Understanding the Links Between Cyanobacteria Physiology and Hydrodynamics may Help Find Adaption Strategies for Toxic Blooms

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Citation Details
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Overview

• Impacts, problems & solutions
• Algal species/strains matter therefore differences in their physiology matters
• Examples
• Summary
• How can we find appropriate approaches?
There are multiple impacts on lakes

• Change due to drivers
  – Direct human use
  – Indirect, such as pollution
  – Climate change

• Result in problems
  – Lake health
  – Human use
# Possible levels of actions

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution</td>
<td>Remove drivers</td>
<td>Reduce toxic algal blooms by intercepting P sources</td>
</tr>
<tr>
<td></td>
<td>Solve “in the pattern”</td>
<td></td>
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<tr>
<td></td>
<td>Resilient outcome</td>
<td></td>
</tr>
<tr>
<td>Mitigation</td>
<td>Reduce impact</td>
<td>Decrease toxic algae temporarily</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Avoid the impact or replace the resource</td>
<td>Post warnings to minimize human impact</td>
</tr>
</tbody>
</table>
Algal species or strains matter

• Therefore – differences in physiology matter to the problem
• Ecological
  – Trophic web
  – Seasonal dynamics
• Human health
  – Toxic vs. nuisance species/strains
Amount of algae

• Need to be clear about
  – Competitive exclusion
  – Bloom from growth
  – Accumulation from a variety of processes

Example:
• B is growing 2x as fast as A (.5 vs .2.5)
• Loss term is same for both (-.2)
• A starts at 100, B starts at 10
• B takes 10 days to exceed A
Species/strains physiological differences

• Can help identify possible mitigation strategies
  – Time scale of days
  – Space scale could be small, such as a single bay
• Can guide monitoring and detection programs
  – Predict dangerous accumulations on 5 day scale
  – Enough time for simple mitigation or adaptation

That’s the point of this talk.
Example 1: nutrients

- Nitrogen from APFA (N2-fixer) supports subsequent growth of MSAE
- Longer growing season can exacerbate this
- Delay onset of APFA or lessen the bloom size
Example 2: buoyancy and mixing

- Bobbi’s work
- Do different short term mixing regimes favor APFA or MSAE?
Example 3: viscosity
Sinking and floating rates very sensitive to viscosity

10°C increase → 17% increase sinking rate
High temperature favors buoyancy
Example 4: disrupting buoyancy control

- See Kit’s study later
- Combination of humic complexing compounds and ion composition
- 1 day exposure to 10% humics could disrupt buoyancy regulation and might lead to more diverse algal assemblage
Summary

• Might have to focus on mitigation rather than full solutions
  – Similar to climate change, because many of the same drivers
• Mitigation strategies might be able to exploit species/strains differences
• Strategies would be local and short duration
• They can be tested and modified
• Same understanding of short term processes can be used to refine predictions and improve adaptation strategies
Can smaller mitigation efforts lead to ultimate solutions?

• Sometimes they interfere
  – “The best is the enemy of the good.”

• What do you think?
  – Not likely
    • Cross scale projects don’t wor
  – Maybe
    • Socolow “wedges”
  – For sure
    • We can definitely design this.
Thank you