Nutrients and Bloom-forming Cyanobacteria in a Mesotrophic Lake

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Background

- Globally recognized water quality crisis
- Elevated concentrations of nutrients → rapid cyanobacterial growth
- Depleted nutrients, hypoxic water, toxins (microcystins)
- Limiting Factors: Nitrogen and Phosphorus

Objectives

- Determine the effects of nutrient addition on phytoplankton biomass
- Determine the effect of dissolved N on abundance of cyanobacteria
- Determine the effect of different forms of dissolved N on cyanobacteria species composition

Predictions

- Increased phytoplankton biomass with added N and P
- Increased cyanobacteria at higher concentrations of N
- Non N-fixing cyanobacteria more abundant in elevated NH₄⁺ than in NO₃⁻

Design

- Lake Microcosm Experiment
- Low and high concentrations of N
- All receive excess concentrations of P
- Concentrations derived from Redfield (16:1)

Controls

- P₀ = 0
- A: Low [N] +15 µM N/L
- B: High [N] +50 µM N/L

Experimental

- C: NO₃⁻ (Low)
- D: NH₄⁺ (Low)
- E: NH₄⁺ + NH₄⁺ ([NH₄]₂CO)
- G: Urea (Low)
- I: Urea (High)

Experiment

- 4 liter cubitainers
- Whole lake water from Calder Lake in Armonk, NY.
- 3 replicates
- Nutrients added: NH₄⁺, NO₃⁻, NH₄NO₃, urea
- 4 day incubation in situ

Results

Chlorophyll-a: Phosphorus +/- N
- Control Treatments (no N added)
- No significant effect adding P (+ 2 µM)
- N is the main factor for algal blooms in Calder Lake

Chlorophyll-a: Low [N] +15 µM N/L
- NO₃⁻: Control
- NH₄⁺: Control
- NH₄NO₃: Control
- Urea: Control

Chlorophyll-a: High [N] +50 µM N/L
- NO₃⁻: Control
- NH₄⁺: Control
- NH₄NO₃: Control
- Urea: Control

Species Composition

- NO₃⁻ (High and Low N)
  - *Sphaerocystis schroeteri*
  - *Oocystis lacustris*
  - *Dolichospermum planctonicum*
  - *Woronichinia naegeliana*
  - *Microcystis aeruginosa*
  - *Aulacoseira sp.*

- NH₄⁺ (High N)
  - *Oocystis lacustris*
  - Similar to NO₃⁻ treatments
  - Much less abundant

- NH₄NO₃ (Low N)
  - Mixed green algae
  - Small diatoms

- NH₄NO₃ (High N)
  - *Oocystis sp.*
  - Small diatoms

- Urea (High N)
  - Motile green algae
  - Colonial Green Algae
  - *Staurastrum sp.*
  - Diatoms

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