The Beach Bum's Guide to Harmful Algal Bloom Ecology and Why Managers Should Care



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Disclaimer: the views expressed in this presentation are those of the presenter(s) and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency. Any data presented are considered provisional.

Harmful Algal Blooms (HABs)

- Caused by photosynthetic microbes.
- Can make water unpleasant or even lethal to drink and swim in.
- Can devastate lake ecosystems and aquatic industries.
- Becoming increasingly more frequent and severe all over the world.

Lake Zurich 2013



Necessitated **avoid-contact** advisories for a couple weeks (credit: UZH)

Ohio River 2015



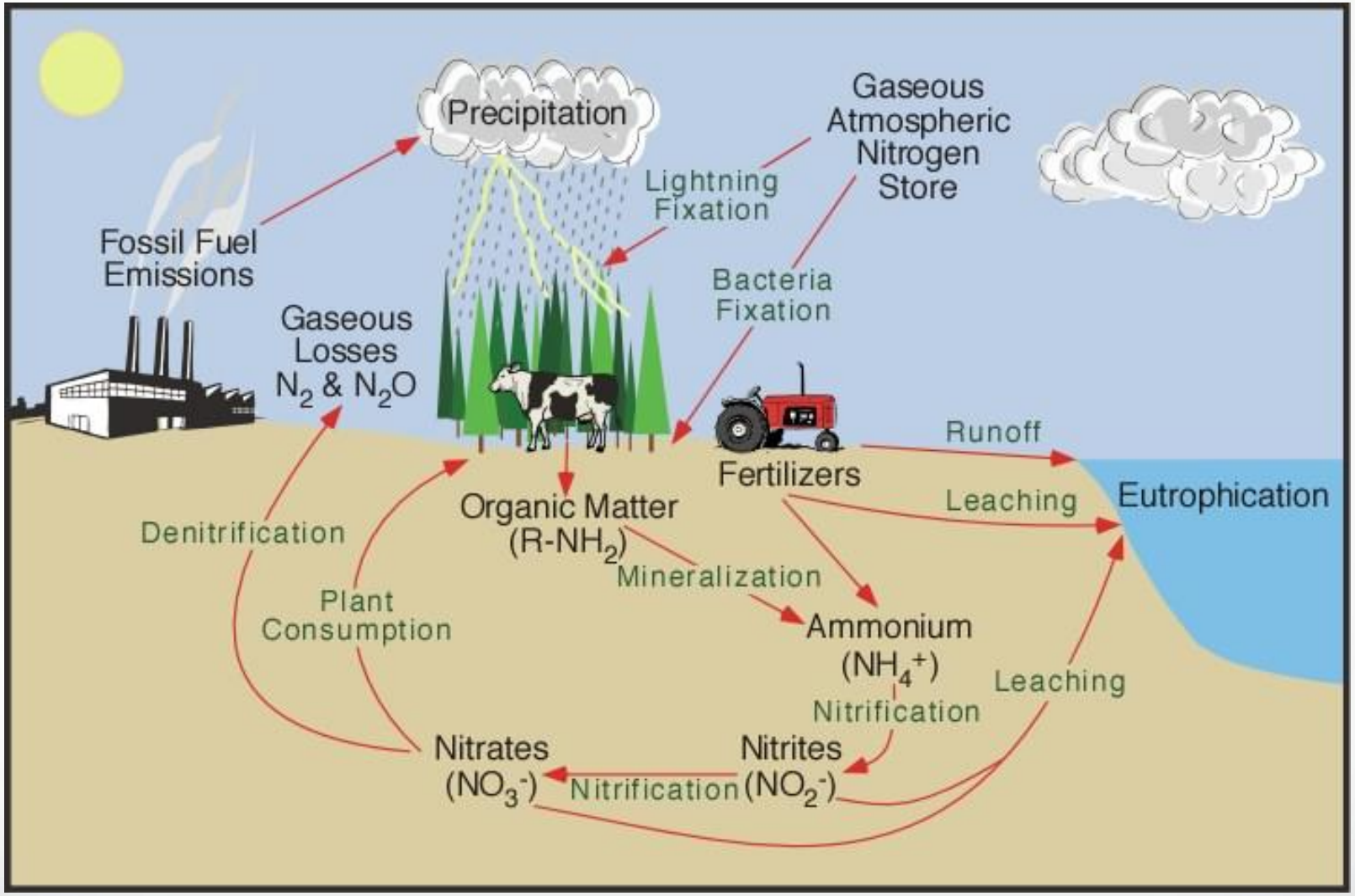
Encompassed ca. **650 miles** for **ten days**.

Lake Erie 2014



Left c**a. 450,000 people** in Ohio without safe drinking water for **two days**.

The Paradigm of HABs



This is not a lake.

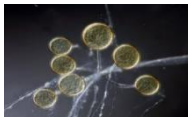


Lake Ecological Community









Predators & Parasites





Faciliators

\- +

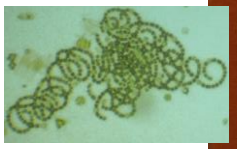


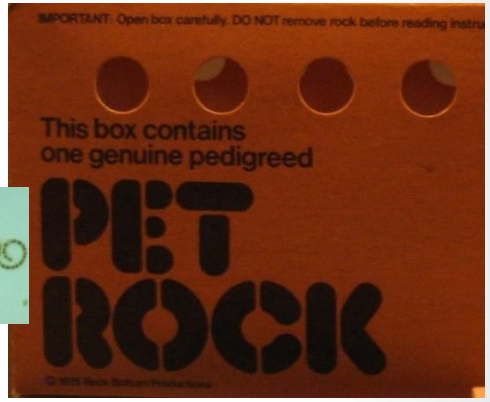


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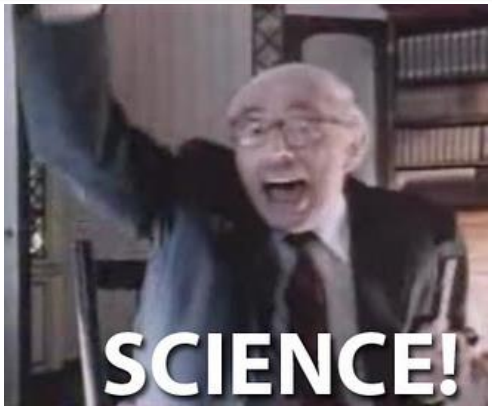


HAB-Forming Cyanobacteria

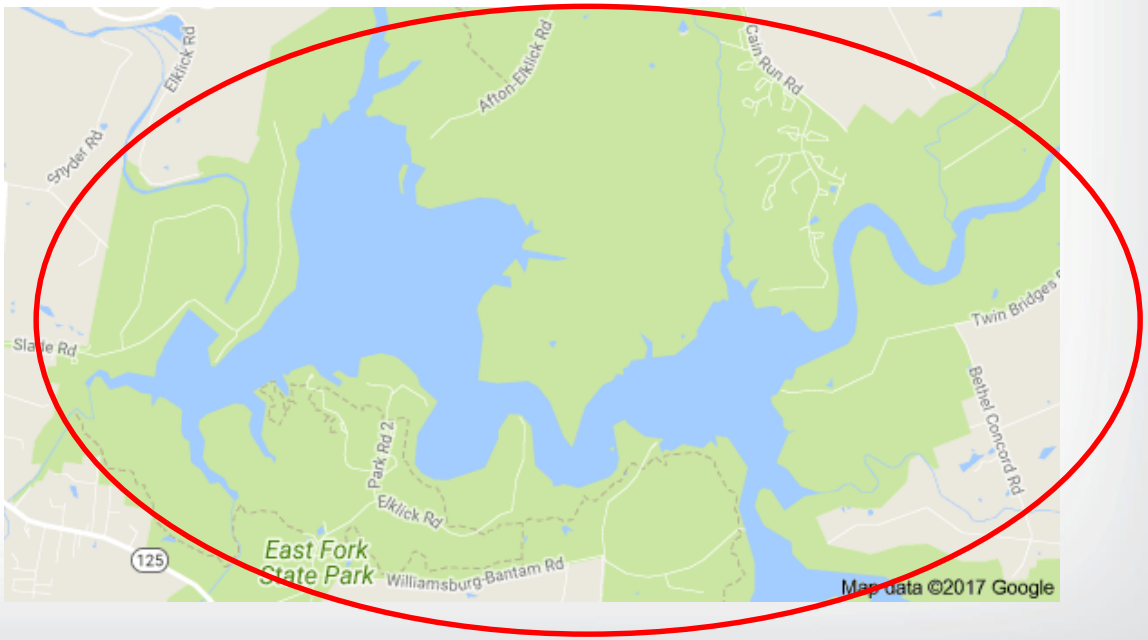
Competitors

The Game Plan:





Lake Harsha (East Fork Lake)



Only Problem Was…

I didn't know how to:

- **Collect zooplankton.**
- **ID zooplankton.**
- **Get authorization for boating and sampling.**
- **Boat.**
- **Sample.**
- **Swim.**



A + B

Field Team:

- Joel Allen
- Jim Lazorchak
- Kit Daniels
- Mia Varner





Genetics Team:

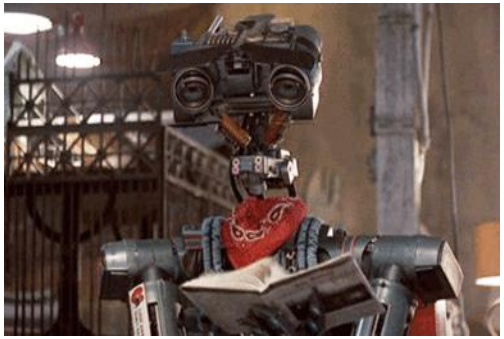
- Eric Pilgrim
- Mark Bagley
- Jorge SantoDomingo
- John Martinson
- Michael Elk
- Sara Okum
- Barry Wiechman
- Ana Braam

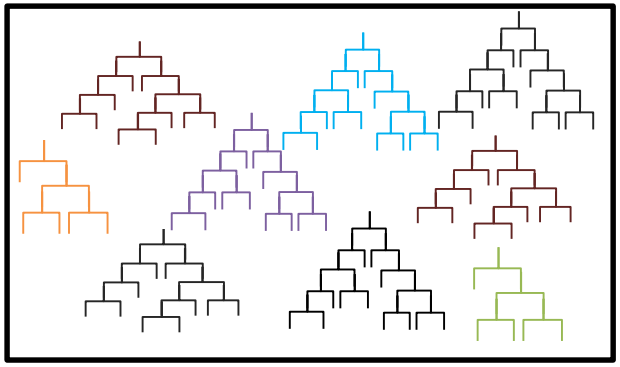


Random Forest Regression

(R package: randomForest)

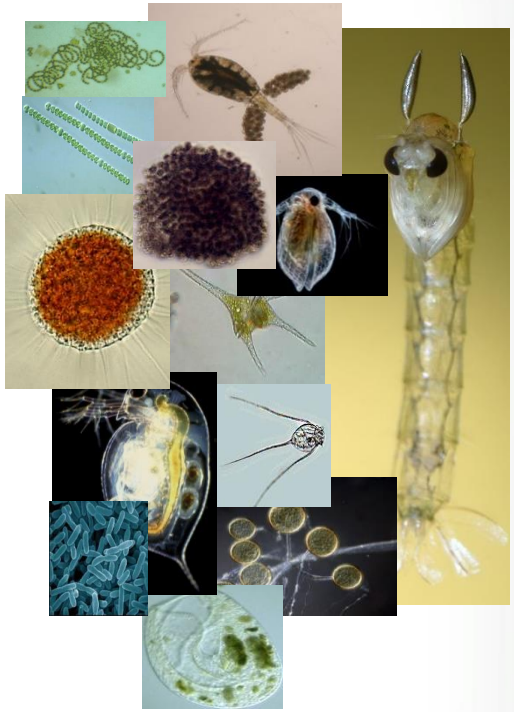
- A machine learning technique that relies on decision trees.
- Applicable in situations where:
  - # Variables >> # Observations.
  - Variables are highly correlated.
  - Variables affect one another via complex interactions.
- Can be coupled with algorithms such as "Boruta" to exclude irrelevant variables.





Results!

- Metabarcoding revealed the presence of over 7,500 different planktonic taxa (post-screening).
  - Toxin-producing cyanobacteria.
  - Other prokaryotes.
  - Various arthropods, dinoflagellates, fungi, ciliates, cryptophytes, and diatoms.
- The **biotic** factors were generally more predictive of toxin concentrations than the **abiotic**.
- Toxin concentrations appeared to have been linked to trophic cascades and some putative mutualistic symbioses.



A. Banerji, M.J. Bagley, J.A. Shoemaker, D.R. Tettenhorst, C.T. Nietch, H.J. Allen, & J.W. Santo Domingo. 2019. Evaluating putative ecological drivers of microcystin spatiotemporal dynamics using metabarcoding and environmental data. Harmful Algae 86: 84-95.

Dear Translational Scientists: A Little Help Here, Please…?!

Taxonomy vs. Traits







"Distance and parsimony indicated that OTUs 1 and 2 branched with members of Class M. Species 8472 was used for the out-group comparison."

Traits vs. Function



"Can you tell what I'm going to bake? Here's hint: I'm using flour!"

Thank you for your attention!



Questions?
Comments?
Snide Remarks?

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