Reconstructing historical water quality patterns in large Kansas reservoirs

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The University of Kansas

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Presentation Roadmap

Blooms and consequences

How to find long-term trends?

Why are lakes changing?

How does past inform present/future?

Summary

Collecting sediment cores on Kanopolis

Harmful Algal Blooms in KS

Made of "blue-green algae" = Cyanobacteria

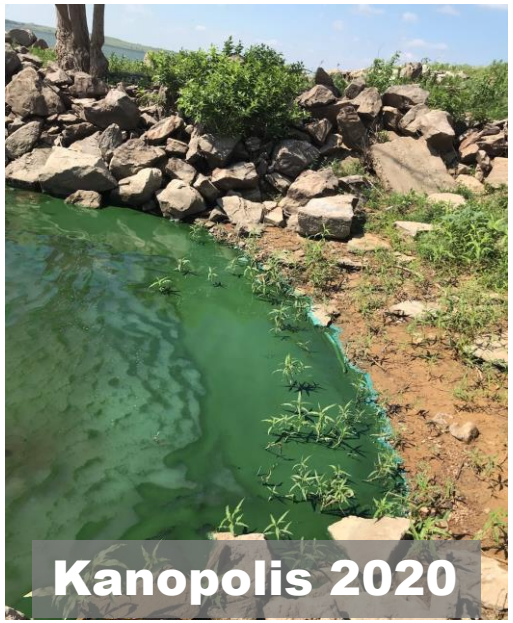
Can **produce potent toxins (more potent than cobra!)**

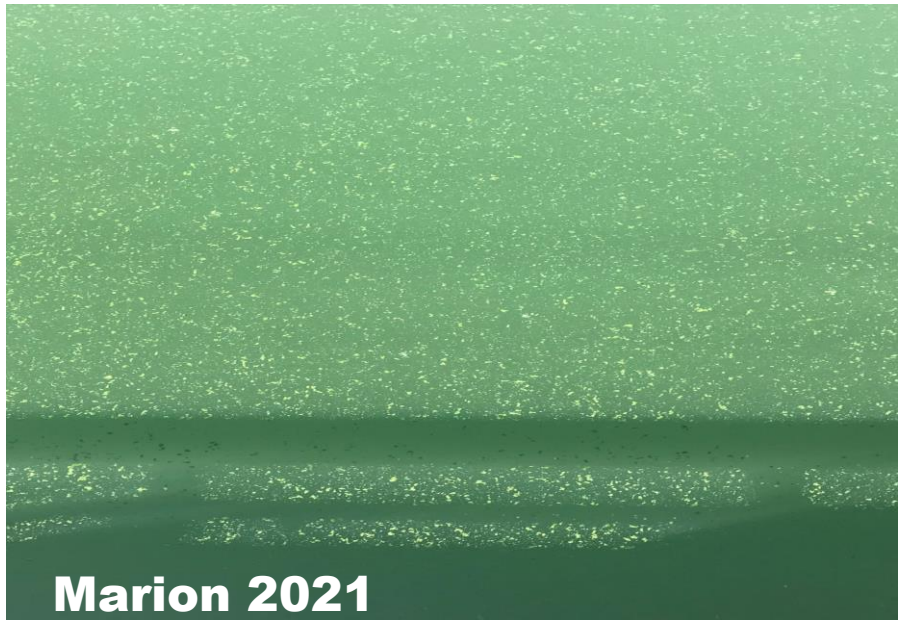
- **Blooms have poisoned dogs and cattle**

Can **produce taste-and-odor compounds**

- **HAB compounds *double* cost of finished drinking water**

But not always (we don't know why)





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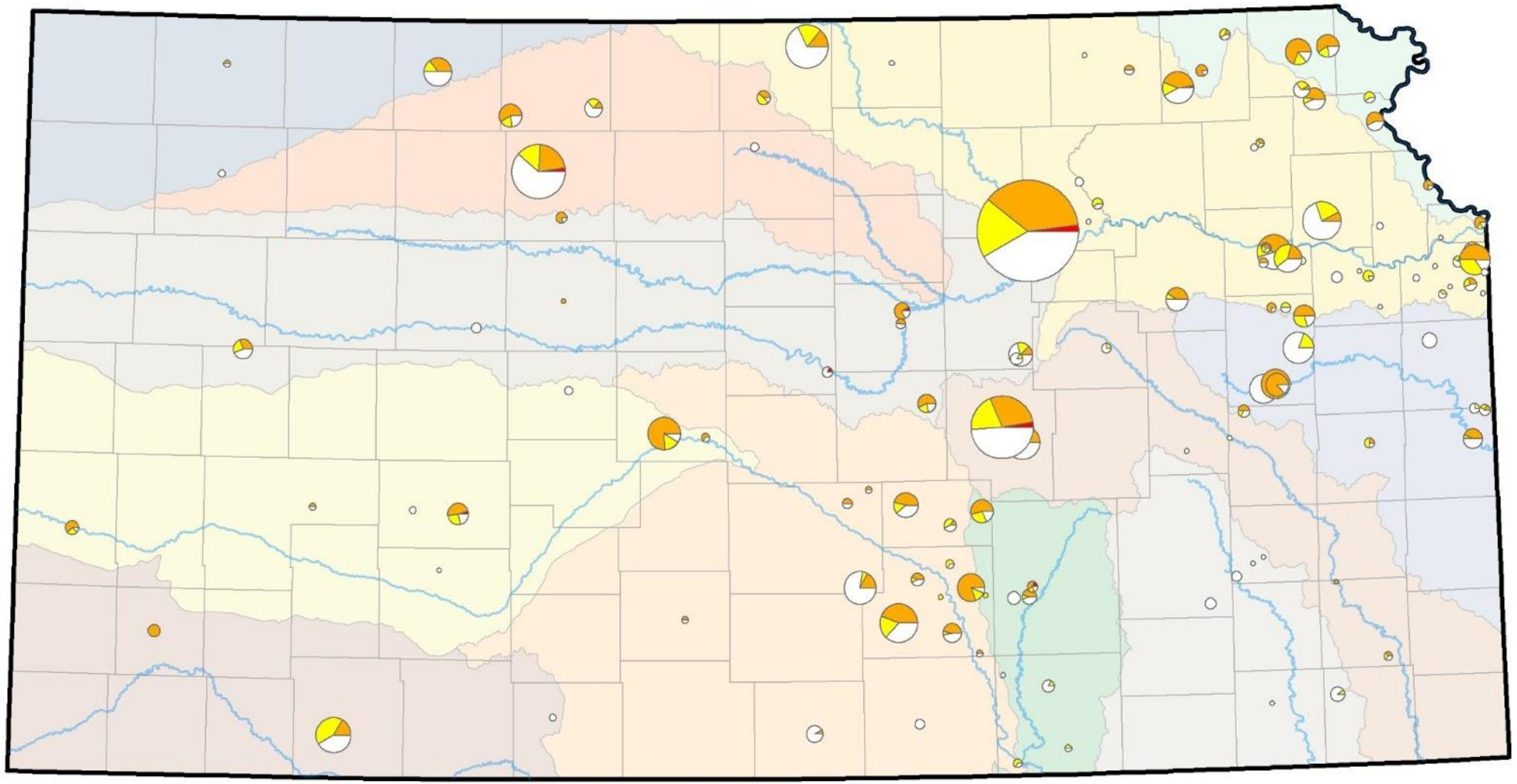
HABs happen in lakes large and small



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Blooms have occurred across state in the last decade

Why HABs?

- **Plants need:**
  - **Light**
  - **Nutrients**
  - **Water**

Many other factors (temp, wind, season) underpin HAB formation and toxicity


Where can we find answers to our HAB problem?

Long-term HAB changes

Sediment cores

Historical reconstruction using sediments

-Integrated timeline of events-

Compile historical data

Combine data from different agencies

Sediment coring

Sediment cores are like tree rings – historical record of HABs

What do algae leave behind?

Algae cells die and sink to sediment

Cellular structure degrades

But photosynthetic pigments stick around

Like deciduous trees, all algae have chlorophyll, but different secondary pigments

Ex: blue pigment in “blue-green algae”

Why cores *and* data?

Both give a view of a long (lake) story……

Analogy with a book: Cores are like cliff note version

Could also think “low resolution with full view”

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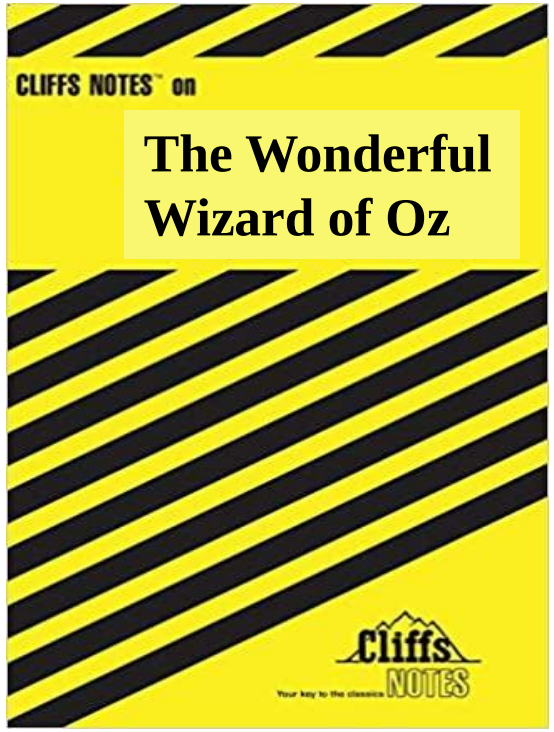


Note all important events, minor events missing, but give full story

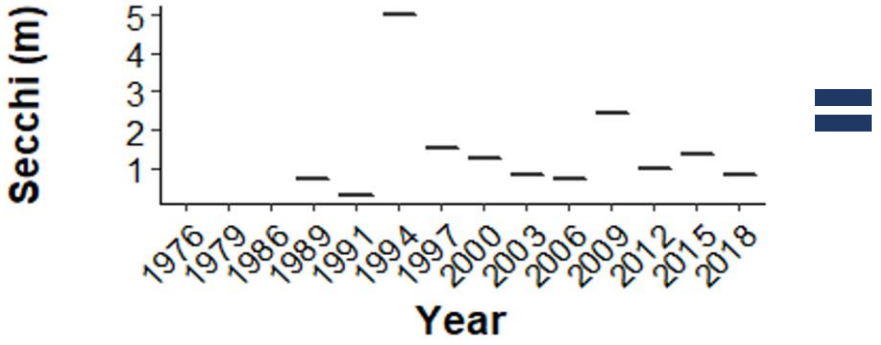
Why cores *and* data?

Analogy with a book:

Each datapoint like an individual page of a book

Could also think “high resolution with very limited view”

Samples very limited (<< 1% of all days)



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Specific details on sample day; may or may not give long-term story

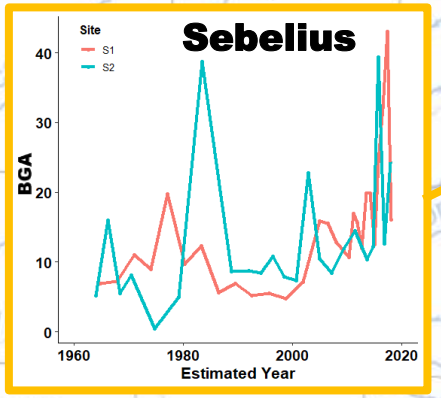
Why cores *and* data?

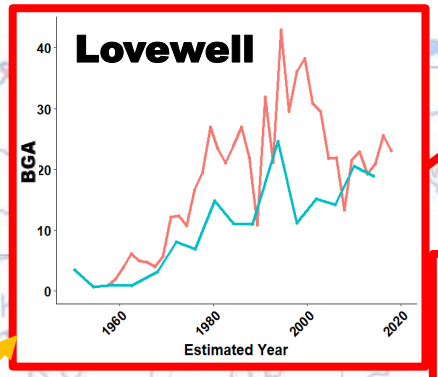
Without the cliff notes - story isn't clear

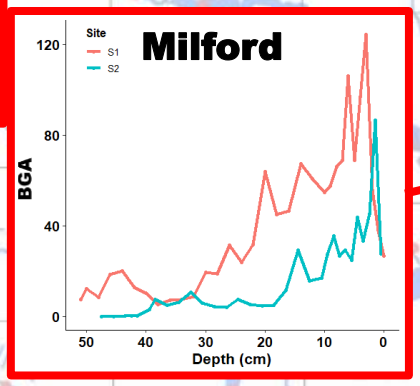
With the cliff notes - pages make sense

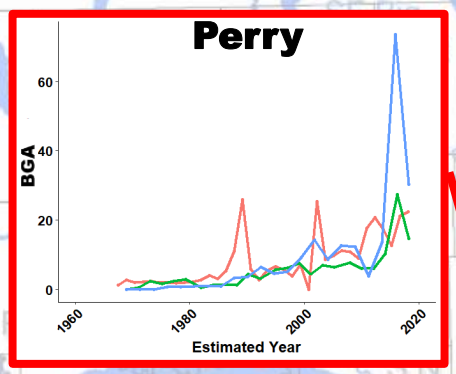
Pages add to the story,
instead of trying to tell story alone

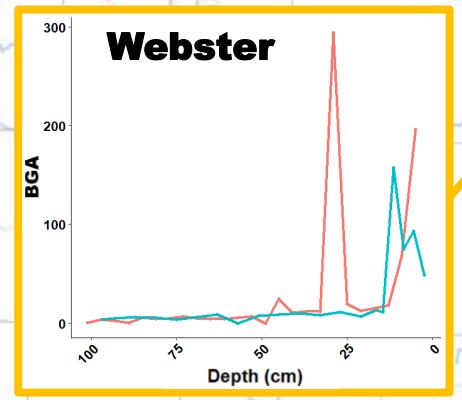
Long-Term Blue-Green Algae Trends

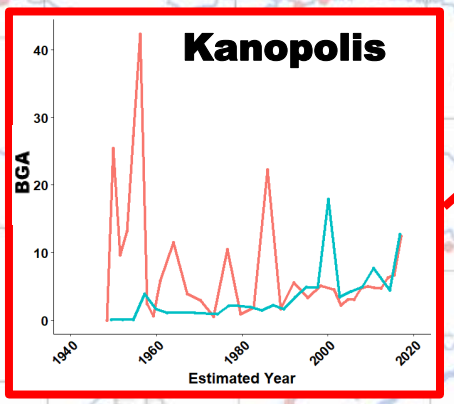


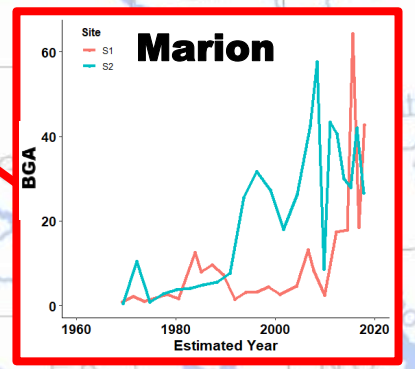












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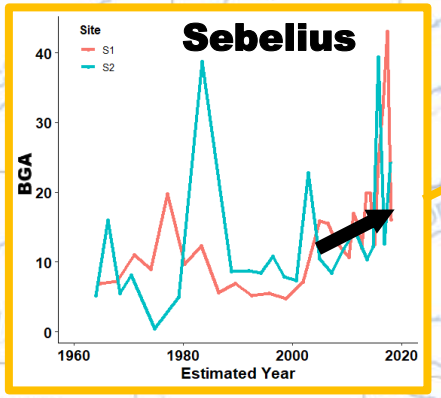
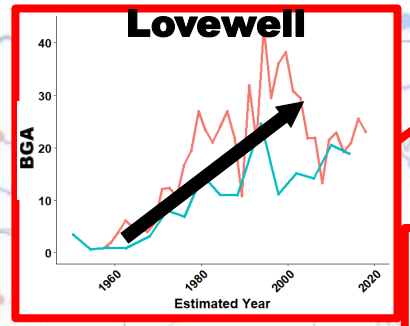
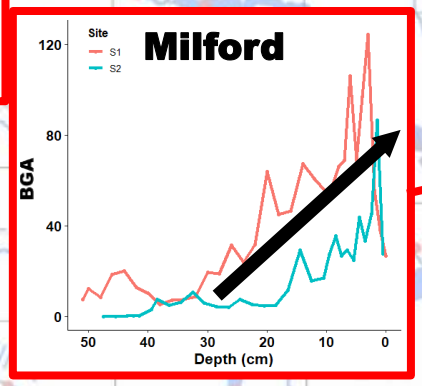
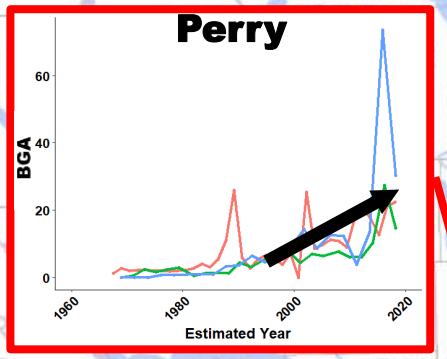
Blue-Green Algae (BGA) trends over time in KS River Basin + Marion

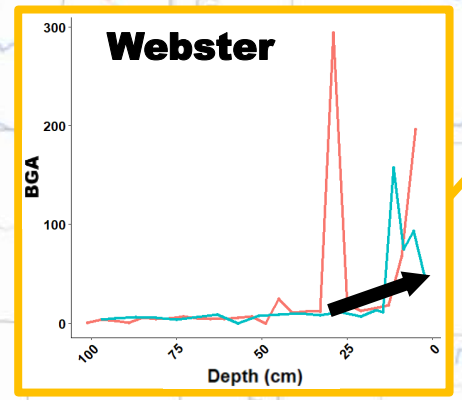
Long-Term Blue-Green Algae Trends

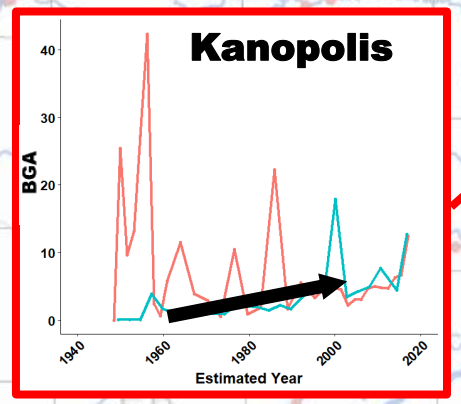


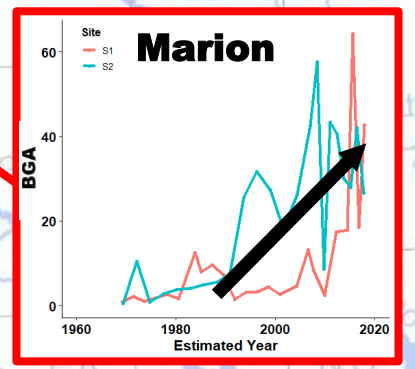












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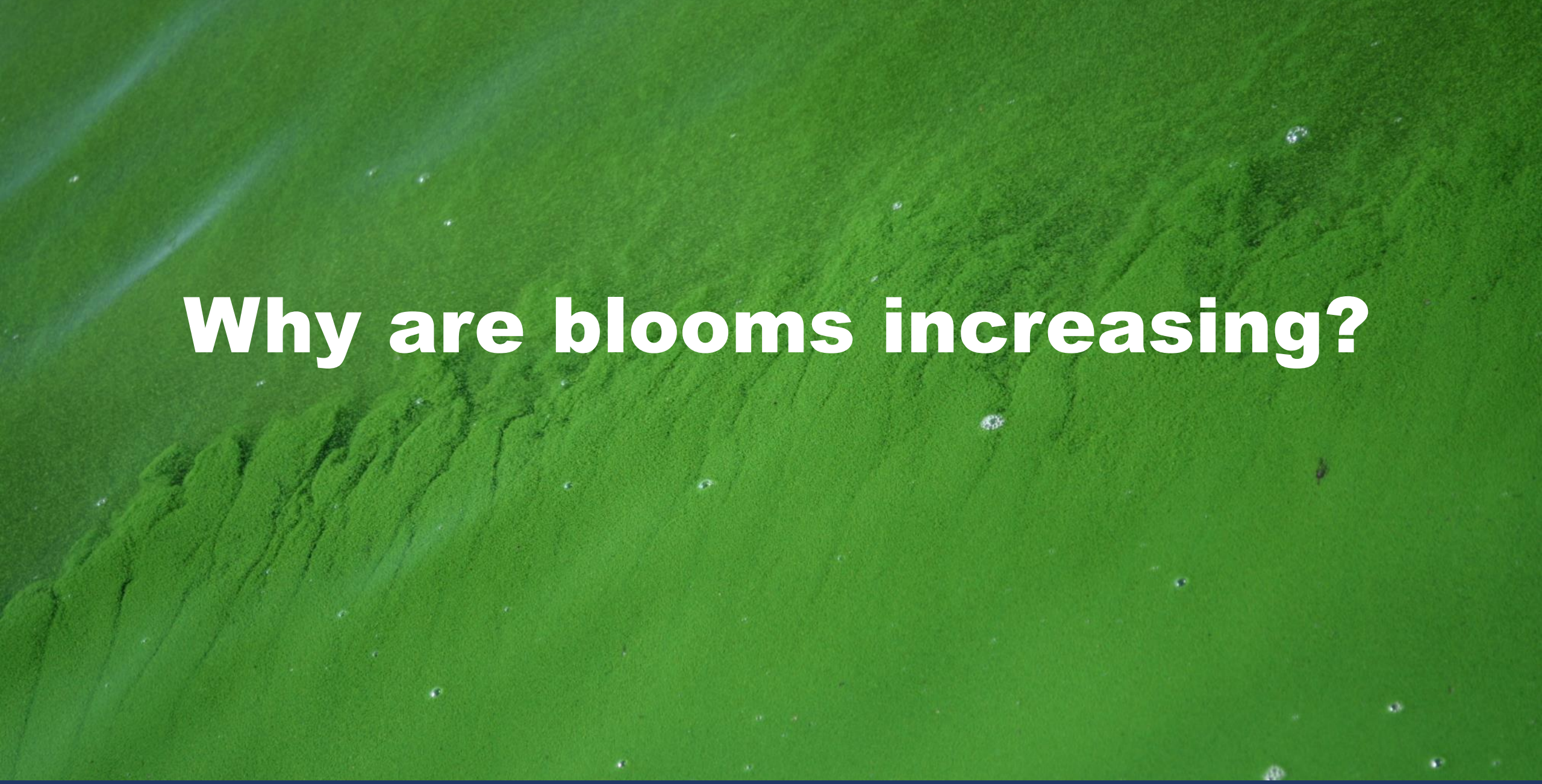
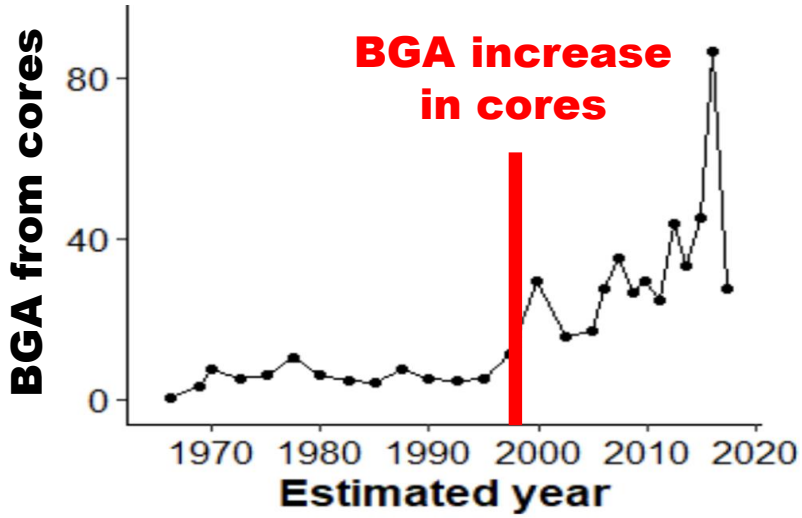
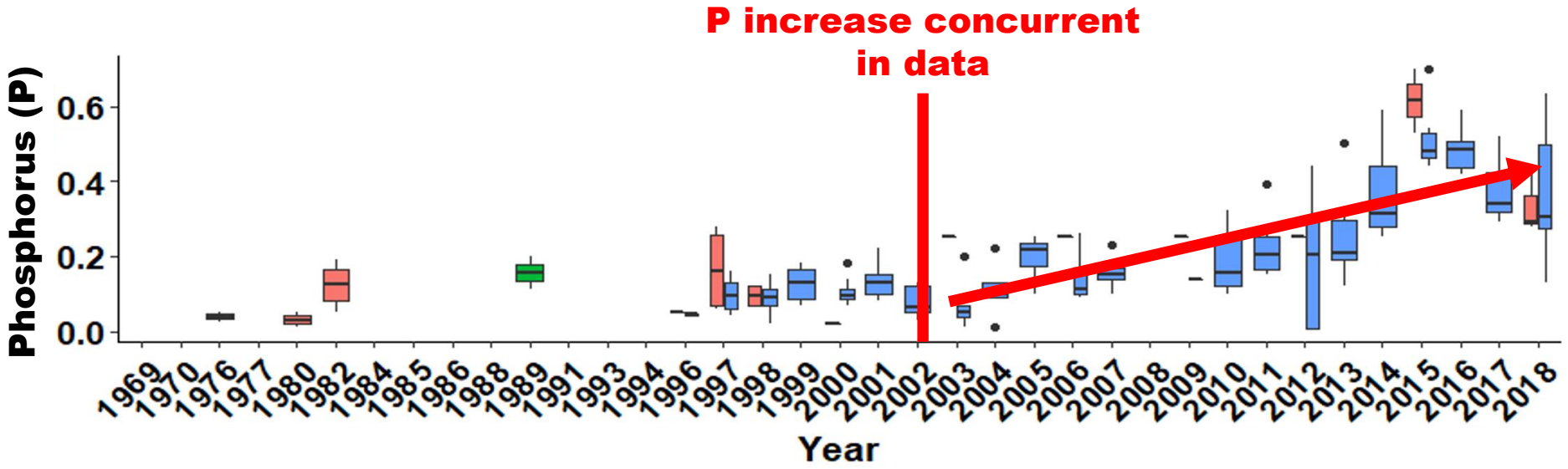
Black Line: Blue-Green Algae increasing over time. Red - LT Yellow - ST


Why are blooms increasing?

Increases in P (Milford, Marion, Perry)

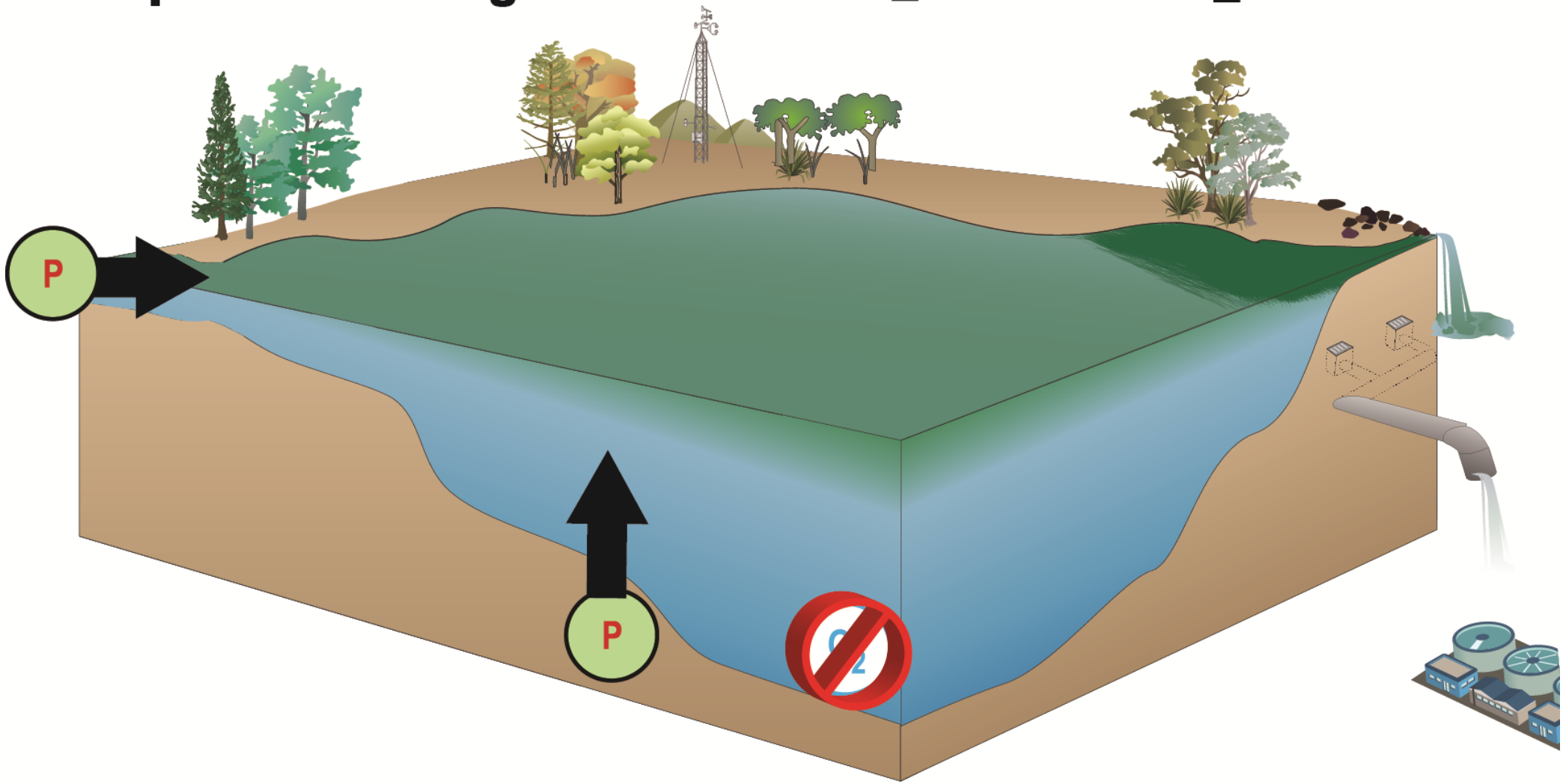




Milford example: P increase → more blooms. Marion + Perry similar

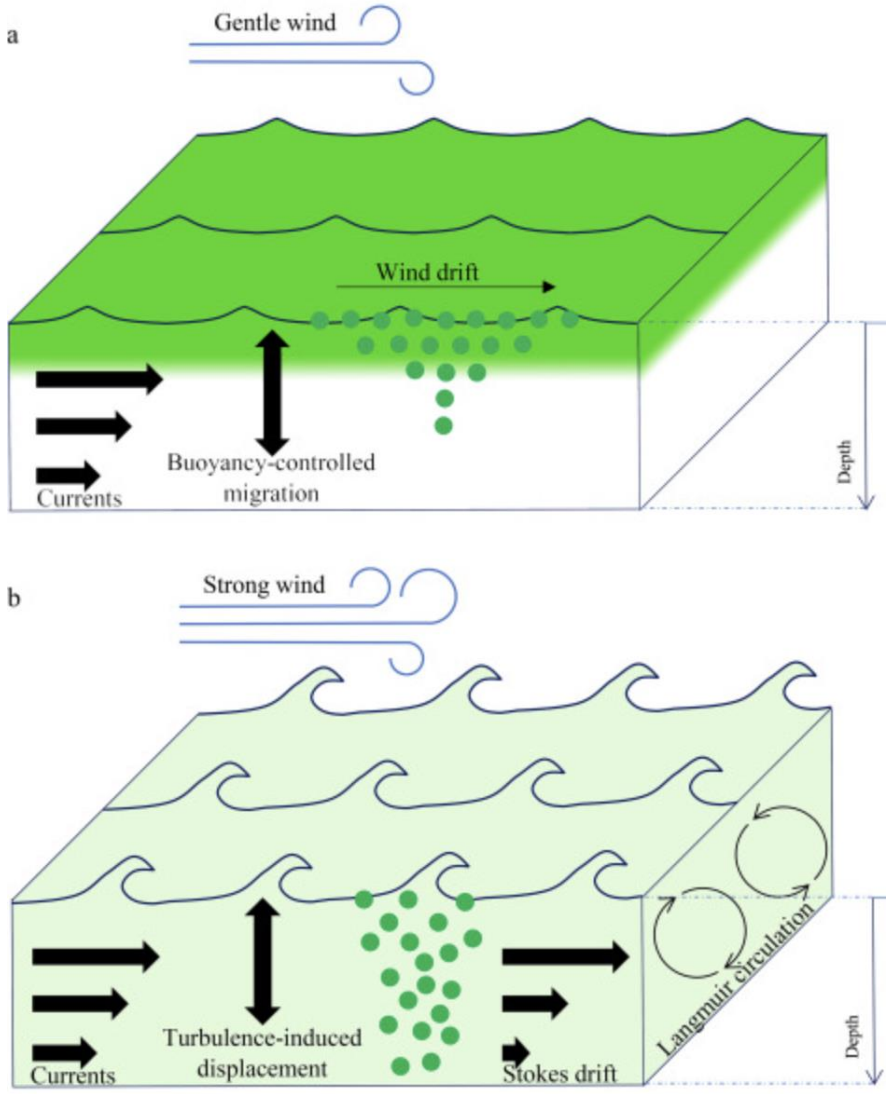
P increased from where?

Phosphorus loading in reservoirs: ↑ external = ↑ internal



Milford example: Change in land use and/or lake internal loading of P?

Other changes that favor BGA? Climate



From Ranjbar et al. 2021

Temporal and spatial variations in the frequency of compound hot, dry, and windy events in the central United States

Ameneh Tavakol, Vahid Rahmani & John Harrington Jr.

Long-term wind study found:

Avg. wind staying consistent

Increases in calm and strong wind days

Increase in calm + strong days makes blooms more dynamic

Harder to predict!

Changes in wind affect BGA. Calm wind = more BGA; Strong wind = less BGA

What does past mean for present/future?

What we know now? Blooms will continue to increase in occurrence and magnitude in most lakes

Future? More blooms →

More (expensive) advanced treatment for drinking water

More HAB warnings and closures at recreational lakes

Health risks for animals and humans

Smaller fish? Blooms disrupt lake food web

Summary

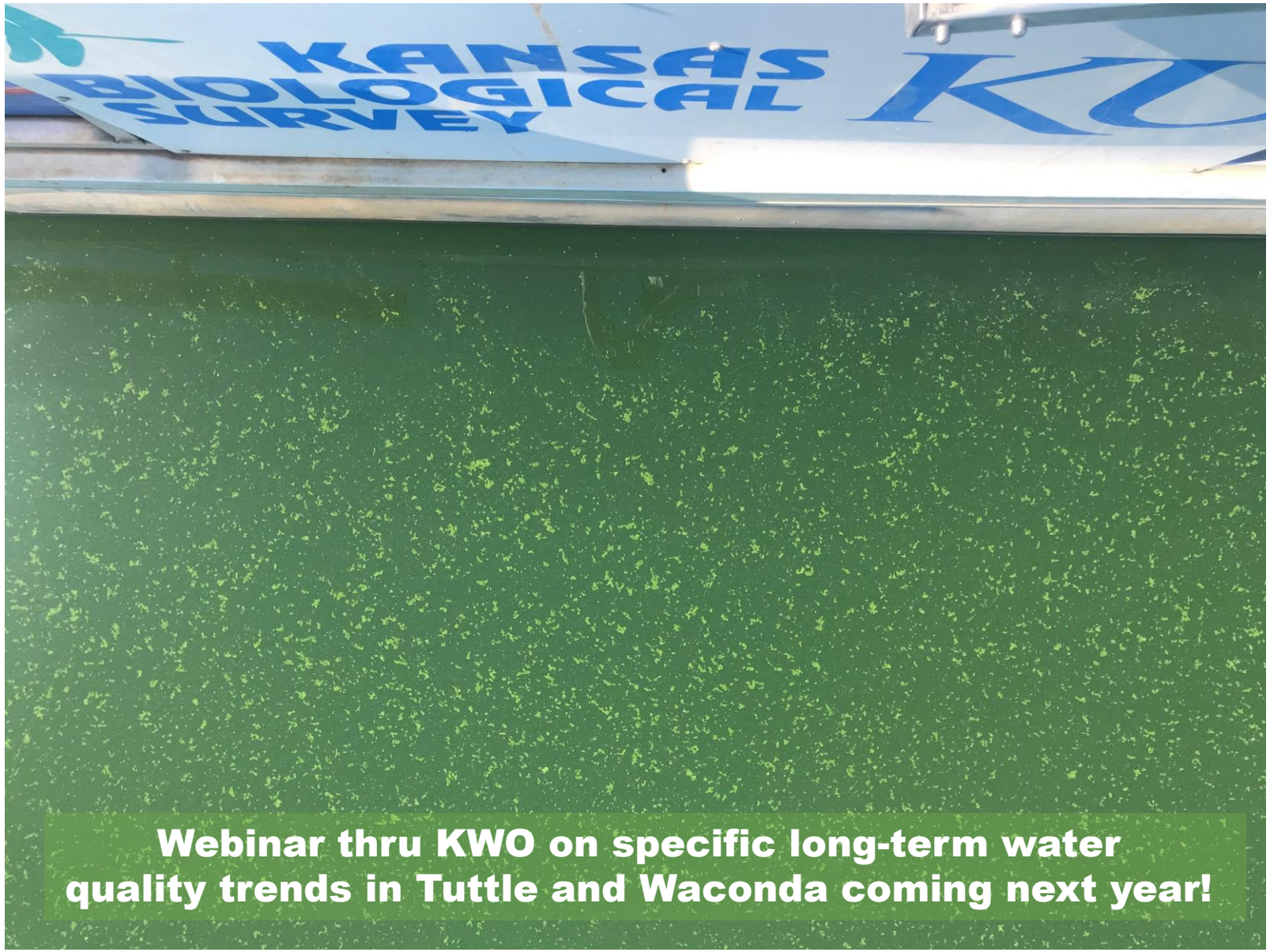
BGA blooms have increased in many large KS lakes

Cores + Data help understand when and why more blooms

Blooms increase → Changes in nutrients and climate
Climate (wind) shifts may help BGA

Nutrients are bloom fuel. Less fuel, (eventually) less blooms even if other conditions more supportive of blooms

We control long-term nutrient loading into our lakes



Webinar thru KWO on specific long-term water quality trends in Tuttle and Waconda coming next year!

Thank You!

Questions?

Thank you KWO for funding and this conference!