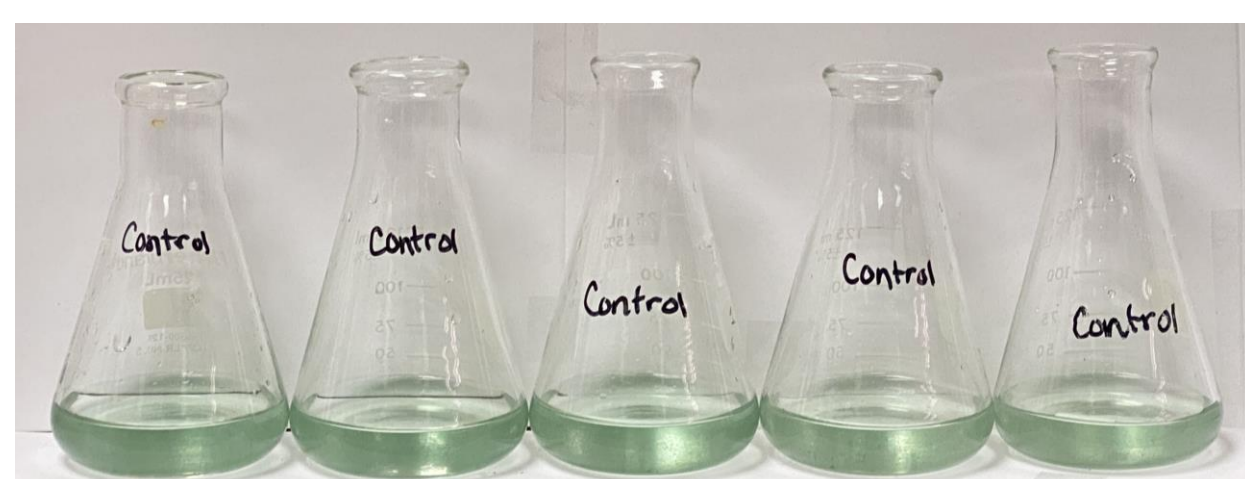


Figure 2. Photo of mixtures during initial setup



Figure 4. Algae was isolated using suction filtration to determine the algal growth.

Table 2. Phosphate (PO₄³⁻) Treatment Levels

mL of algae	mL of 100 ppm K ₂ PO ₄	mL of spring water	[PO ₄ ³⁻] (ppm)
10	0	20	0
10	2	18	10
10	4	16	16.7
10	6	14	23.3
10	8	12	30
10	10	10	36.7

Results & Discussion

- Figures 5 and 6 show the average mass of the *Anabaena* at each of the nitrate and phosphate levels, respectively.
- Tables 3 and 4 show the results of two t-tests (assuming equal variances).
- No significant difference in algal growth resulted from the enhanced nitrate or phosphate levels as compared to the control.

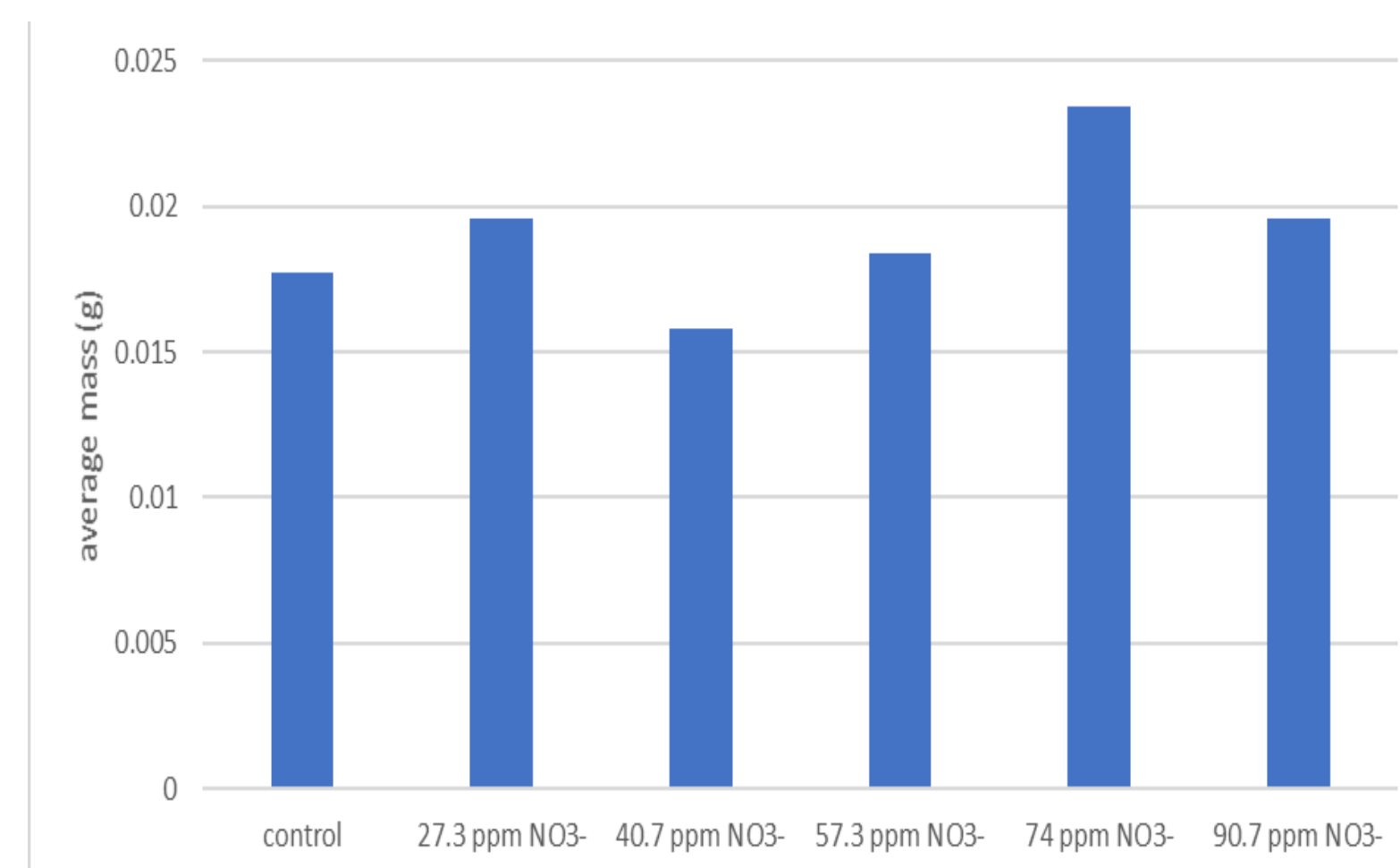


Figure 5. Average Algal Growth as a Function of Nitrate Level. The histogram above shows the most algal growth at the 74 ppm NO₃⁻ treatment level.

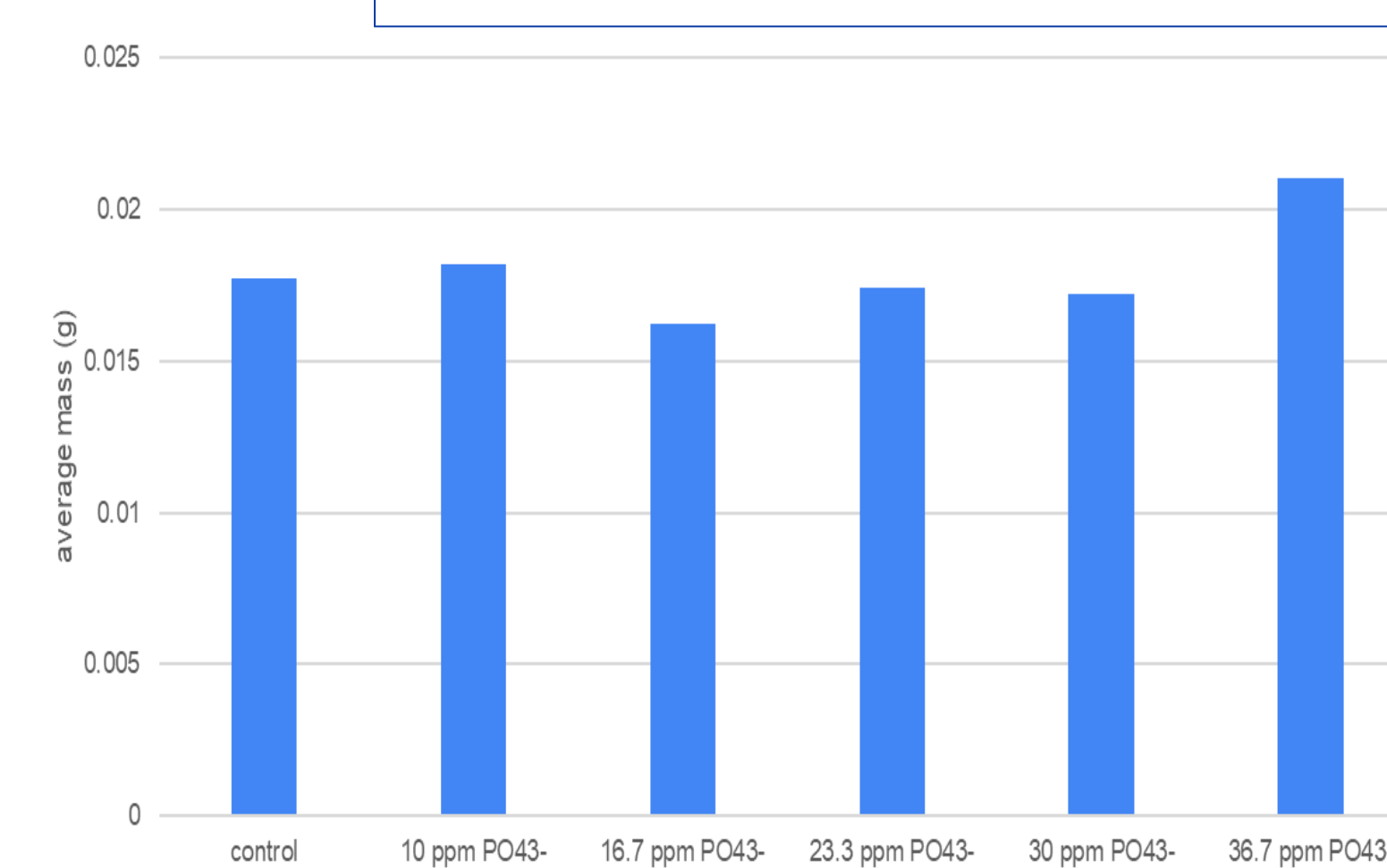


Figure 6. Average Algal Growth as a Function of Phosphate Level. The histogram above shows the most algal growth at the 36.7 ppm PO₄³⁻ treatment level.

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	Variable 2
Mean	0.0234	0.0177
Variance	0.0001343	6.22333E-05
Observations	5	10
Pooled Variance	8.44077E-05	
Hypothesized Mean Difference	0	
df	13	
t Stat	1.132721685	
P(T<=t) one-tail	0.13889551	
t Critical one-tail	1.770933396	
P(T<=t) two-tail	0.27779102	
t Critical two-tail	2.160368656	

Table 3. Results of a t-test comparing the mean algal mass for the 70 ppm NO₃⁻ to the control group. The P (one-tail) was greater than alpha (0.05) indicating that there was no significant difference in the two means.

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	Variable 2
Mean	0.0177	0.021
Variance	6.22E-05	2.4E-05
Observations	10	5
Pooled Variance	5.05E-05	
Hypothesized Mean Difference	0	
df	13	
t Stat	-0.84809	
P(T<=t) one-tail	0.205867	
t Critical one-tail	1.770933	
P(T<=t) two-tail	0.411733	
t Critical two-tail	2.160369	

Table 4. Results of a t-test comparing the mean algal mass for the 36.7 ppm PO₄³⁻ to the control group. The P (one-tail) was greater than alpha (0.05) indicating that there was no significant difference in the two means.

References

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