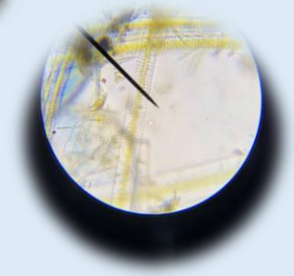
CYANOBACTERIA IN OUR BLUE SPACES

A Presentation of Data Collected by Local Community Scientists
In and Around Worcester in 2022





Thursday, December 8th
6:15 pm Levi Lincoln Room
3rd Floor City Hall

Together, We Can Keep Our Blue Spaces Beautiful!

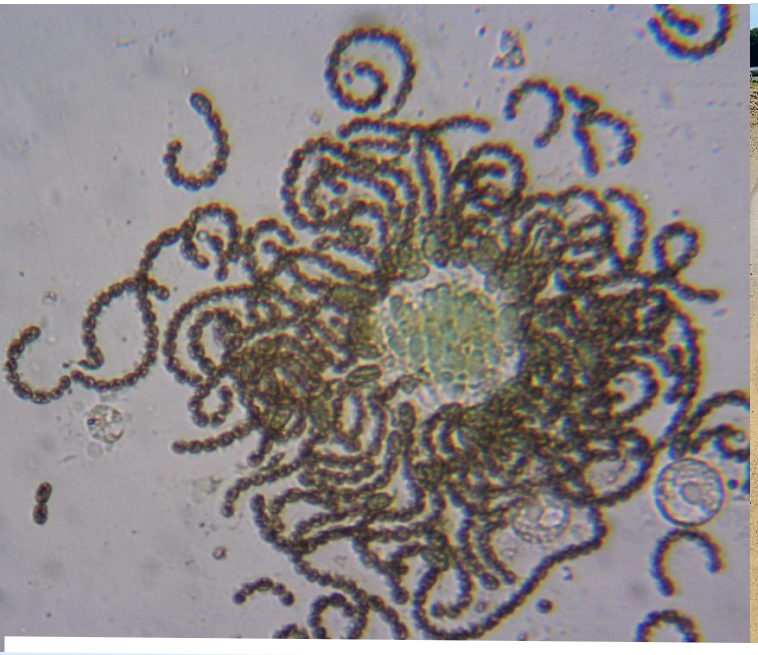
GREEN WORCESTER
Community | Resilience | Sustainability

OVERVIEW

- What are cyanobacteria and why do I care?
- Who is the WCMC and what do they do do?
- Accomplishments
- Findings from our lakes in 2022
- 2023 and beyond

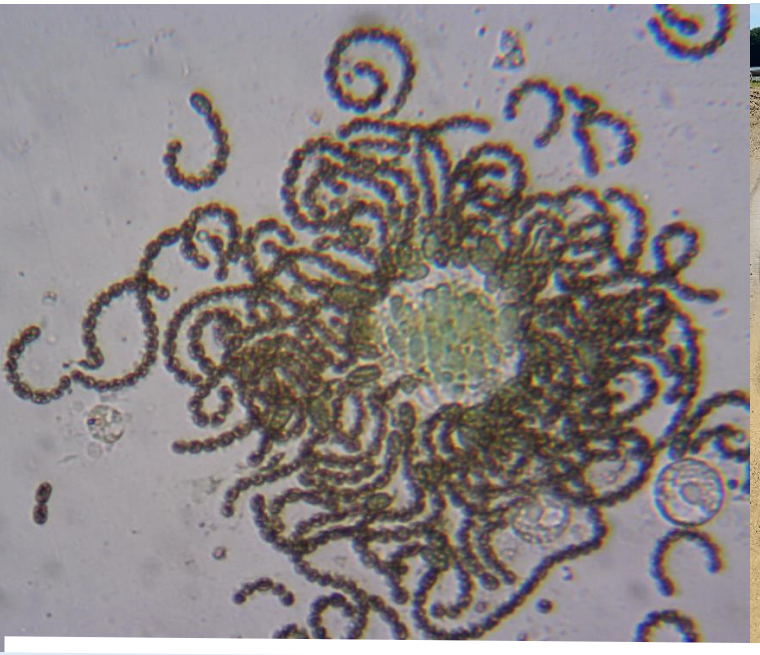
WHAT ARE CYANOBACTERIA AND WHY DO I CARE?

- Oldest forms of life on the planet, adapted to every ecosystem
- Naturally occurring in our lakes, but can “bloom” under the right conditions
- Blooms can be harmful to aquatic ecosystems, public health, and recreation
    - Green lakes can get smelly and unsightly
    - Decomposition of organisms can cause drops in dissolved oxygen, asphyxiating wildlife
    - Cyanobacteria can produce toxins harmful to pets and human health




WHAT ARE CYANOBACTERIA AND WHY DO I CARE?

- Triggers for blooms and toxin production are not entirely understood
- Blooms can produce toxins without scums
- Current testing procedures are problematic
- City only able to manage at major recreational waterbodies
- Reports of blooms are becoming more frequent




WHO IS THE WCMC AND WHAT DOES IT DO?

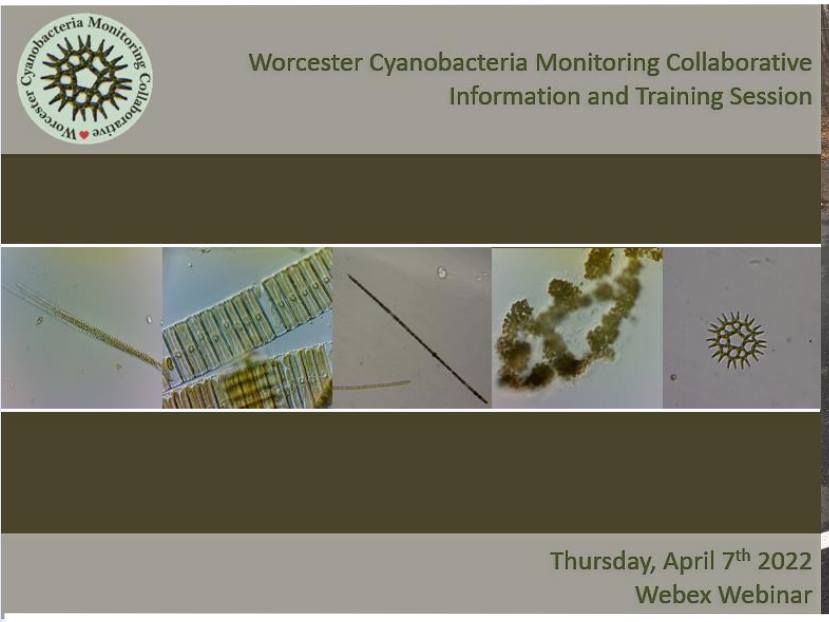
- Community requests for information on cyanobacteria increased
- City worked with EPA and UNH to determine other methods to detect cyanobacteria
- In 2017, a small group of community members began using plankton nets and microscopes
- Over time, the number of volunteers and information on our lakes grew, and we were able to refine our methods

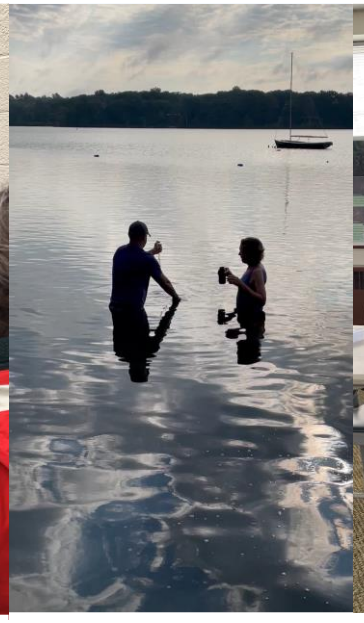
Lakes sampled to date (28):

- Bell Pond
- Burncoat Pond
- Coes Reservoir
- Coes Pond
- Cooks Pond
- Curtis Pond
- Dark Brook Reservoir
- East Lake Waushacum
- Ecotarium Pond
- Elm Park Pond
- Farm Pond
- Flint Pond
- Green Hill Park Pond
- Indian Lake
- Jordan Pond
- Kiver Pond
- Leeseville Pond
- Lake Quinsigamond
- Little Indian Lake
- Manchaug Pond
- Newton Pond
- Patch Pond
- Patch Reservoir
- Salisbury Pond
- Singletary Lake
- Stevens Pond
- Stoneville Pond
- University Pond

WHO IS THE WCMC AND WHAT DOES IT DO?

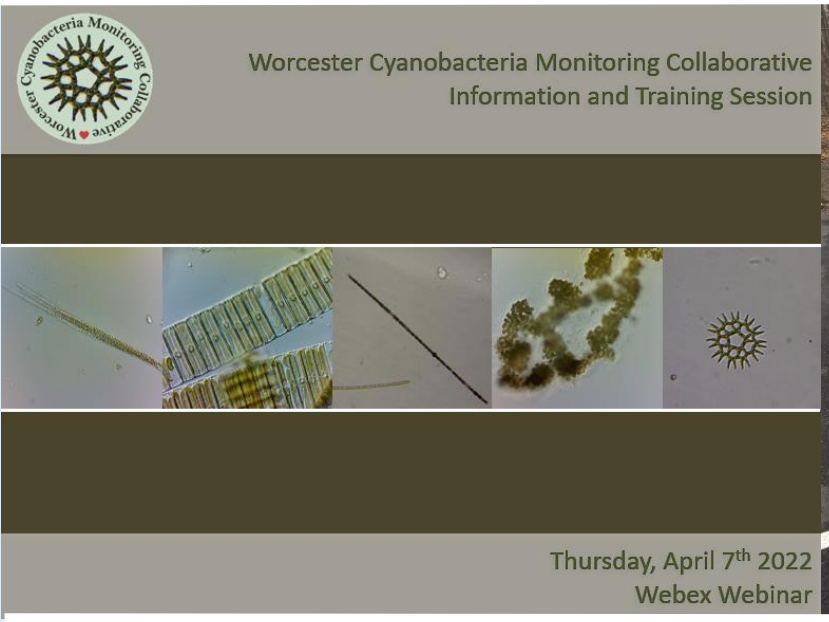
- Volunteers:
  - Are trained in the significance of cyanobacteria, sample collection, and taxa identification
  - Collect samples up to 2 times per month in local waterbodies of their choice
  - Use microscopes to identify cyanobacteria
  - Meet other water quality advocates in their community

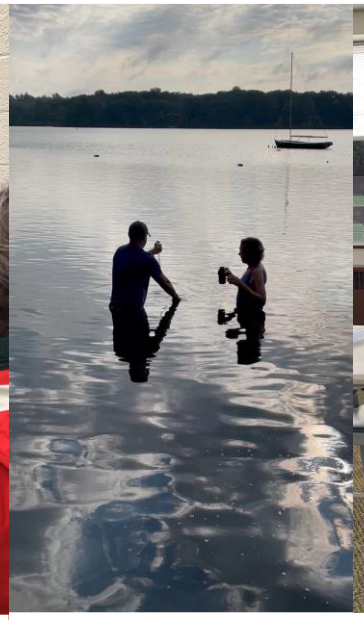




WHO IS THE WCMC AND WHAT DOES IT DO?

- The City:
    - Coordinates sample collection and provides training, location, and materials
    - Runs additional tests on volunteer water samples
    - Provides twice monthly reports on water quality results

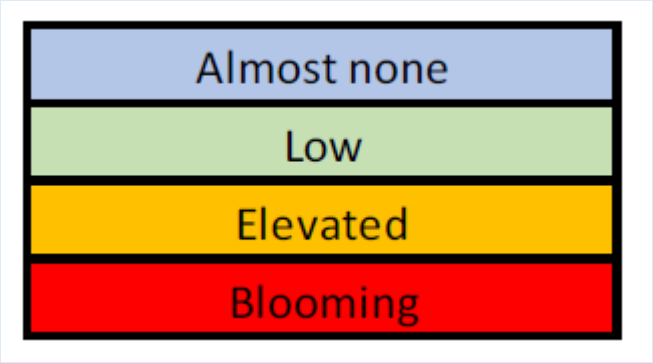




2022 GOAL: DETERMINE THE TOXIN EXPOSURE RISK

(Simple, Quick, Cheap, and Easy to Interpret)

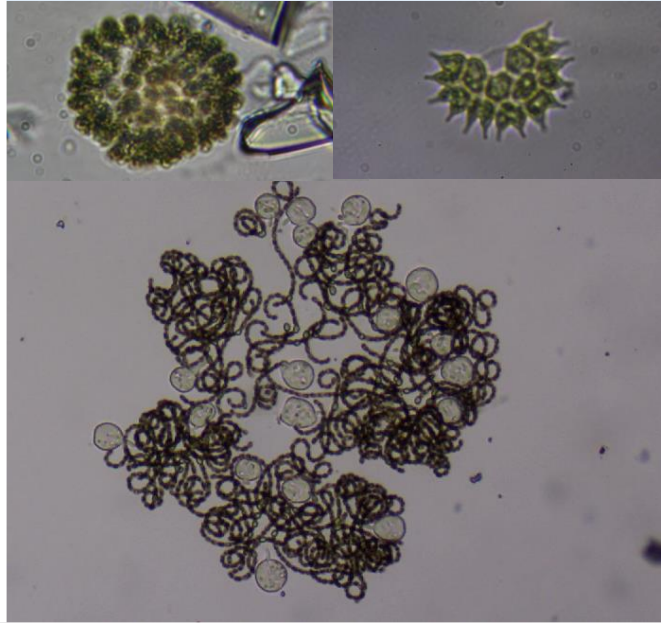
TOXIN EXPOSURE RISK



BASED ON EPA APPROVED METHODS, BUT NOT MA RECOGNIZED

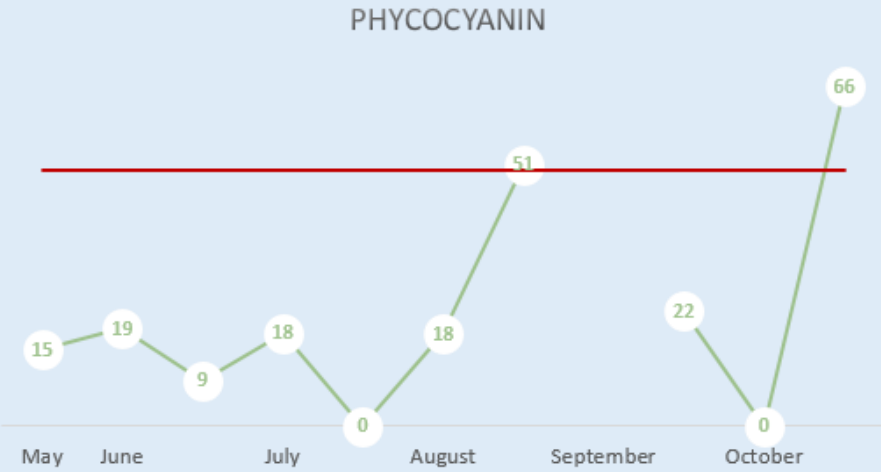
SAMPLES TAKEN: NET SAMPLE FOR PHOTOS

- The NET: A PLANKTON NET sample to collect as many organisms as possible from the lake surface
- Volunteers prepare slides and examine the samples on a ***microscope***, scanning the concentrated sample for the diversity of organisms present
- <u>Photos and notes</u> of the organisms are taken and reviewed over the course of the season, used for QC of data and give early warnings of problems



SAMPLES TAKEN: IT SAMPLE FOR PIGMENT

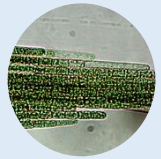
- The IT: An INTEGRATED TUBE sample collects a fixed amount of water from the upper portions of the surface where cyanobacteria live
- Samples are brought to the lab, and scanned on a ***fluorometer***, which can measure a photosynthetic pigment found only in cyanobacteria
- <u>Results are graphed relative to 50 relative fluorescence units (RFUs)</u>, which is about when we begin to see visual signs of a bloom occurring in a lake



SAMPLES TAKEN: GRAB SAMPLE FOR DIVERSITY AND COMPARITIVE DENSITY

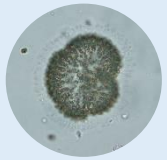
- The GRAB: A GRAB sample is collected to get a snapshot of what is occurring at the surface with a convenient and easy method
- Samples are brought to the lab and scanned on a ***FlowCam***, which can measure and photograph particles between 10 and 100 um in size
- <u>Comparative density of cyanobacteria</u> and other taxa are graphed and depicted

Oscilltoria

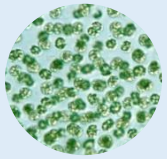


Aphanizomenon

Dolichospermum

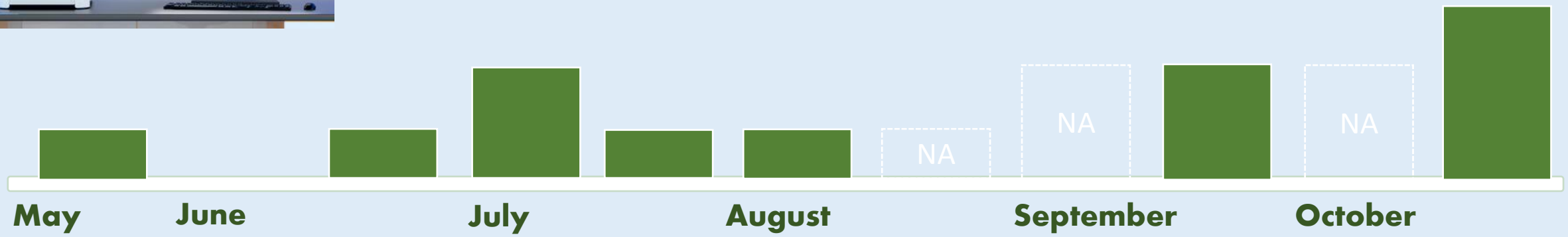


Woronichinia



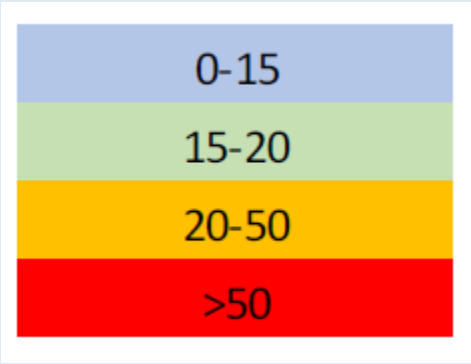
Microcystis

Microcystis debris



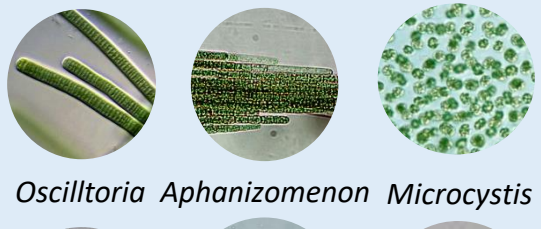
EVALUATING TOXIN EXPOSURE RISK

IT SAMPLE = PIGMENT (RFUs) DENSITY OF THE INDICATOR PHYCOCYANIN

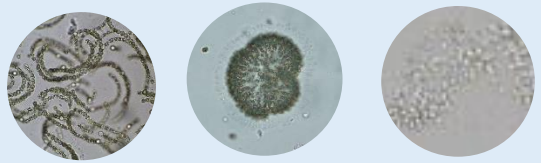


Different taxa = different pigment production

GRAB SAMPLE = SPECIES/TAXA PRESENT



Oscilltoria *Aphanizomenon* *Microcystis*



Dolichospermum *Microcystis debris* *Woronichinia*

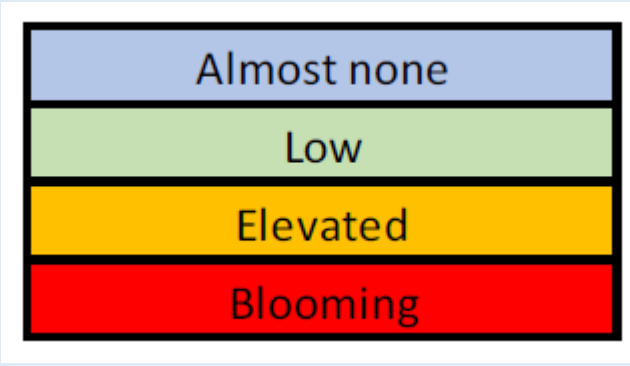
Different taxa = different toxins and toxin concentrations

GRAB SAMPLE = COMARATIVE DENSITY OF CYANOS TO OTHER ORGANISMS

Lower comparative density

Higher comparative density

TOXIN EXPOSURE RISK



REPORTS AND INFORMATION SHARING

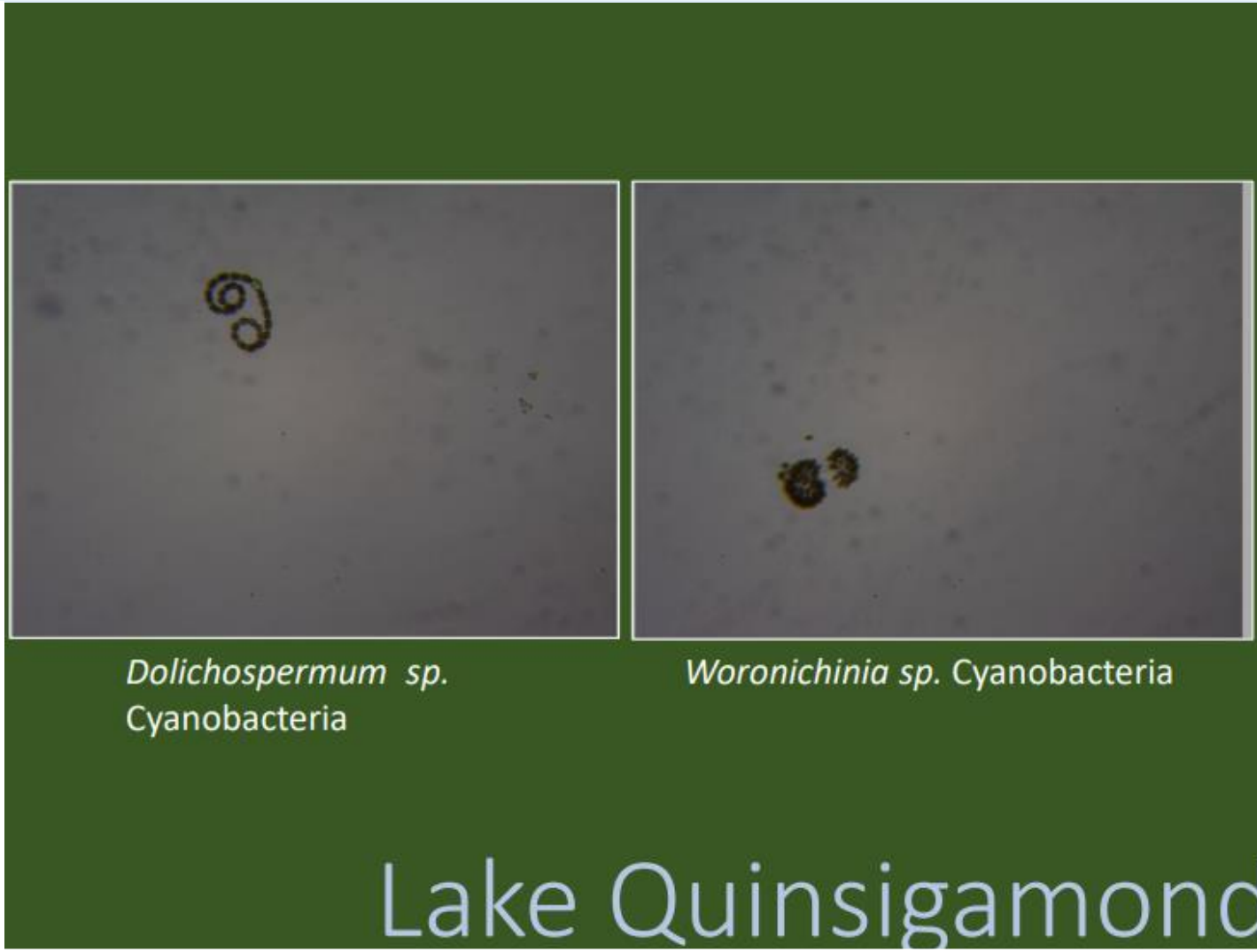
WCMC Results October 3, 2022

Lake and Overall Risk	Phycoyanin Concentration (ug/l)	Particle Concentration (#/ml)	Cyanobacteria Density	Cyanobacteria Observed
Bell Pond	ND	639	low	*Microcystis debris*
Coes Reservoir	107	8321	high	*Woronchinia, Dolichospermum, Aphanizomenon*
Cooks Pond	ND	3894	low	*Microcystis debris*
Ecotarium Pond	10	4091	none	
Elm Park Pond	222	19755	high	*Microcystis debris*
Green Hill Pond	9	7806	some	*Microcystis debris, Dolichospermum*
Indian Lake	10	9019	low	*Microcystis debris*
Manchaug Pond	ND	491	none	
Newton Pond	ND	946	low	*Aphanizomenon*
Patch Pond	ND	17527	none	
Salisbury Pond	9	3226	none	
Stevens Pond	ND	1450	low	*Dolichospermum, Microcystis debris*

Risk of Exposure	Phycocyanin ug/l	Particles/ml	Comparative density of cyanobacteria
Almost none	0-15	0-1000	none
Low	15-20	1000-5000	low
Elevated	20-50	5000-10000	some
Blooming	>50	>10000	high

Worcester Cyanobacteria Monitoring Collaborative

See reverse side for details



WorcesterMA.gov/WCMC

ACCOMPLISHMENTS OF 2022

- We have come a long way!
- Over 50 samplers were trained
- 24 waterbodies sampled

Bell Pond
Burncoat Pond
Coes Reservoir
Cooks Pond
Dark Brook Reservoir
Lower Ecotarium Pond
Elm Park Pond
Farm Pond
Flint Pond
Green Hill Park
Indian Lake
Jordan Pond
Kiver Pond
Leeseville Pond
Little Indian Lake
Manchaug Pond
Newton Pond
Patch Pond
Patch Reservoir
Lake Quinsigamond
Salisbury Pond
Singletary Lake
East Lake Waushaccum
Stevens Pond

- 12 sampling events
- 75% of lakes attended 8 or more events

Cooks Pond

Newton Pond

Green Hill Park Pond

Manchaug Pond

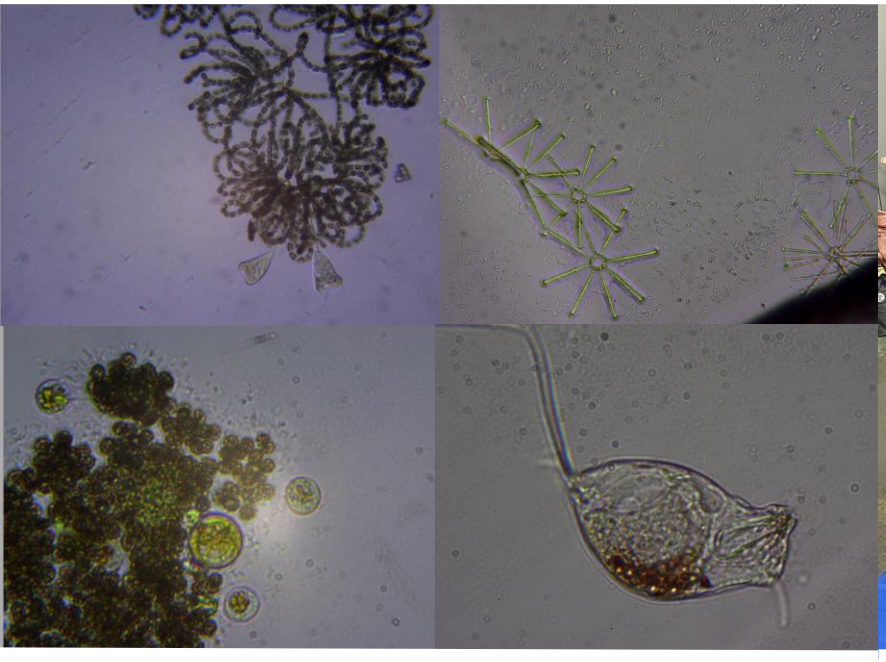
Indian Lake

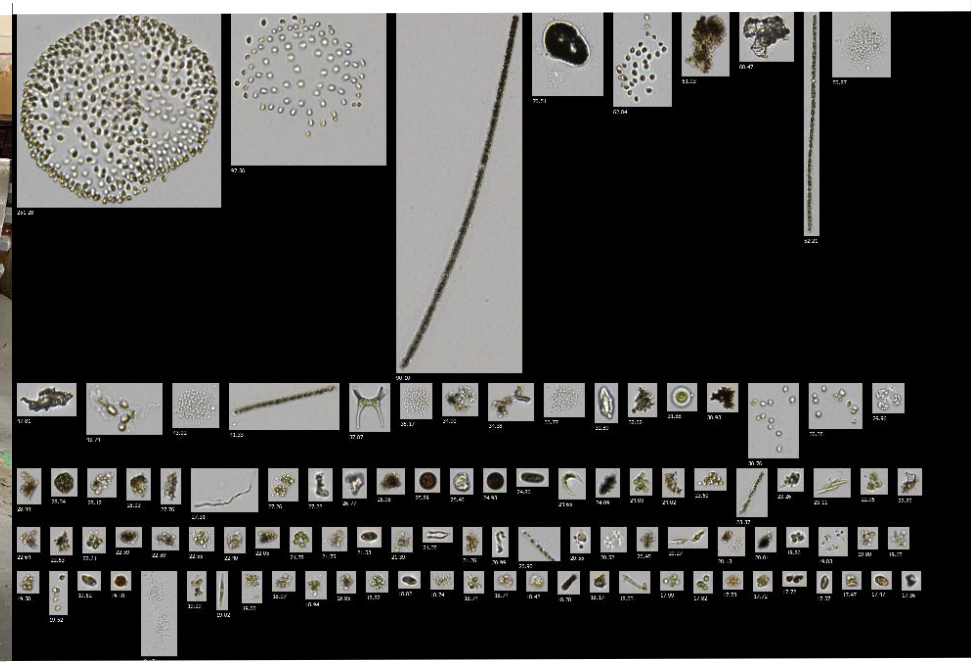
Stevens Pond

Patch Pond

ACCOMPLISHMENTS OF 2022

- 86 microscope photos
- 1176 Fluorometry samples processed
- 196 FlowCam runs





ACCESS AND SIGNAGE

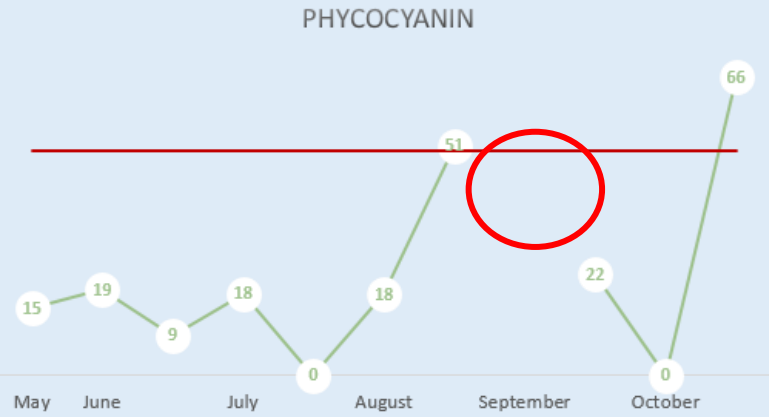
WCMC IN THE COMMUNITY

WCMC AS A VEHICLE FOR LEARNING

- 2022 saw increased use of WCMC as a learning tool for students in high school and college
  - After-school program at the EcoTarium collected samples at Lower Ecotarium Pond
  - Students at Bancroft School studied Indian Lake at Shore Park
  - WPI students sampled Green Hill Park Pond as part of their IQP
  - Students at QCC used their findings at the WCMC for their final project on Lake Singletary

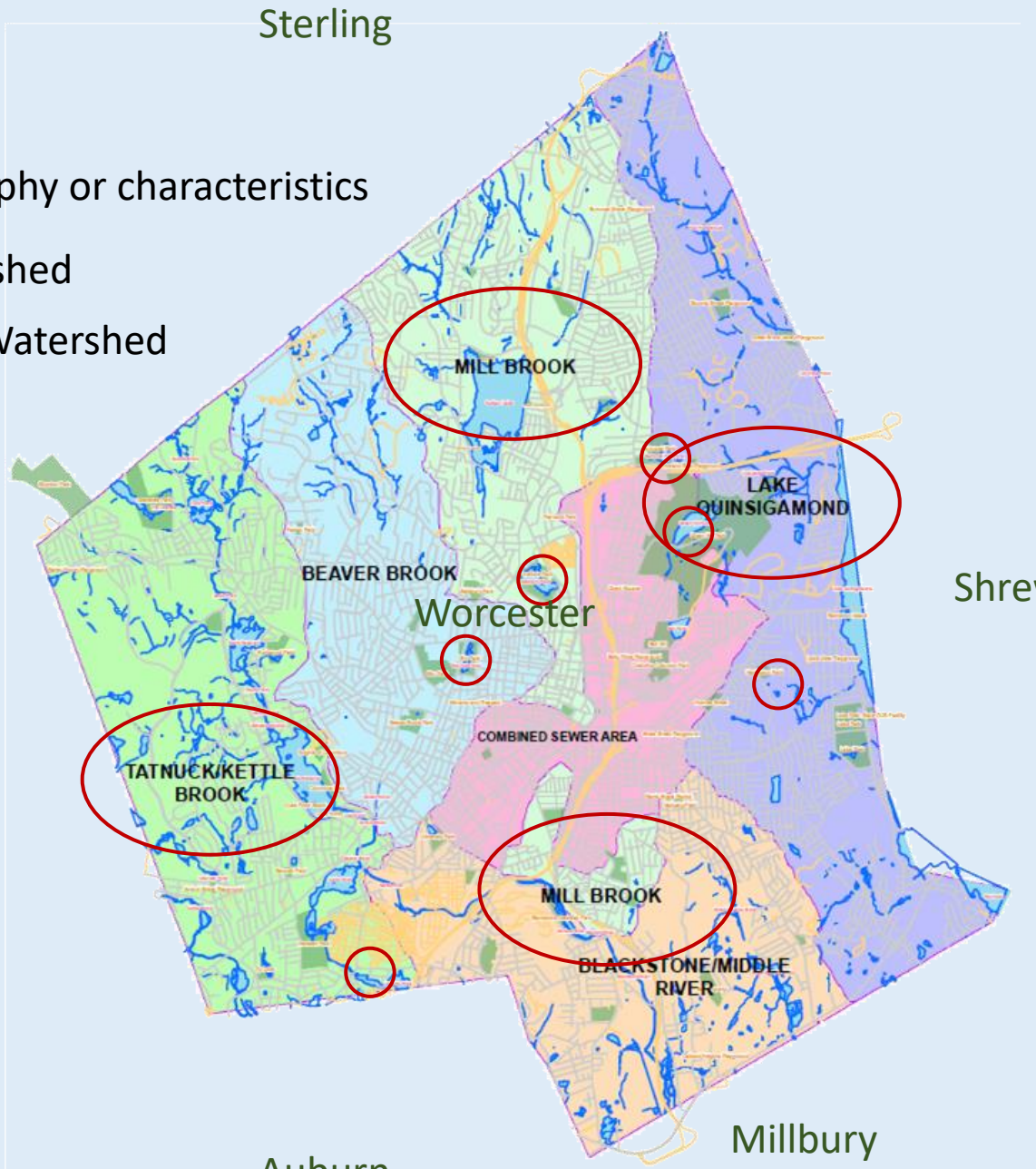
INTERPRETING THE DATA

- **Visual inspection** of clarity and scums
- **Pigment** concentrations from fluorometry analysis
- The **comparative density** of cyanobacteria observed through FlowCam analysis
- The **Community/Diversity** of cyanobacteria
- Overall **Exposure Risk** throughout the season
- How these results compare to 2021 results



PROGRAM LAKES

- 24 lakes sampled in 2022
- Grouped based on geography or characteristics
  - Tatnuck Brook Watershed
  - Lake Quinsigamond Watershed
  - Mill Brook Watershed
  - Urban Park Ponds
  - Rural Ponds



TATNUCK BROOK WATERSHED

WATERBODIES SAMPLED

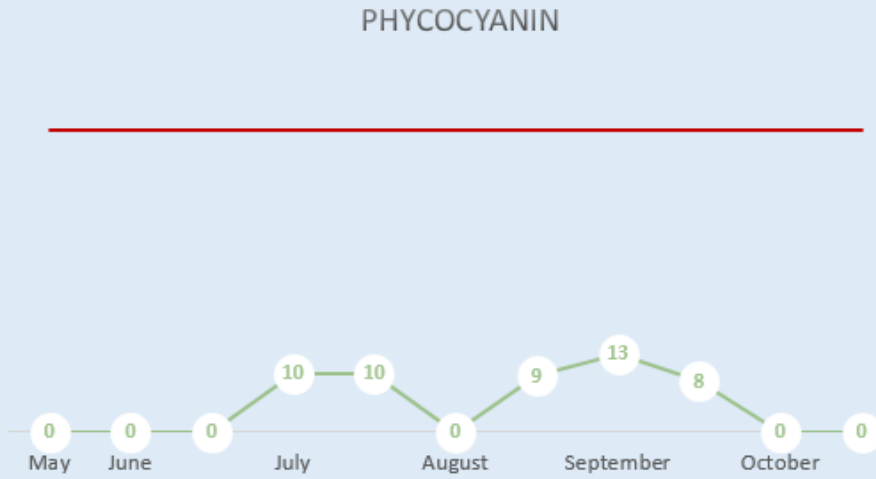
- Cooks Pond
- Patch Pond
- Patch Reservoir
- Coes Reservoir

CHARACTERISTICS

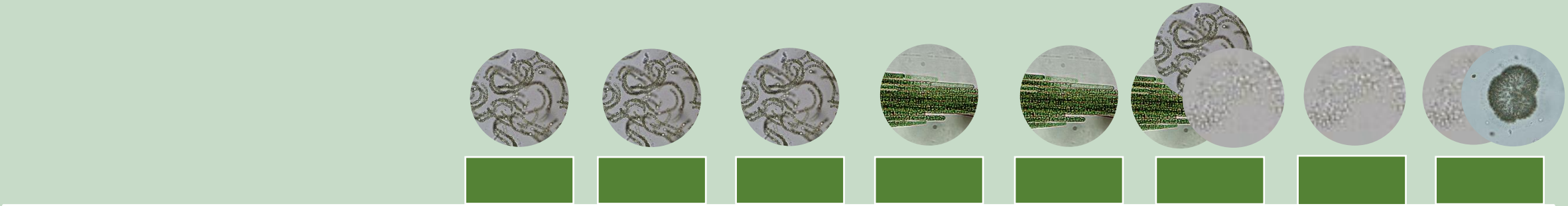
- Tatnuck Brook brings flow from NW to SE
- Series of impoundments through increasing development
- Has been known to host cyanobacteria in the lower regions

COOKS POND

- Water generally reported as clear
- Highest pigment reading was 13 RFUs, and generally low or undetectable
- Cyanobacteria density remained low all season
- Generally dominated by one taxa: *Dolichospermum* or *Aphanizomenon*
- Results similar to 2021

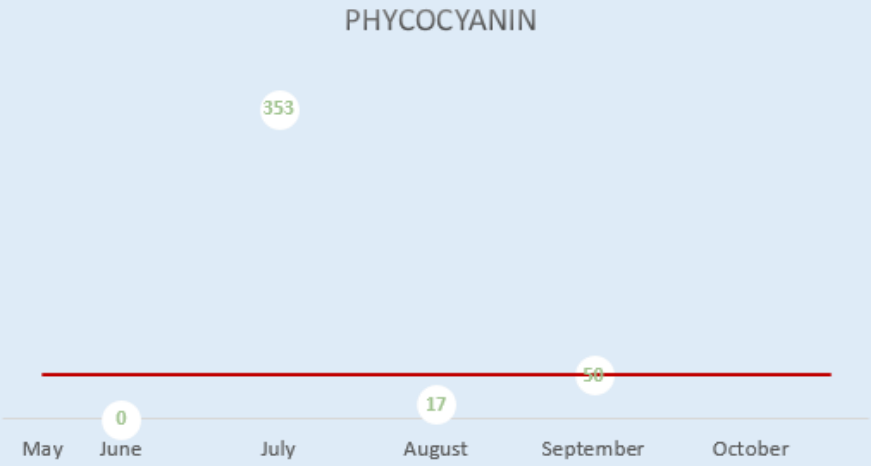


Thank you to our volunteers, Elsie, Dan, and Patti!

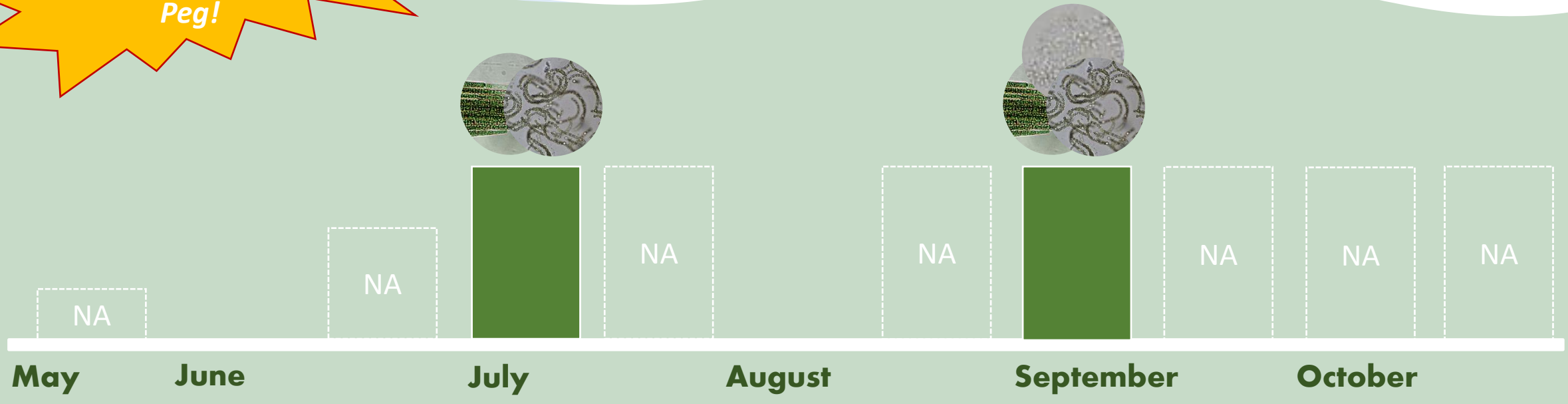


PATCH RESERVOIR

- After June, water reported as turbid
- Max. pigment in early July at 353 RFUs
- Cyanobacteria density oscillated between high an none during summer months
- Generally two taxa *Dolichospermum* or *Aphanizomenon*
- Elevated pigment occurred later in 2021, and was not as extreme



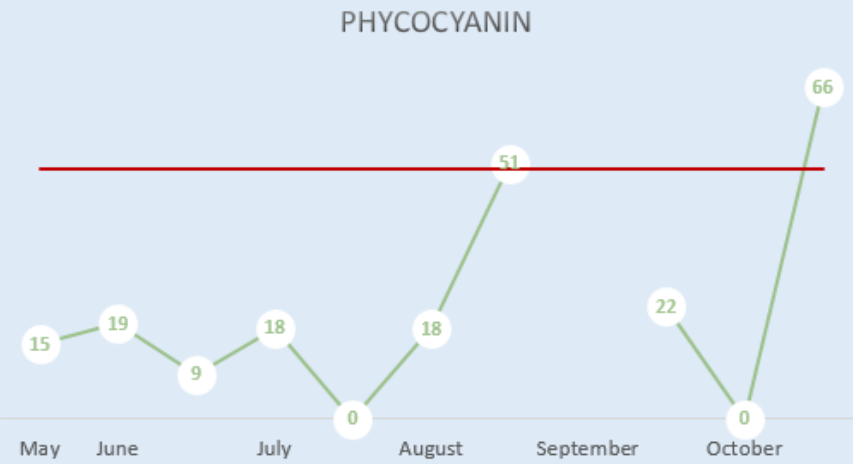
Thank you to our volunteers, Donna and Peg!

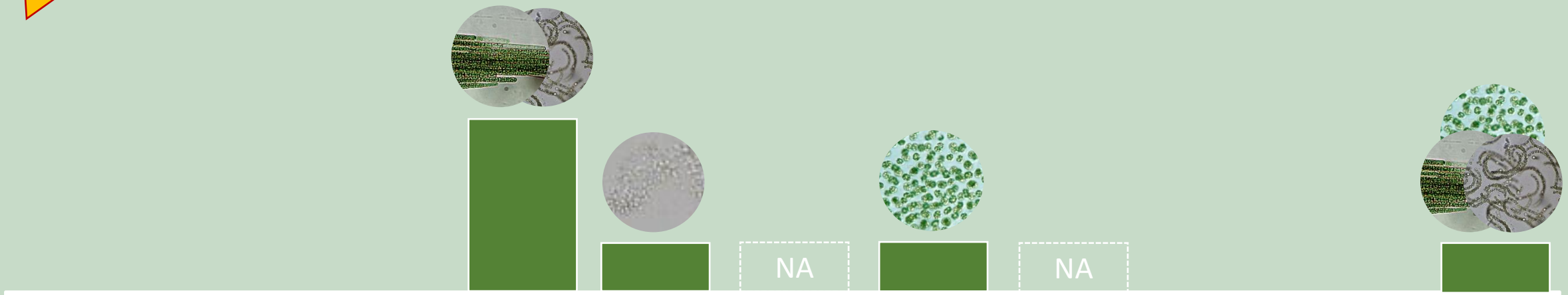


PATCH POND

Thank you to our volunteers, Alyssa and Emily!

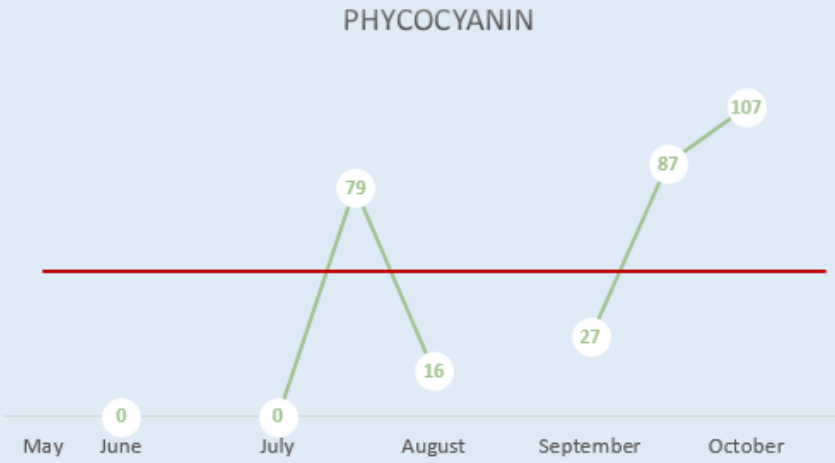
- Water reported as turbid all season, with occasional scums
- Max. pigment of 66 RFUs in mid-Oct
- Cyanobacteria density oscillated between high and none during summer months
- *Microcystis* is present in high pigment samples
- This data will be a baseline for future sampling





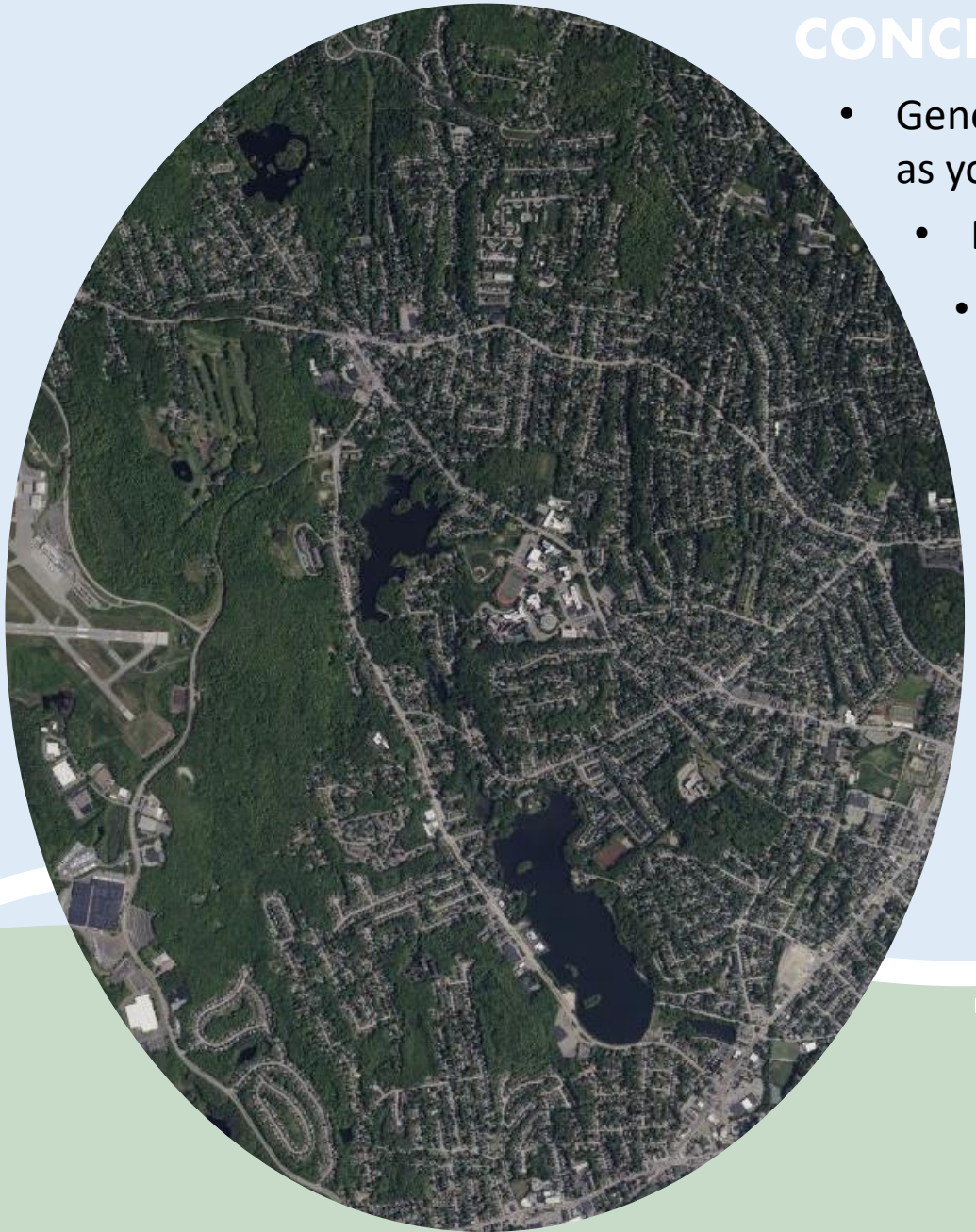
COES RESERVOIR

- Scums seen at lake edges multiple times throughout the season
- Pigment >50 RFUs end-July and early Oct
- Density elevated on all sampling days, with an active bloom throughout Oct.
- Diverse taxa, including *Woronichinia*
- Pigment was elevated over 2021 results



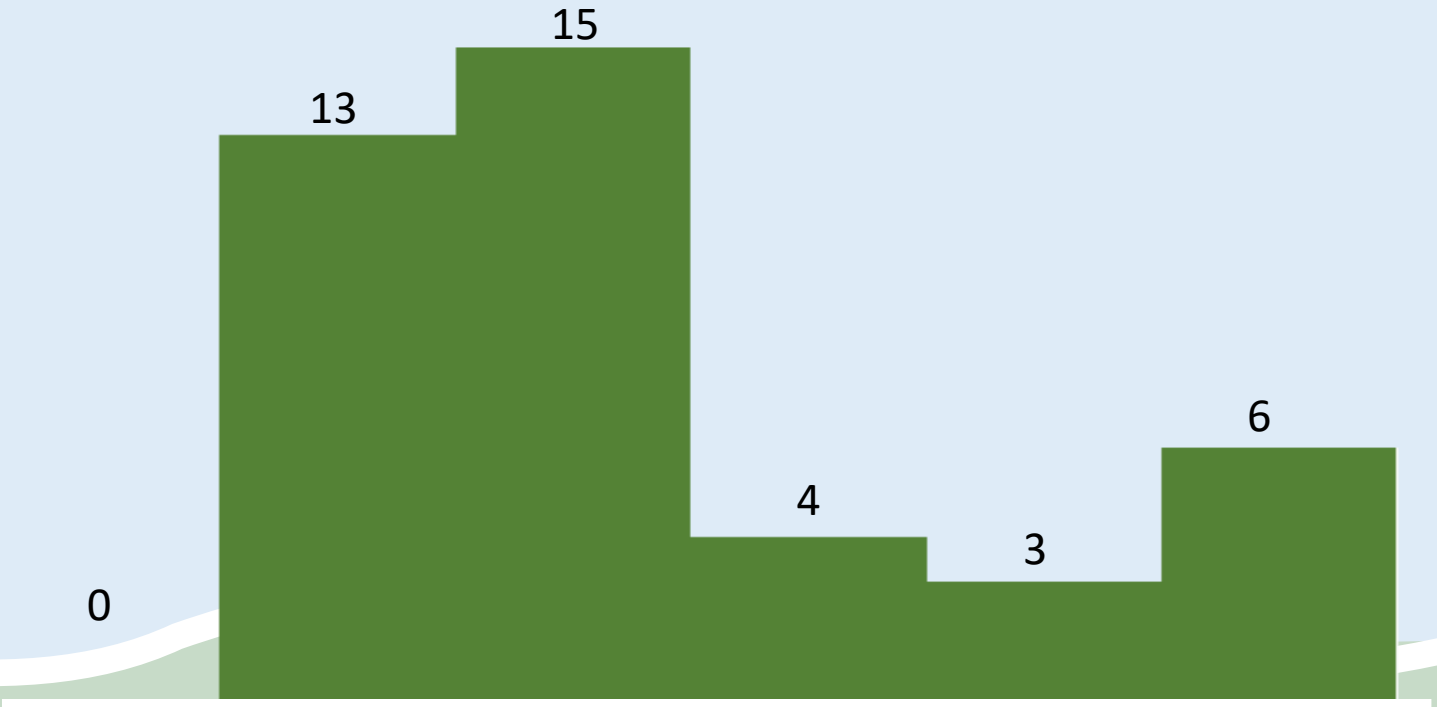
Thank you to our volunteer, Pat!

TATNUCK BROOK WATERSHED



CONCLUSIONS

- Generally higher pigment and more diverse cyanobacteria as you descend through the watershed
  - Blooms don't necessarily occur at the same time
    - *Dolichospermum* and *Aphanizomenon* most commonly observed



Oscilltoria *Aphanizomenon* *Dolichospermum* *Woronichinia* *Microcystis* *Microcystis debris*

LAKE QUINSIGAMOND WATERSHED

WATERBODIES SAMPLED

- Newton Pond
- Jordan Pond
- Bell Pond
- Lake Quinsigamond
- Flint Pond

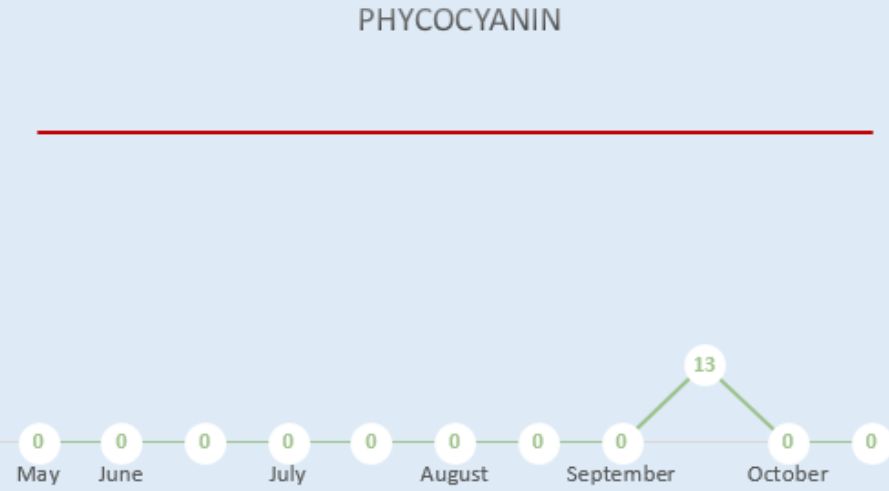
CHARACTERISTICS

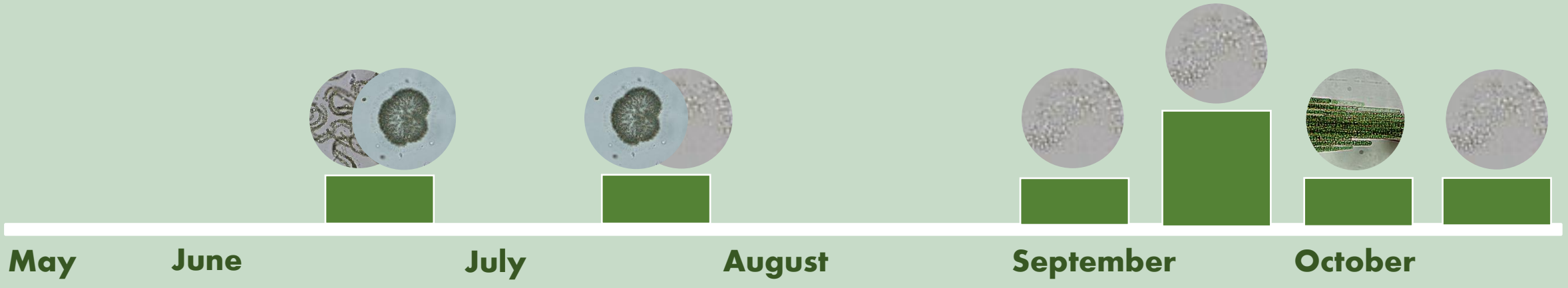
- Includes multiple municipalities (Shrewsbury, Grafton, Worcester)
- Generally, flows to Lake Quinsigamond, then to Quinsigamond River
- Cyanobacteria have been observed in the colder months in Lake Quinsigamond

NEWTON POND

- Clarity slightly turbid to opaque throughout season, green slimes observed at times
- Pigments generally undetectable, apart from late Sept
- Cyanobacteria density low apart from except for late Sept
- Early occurrence of *Woronichinia*, but mostly *Microcystis* was observed
- Results and diversity reflect 2021 observations, though “spike” was in Aug

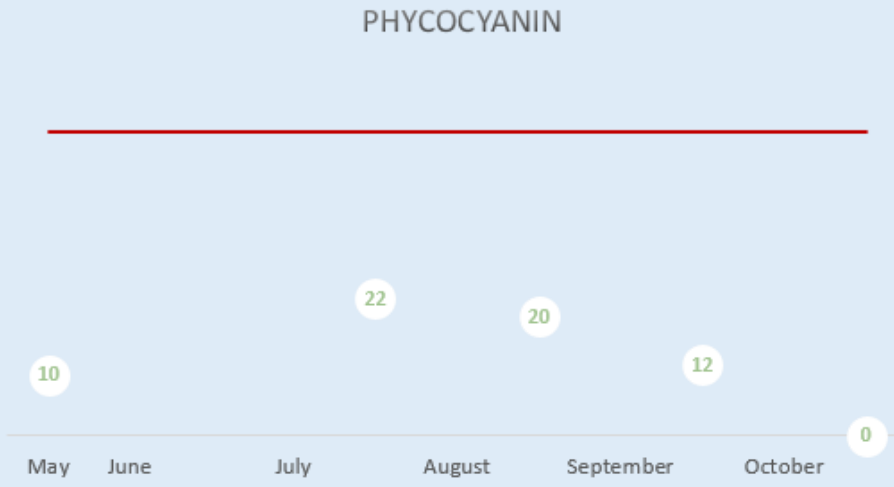
Thank you to our volunteers, Linda, Bob, and Phil!



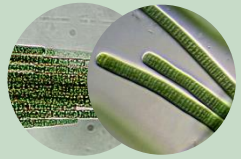


JORDAN POND

- Clarity rated from clear to slightly turbid, green scums observed at times
- Pigments peaked at 22 RFUs in late July and fell to undetectable by mid-Oct
- Cyanobacteria were not detected in most samples taken
- *Aphanizomenon* and *Oscillatoria* coexisted in mid-July
- 2022 data will provide a baseline for future comparison



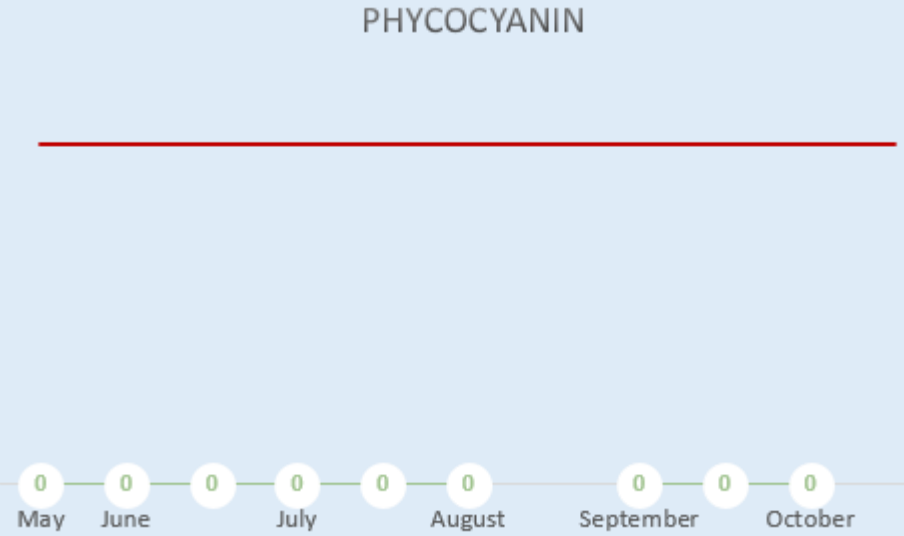
Thank you to our volunteer, Barbara!

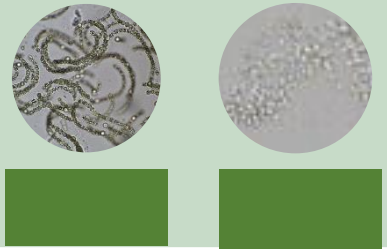


BELL POND

- Lake was observed to be clear almost all season
  - Pigment concentration was below detection limits every session
    - Cyanobacteria were detected in low density end-Sept and early Oct
      - *Dolichospermum* and *Microcystis* debris observed
      - Results are similar to 2021, with slightly lower pigment concentrations

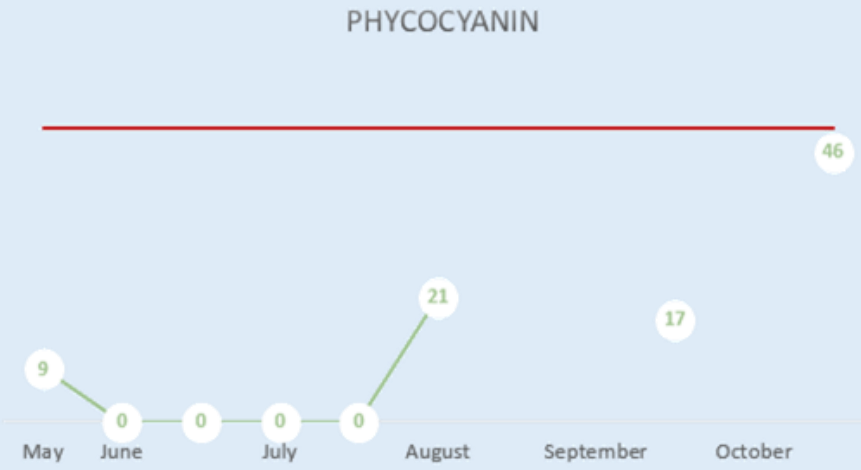
Thank you to our volunteer, Cathy!





LAKE QUINSIGAMOND

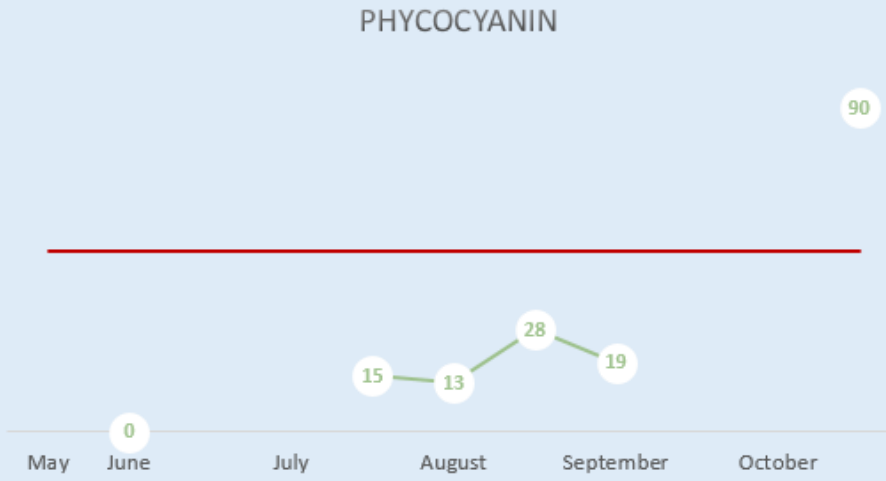
- Clarity generally high, with some scums appearing at the end of the season
- Pigments begin low to undetectable, but rise, approaching 50 RFUs in Oct
- Cyanobacteria observed every session sampled less early-June
- One taxon dominated in the early season, but generally the community is diverse
- In 2021, pigment dropped from near 50 RFUs from June to October



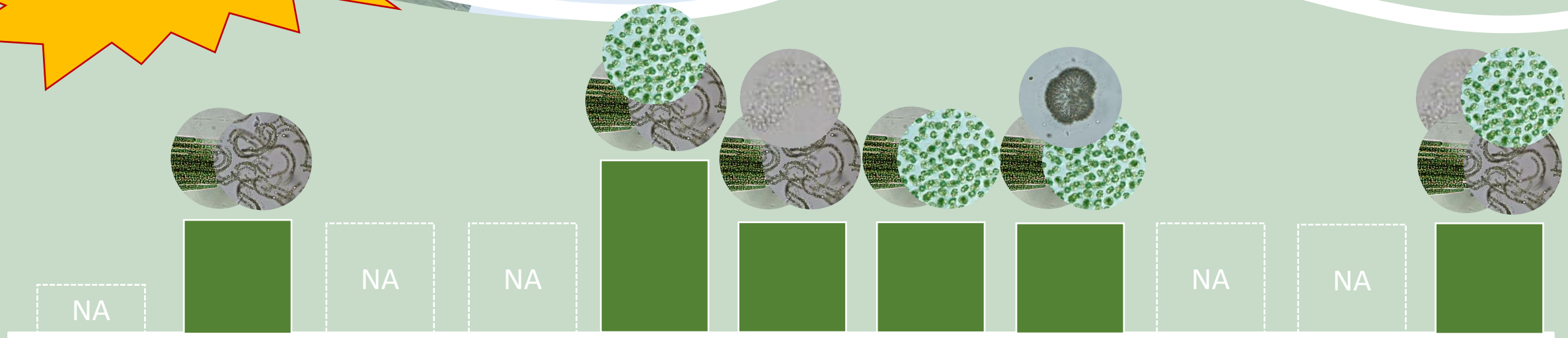
Thank you to our volunteers, Steve and Sarah!

FLINT POND

- Higher turbidity throughout season; green scums appearing in later months
- Pigment generally low until peaking in mid-Oct at 90 RFUs
- Cyanobacteria density elevated in all samples
- Diverse taxa identified, no dominant group
- 2022 data supports and expands 2021 findings for pigment and diversity



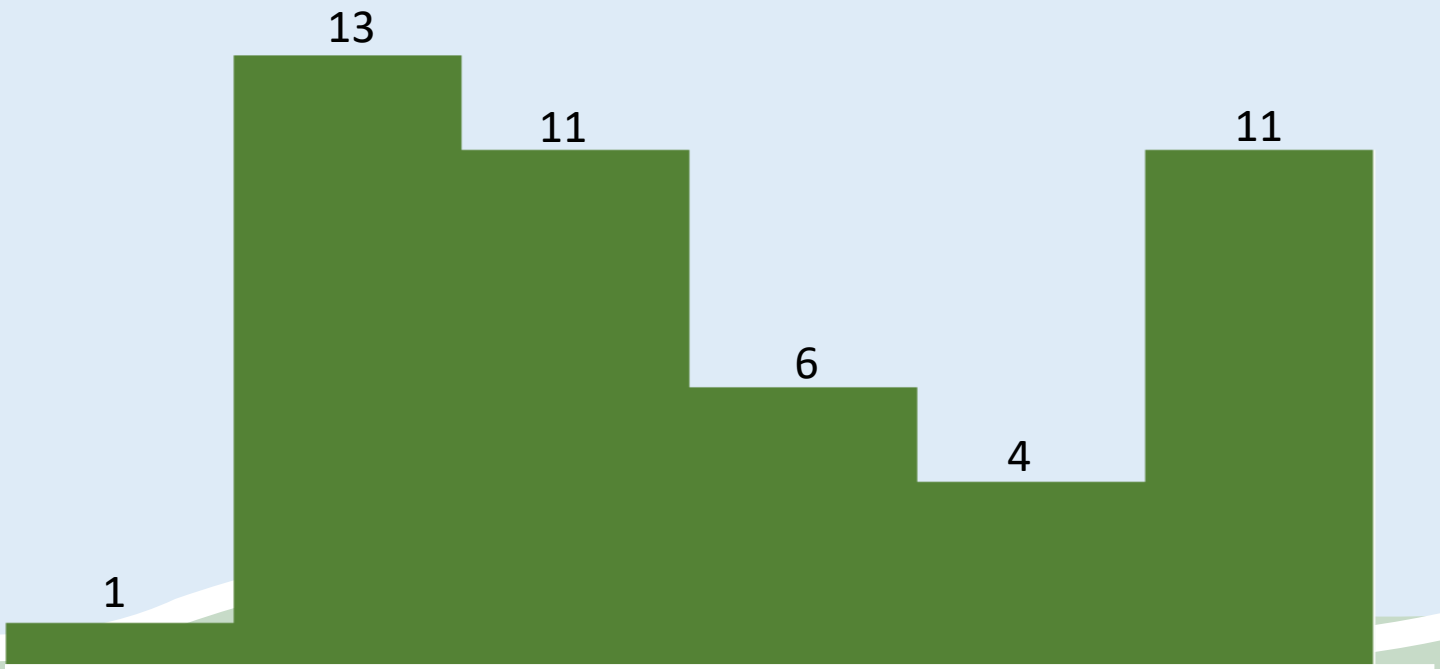
Thank you to our volunteer, Peter!



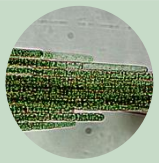
LAKE QUINSIGAMOND WATERSHED

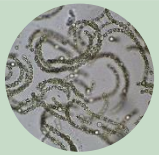
CONCLUSIONS

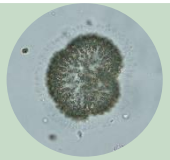
- Small “tributary” ponds to Lake Quinsigamond are low risk comparatively
  - Lake Quinsigamond, Flint Pond at risk for late season blooms
    - *Aphanizomenon* was the most observed group of cyanobacteria

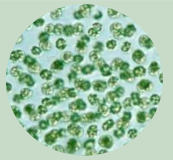



Oscilltoria


Aphanizomenon


Dolichospermum


Woronichinia


Microcystis


Microcystis debris

MILL BROOK WATERSHED

WATERBODIES SAMPLED

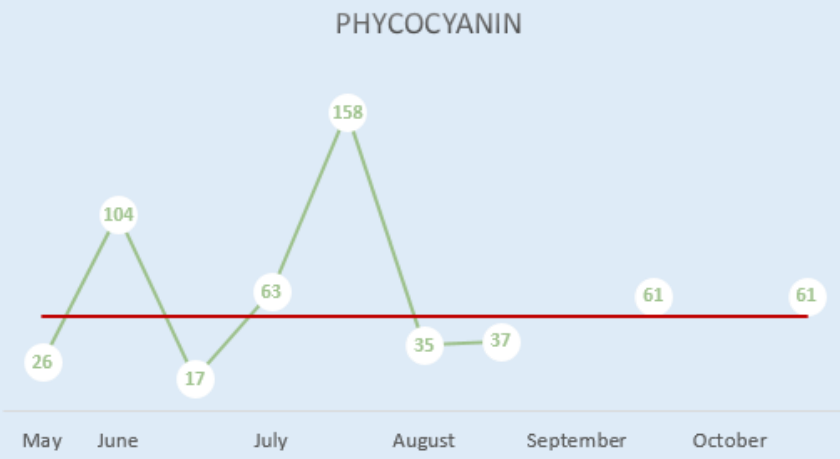
- Kiver Pond
- Little Indian Lake
- Indian Lake

CHARACTERISTICS

- Urban watershed dominated by Indian Lake
- Culverted from Indian Lake to Salisbury Pond
- Known for cyanobacteria blooms

KIVER POND

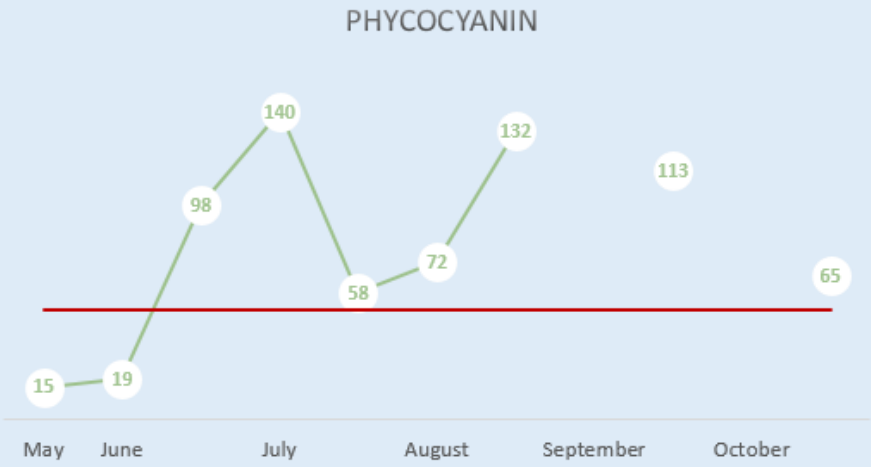
- Water reported as opaque or turbid all season until clear in late Sept
- Quick swings in pigment from low to high, highest in late July
- Despite pigment, no cyanobacteria observed, suggesting picocyanobacterial presence
- Lack of cyanobacteria observations similar to 2021, but high pigments occurred earlier this year



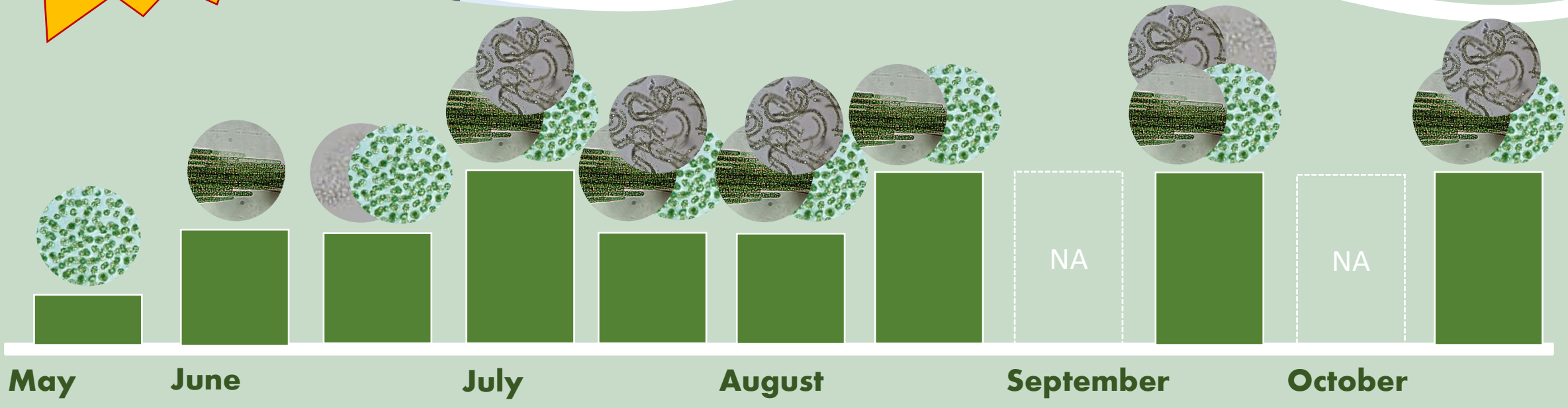
Thank you to our volunteers, Dana, Karen, and Preston!

LITTLE INDIAN LAKE

- Water opaque or turbid almost all season
- Pigments >50 RFUs starting mid June for the rest of the season
- Elevated cyanobacteria density for every sampling event after May
- Cyanobacteria community diverse, with generally three taxa coexisting
- Pigment swings and taxa consistent with 2021 data, though pigment results are lower this year

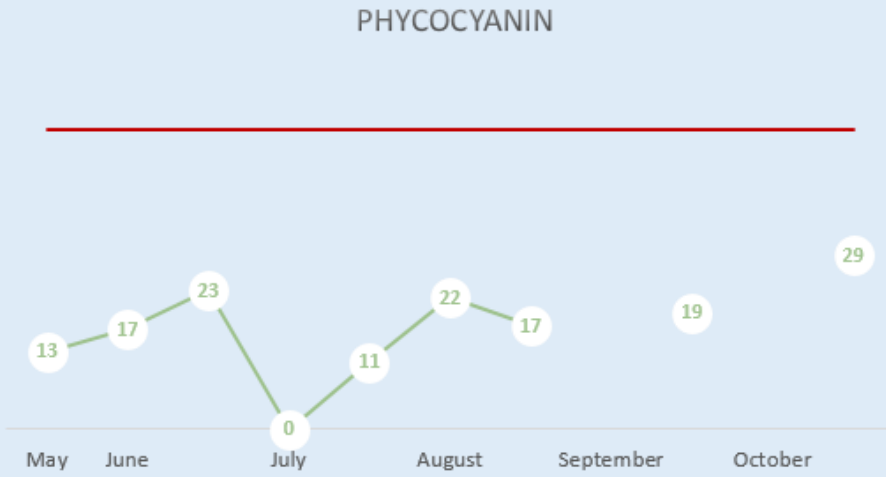


Thank you to our volunteers, Dana, Karen, and Preston!

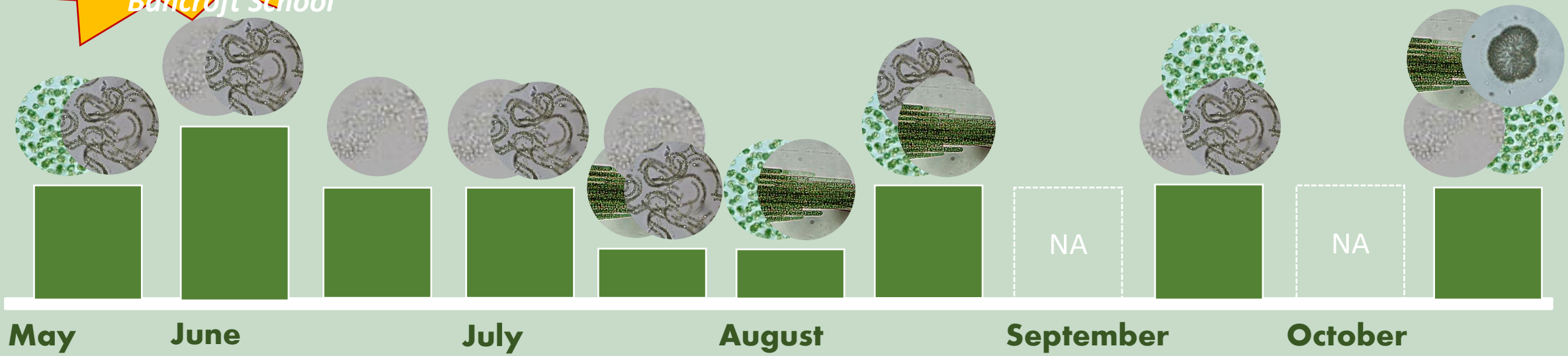


INDIAN LAKE

- Water generally reported as clear to slightly turbid
- Pigments <50 RFUs all season, usually <20
- Cyanobacteria density was highest in early June and dipped during the hottest part of the season
- Generally, there was more than one taxa present
- Taxa are consistent with 2021 data; but no bloom in 2022



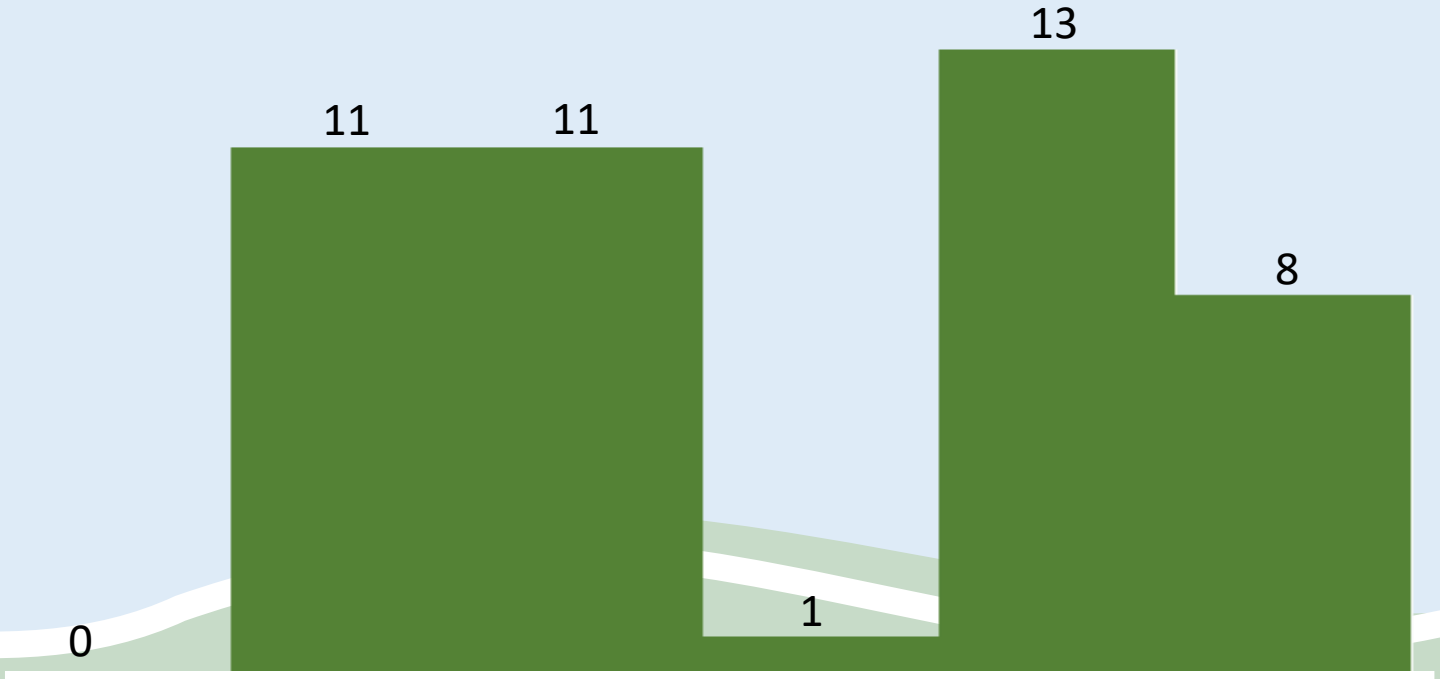
Thank you to Dana, Karen, and Preston, as well as Ms. Herliczek and her class from Bancroft School

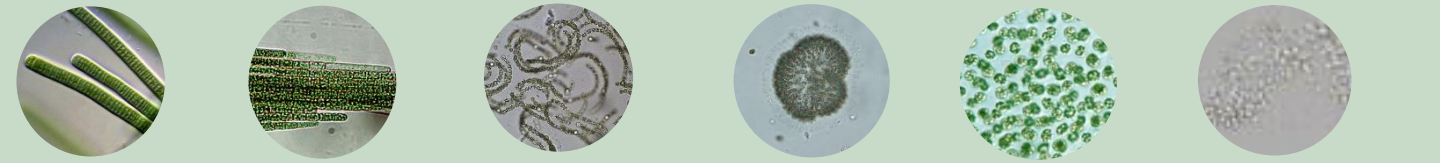


MILL BROOK WATERSHED

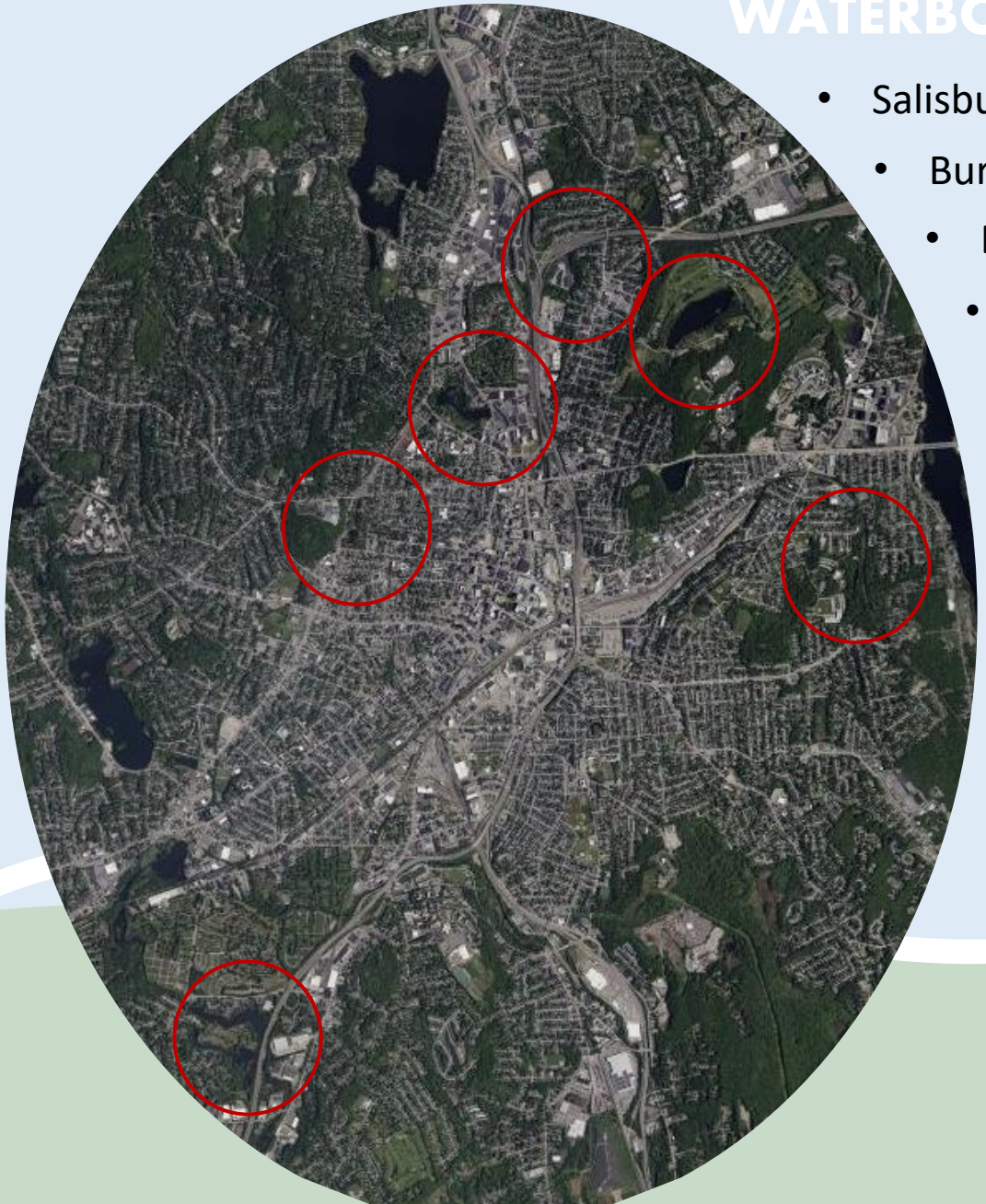
CONCLUSIONS

- Summer blooms occurred in Kiver Pond and Little Indian Lake, but not in Indian Lake
  - *Microcystis* most commonly observed, though picocyanobacterial may be present at Kiver pond





PARK PONDS



WATERBODIES SAMPLED

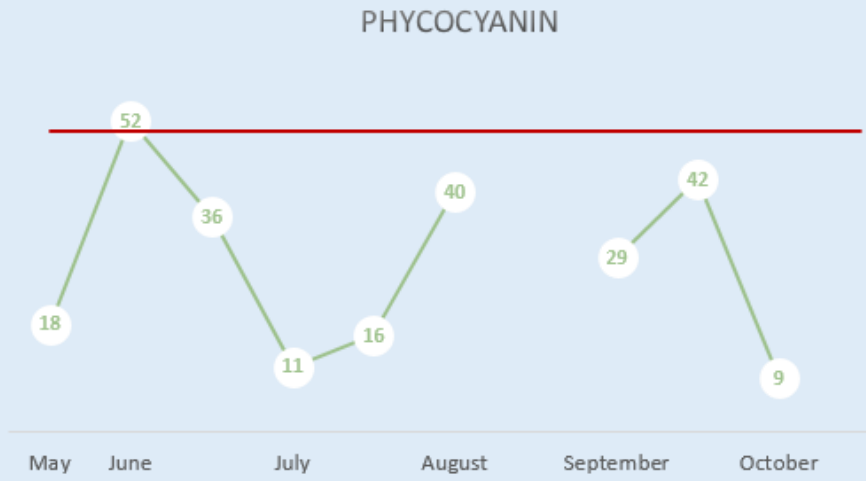
- Salisbury Pond
- Burncoat Pond
- Elm Park Pond
- Green Hill Pond
- Lower Ecotarium Pond
- Leesville Pond

CHARACTERISTICS

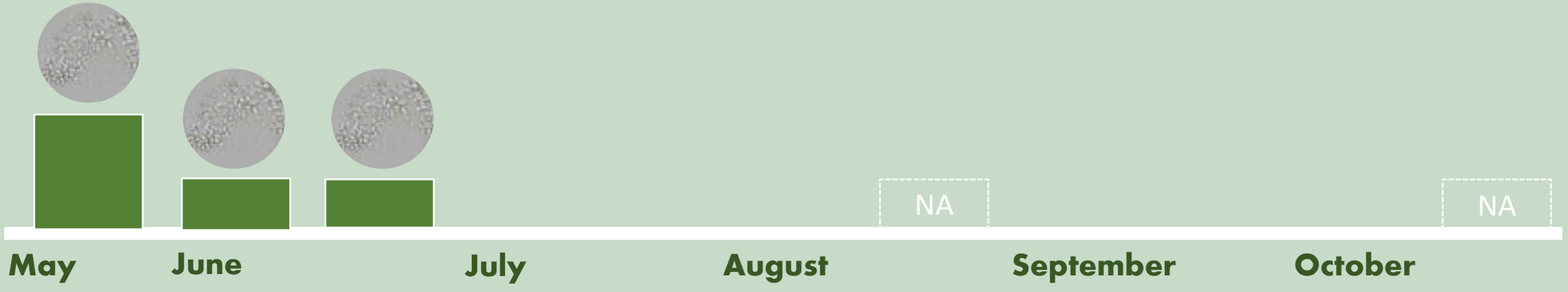
- Small, shallow, often ornamental ponds
- Located in high recreation urban areas (Worcester Parks)
- Potentially high risk of bloom and exposure

SALISBURY POND

- Water generally reported as turbid; no scums were observed
- Pigment was highest in early June at 52 RFUs, but < 50 RFUs otherwise
- Cyanobacteria detected only until July
- Only *Microcystis* debris was observed; picocyanobacteria may have been present
- Taxa and pigment patterns are consistent with data from 2021

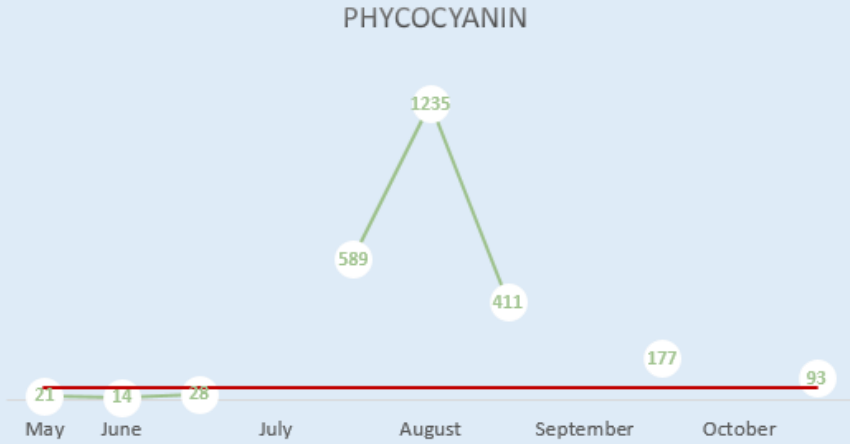


Thank you to our volunteers, Erin and Junghyo!

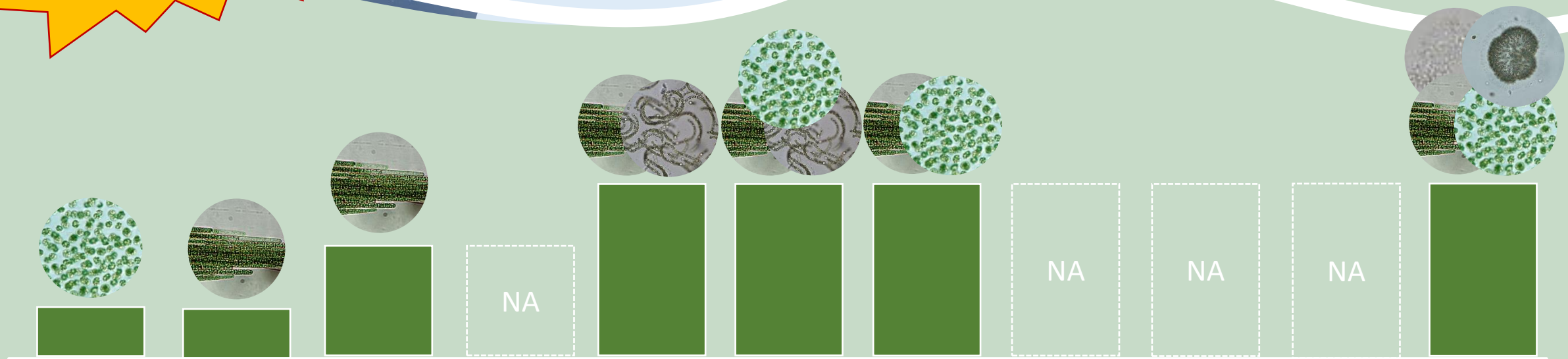


BURNCOAT POND

- Water generally turbid with scums visible at times
- Pigment >50 RFUs after June, peaked at 1235 RFUs
- Cyanobacteria were observed in increasing density throughout the season
- Cyanobacteria community more diverse as season progressed
- Pigments elevated over 2021 data, taxa consistent



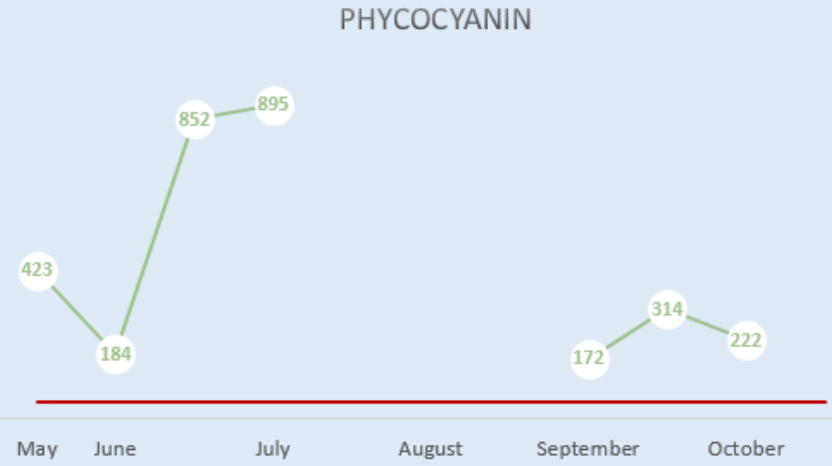
Thank you to our volunteers, Meredith and Fordyce!

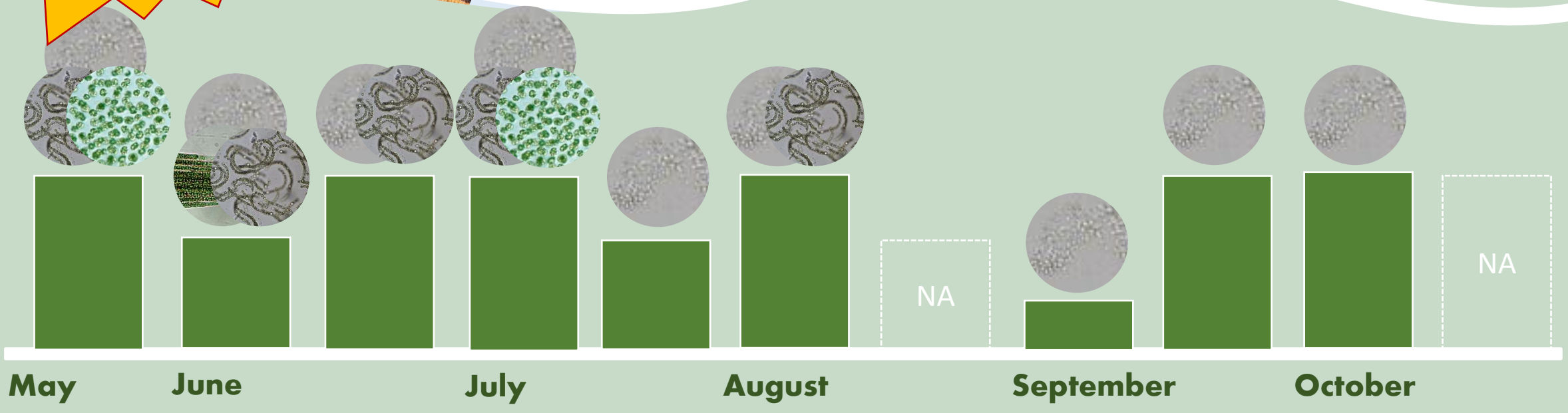


ELM PARK POND

Thank you to our volunteers, Erin and Junghyo!

- Water turbid to opaque; strong smell all season
- Pigment between 150 and 900 RFUs every sampling event
- Cyanobacteria elevated in almost every sampling event
- *Microcystis, Microcystis* debris, and *Dolichospermum* dominated the samples
- These data will be a baseline for future sampling

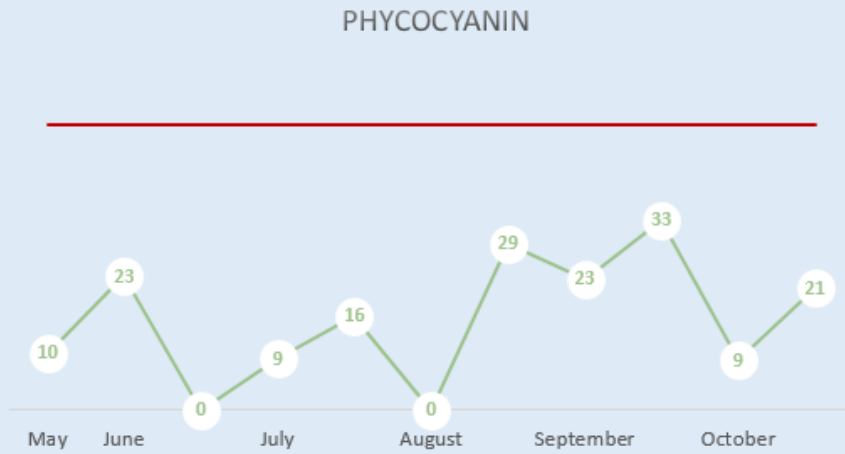




GREEN HILL PARK POND

Thank you to our volunteers, Brian, Gabriel, and Michael!

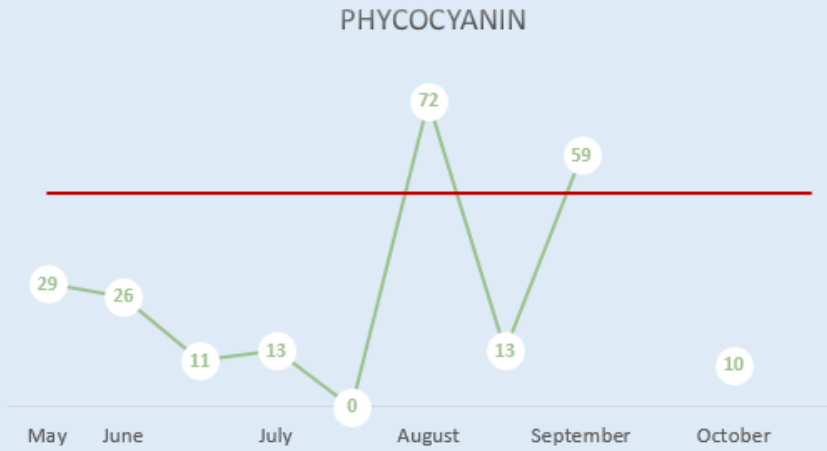
- Water clear to slightly turbid back to clear throughout the season
- Pigment peaks at 33 RFUs in late Sept, but oscillates throughout the season
- Cyanobacteria observed every sampling event, lowest density Aug-Early Sept.
- Cyanobacteria dominance varies throughout the season
- Taxa and pigment patterns are consistent with data from 2021

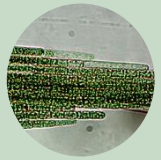


LOWER ECOTARIUM POND

Thank you to our volunteers, Jake, Susan, and the Ecotarium team!

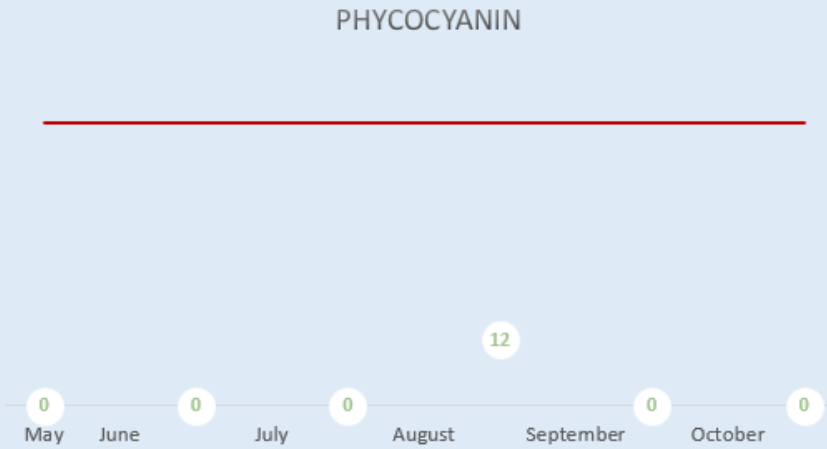
- After turbid in the spring, lake clear with only one slightly turbid day the rest of the season
- Pigment peaked at 72 in August, generally below 50 RFUs
- Cyanobacteria only observed during one sampling event
- Generally no cyanobacteria observed, suggesting picocyanobacterial activity
- Data will be used as a baseline for future analysis



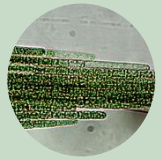


LEESVILLE POND

- Water reported as clear on all but the late-Aug sample event, when it was slightly turbid
- No pigment detected apart from the late-Aug event
- No cyanobacteria observed until mid-Oct, when a low density of *Aphanizomenon* was identified
- 2022 data will be used as a baseline for future sampling



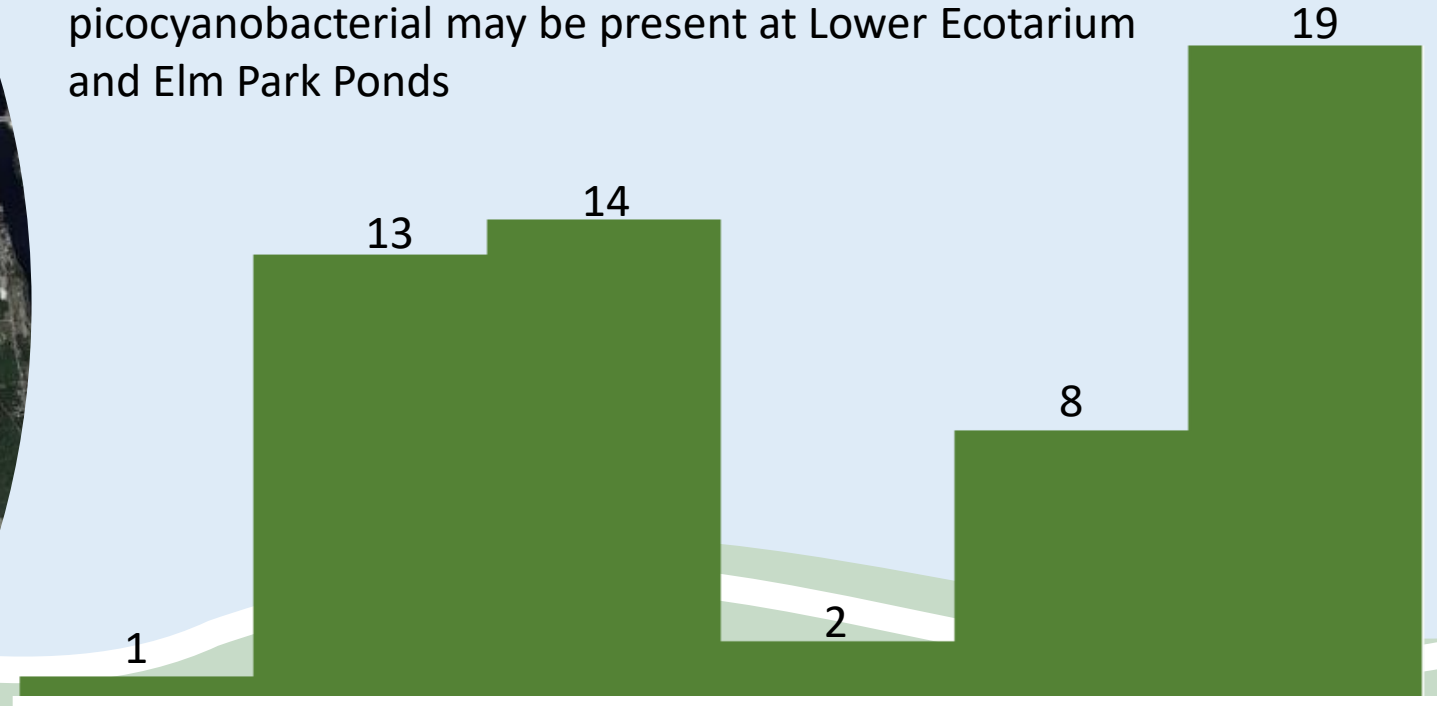
Thank you to our volunteers, Diane and Michael!



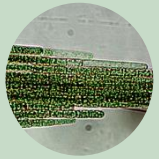
PARK PONDS

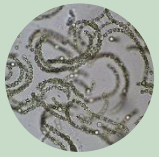
CONSLUSIONS

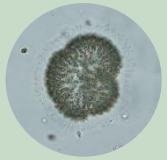
- 4 of 6 Park Ponds had pigment over 50 RFUs, some multiple times
  - Smaller, shallower ponds have highest risk
    - *Microcystis* debris is the most observed cyanobacterium, picocyanobacterial may be present at Lower Ecotarium and Elm Park Ponds

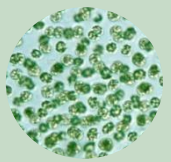



Oscilltoria


Aphanizomenon

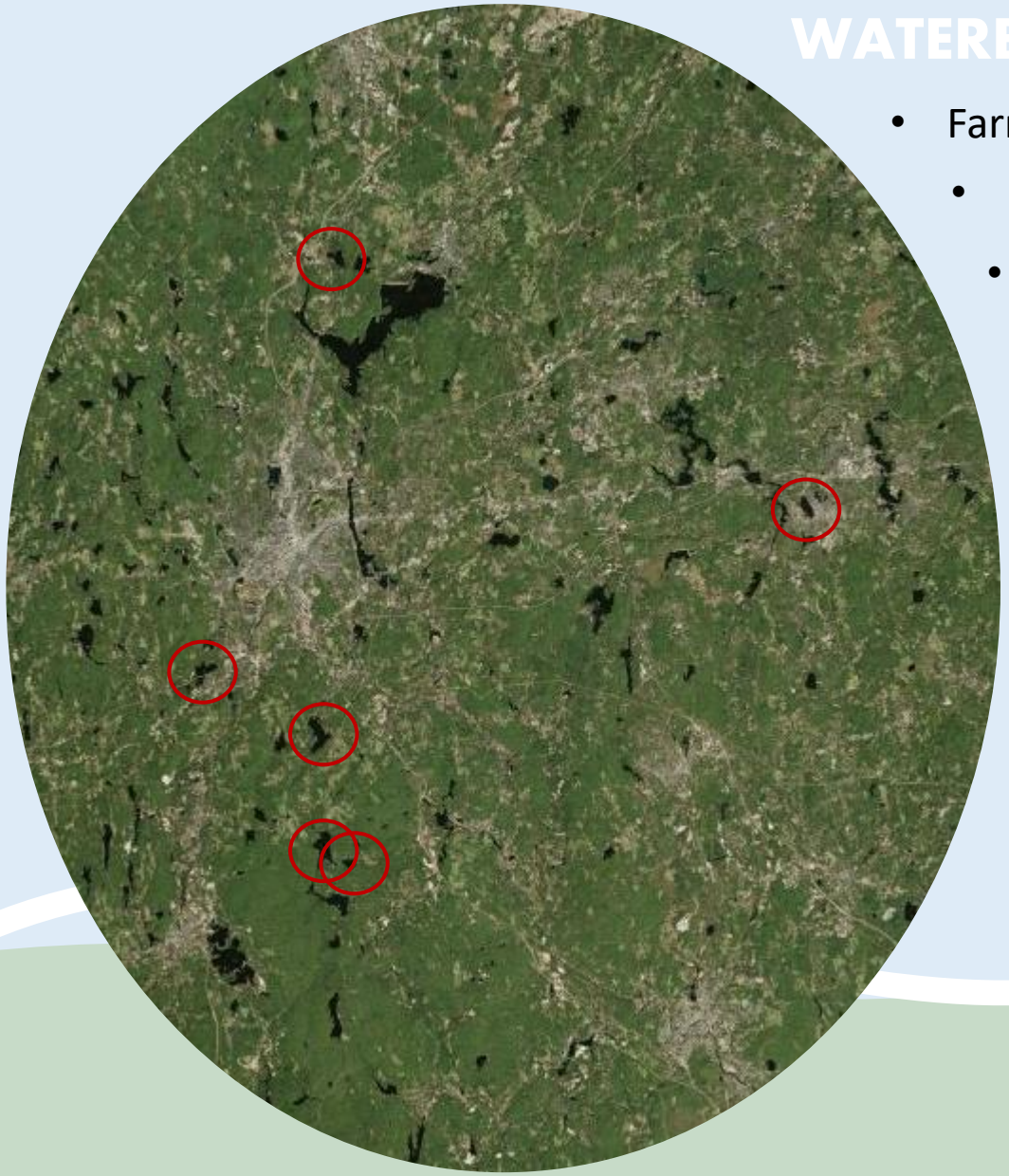

Dolichospermum


Woronichinia


Microcystis


Microcystis debris

RURAL PONDS



WATERBODIES SAMPLED

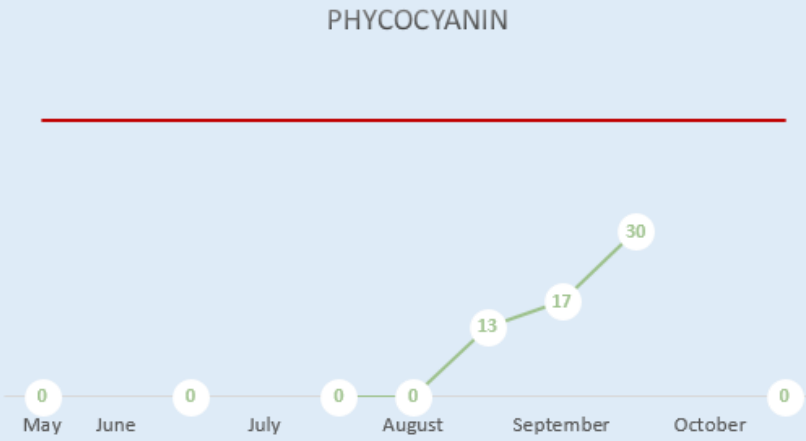
- Farm Pond (Sherborn)
- East Waushaccum Pond (Sterling)
- Manchaug Pond (Sutton)
- Stevens Pond (Sutton)
- Singletary Lake (Millbury)
- Dark Brook Reservoir (Auburn)

CHARACTERISTICS

- Located outside of Worcester
- Often larger and deeper than Park Ponds
- Generally much more rural landscape

FARM POND

- Clear until end-Aug, when it became turbid and opaque until the end of the season
- Pigment undetectable until end-Aug, rises to 30 RFUs
- Low to moderate cyanobacteria density observed throughout the season
- Cyanobacteria dominated by *Dolichospermum* and *Microcystis* debris
- Pigment data aligns with 2021, although clarity suggested a non-cyanobacteria bloom occurred

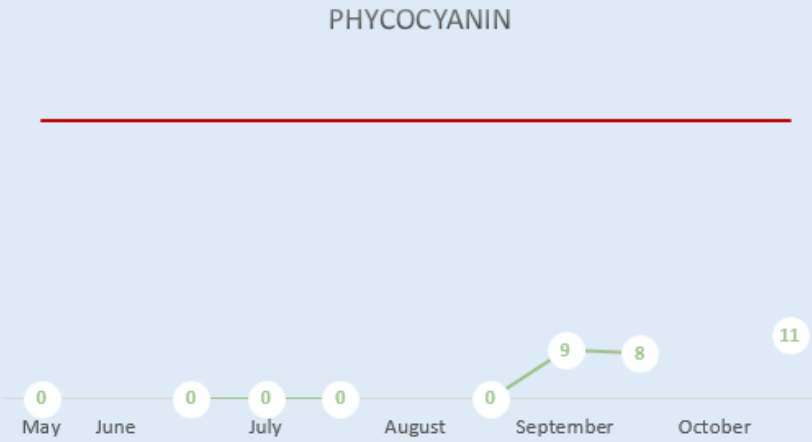


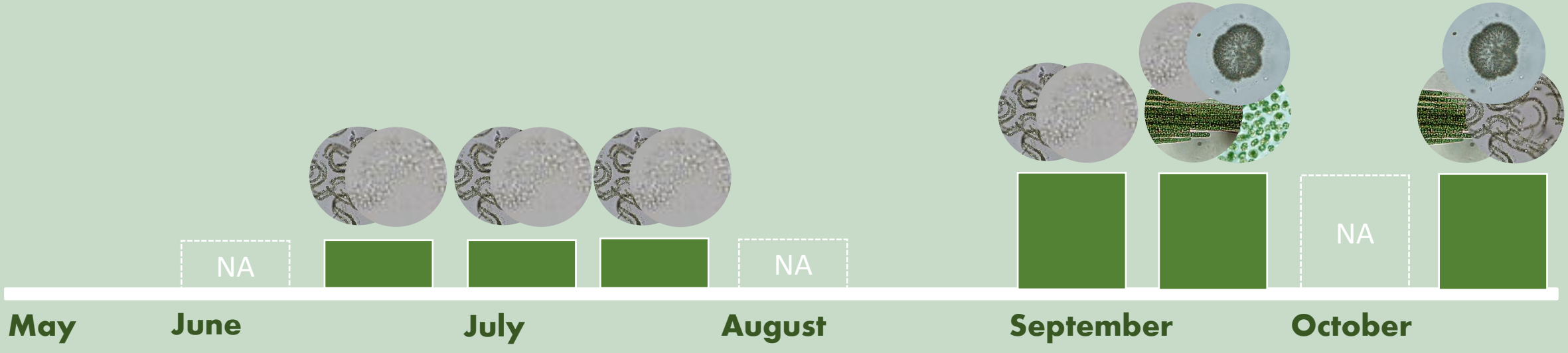
Thank you to our volunteers, Tom, Taylor, Karyn, Penelope, Jackie, Peggy, Dale, Catherine, and Zenya!

EAST LAKE WAUSHACCUM

Thank you to our volunteers, Sue and Serena!

- Generally clear, occasionally slightly turbid throughout the season
- No pigment detected until late-Sept, highest at 11 RFUs
- Cyanobacteria observed throughout the season in low to medium densities
- Community becomes more diverse over the season
- This data will be used as a baseline for future analysis

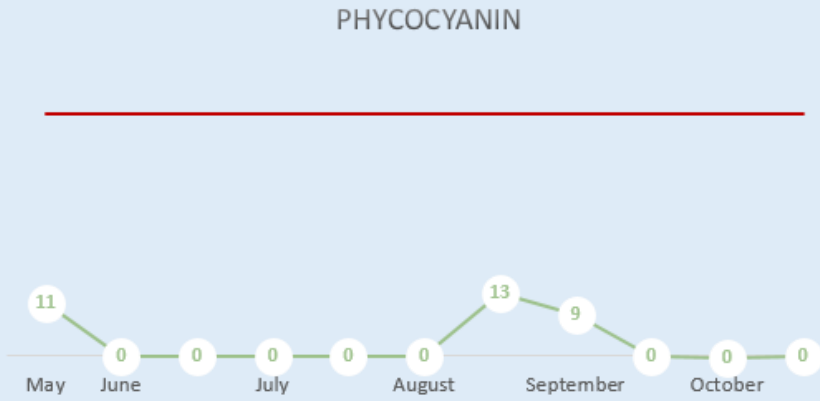


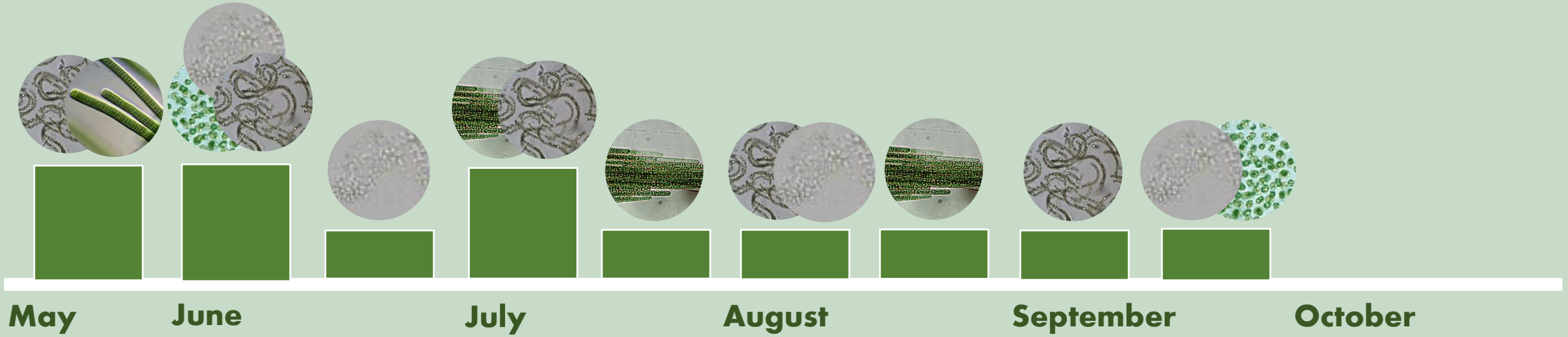


MANCHAUG POND

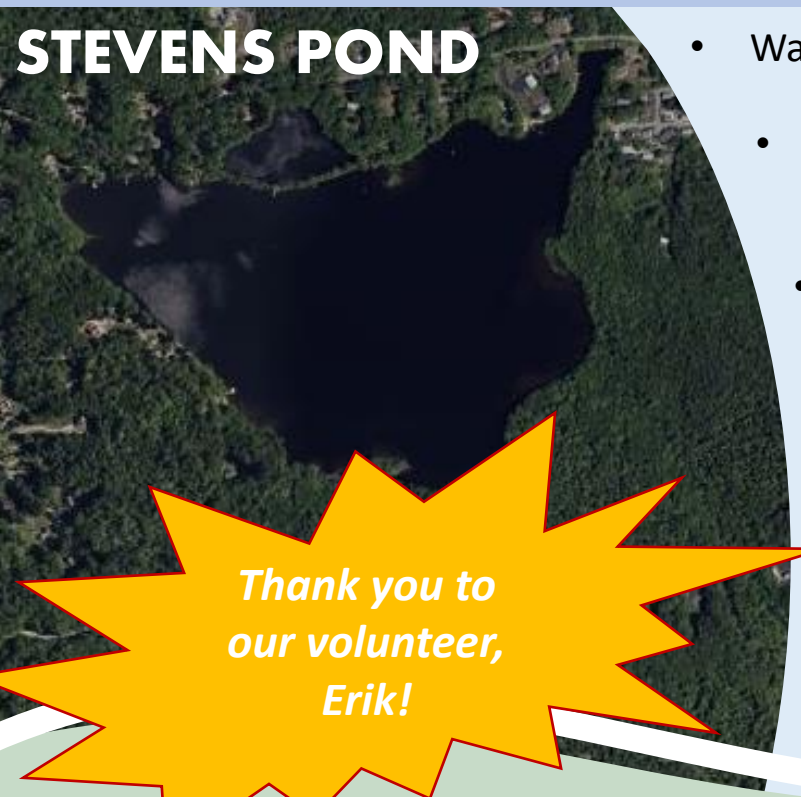
Thank you to our volunteers, Phyllis and Rose!

- Water reported as clear all season
- When pigment was detected, it was < 15 RFUs
- Cyanobacteria observed in low to medium densities until Oct, then disappears
- Cyanobacteria dominance shifts between *Dolichospermum* and *Aphanizomenon*, with *Microcystis*
- Taxa and pigments are consistent with 2021 data



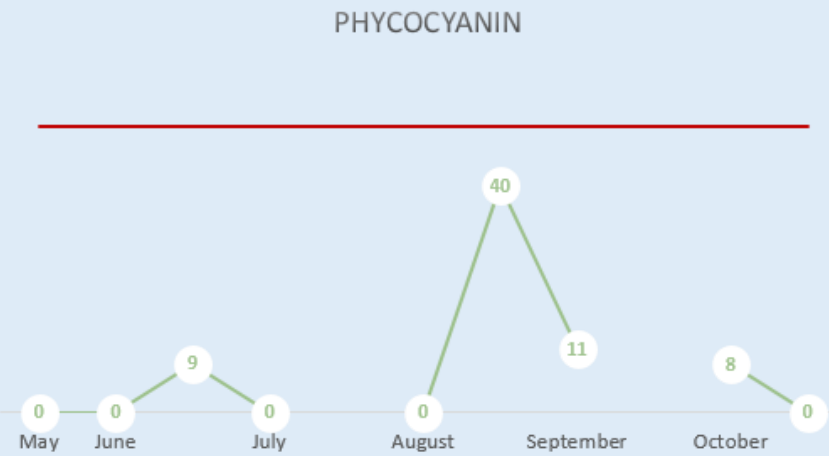


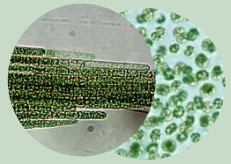
STEVENS POND

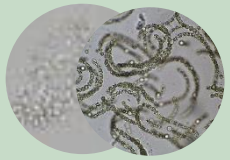


Thank you to our volunteer, Erik!

- Water clear all season except in early-Aug when turbid
- Pigment low to undetected, except for late-Aug, when it reached 40 RFUs
- Cyanobacteria only observed in low densities early-Sept and Oct
- Cyanobacteria included *Dolichospermum*, *Aphanizomenon*, *Microcystis, and Microcystis* debris
- Data will be used as a baseline for future analysis







NA

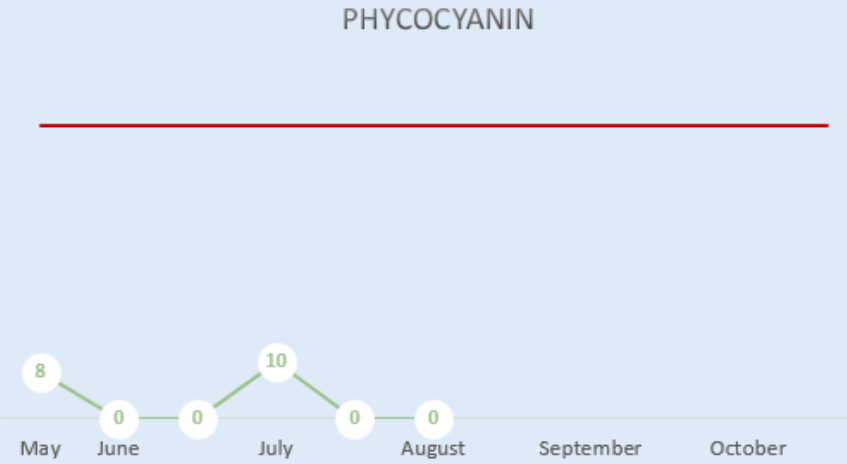
NA

May June July August September October

SINGLETARY LAKE

- Water generally reported as clear
- Pigment generally low to undetected
- Cyanobacteria not observed until July, and then in low density
- Cyanobacteria community dominated by *Dolichospermum*
- This data will be used as a baseline for future analysis

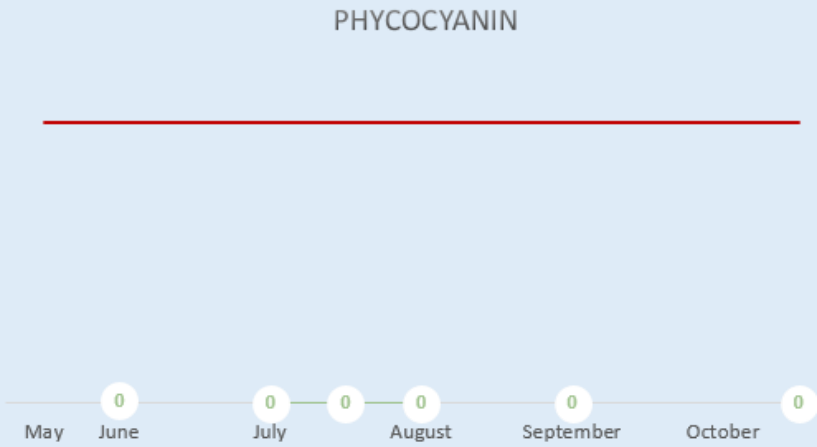
Thank you to our volunteers, Haley and Danielle!



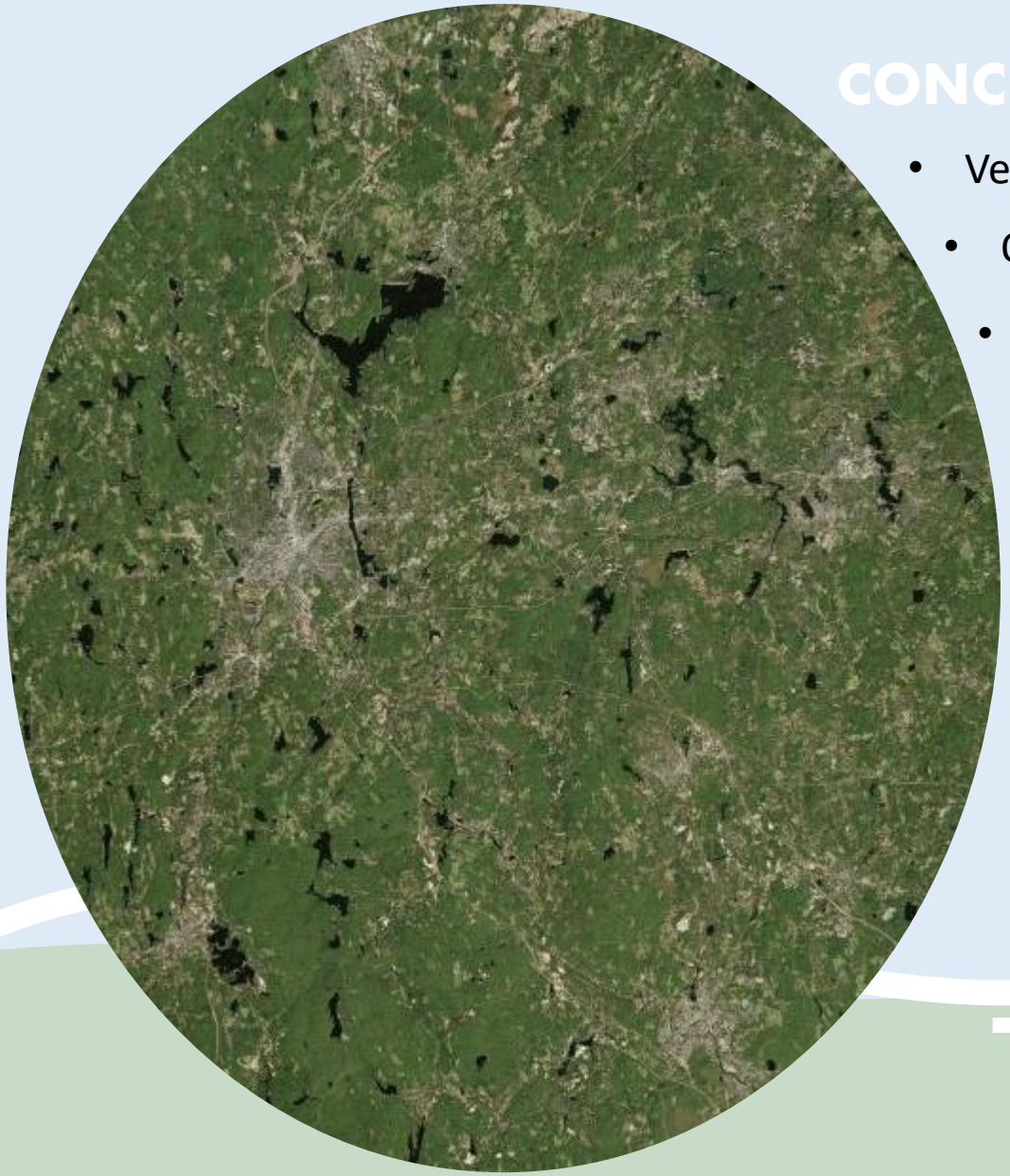
DARK BROOK RESERVOIR

Thank you to our volunteer, Michelle!

- Water reported as clear on all sampling dates
- Pigment undetectable every sampling event
- Cyanobacteria generally observed in low densities
- Cyanobacteria observed included *Dolichospermum*, *Microcystis,* and *Microcystis* debris
- Data will be used as a baseline for future analysis

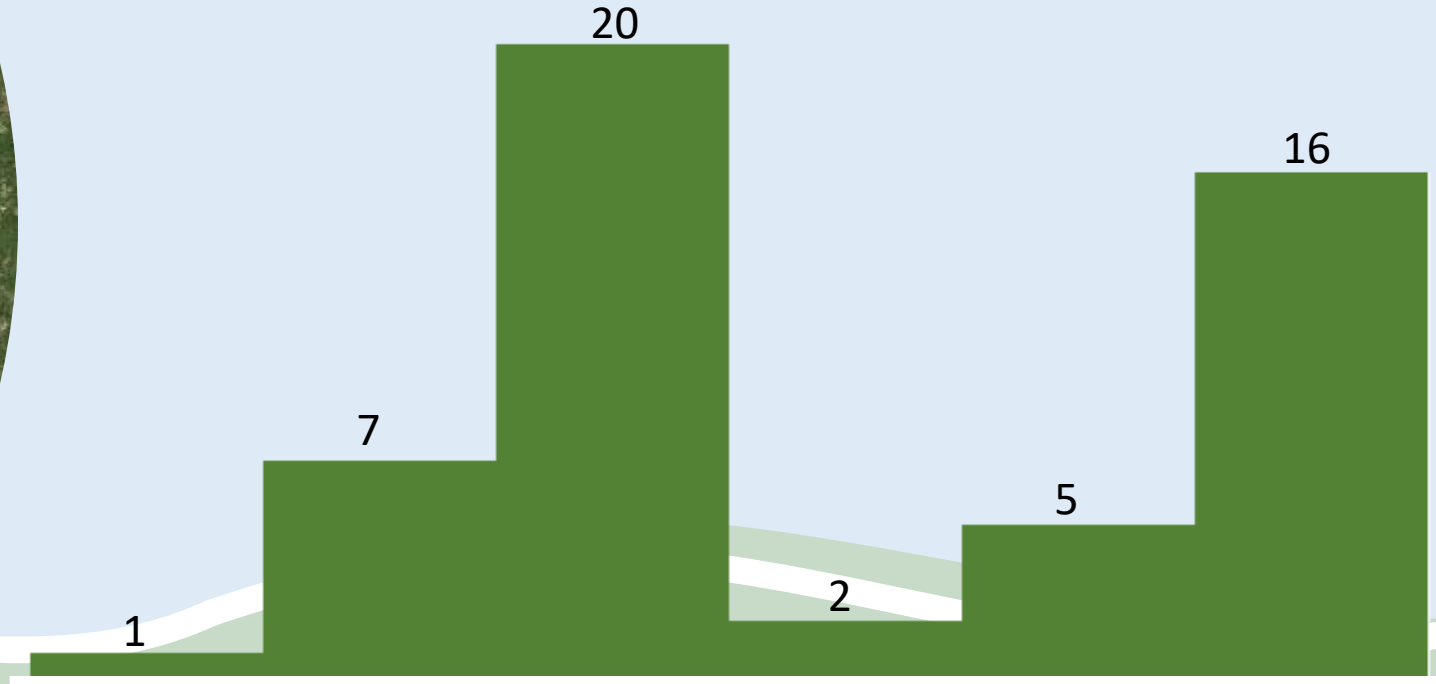


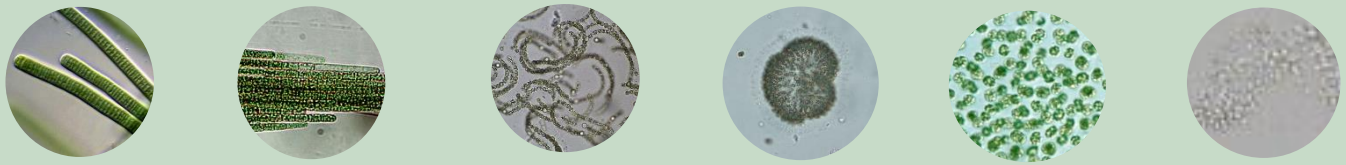
RURAL PONDS



CONCLUSIONS

- Very low pigment concentrations throughout the season
- On average, lower cyanobacteria density than other program lakes
- *Dolichospermum* is the most common cyanobacterium observed

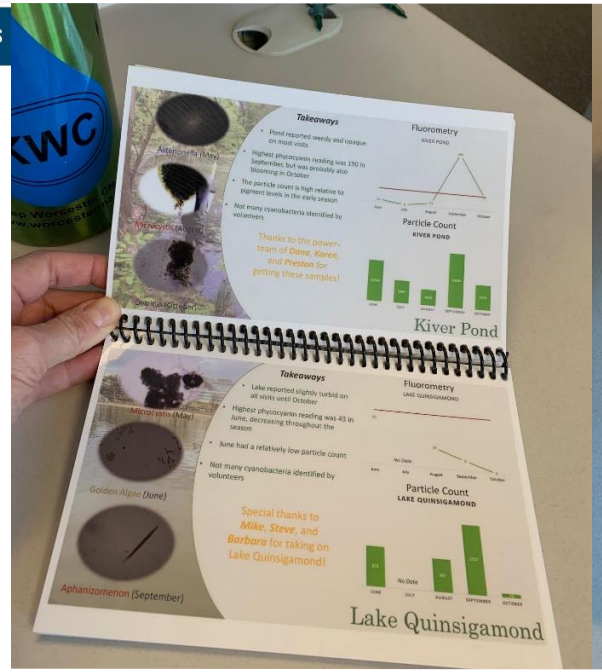


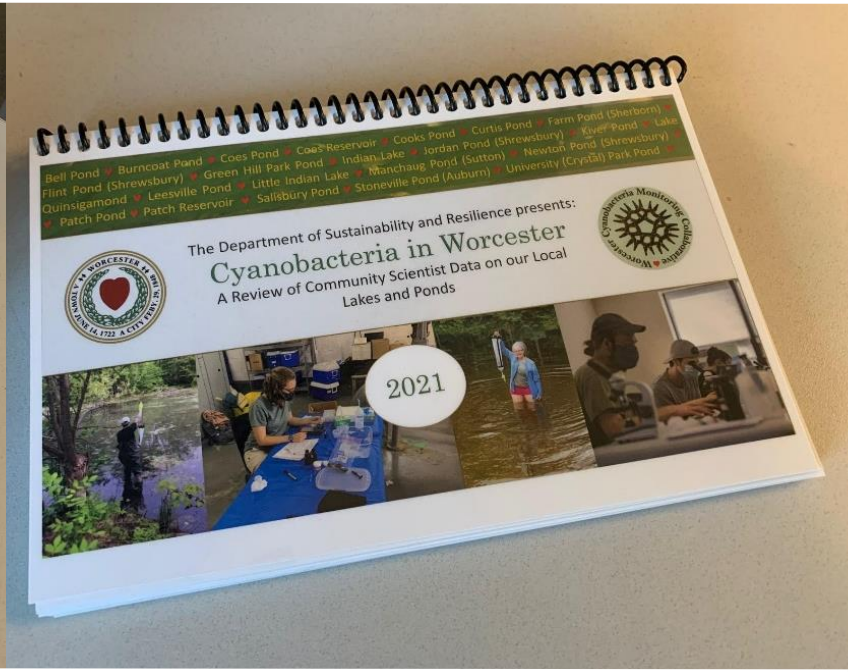


Oscilltoria *Aphanizomenon* *Dolichospermum* *Woronichinia* *Microcystis* *Microcystis debris*

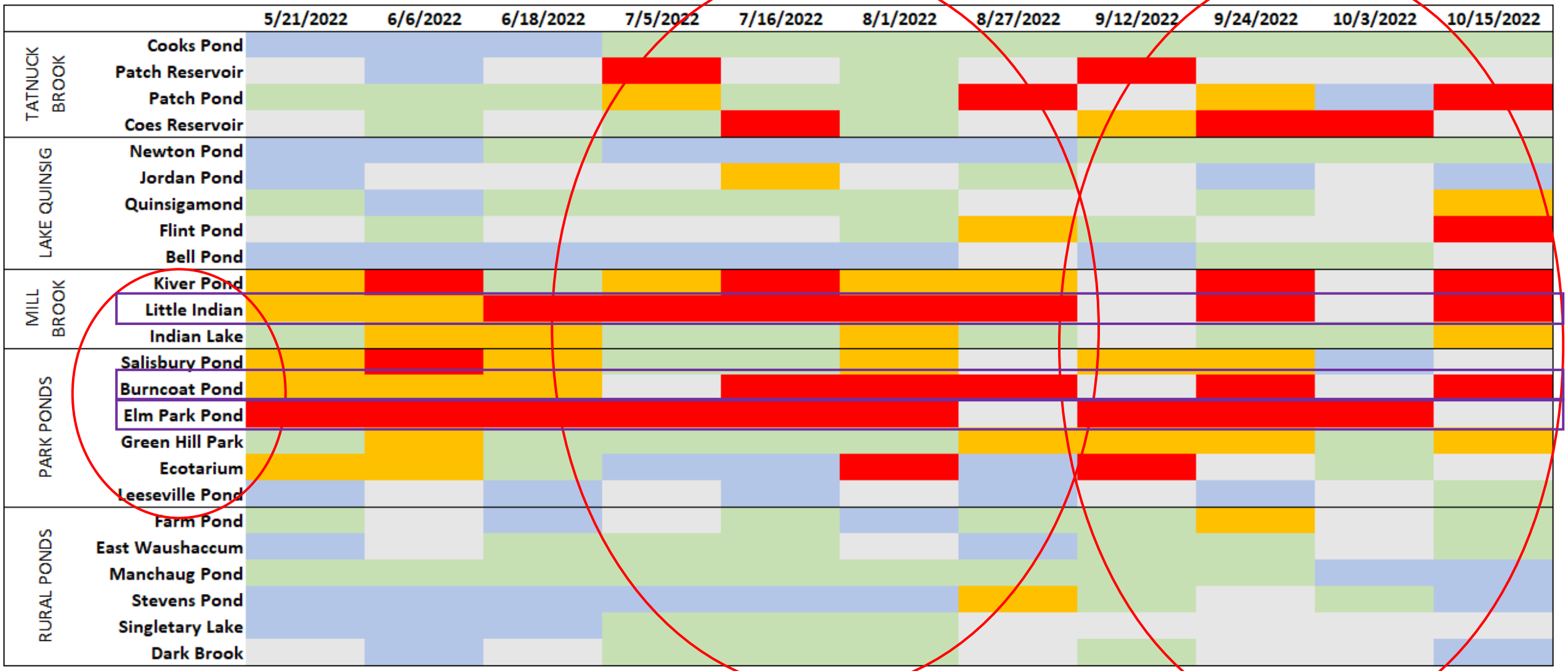
TAKING ANOTHER LOOK

- All of the monthly data reports can be found on Worcesterma.gov/wcmc
- This presentation will be posted on the webpage
- Hard copies of these slides will be made available to all volunteers



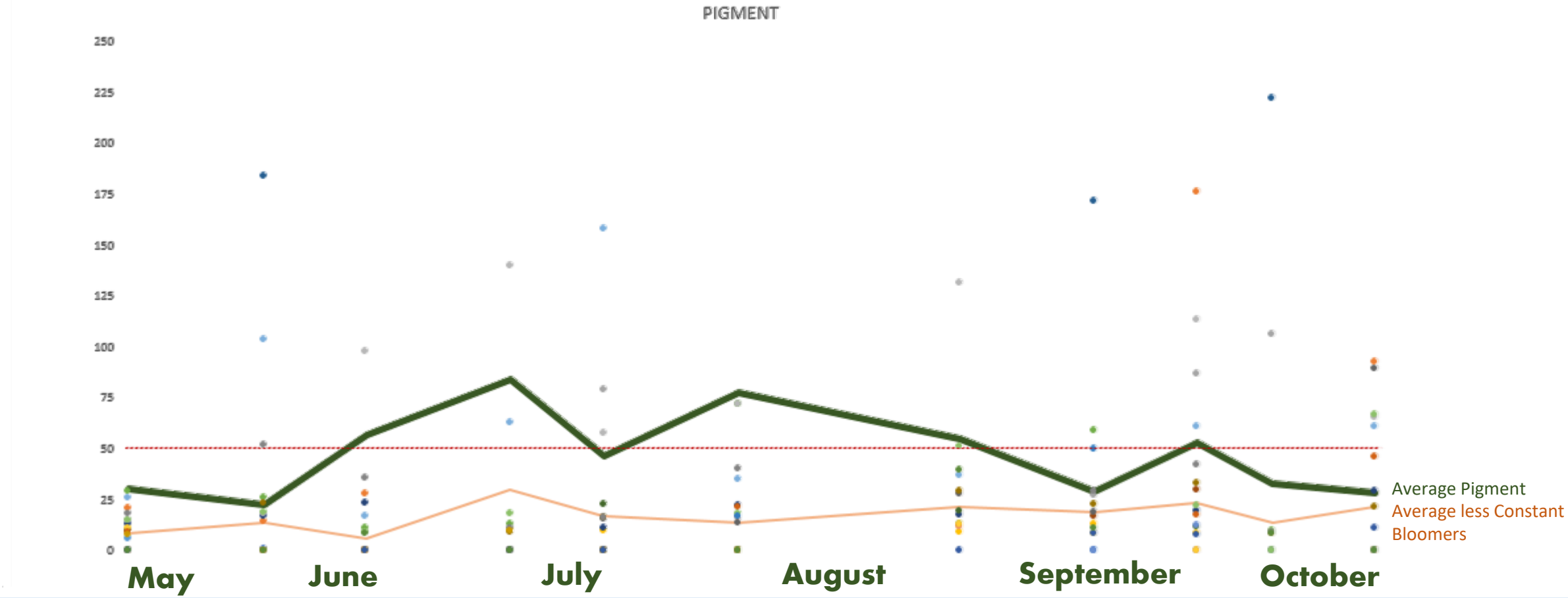


TAKEAWAYS: OVERALL BLOOM RISK ACROSS PONDS



- Blooms occur in the hottest months, but also in the fall to late fall
- Little Indian Lake, Burncoat Pond, and Elm Park Pond seem to be at high risk for the whole sampling season

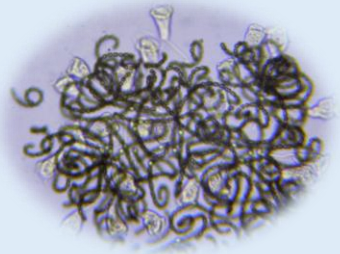
TAKEAWAYS: OVERALL PIGMENT ACROSS PONDS



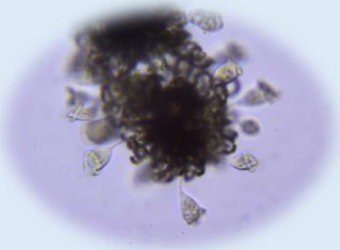
- Average pigment across all lakes is highest late-June through August
- When you remove the three constant bloomers, the early July has the highest phycocyanin
- This data with the ER data suggusts blooms in the summer were more intense, and the ones in the fall were more numerous

OVERALL TAKEAWAYS: TAXA ACROSS PONDS

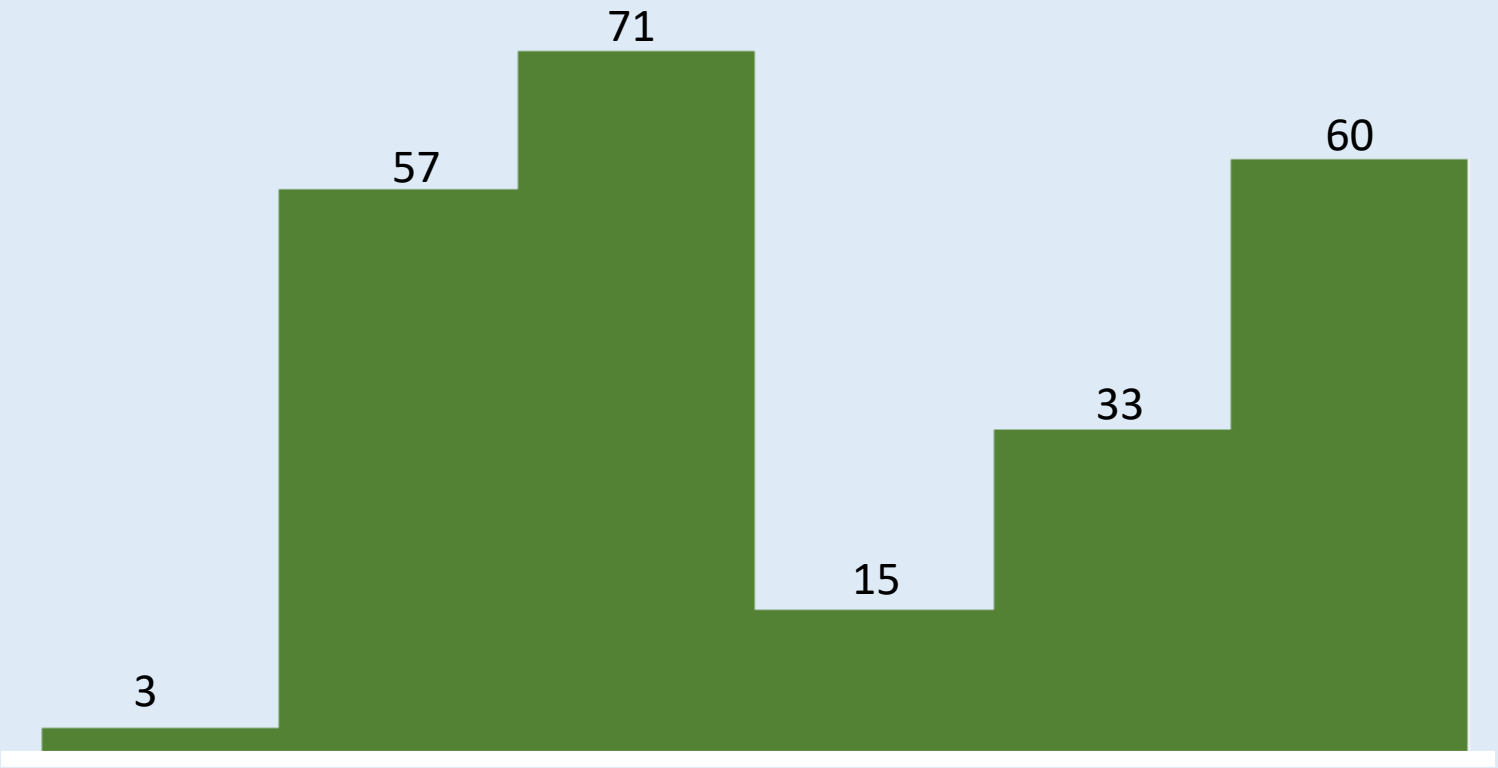
Lake Quinsigamond



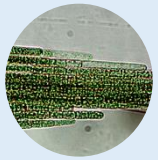
Indian Lake



Singletary Lake

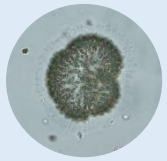


Oscilltoria

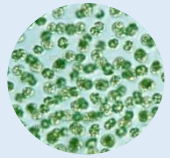


Aphanizomenon

Dolichospermum

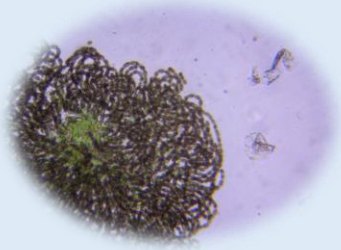


Woronichinia



Microcystis

Microcystis debris



Green Hill Park Pond

Manchaug Pond

Elm Park Pond

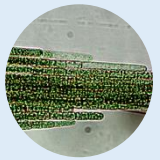
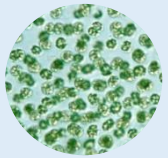
- Dolichospermum was the most observed cyanobacteria genus, with Aphanizomenon as a second
- Picocyanobacteria are also thought to have played a role

CONCLUSIONS

- 2022 was the most successful year of the WCMC to date
  - Twice as many sampling dates
  - More volunteers and partnerships than ever before
  - Richest data set yet
- But there is still a lot that we don’t know…

2023 GOAL: MAKE IT BETTER

CYANOBACTERIA AND THEIR TOXINS

	Microcystin (Hepatotoxin)	Cylindrospermopsin (Hepatotoxin)	Anatoxin (Neurotoxin)
 *Dolichospermum*	✓	✓	✓
 *Aphanizomenon*	✓	✓	✓
 *Microcystis*	✓		
Picocyanobacteria			✓

CYANOCASTING TOXIN ESTIMATION CALCULATOR

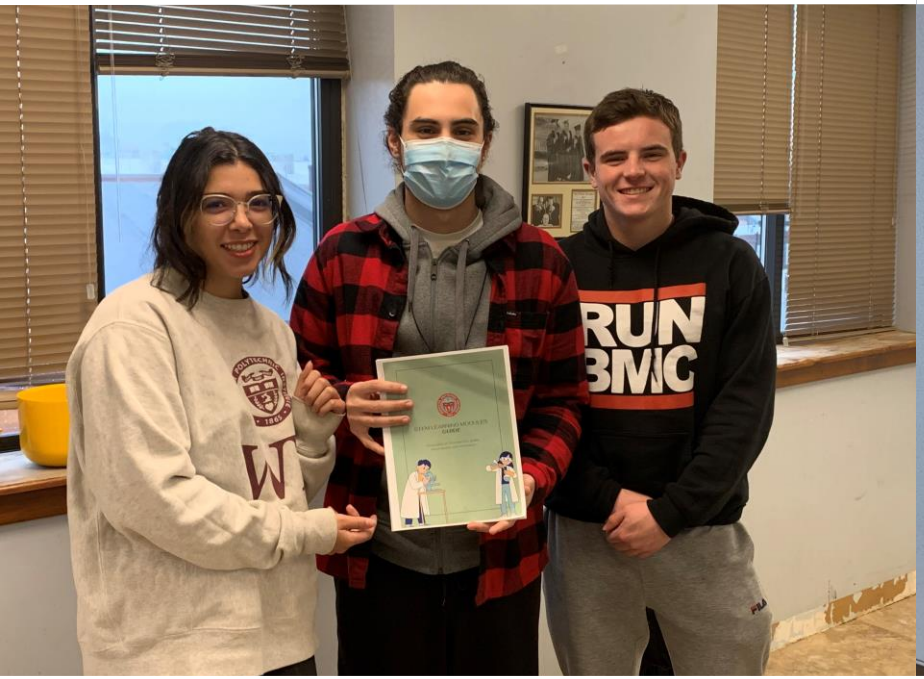
- Researcher Nancy Leland from University of New Hampshire
- Creating a “toxin estimator” based on regressions from her research
- Inputs to the calculator are Pigment concentration and Cyanobacteria Genus
- Will allow us to refine our risk estimates for both present and future data

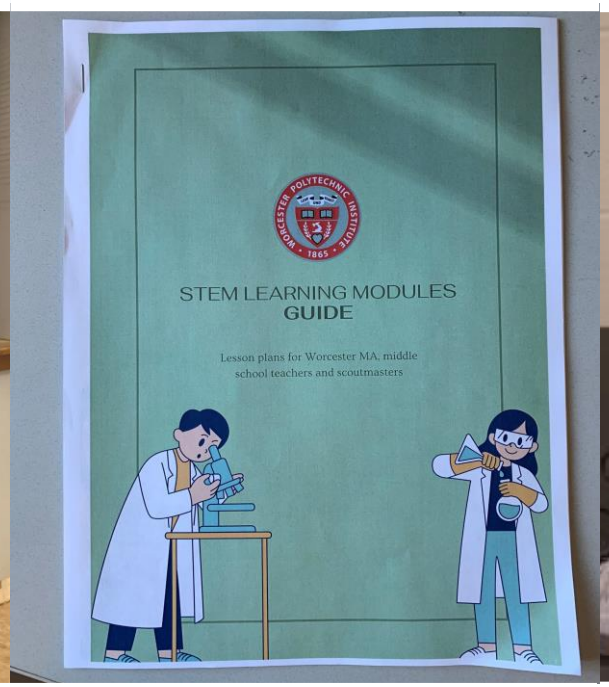
CYANOBACTERIA REMEDIATION

- Barley Straw Project at Burncoat Pond
  - Decomposition products of barley straw thought to negatively impact cyanobacteria
  - Pilot project in Northampton shows promising results
  - Burncoat Pond has been identified as a Worcester location due to size and bloom history
  - We will be looking for volunteers in the packing of barley straw bags and deployment in early spring

MORE OUTREACH

- Current WPI IQP: Increasing Environmental Literacy in Worcester Through STEM Learning Modules
  - Using WCMC methods as a STEM learning device
  - Creating modules for teachers and Scout Leaders that fit into curricula standards
  - Exploring having a materials rental system through the DSR or WPL
  - Increase scientific literacy and perhaps inspire more volunteers



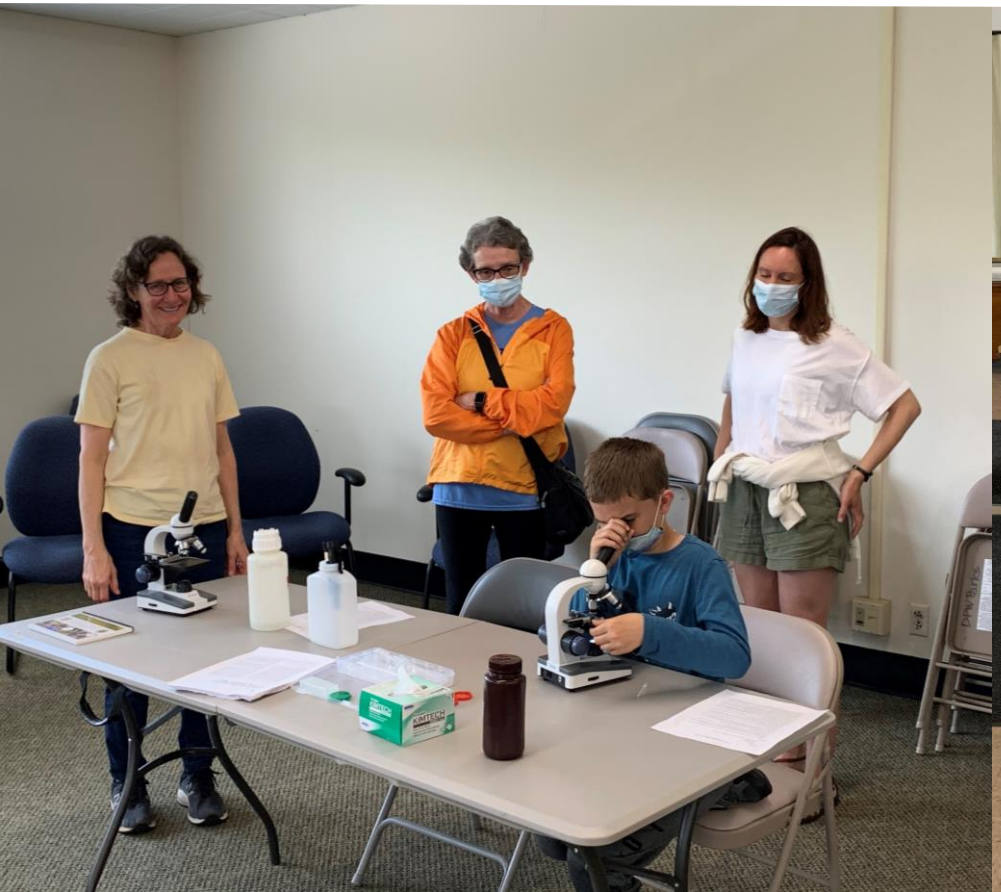


CITY OF WORCESTER WCMC INTERN

- Additional committed help has been necessary as the program expands
- Interns and volunteers have helped to prepare and run pigment samples, create reports
- Next year we will have City Employed Intern!

THANK YOU FOR ANOTHER GREAT YEAR!

- SPECIAL THANKS TO
  - City of Worcester Department of Public Works & Parks
  - US EPA
  - Nancy Leland



WE COUND NOT DO THIS WITHOUT YOU!