The Impact of Nutrient Variability on Algal Growth in Controlled Aquatic Ecosystems

Malayzia Roseboro

Malayzia Roseboro, Class of '24 is majoring in Public Health with a concentration in Community Health.

Abstract

This project aimed to investigate how different nutrient concentrations affect algal growth in a controlled laboratory environment. By simulating various nutrient conditions commonly found in natural bodies of water such as nitrogen and phosphorus variations, I sought to understand nutrient influence on algal bloom dynamics—a crucial aspect of freshwater ecosystem management.

Project Background and Purpose

Algal blooms, often driven by nutrient runoff, can severely impact freshwater ecosystems by depleting oxygen and releasing toxins that affect water quality and aquatic life. Understanding the relationship between nutrient levels and algal growth rates is essential for environmental monitoring and mitigation efforts. This experiment simulated freshwater conditions with varying nitrogen and phosphorus concentrations to observe growth differences and identify thresholds for bloom formation.

Methodology

Using a set of ten aquaria, each filled with synthetic freshwater, I introduced controlled amounts of nitrogen and phosphorus to simulate a range of nutrient conditions, from low to high concentration levels. Each aquarium was seeded with a standard concentration of green algae (Chlorella vulgaris) and maintained under consistent lighting and temperature conditions. Over a two-week period, I measured algal growth using optical density readings at 600 nm with a spectrophotometer every two days.

Results

The data showed a clear correlation between nutrient concentration and algal growth rate:

- **Low Nutrient Levels**

Aquaria with low nitrogen and phosphorus levels showed minimal algal growth, with an average optical density increase of only 0.1 units.

- **Moderate Nutrient Levels**

Algal growth rates increased significantly, with optical density increasing by 0.6 units on average, demonstrating the effect of moderate nutrient availability.

- **High Nutrient Levels**

Aquaria with high nutrient concentrations experienced rapid growth, with optical density readings increasing

Nutrient Level	Nitrogen Concentration (mg/L)	Phosphorus Concentration (mg/L)	Average Optical Density Increase (OD 600 nm)
Low	0.5	0.2	0.1
Moderate	1.5	0.8	0.6
High	3.0	1.5	1.2

Table 1: Nutrient concentrations and algal growth correlations.

by 1.2 units. By the end of the experiment, these aquaria showed signs of nutrient saturation and potential bloom conditions.

Table 1 illustrates the correlation between nutrient concentrations and algal growth

The results confirmed that nutrient concentration significantly impacts algal growth, with higher nutrient levels driving more rapid and sustained growth. These findings underscore the importance of monitoring nitrogen and phosphorus inputs in freshwater systems to mitigate harmful algal blooms.

Image by Samantha Smith
The beautiful falling water was captured in Nantahala National Forest, while I explored the mountains with my parents early November. The way the falls arched allowed for us to walk behind the waterfall and hear how loud the water really was.

Conclusion and Technical Reflection

This experiment enhanced my technical skills in experimental design, laboratory procedures, and data analysis. Working with spectrophotometric measurements, I gained hands-on experience in quantitative analysis and data interpretation, crucial for understanding environmental impacts on ecosystems. This project emphasized the importance of precise nutrient control in managing algal blooms, highlighting my ability to conduct research with practical environmental applications.