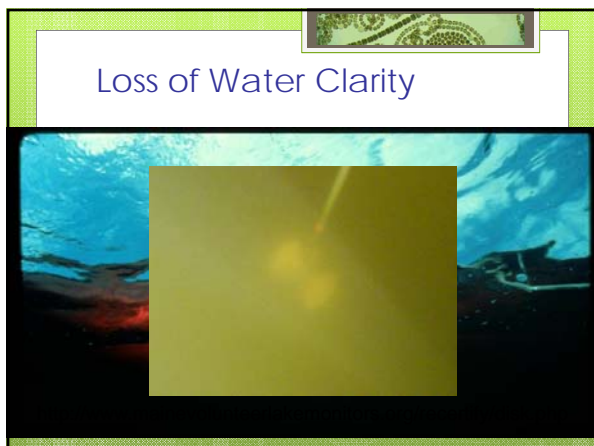
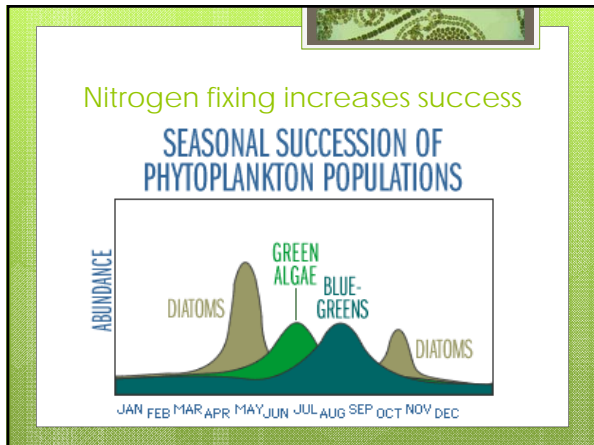


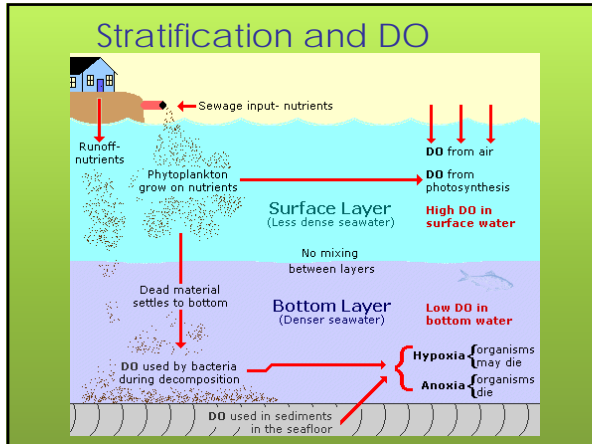
We know...

- Cyanobacteria have been around for a LONG time (3.5 Billion years),
- Some scientists believe they helped convert the atmosphere to an oxygen enriched system,
- Much of our Proterozoic oil reserves are attributed to the activity of cyanobacteria,
- Important for the health and growth of many plants by fixing nitrogen (think legumes),
- *Spirulina* is even considered an important, high protein food source, a "health food"

<http://www.ucmp.berkeley.edu/bacteria/cyanofr.html>



Blooms block sunlight and kill off submerged plants – shifting lake ecology entirely



- ### What we know...
- Some species of cyanobacteria can produce toxins;
 - Toxin producing species don't always produce toxins;
 - We don't understand what conditions cause the toxin producing genes to be switched on in toxigenic species;
 - We know enough to be concerned, but still need to do a lot more research to fully understand the causes and implications.

Types of Toxins Produced by Cyanobacteria

- Hepatotoxins (liver toxins)**
 - Common toxins: microcystins, cylindrospermopsins
 - Symptoms of exposure: Vomiting, Diarrhea, Fever, Cramps. Similar to illnesses caused by water borne pathogens.
- Neurotoxins**
 - Common toxins: anatoxins, saxitoxins
 - Symptoms of exposure: Paralysis, Seizure
- Dermatotoxins**
 - Common toxins: lipopolysaccharides, lyngbyatoxin
 - Symptoms of exposure: Irritation to eyes, ears, throat; Rashes, and skin lesions

Photo courtesy of L. Merchant-Masonbrink

USGS logo

Toxic Cyanobacteria

- 2,000 species: ~ 40 known to produce toxins
- Anabaena* spp.
- Microcystis* spp.
- Planktothrix* spp.
- Nostoc* spp.
- Nodularia spumigena*

BMAA Neurotoxin

- Produced by over 30 species of cyanobacteria:
 - Microcystis,
 - Anabaena,
 - Nostoc,
 - Planktothrix
- Can cause motor neuron disease or death
- Accumulates in brain tissue
- Linked to ALS in Guam
- Questions about possible BMAA links to other neurodegenerative diseases

How People and Animals are Exposed to Cyanobacterial Toxins

- Ingestion and inhalation during recreational activities
- Inhalation of aerosolized toxins
- Consumption in drinking water
 - Drinking-water treatment processes effectively remove most toxins



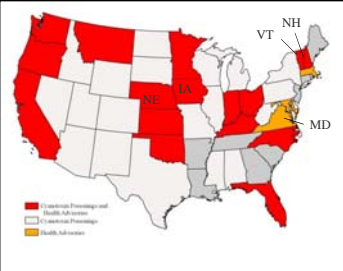

Do not try this at home (or anywhere else)!

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How Common are Toxic Cyanobacterial Blooms?

At least 36 U.S. states have anecdotal reports of human or animal poisonings associated with cyanotoxins, but there are not good records of how frequently cyanotoxin-related poisonings occur.

- 5 states have routine monitoring programs for cyanotoxins.
- 17 states have action plans and/or public education programs for cyanotoxins, including Kansas
- USGS has measured cyanotoxins in most states, including 5 that have not had poisonings or advisories (AK, AR, LA, GA, and DE).



Legend:
 ■ Routine Monitoring
 ■ Action Plan / Public Education
 ■ No Data / No Program
 ■ Health Advisories

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After Graham and others, 2009

We Know Why Algal Blooms Bad

- Ecologic Concerns**
 - Low dissolved oxygen
 - Food web shifts
 - Fish kills
- Economic Concerns**
 - Loss of recreational revenue
 - Taste and odor
 - Added drinking water treatment costs
- Health Concerns**
 - Toxicity (cyanobacteria only)



Iowa - cyanobacteria bloom



Kansas - cyanobacteria bloom

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Treatment Options Are Limited

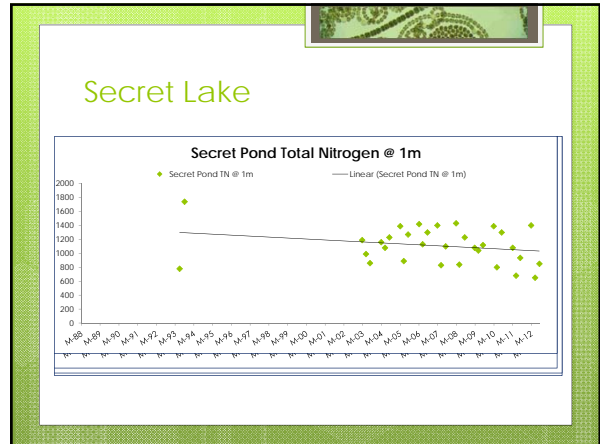
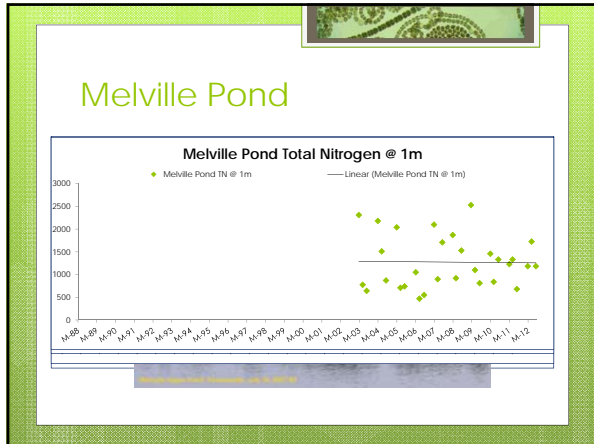
- Not sure what causes toxicity
- Algae blooms are caused by:
 - Excess nutrients / cycles ratios (N/P) thrown off
 - Urban/Residential runoff
 - Lack of/not enough BMP's in place
 - Watershed scale management needed
- In lake controls (Phosphorus inactivation)
- Algaecides / copper sulfate NOT recommended because the dead algal cells can release toxins

Emerging technology

- Appropriate for smaller, shallow ponds
- Works best as a preventative (i.e. installed BEFORE the onset of an algal bloom)
- Which makes it difficult to assess the efficacy
- May be a good option for decorative detention ponds, RWP Ponds, others



SonicSOLUTIONS
Control Algae Without Chemicals



- ### Long-term solutions are best
- Watershed based best management practices
 - Stormwater management
 - Shoreland and wetland
 - Protection
 - Restoration
 - In lake techniques when feasible
 - Avoidance (you and your pet) when the lake looks **GREEN**



Presentation Outline

- What are (harmful) algae?
- Why are they growing so bloomin' well?
- What are their impacts?
- Options for treatment?
- Blooms in Rhode Island
- RI's response to the issue

Melville Pond, Portsmouth RI