Cyanobacteria monitoring in Cape Cod Ponds and the status of cyanobacteria in Bourne

Dr. Julie Hambrook Berkman
Pond and Cyanobacteria Program Manager
Association to Preserve Cape Cod

Cyanobacteria Monitoring Program: 2017 - ongoing

Website: https://apcc.org/our-work/science/community-science/cyanobacteria/

Need:

- 890 freshwater ponds, herring spawning;
- Pond associations and public concerns;
- EPA-approved method enables rapid assessment of cyanobacteria blooms and pond water quality.

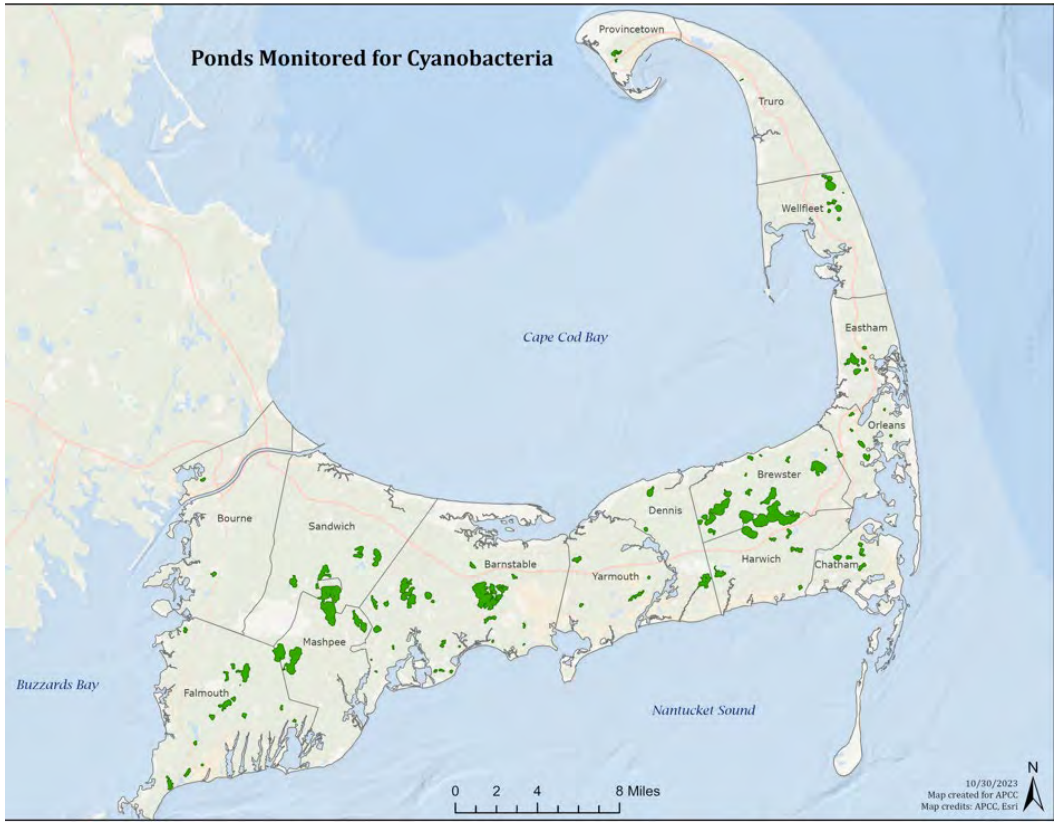
Goals:

- Collect data to educate public on risks of harmful cyanobacteria blooms (HCBs),
- Motivate action to improve water quality.

Elements:

- **Biweekly sampling** from May - October;
- **Data interpreted within a framework of health regulations and guidance, risk levels and recommended actions;**
- **Website and interactive map viewer with results;**
- **Results to health agents and public within 24 hours**.

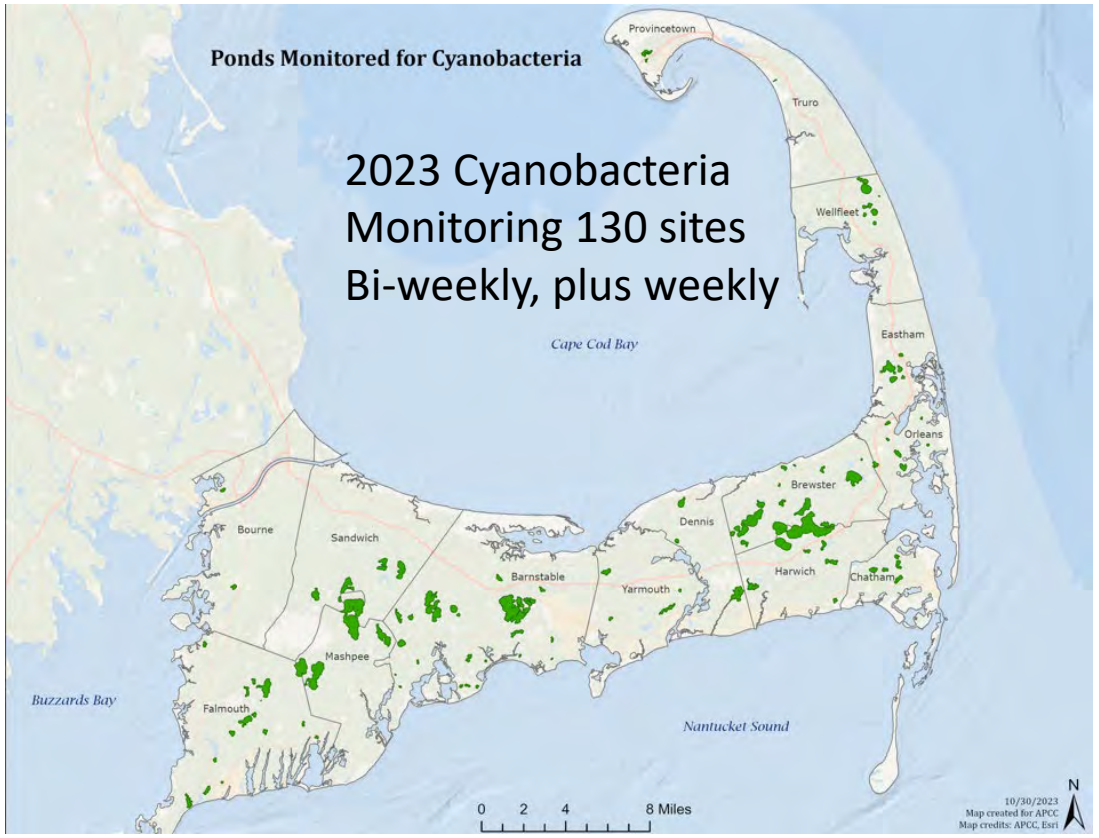
Methods: EPA-approved QAPP for Cyanobacteria Monitoring Collaborative, and Cyanocasting (Nancy Leland). Toxin tests added in 2022.

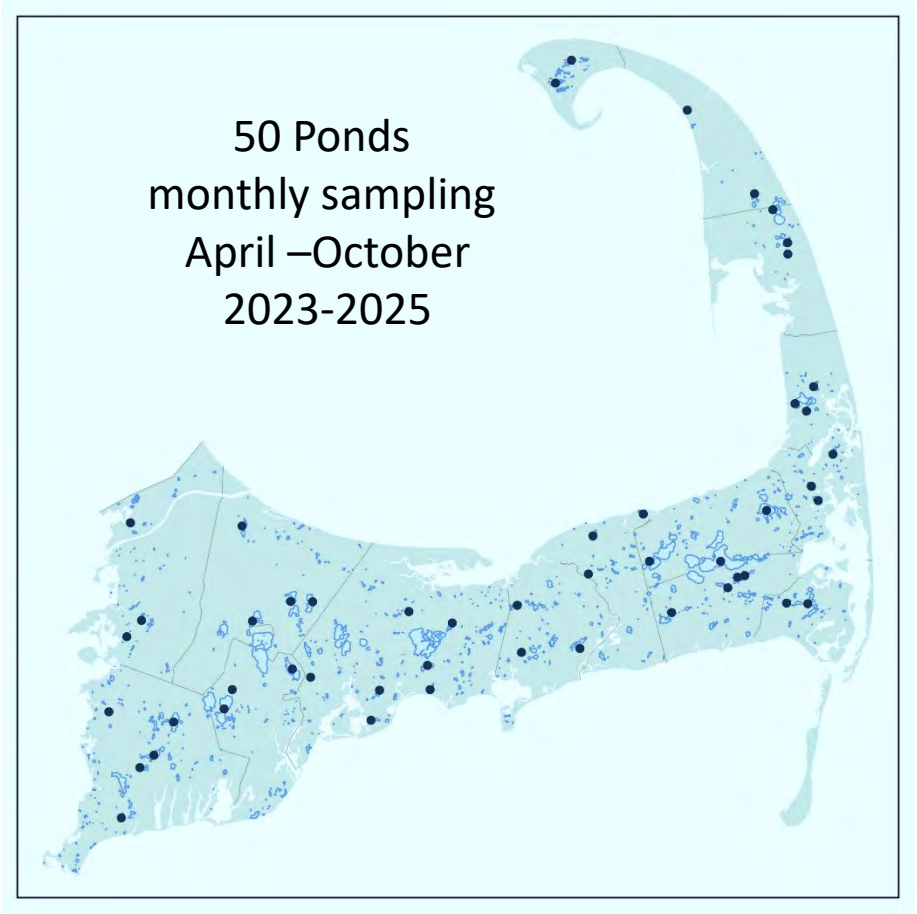


Cyanobacteria data has been collected from Cape Cod Herring run ponds including Bourne Pond, Falmouth MA

APCC Two Pond Monitoring Projects

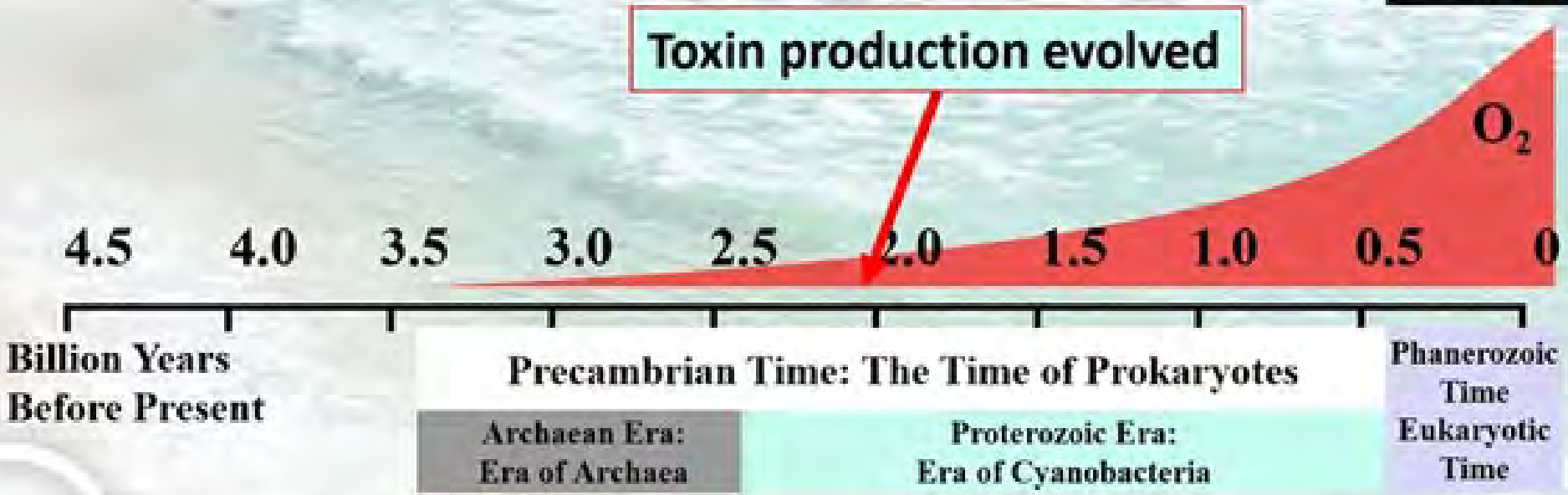
Cyanobacteria and Cape Cod Regional Pond Monitoring Project

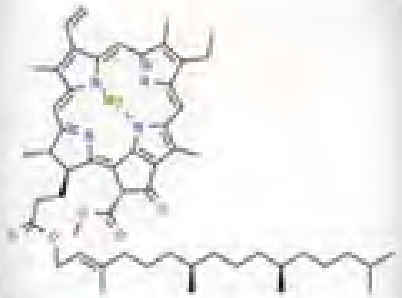




Great Oxygenation Event-lead by the Cyanobacteria!

(wipe out as many competitors as possible!)





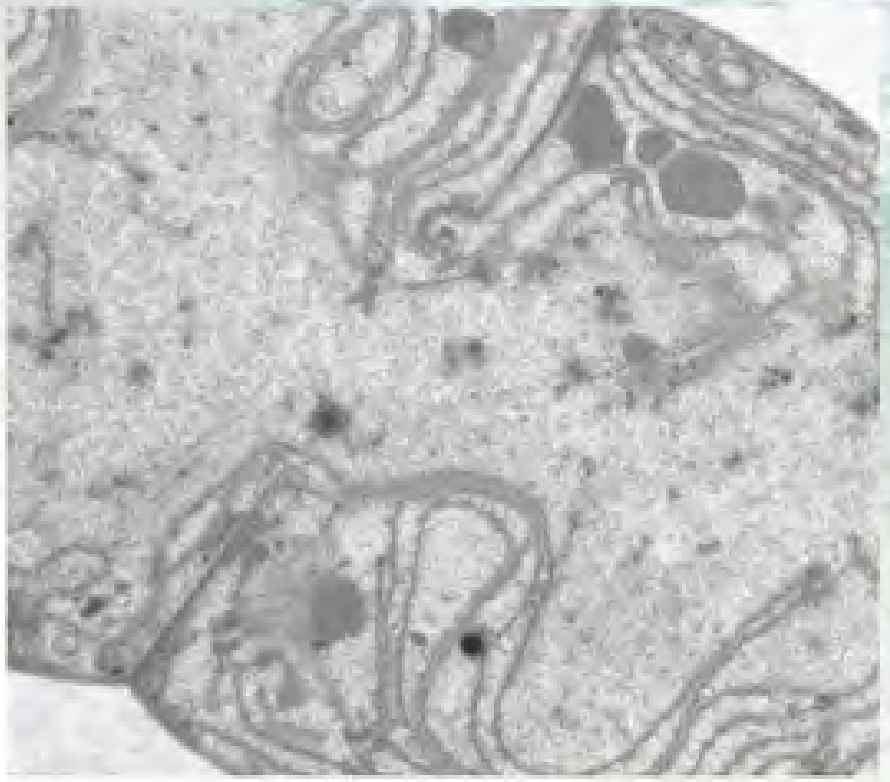
chlorophyll *a*

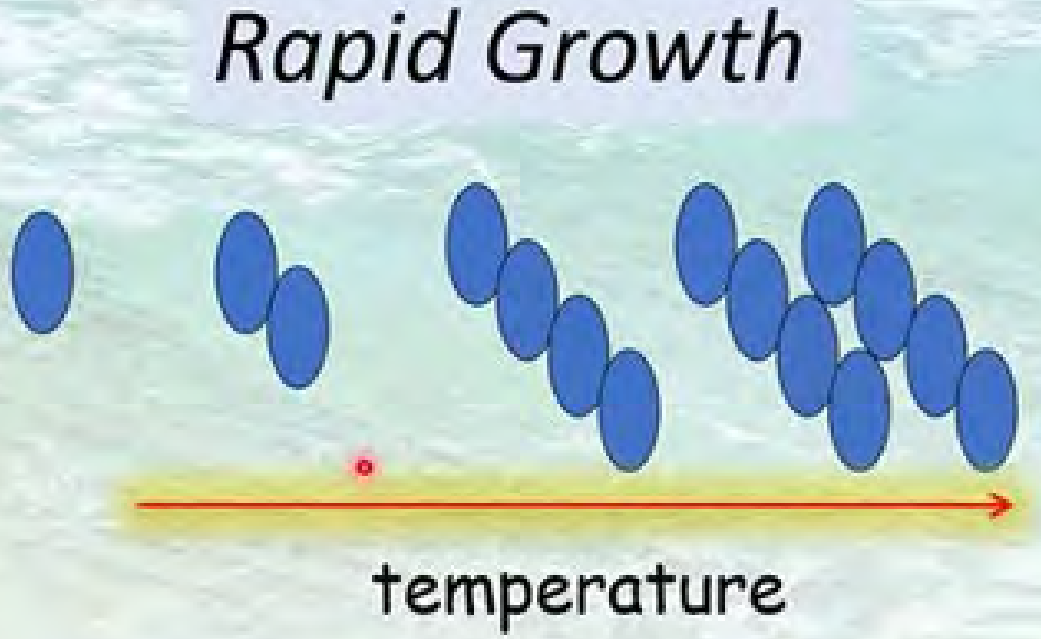
Why toxins? Scavenger for iron, nitrogen storage, grazing? (pre-date metazoans), oxidative stress, quorum sensing, allelopathy. **Human perspective is inadequate.**

Cyanobacteria Blooms scum examples

- Ancient group of photosynthetic microorganisms
- Can produce toxins that can be harmful to humans
- Blooms form due to nutrient enrichment and rising water temperatures resulting from climate change

Ecological Strategies: bacteria in a eukaryotic world-thermophiles grow faster





3 "doublings" or divisions per day!

Caveats: light, temperature, nutrients must not be limiting

Barry Rosen,
EPA CyanoSymposium 2023

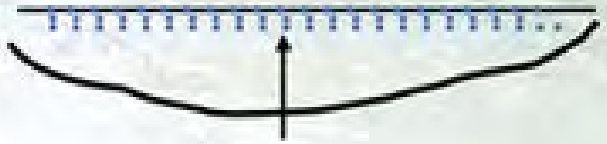
Drinking water & recreational impact

Beware of this phenomenon when sampling

initial distribution

100,000 cells/L;
20 µg/L toxin

buoyancy



10,000,000 cells/L;
2000 µg/L toxin

wind

100,000,000 cells/L;
20,000 µg/L toxin

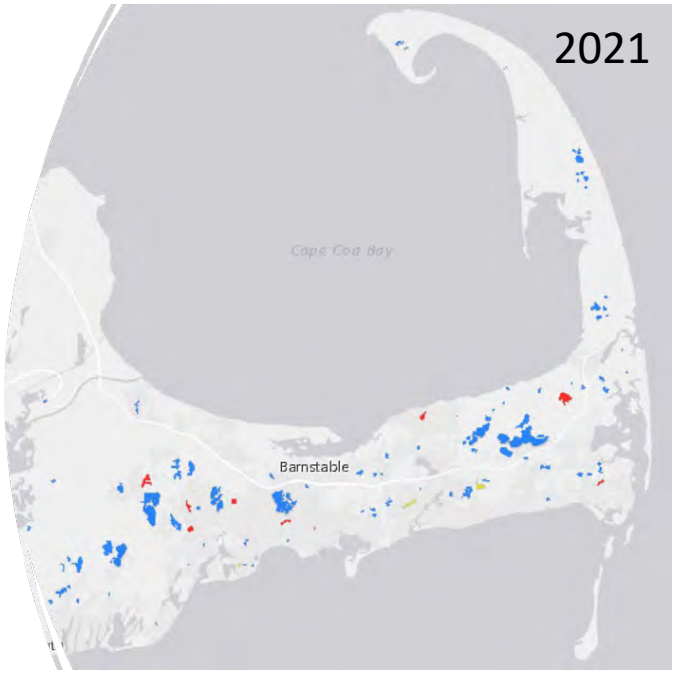
Barry Rosen, EPA
CyanoSymposium 2023

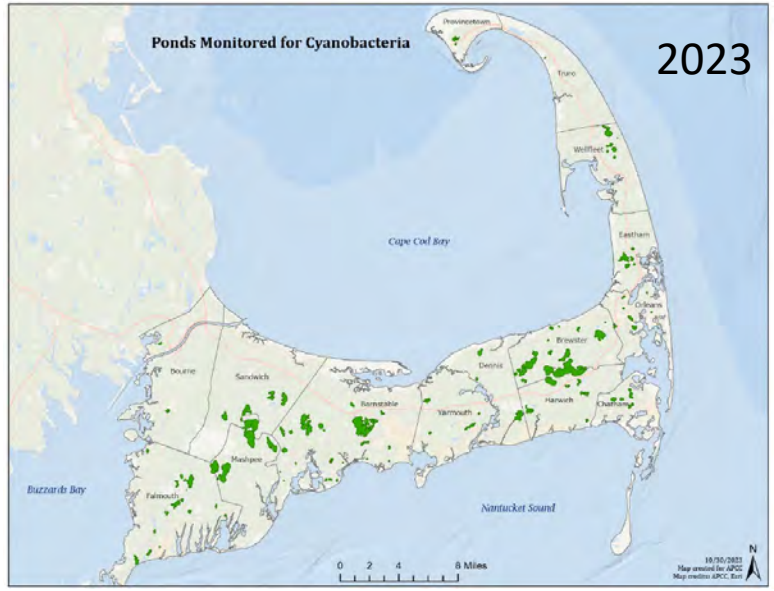
Cyanobacteria Monitoring Program: Results 2021-2023

- In 2021, 144 ponds in all 15 towns monitored;
  - HCBs in ponds of 12 of 15 towns;
  - 36 ponds had recommendations for “Use Restriction” advisory (i.e., “high” levels warranting advisories to avoid contact with water);

- In 2022, 140 ponds in all 15 towns
  - HCBs in ponds of 11 of 15 towns
  - 24 ponds had recommendations for “Use Restriction” advisory (i.e., “high” levels warranting advisories to avoid contact with water);

- In 2023, 116 ponds in all 15 towns , 130 locations monitored
  - HCBs in ponds of 7 of 15 towns
  - 13 ponds had recommendations for “Use Restriction” advisory (i.e., “high” levels warranting advisories to avoid contact with water);
  - 31 ponds in 2023 had scums that warranted Potential for Concern.

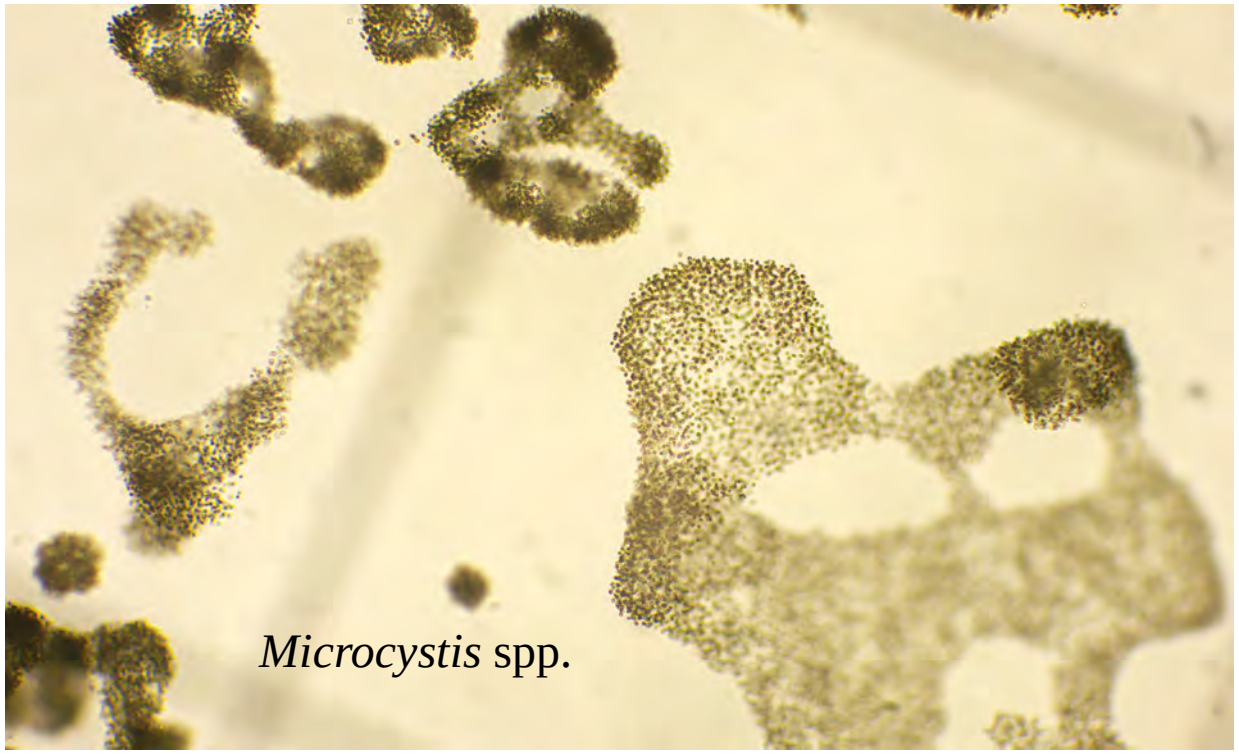


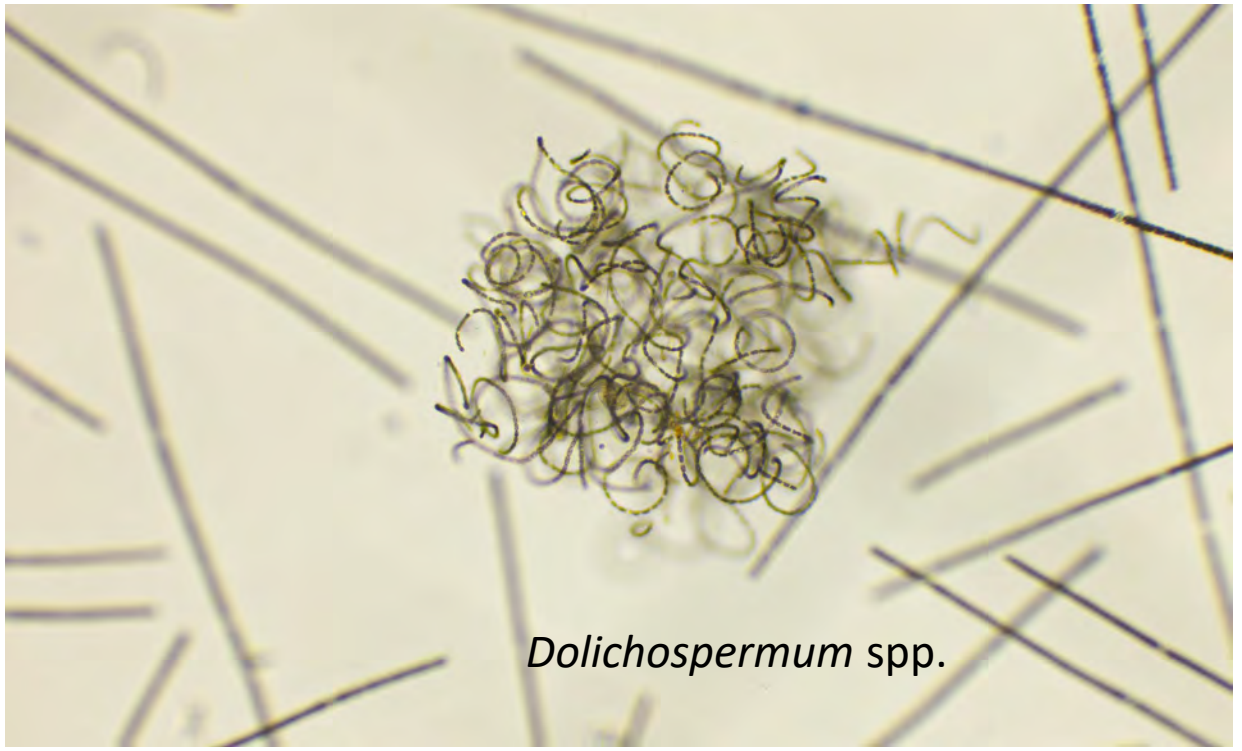


500 mL sample from an integrated tube

500 mL sample from a plankton net

Procedure for Processing


Microcystis spp.


Dolichospermum spp.


Aphanizomenon


Woronichinia

Bourne Pond Falmouth

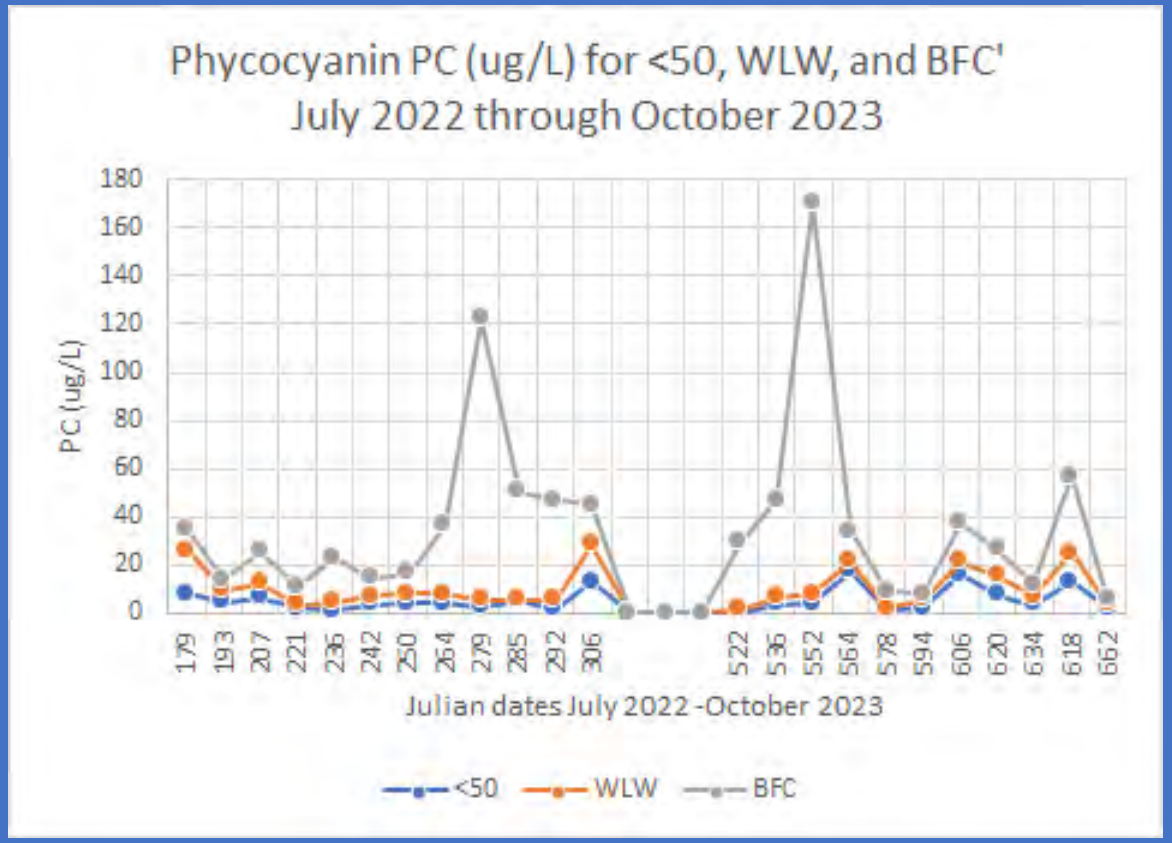
a watershed perspective

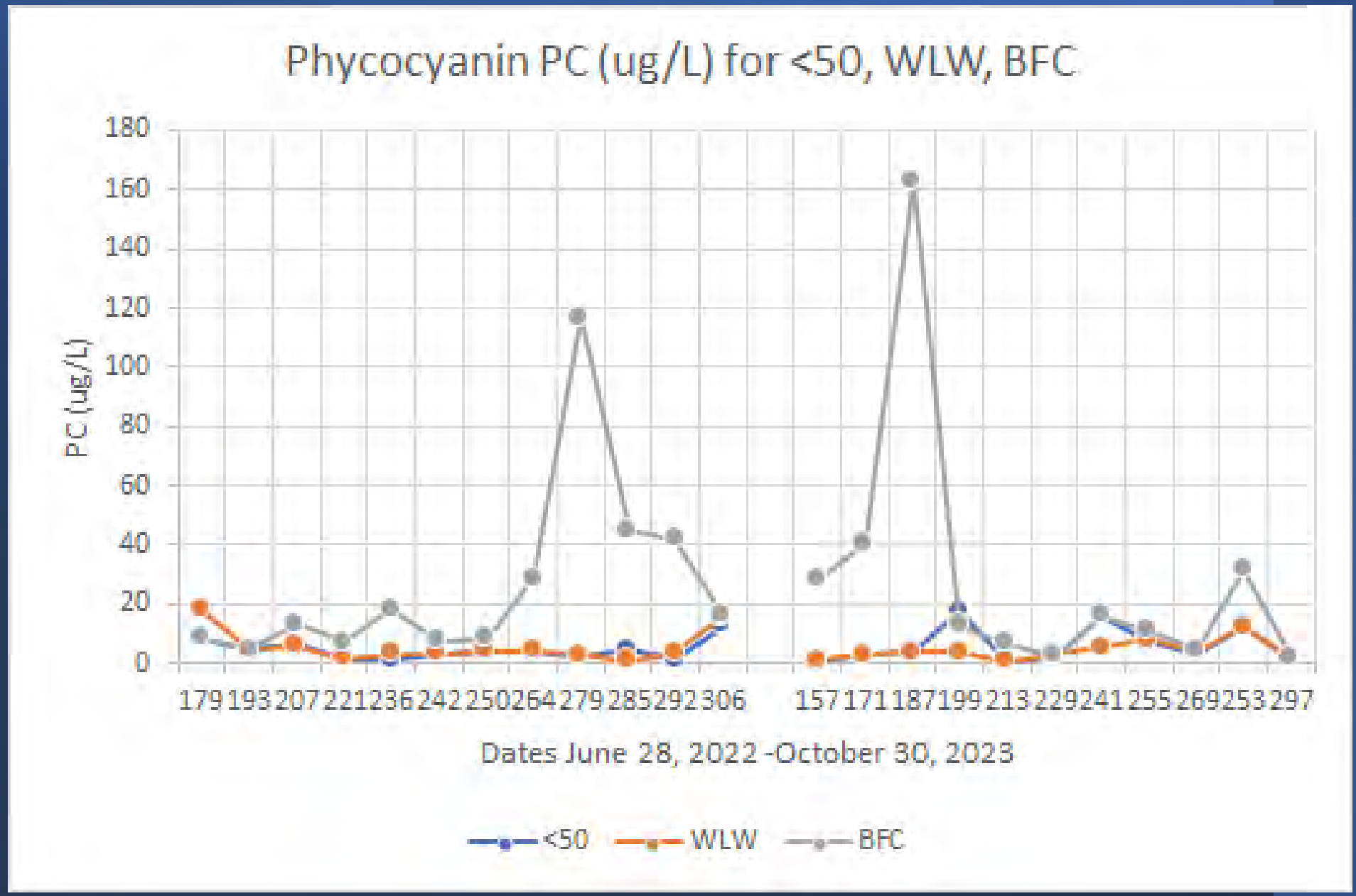
Cape Cod Commission FA-941

11.2 acres and max depth 18 ft.

40% Protected Open Space in
300 ft buffer

- <50 (µm) = Pico Plankton
- WLW= Whole Lake Water
- BFC = Bloom Forming Colonies





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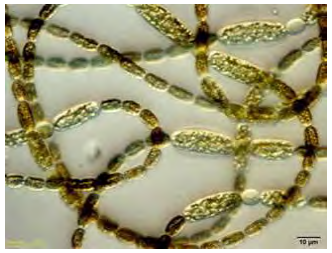
Microcystis

Dolichospermum



Step 3: Pigment Analysis of Samples

Freeze samples (<50µm, WLW and BFC).
Thaw in warm water bath to 21-24°C.
Fluorometry readings within 20 mins.

Step 1: Collect and Process Samples

Collect 250 ml "Net" sample. Dark bottle/chilled 2 hours.

3m vertical tow
50µm mesh net

50 L raw water
50µm filtration chamber

Separate "Net" sample in Pocket ZAPPR for 30 minutes.
Collect BFC isolates.

3-4ml BFC isolates.
Fluorometry & toxin

1-4ml BFC isolate.
Identification & Composition
1-4 ml Zoop sample (optional)

Step 2: Composition and Relative Dominance of BFC's

Scan at 40X.
Estimate dominance.

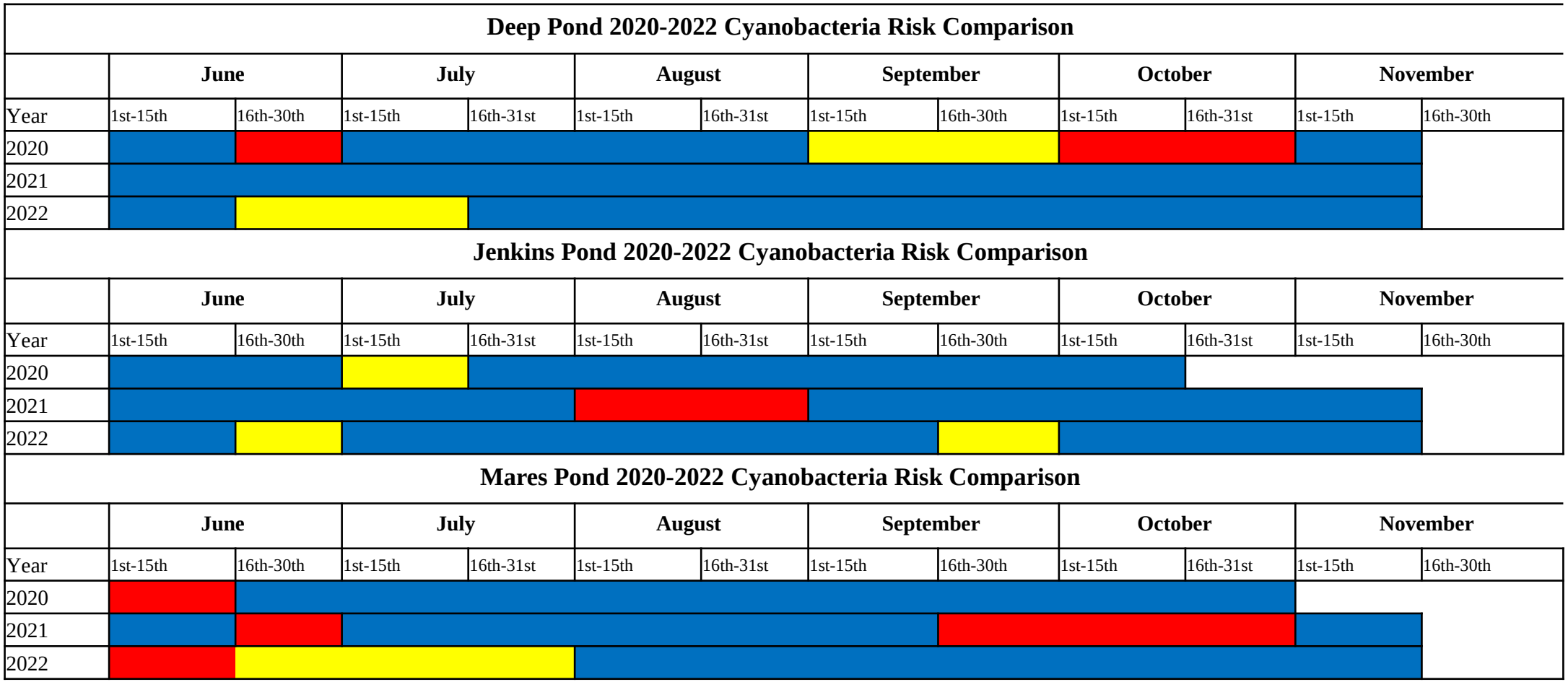
Identify at 160X.
Count 1st 100.

Document relative dominance
and succession by genus.

Cyanobacteria sampling methods and process

Fluorometry	<50	WLW	BFC
Date	PC (ug/L)	PC (ug/L)	PC (ug/L)
6/6/2023	0.19	1.31	28.01
6/20/2023	3.08	3.08	40.37
7/6/2023	3.83	3.80	162.47
7/18/2023	17.28	3.90	12.73
8/1/2023	0.82	0.86	6.96
8/17/2023	1.98	3.38	2.48
8/29/2023	15.60	5.53	16.22
9/12/2023	7.12	8.04	11.18
9/26/2023	3.20	3.82	4.64
10/10/2023	12.80	12.20	31.66
10/24/2023	1.68	1.68	2.11

Seasonality of Cyanobacteria Blooms in three Falmouth Ponds 2020 - 2022

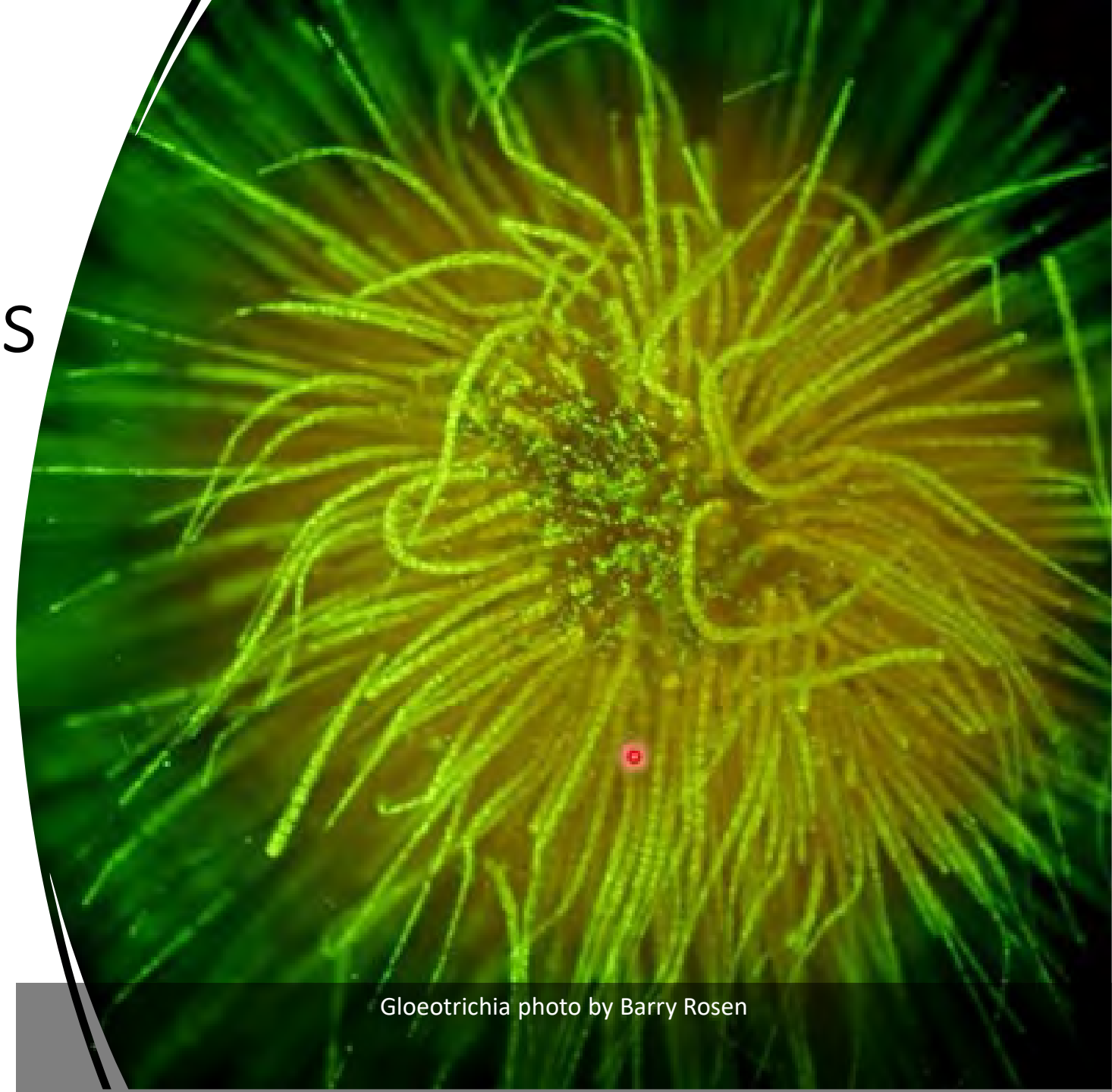


Cyanobacteria

Harmful Cyano Blooms HCBs

in Cape Cod Ponds

- HCBs have occurred in 13 of the 15 Cape Cod Towns since 2021
- HCBs are variable in their occurrence within ponds
- HCBs vary between years
- HCBs serve like the canary in coal mines to raise awareness of pond ecosystem health



Gloeotrichia photo by Barry Rosen

Keep a look out for the
Bio Indicators of Healthy Life
on our Cape Cod Ponds
Thank you!

Julie A. Hambrook Berkman
Association to Preserve Cape Cod
jhambrook@apcc.org
APCC.org

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