Session One Summary

What You Should Know About Cyanobacteria:

What are Cyanobacteria? Why are they a concern?

- Previously referred to as blue-green algae
- Single-celled organisms lacking a nuclear membrane
- Contain photosynthetic pigments: Chlorophyll-a & Phycobilins (produce the characteristic blue-green color)
- Some cyanobacteria produce toxins that can adversely impact both animals and humans.
- Toxic cyanobacteria are found worldwide in both inland and coastal waters.
- We know they are here. First reports of toxic cyanobacteria in NH occurred in the '60s & '70s.
- Most human health impacts have resulted from ingestion of contaminated water; illnesses have also been attributed to swimming in waters infested with cyanobacteria.

Common Cyanotoxins in NH:

Toxin	Target Organ	Cyanobacteria
Microcystin/Hepatotoxin	Liver	Microcystis, Oscillatoria, Anabaena
Anatoxin/Neurotoxin	Nerve synapses	Anabaena, Oscillatoria
Saxitoxin/Neurotoxin	Nerve axons	Aphanizomenon, Anabaena
Dermatotoxin/Aplysiatoxin	Skin	Lyngbya, Oscillatoria

What Accelerates Growth Rate?

- Sunlight
- Warm water (hot summer days)
- Calm, stagnant conditions
- Phosphorus

Cyanobacteria Seasonal Cycle

Spring => more sunlight + warmer temperatures => cyanobacteria move up the water column, rising toward the surface where they can form dense blooms or scums usually observed from mid summer well into the fall.

Problems with Blooms

- Unsightly
- Taste Problems: can lead to bad tastes in water including bitter, fishy, & sweet.
- Toxins
- Odor Problems: water can smell fishy, grassy, like geraniums, or musty.
- Fish Kills

Phosphorus is a Problem! Possible sources:

- Stormwater Runoff
- Waterfowl
- Septic systems
- Domestic animals
- Agriculture
- Fertilizers
- Construction

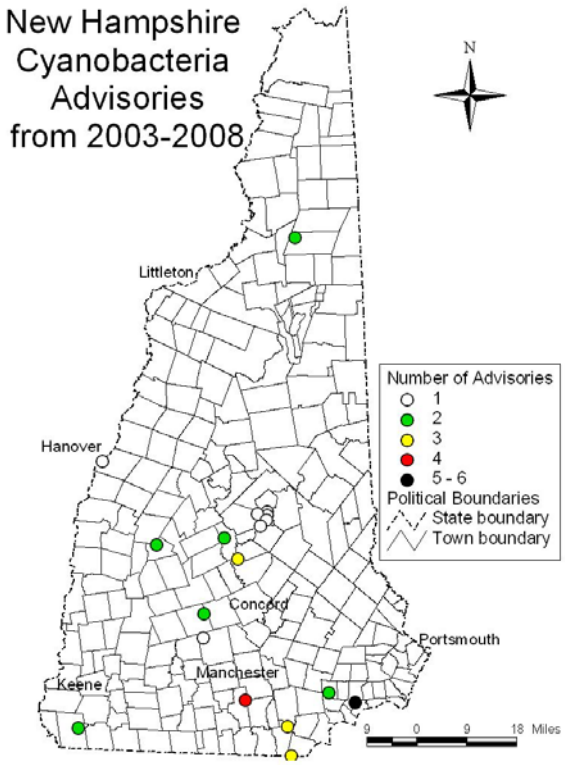

Figure 1. Map illustrating the **distribution and frequency** of cyanobacteria blooms across NH in terms of advisories & warnings issued by the NHDES.

Results of the 1999-2000 Microcystin Survey of 50 NH Lakes
(Jim Haney, John Sasner & Mike Ikawa, University of New Hampshire)

- Demonstrated that some lakes have very small amounts of relatively toxic plankton while other lakes have large quantities of plankton with low specific toxicity.
- Microcystin toxins were present in <u>all</u> 50 of the lakes examined.
- These results *shifted the emphasis* from asking, "Which lakes have toxic cyanobacteria?" to "<u>What controls the level of cyanobacteria toxins in lakes</u>?"

Session Two Summary
Public Health Implications & Non-human Lake Users:

- Reports of deaths and illnesses due to cyanobacteria are increasing world-wide.
- However, cyanobacteria blooms are not a recent phenomenon and may be the cause of mass die-offs of prehistoric animals
- Human activities on and in the lake watershed tend to promote the growth of toxic cyanobacteria
- Reported cases of deaths of domestic animals often associated with the ingestion of water by pets, cattle, sheep, etc.
- There are many examples of large-scale deaths of aquatic birds and fish related to blooms of cyanobacteria
- Most studies have focused on the acute toxicities caused by cyanobacteria; There is very little known about chronic effects of long-term exposure to cyanotoxins

Major known cyanotoxins and their health-related effects

Toxin	Target Organ	Symptoms of Exposure
Microcystins/Nodularins	Liver	**Acute**: hepatocyte apotosis (live cell death), death in days **Chronic**: linked to liver & colon cancer, tumor growth
Anatoxin a/Anatoxin a(s)	Nerve synapses	Convulsions, rapid death; Often associated with deaths of dogs and birds
Saxitoxin/Neurotoxin	Nerve axons	Numbness, trembling, paralysis, death by respiratory arrest; interference with neurodevelopment in fish
Cylindrospermopsins	Liver	Mainly hepatic and renal effects in humans; poorly studied
β-*N*-methylamino-L-alanine (BMAA)	Nerve	Neurotoxic effect appears to be release of excess calcium in the neurons; may be linked to neurological diseases

Example Case Studies

- 1979 Palm Island Mystery Disease in Queensland, Australia. 140 aboriginal children & 10 adults treated for hepato-enteritis related to bloom of *Cylindrospermopsis* that was treated with copper sulfate
- 1988 Gastro-enteritis epidemic at Itaparica Dam, Brazil. 2000 cases, with 88 deaths. Suspected cause: *Anabaena* and *Microcystis*.
- 1996 Caruaru, Brazil, 117 dialysis patients developed severe hepatitis, 50-60 died from use of filtered lake water contaminated with microcystins.

Possible Pathways of Transmission of Cyanotoxins

- Direct contact with water, e.g. recreational use
- Drinking water, water supplies and accidental ingestion
- Ingestion through the food chain
- Inhalation of aerosolized toxins

Session Three Summary

The sampling process and keeping you informed

Cyanobacteria Warnings at Lakes and Advisories for Beaches: When are They Issued, What do They Mean, and What Makes Them Go Away

How does DES sample for cyanobacteria?

- If staff see a suspected cyanobacteria bloom during a lake or river visit, a sample is taken.
    - Freshwater Beach Inspector visits 163 beaches 3 times in the summer
    - Volunteer Lake Monitor Staff visit 173 lakes at least once each year.
    - Biology Section staff visit at least 158 lakes statewide each summer for other studies.
- If a citizen contacts DES with a sighting, staff visits waterbody within 24 hours.

What happens to a sample brought to the Concord Lab?

- Sample microscopically examined within 24 hours
- Relative abundance of toxin producing cyanobacteria calculated
    - Count cells of toxin producing vs. non-toxin producing
    - Standard is more than 50% of the cells counted are toxin producing
- Sample frozen for future microcystin toxin analysis

What is the next step if a sample contains more then 50% toxin producing cyanobacteria?

- Either a Beach Advisory or Lake Warning is issued

What determines whether situation is a Beach Advisory or a Lake Warning?

- Beach Advisory if sample collected at a beach
    - Beach manager contacted directly
    - Signs posted at entrance to beach or other prominent locations
- Lake Warning if sample collected at a lake without a beach or on a large lake far from a beach
    - If citizen or volunteer brought in sample, they are contacted
- For both:
    - Press Release issued
    - Posted on: **http://des.nh.gov** & Twitter Feed **www.twitter.com/NHDES_Beaches**
    - Email sent to people who signed up for enews subscription at **http://des.nh.gov**

When is a Beach Advisory or a Lake Warning removed?

- Further weekly samples are analyzed and relative abundance is below 50%
- Beach Manager contacted, web posting removed, status updated on Twitter, email sent