2022: Two late-season cyanobacteria blooms

- No significant blooms were observed June, July or August, likely due to the drought which meant little runoff of nutrients into the lake.

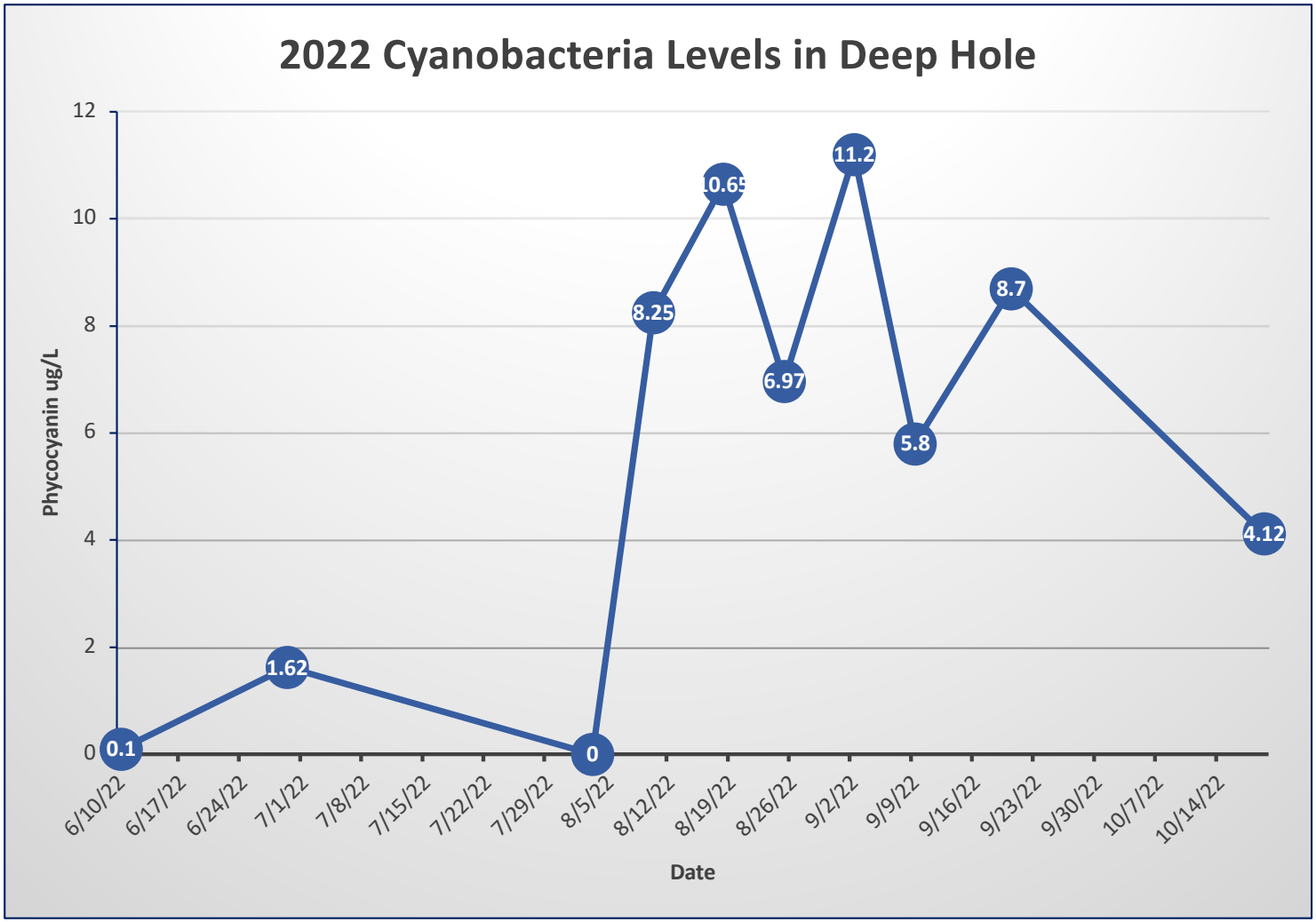
- On **Sept 9**, after a 4.3 inch rain event on Sept 5-6, cyanobacteria were seen as bright small green bits in top few feet of water in the northwest section of the lake, including the deep hole. A grab sample from the west cove (Fletcher's cove) was 61% *Dolichospermum* and 39% *Microcystis* by microscopy, and fluorimetry showed high levels of a pigment produced by cyanobacteria (1,194 ug/L phycocyanin).
- On **Sept 11,** after two days, cyanobacteria had cleared from deeper water, but clumps of cyanobacteria persisted, and were seen on the eastern and western shores.
- On **Oct 16-18**, cyanobacteria was sighted at Memorial Beach, along the eastern shore, and Fletcher's cove. A sample from Memorial beach on Oct 17 showed a significant level of phycocyanin (20,280 ug/L). This bloom also cleared quickly.

- Photos are on next page.

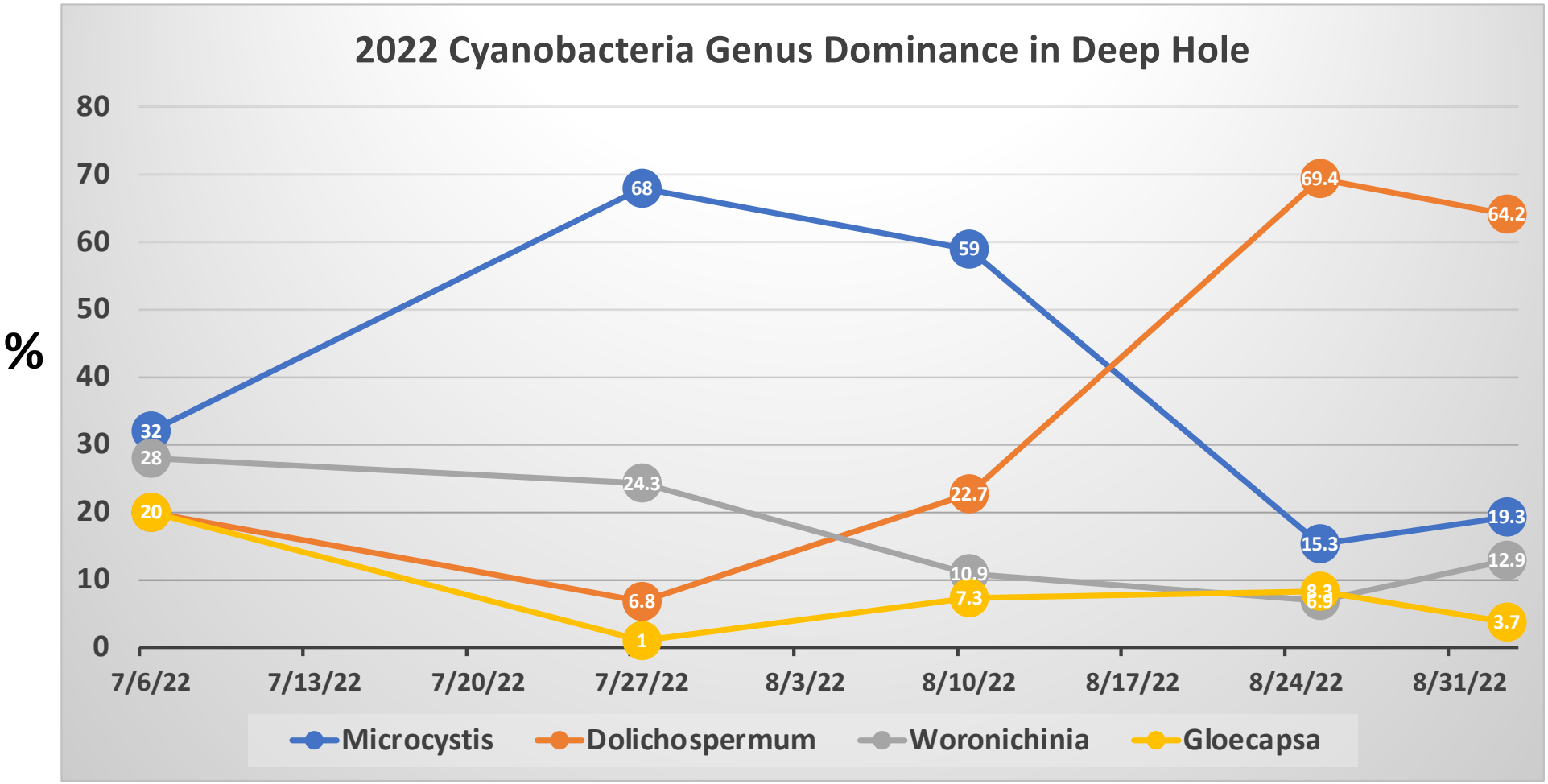
Keep you and your pets away from these clumps of cyanobacteria.

Photos below *(right to left)* are from:

- Sept 14, Massapoag Yacht Club
- Sept 14, south of Everwood Day Camp
- Oct 16, eastern side of lake



- Deep hole monitoring of cyanobacteria levels: Samples integrated over the top 3 meters of water in the deep hole were tested for levels of phycocyanin, a cyanobacteria-specific protein.
- Levels were low/non-detectable in June & July, and detectable but low in August.
- Benchmarks developed by the Worcester Cyanobacteria Monitoring Collaborative suggest there is low risk of toxin exposure under these conditions (*ie.* Dolichospermum and Microcystis are the predominant cyanobacteria; <12 ug/L phycocyanin.)

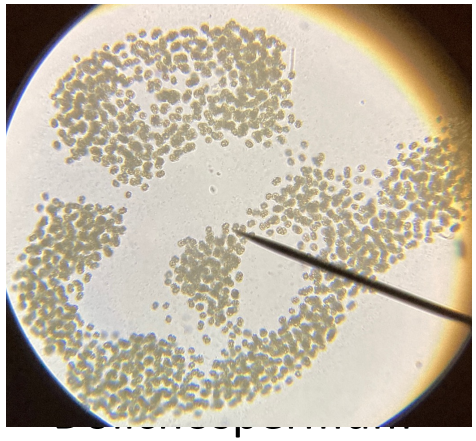
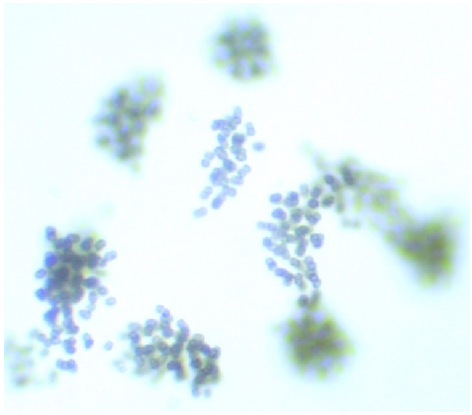


- Deep hole cyanobacteria monitoring: Plankton from the top 3 meters of water in the deep hole were concentrated with a plankton net. Bloom forming colonies were separated by flotation (ZAPPR), and counted using a Sedgewick Rafter counting chamber.

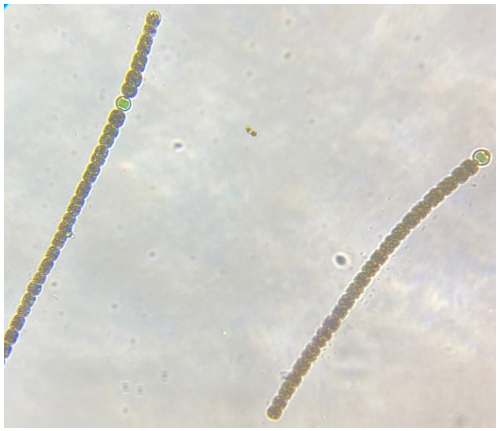
- Microcystis was the dominant genus in late July – Early August; Dolichospermum became the dominant genus in Late August.

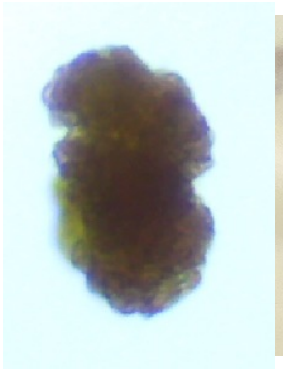
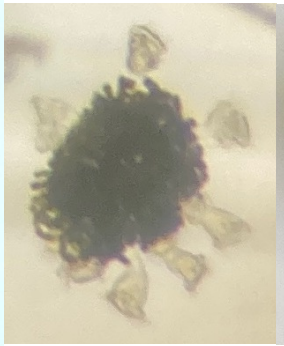
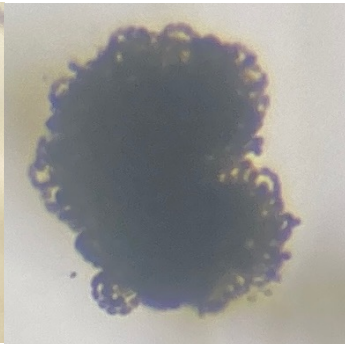
2022: Predominant cyanobacteria in Deep Hole by genus

Microcystis

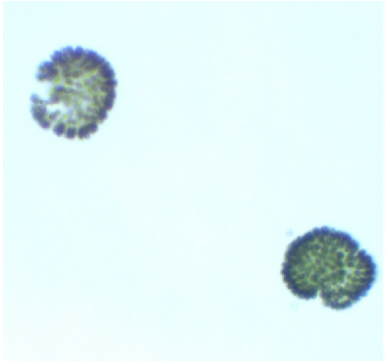
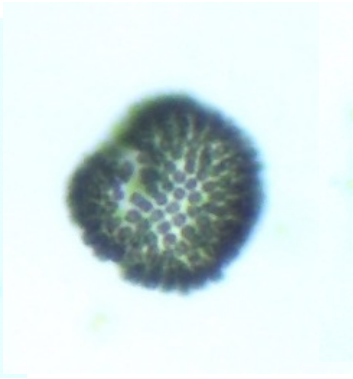
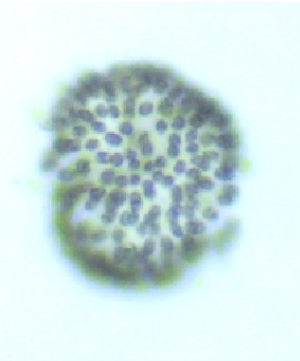



Dolichospermum

Woronichinia


Background on genuses and their toxins (Souce: iNaturalist)

- *Dolichospermum* and *Microcystis* blooms often form during warm, calm weather in lakes and ponds with relatively high nutrient concentrations (nitrogen or phosphorus). *Dolichospermum* blooms usually contain other types of cyanobacteria, especially *Microcystis*, *Woronichinia* , *Aphanizomenon*, & *Gloeotrichia*. Tangled clumps of *Dolichospermum* may be colonized by stalked, filter-feeding zooplankton (Slide 4, 2nd row, 2nd image from right).

Toxins

- Not all *Microcystis* and *Dolichospermum* blooms result in the release of toxins.
- Higher water temperature and light appear to be associated with increased toxin production.
- Toxins are released into the environment when the cell wall degrades.
- It is not entirely known which cyanobacteria produce which toxins; the list below is preliminary.

Genus/Toxin	Microcystin (liver)	Cylindrospermopsin (liver)	Anatoxins (nerve)	Saxitoxins (nerve)	BMAA (nerve)	LPS (skin)
Dolichospermum	X	X	X	X	X	X
Microcystis	X		X		X	X

- Microcystins are rapidly degraded by specialized, naturally occurring bacteria. If the specialized bacteria are not present, microcystins can persist in the aquatic environment for months.
- Anatoxins are rapidly degraded by sunlight & pH slightly above 7.0. At low pH, and in the absence of light, anatoxins may persist in the aquatic environment for a few weeks.
- BMAA can bioaccumulate in zooplankton and fish, and can contribute to health risks long after the toxic bloom has died back.
- Little is known about environmental degradation of cylindrospermopsin and saxitoxins, but both toxins can persist for weeks in the aquatic environment.