Algal Ecology

Harmful Algal Bloom Workshops
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Algal Ecology

- What are algae?
- What kinds of algae are there?
- What are the nutrient requirements of algae?
- Plants – phytoplankton – major habitats
- Literature lake algal sequence vs Mn lake algal sequence
- More on BGA and special attributes that enable them to bloom so successfully?
- Examples of BGA and some recent incidents
- Why is BGA toxicity hard to predict
What are algae?

• algae generally are small to microscopic plants, but some marine brown algae can grow very large

• algae have a world-wide distribution and can be found in water, soils, and the air

• algae photosynthesize during the day and respire 24/7
What kinds of algae are there?

- most common types are diatoms, blue-green algae, green algae, dinoflagellates, and chrysophytes
Diatoms [Bacillariophyceae]
Bluegreen Algae [Cyanobacteria]
Green Algae [Chlorophyta]
Dinoflagellates [Pyrrhophyta]
Yellow-brown algae [Chrysophyta]
Plants – phytoplankton – major habitats

• Algae
  – Phytoplankton (float freely in the water)
  – Periphyton (attached to aquatic vegetation, rocks, wood and other substrates)
  – Benthic algae (grow on the lake bottom/sediments); also sometimes called periphyton
What are the nutrient requirements of algae?

- Algae are plants, so they need CO$_2$ & H$_2$O, plus nutrients like phosphorus and nitrogen.
- Diatoms have an added requirement, silica, because of their outer case.
How do algae fit into the food web?
Literature lake algal sequence vs Mn lake algal sequence

• The ‘literature’ refers to a classical lake algal seasonal sequence: diatoms to greens to blue-greens to diatoms

• In Minnesota lakes, we have found the green algae step to be very diminished
Seasonal Trends

Seasonal Succession of Phytoplankton Populations

Washburn Lake Summer Algal Trend Site 103

Rapid Assessment of Algal Community
Eden Lake

Percent of Abundance

Blue Greens | Diatoms | Yellow-Browns | Other

June | July | Aug | Sept

0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100%

June | July | Aug | Sept

0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100%

Blue Greens

- Unicellular, (non-N\textsubscript{2} fixing)
  *Microcystis*, *Gomphosphaeria*

- Filamentous, non-heterocystous
  (mostly non-N\textsubscript{2} fixing)
  *Lyngbya*, *Oscillatoria* *

- Filamentous, heterocystous (N\textsubscript{2} fixing)
  *Anabaena*, *Aphanizomenon*,
  *Cylindrospermopsis*, *Nodularia*

* Contains Toxic strains

Hans Paerl, UNC
What are the special attributes of Blue-green algae that enable them to bloom so successfully?

- nitrogen fixation
- buoyancy
- iron fixation
Complexity in predicting toxic conditions

![Graph showing Chl-a and Microcystin concentrations over different months.]

- **May**: 8,400 µg/L, 96% Chl-a, 22% Microcystin
- **June**: 200 µg/L, 20% Chl-a, 5.2% Microcystin
- **July**: 238 µg/L, 37% Chl-a, 3.1% Microcystin
- **Early August**: 37 µg/L, 26% Chl-a, 4.9% Microcystin
- **Late August**: 4.9 µg/L, 29% Chl-a, 4% Microcystin
- **September**: 4 µg/L, 29% Chl-a, 4% Microcystin

Legend:
- **Chl-a**: Chlorophyll-a
- **Microcystin**: Microcystin toxin producers
- **% Toxin Producers**: Percentage of toxin-producing cyanobacteria

Note: The graph indicates complexity in predicting toxic conditions due to varying concentrations and percentages.
Blue-green Algal toxicity

- Cyanobacteria can produce a wide array of neurotoxins, liver toxins, cell toxins and skin irritants. In addition, many genera, such as *Anabaena*, can produce multiple toxins.
- The rest of the Workshop will discuss this in greater detail.