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

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Understanding the links between cyanobacteria physiology and hydrodynamics may help find adaptation 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

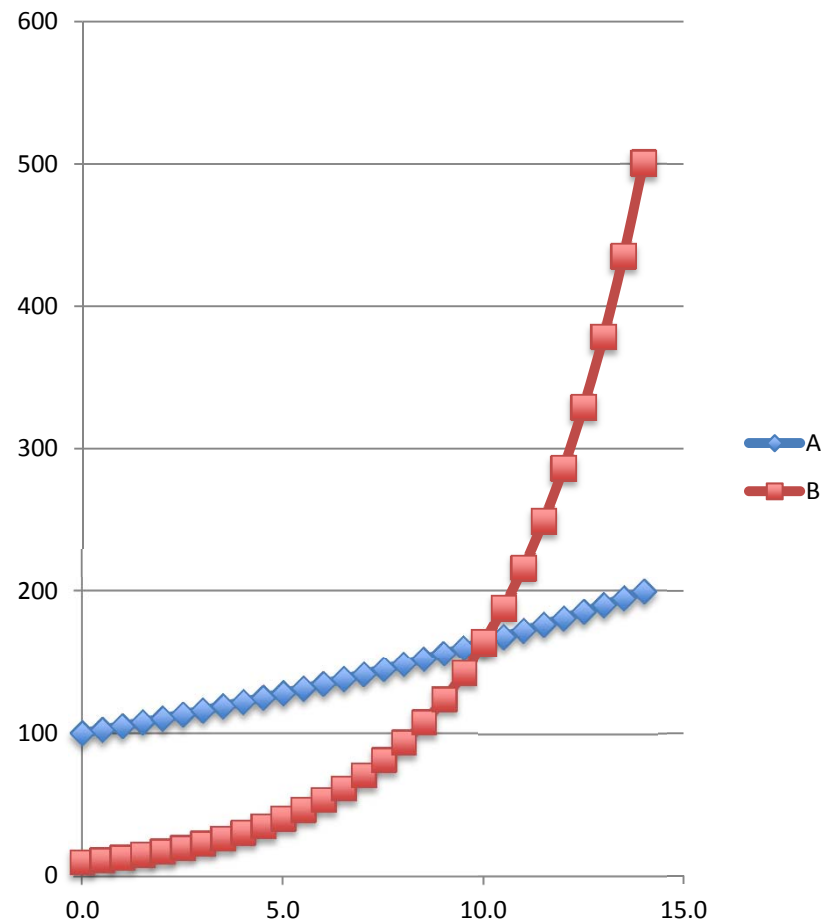
- Therefore – differences in physiology matter to the problem
- Ecological
 - Trophic web
 - Seasonal dynamics
- Human health
 - Toxic vs. nuisance species/strains

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 .25)
- Loss term is same for both (-.2)
- A starts at 100, B starts at 10
- B takes 10 days to exceed A



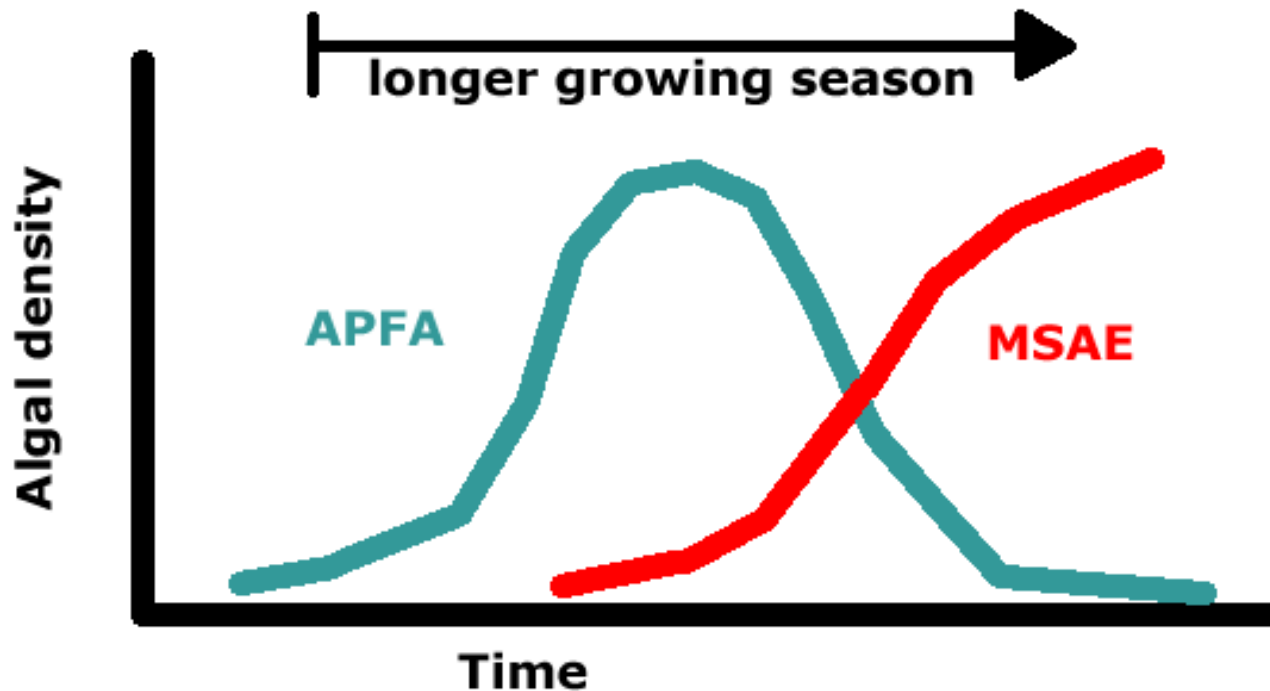
Species/strains physiological differences

- 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

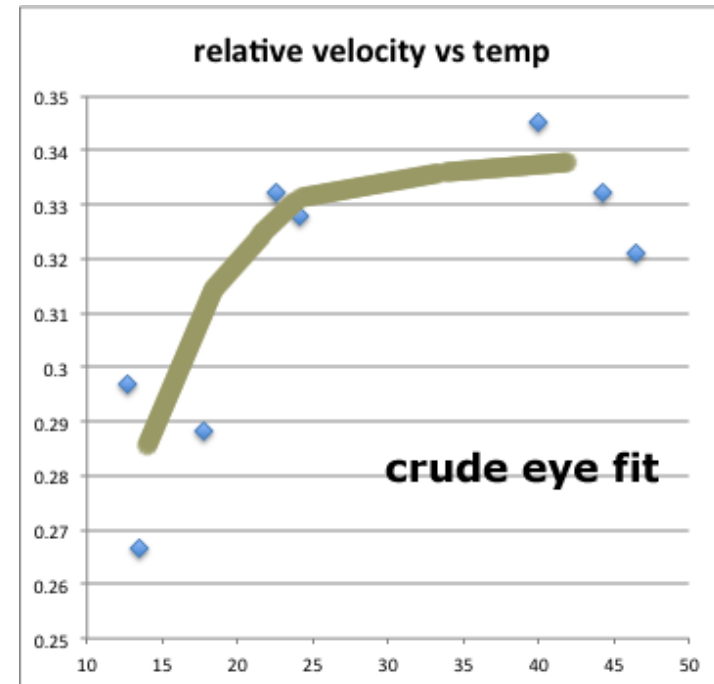
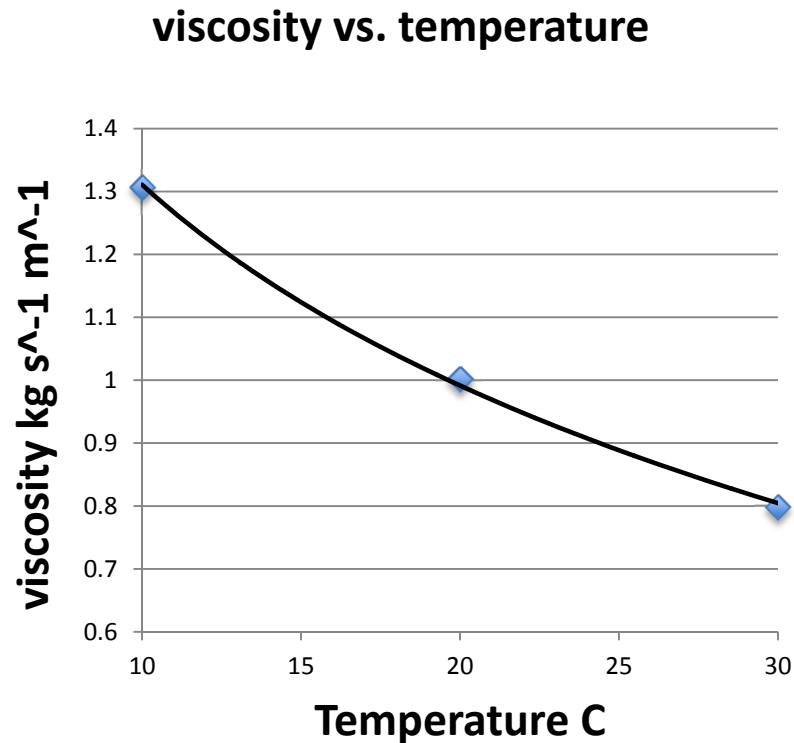


Example 2: buoyancy and mixing

- 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 \rightarrow 17% increase sinking rate
High temperature favors buoyancy

Example 4: disrupting buoyancy control

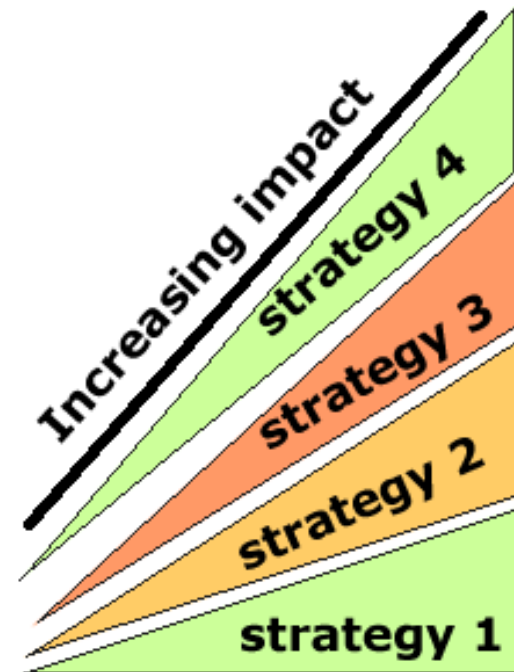
- See Kit's study later
- Combination of humic complexing compounds and ion composition
- 1 day exposure to 10% humics could disrupt buoyancy regulation and might lead to more diverse algal assemblage

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 work
 - Maybe
 - Socolow “wedges”
 - For sure
 - We can definitely design this.



Thank you