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

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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

Level	Description	Example
Solution	Remove drivers Solve “in the pattern” Resilient outcome	Reduce toxic algal blooms by intercepting P sources
Mitigation	Reduce impact	Decrease toxic algae temporarily
Adaptation	Avoid the impact or replace the resource	Post warnings to minimize human impact

Algal species or strains matter

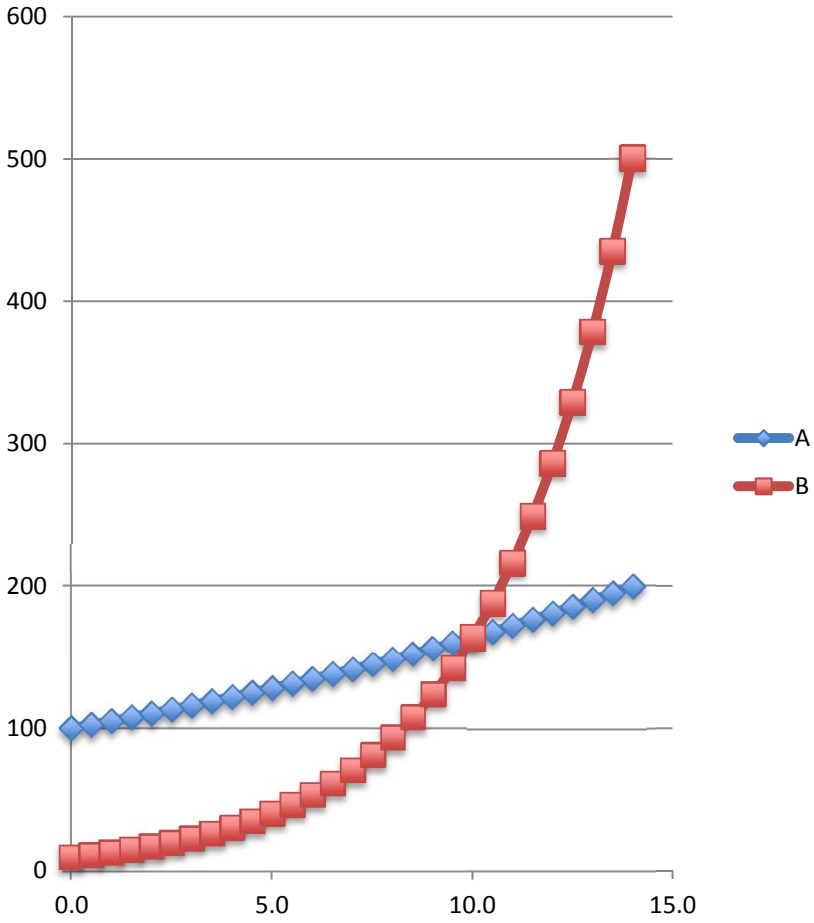
- Therefore – differences in physiology matter to the problem
- Ecological
  - Trophic web
  - Seasonal dynamics
- Human health
  - Toxic vs. nuisance species/strains

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



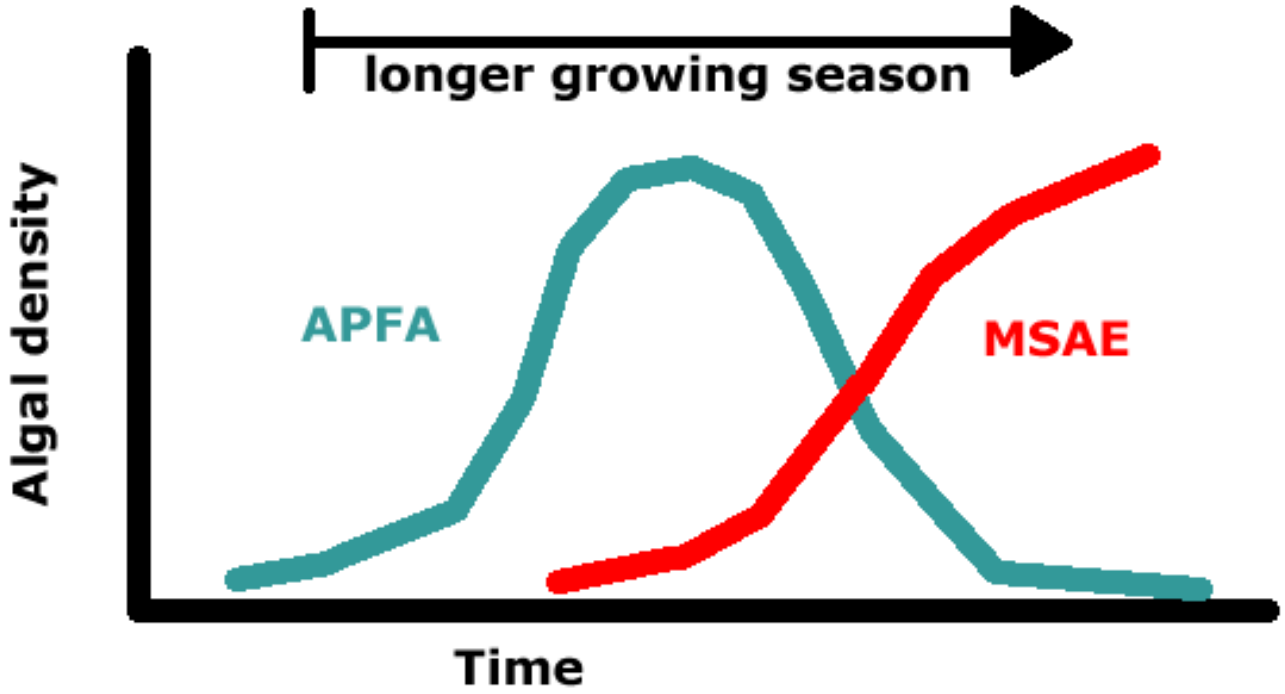
Species/strains physiological differences

- 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

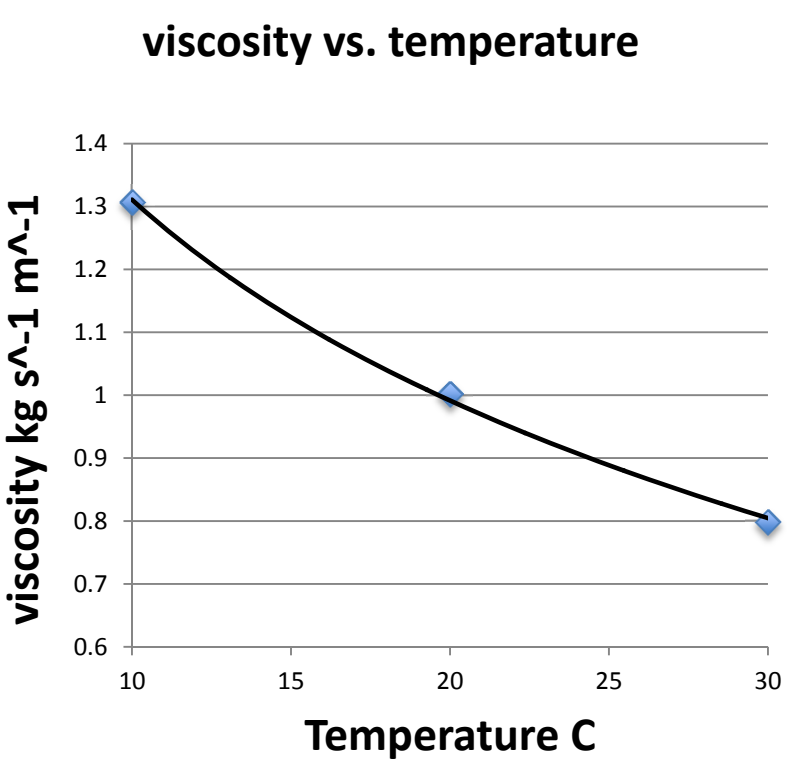


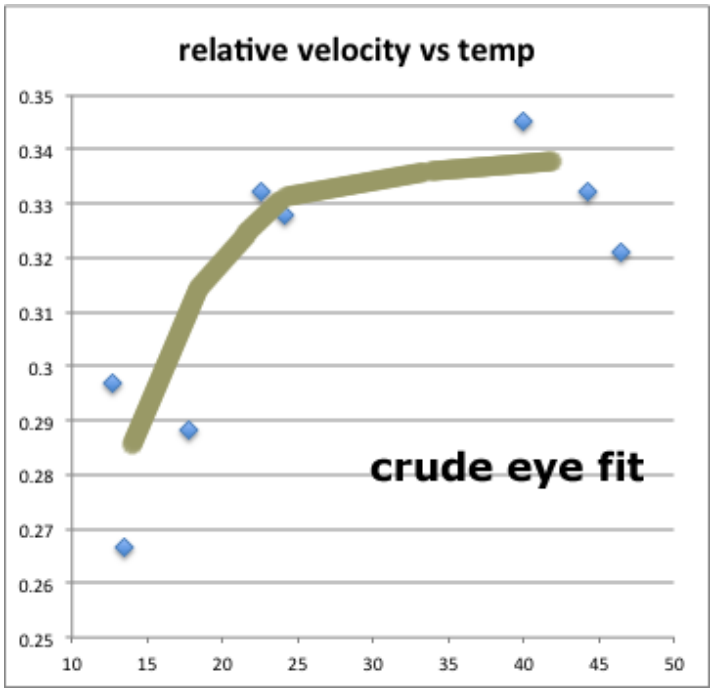
Example 2: buoyancy and mixing

- 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

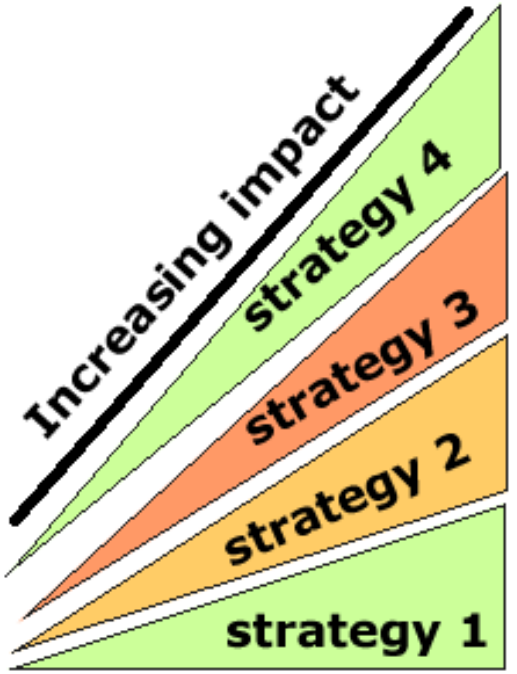
Summary

- 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