Harmful algal blooms: A quick recap of the 2014 sample season

Greg Boyer

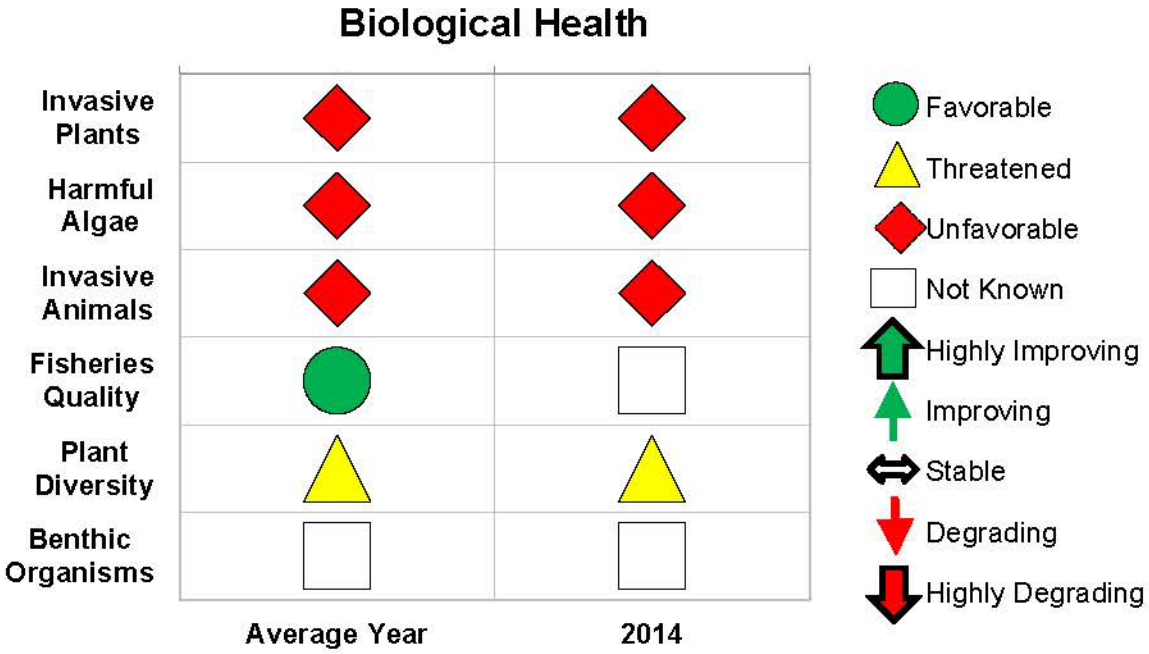
State University of New York
College of Environmental Science and Forestry, Syracuse, NY

- Katherine Perri
- Jeff Russell
- Samantha Weber
- Marci Savage
- Justine Schmidt

Some rash assumptions…..

- Most of you are here because you are interested in your CSLAP report.
  - Introduction to HABs: 9:00 tomorrow morning
  - Overview of State Results (Scott)
  - Setting up a monitoring program; 11:15 tomorrow
- What is in your CSLAP report…..
- What happened statewide.

Lets start with the CSLAP reports……



So you got an unfavorable rating on your Biological health for Harmful Algae. Where did that number come from?

2-minute review

- Blue-green algae are common in our waters.
- High nutrient conditions can lead to high levels of algae (blooms) in the water.
- Some, not all of the algae produce toxins (HAB)
- CSLAP monitors for those blooms and toxins
- Scott generates a HAB report

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Published: Saturday, 8/2/2014 - Updated: 2 seconds ago

State of emergency declared in Lucas County after toxins found in Toledo water

Microcystin found in samples; boiling not recommended

BLADE STAFF

Scenes like this were common this morning as area residents traveled all over in search of bottled water.
THE BLADE/ JETTA FRASER Enlarge | Buy This Photo

A state of emergency was declared today in Lucas County and the greater Toledo area after tests at the Collins Park water-treatment plant in East Toledo produced two toxin sample readings.

Chemists testing water at Collins Park plant found two sample readings for microcystin that exceeded the recommended "do not drink" standard of one microgram per liter standard.

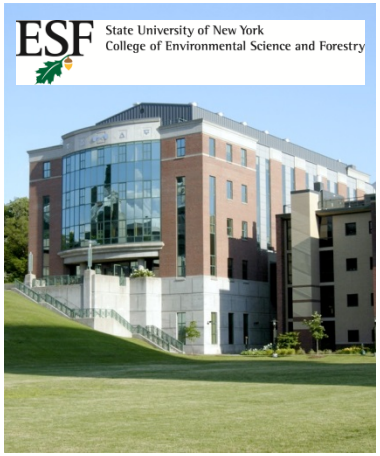
Toledo Mayor D. Michael Collins and health leaders asked residents to remain calm and said they may have answers later today on when Toledo-area water supply will be safe to drink again.

Lets follow what happens to your samples……

You collect your samples

Place in tube…

Mail…

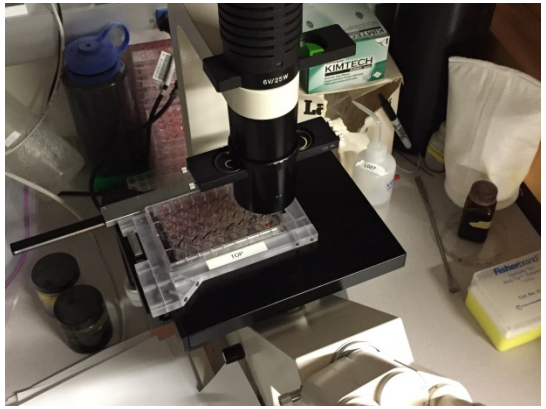


Information you provided is carefully entered into a computer. We assign a separate ESF id number.

Next your samples are processed……

First we look who is there….

“FluoroProbe” tool measures the amount of Blue-green algae chlorophyll and total chlorophyll



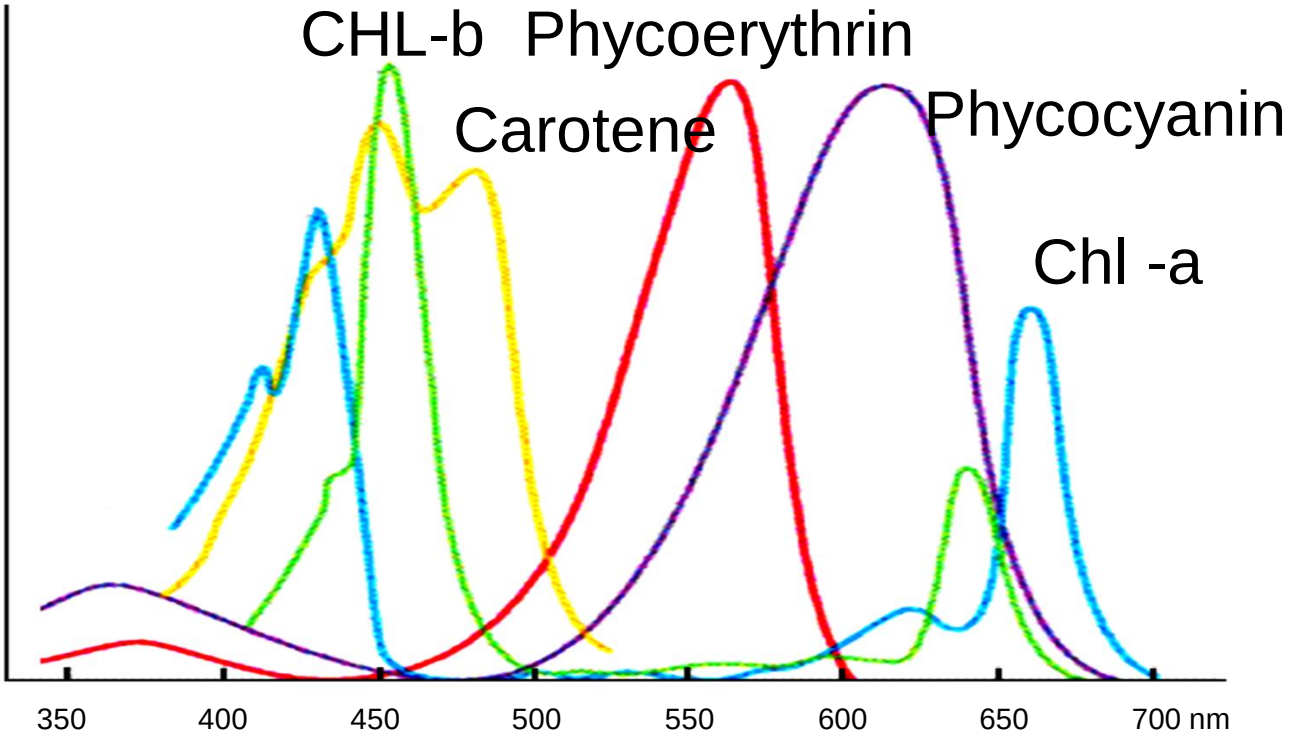
A microscope is used to identify what Blue-green algae are present

Photographs taken if needed

How do these instruments work?:

All plants collect light which is used for photosynthesis.

All plants contain chlorophyll – this is what makes them green……..



Different algae use different pigments to collect light

- Green Algae
- Yellow algae (dinoflagellates and diatoms)
- Blue-green algae

We can use the pigments to estimate the amount of algae in the water

CSLAP uses a FluoroProbe for its monitoring.

- BBE FluoroProbe rapidly determine five classes of algae
- Your CSLAP report contains the FP-chl and FP-BGA values

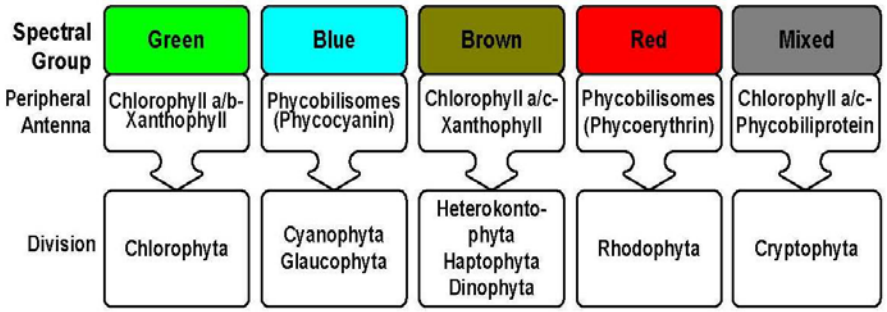
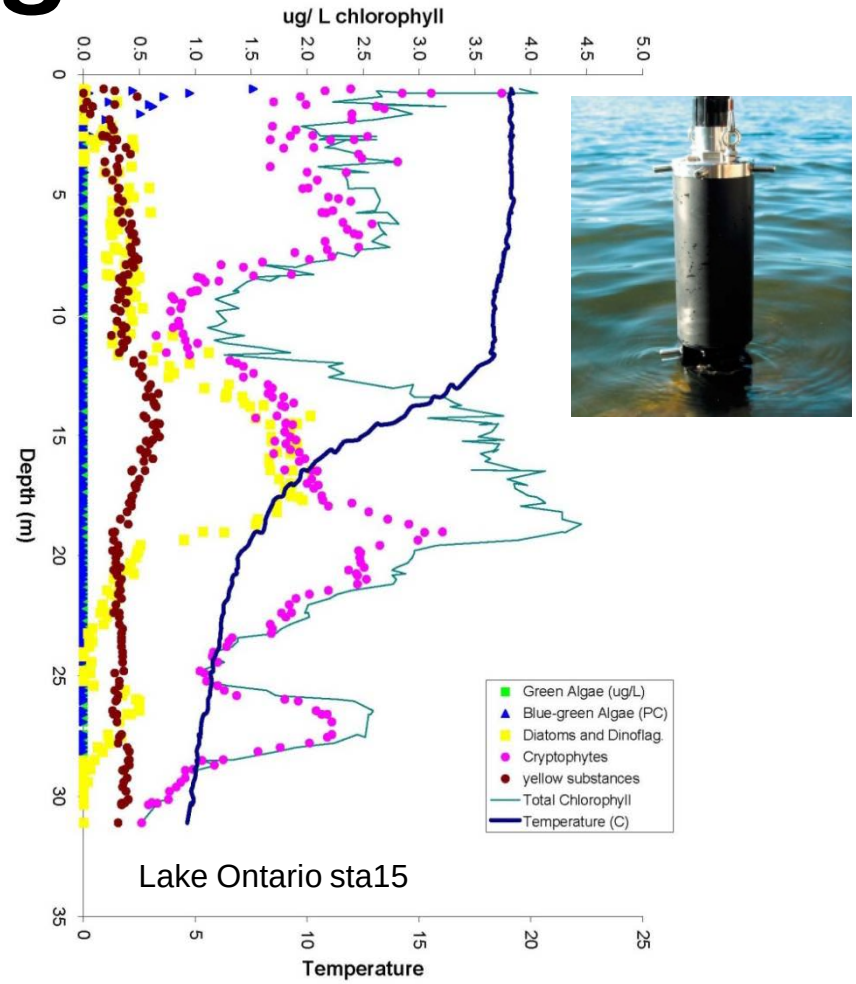
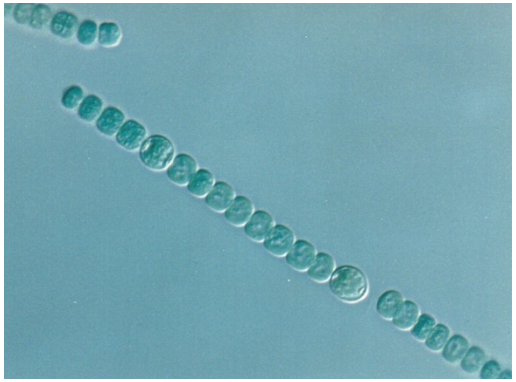


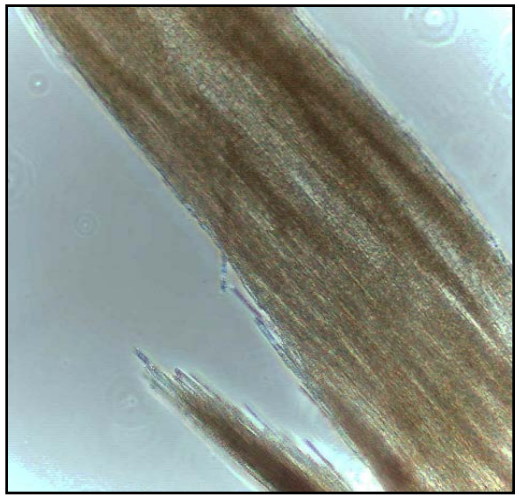
Fig. 1: Assignment of several algal divisions in spectral groups



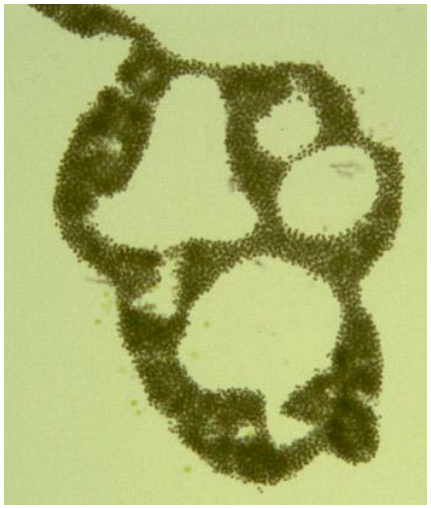
We are looking for potentially toxic species under the microscope…

Anabaena





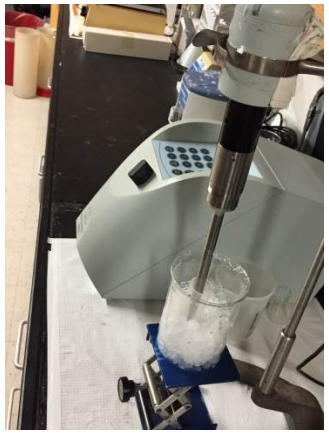
Aphanizomenon



Microcystis

Known to a generation of scientists as Anni, Fanni and Mike
(3 most common bloom-forming species)

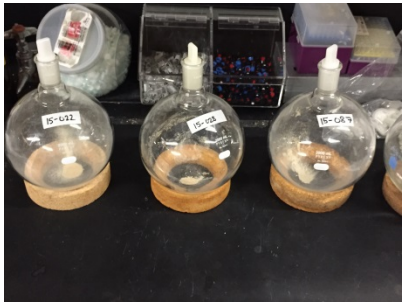
Next your samples are processed for toxins……

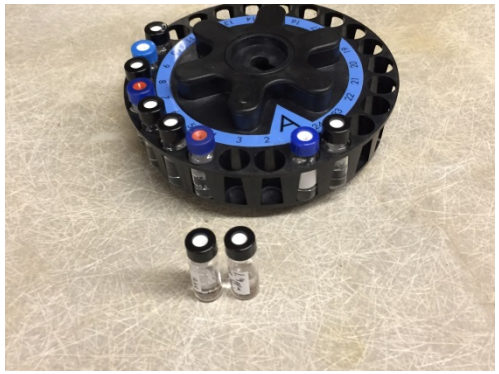


Liquid is transfer to a vial for analysis and storage

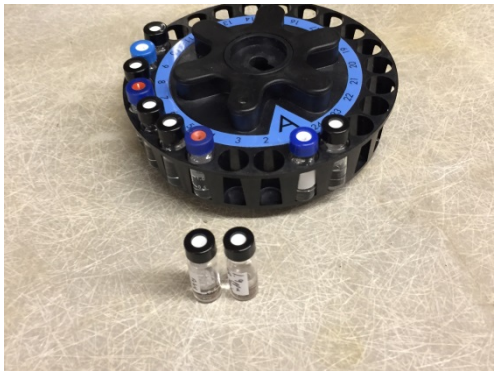
Bloom samples are freeze-dried overnight(s)

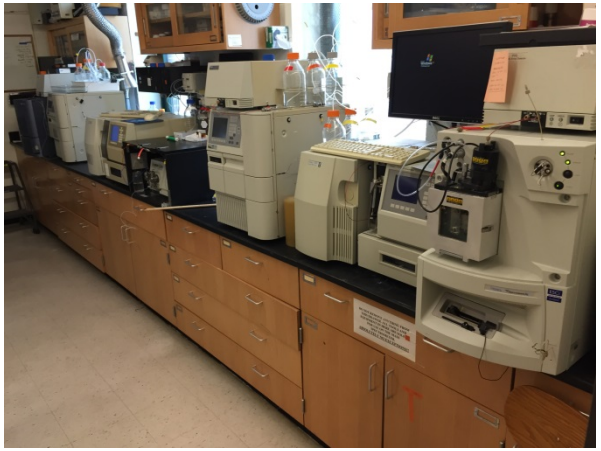
Cells are broken with ultrasound





We use a number of different tests for toxins……



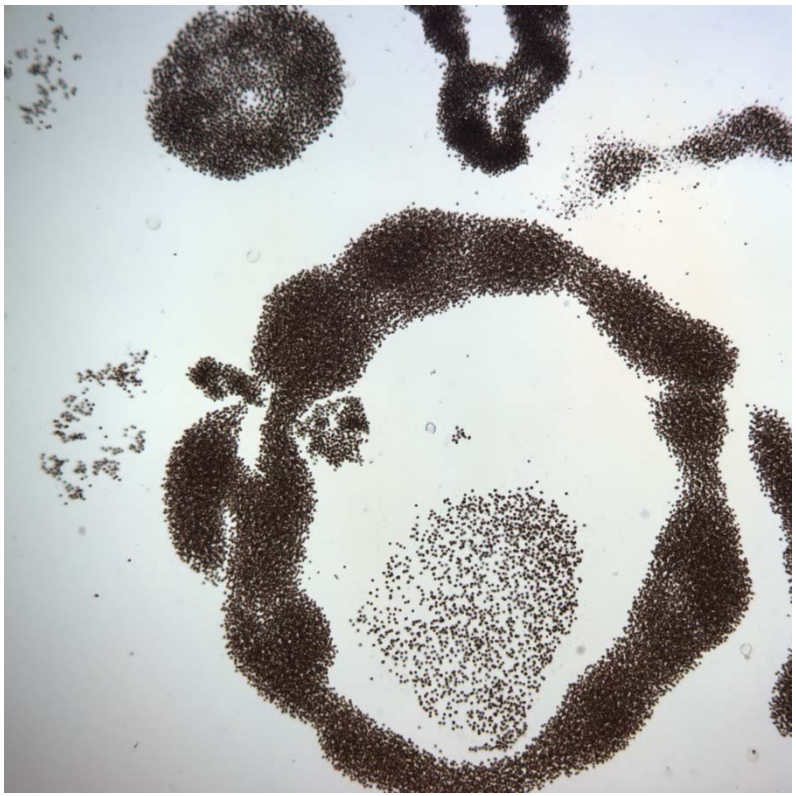


Mostly we test for specific toxins using mass spectroscopy……
There are many different toxins we look at include:

- microcystins (14 forms) (liver toxin)
- anatoxins (2-6 forms) (neurotoxin)
- cylindrospermopsins (3 forms) (cell toxin)

These show up in your CSLAP report as MC-LR, Ana-a and Cyl

Who makes these toxins?



Microcystis makes a family of toxins called microcystins.

(remember Mike?)

- *Microcystis aeruginosa*
  - non-N fixer.
  - Likes organic N
  - forms surface blooms
- Very common genera
  - Found in every lake in the US
- Not all Microcystis is toxic

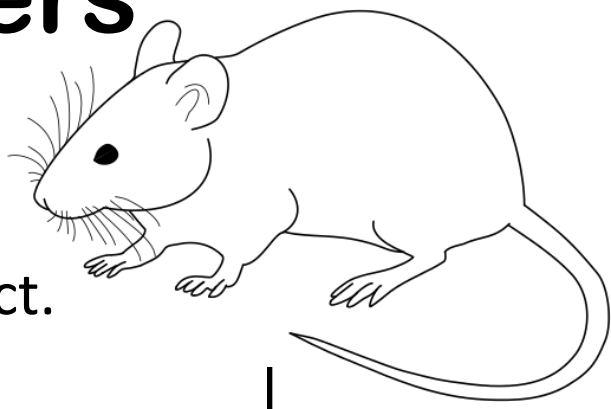
⇩

- Microcystins are potent toxins (40x more toxic than cyanide)
- Toxin is very stable to boiling
- 1 ug/L allowed in drinking water
- 20 ug/L for recreational contact

What happens with the numbers?

Score	Criteria
Favorable	Toxins below 4 ug/L Algae below 10 ug/L
Threatened	Toxins exceed 4 ug/L microcystin toxins FP chlorophyll greater than 10 ug/L BGA CHL Visual evidence of Bloom or high levels of PC
Unfavorable	Toxins exceed 10 ug/L open water, 20 ug/L bloom FP chlorophyll greater than 30 ug/L BGA CHL
Not known	No HAB data available for Lake

Where do these numbers come from?



- Start with a mouse (how cute!)
- Measure the highest level that has no effect.
  - 40 µg/kg body weight for microcystins
- Include safety factors
  - 10x (mice are not people)
  - 10x (not every mouse is the same)
  - 10x (limited number of studies)
- Average body weight of adult
- Consume 2 L water per day for life

World Health Organization DW Guideline value:

= 1 ug / L (part per billion)

(EPA currently has no guidelines; most states use the WHO values)

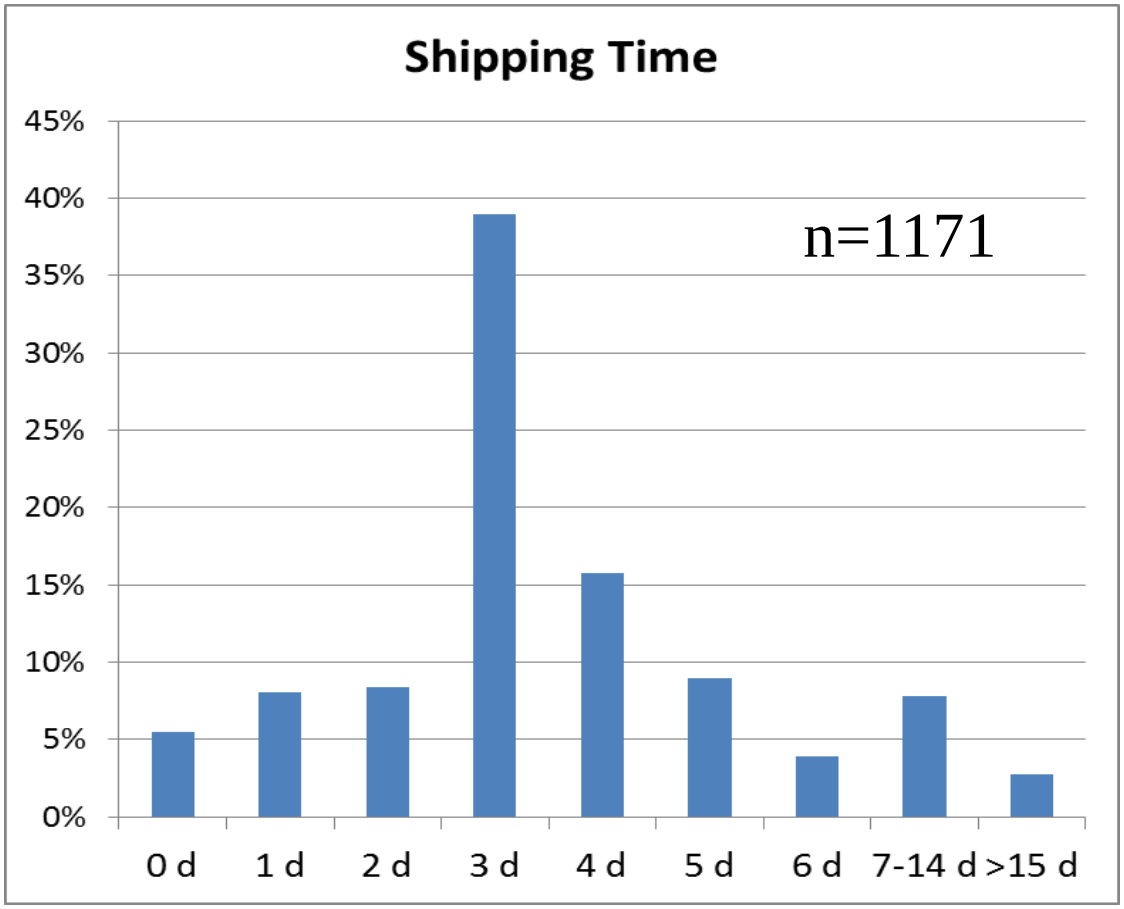
- Recreational Contact more difficult
  - 8 ug/L -50 ug/L (CSLAP uses 10-20 ug/L)

Some random observations about CSLAP HAB samples.

Always remember as bad as you think you have it, someone has it worse.

(Taihu is the drinking water source for 7 million people!)

What is the Shipping time ?
(2014 data: Collection to receipt)



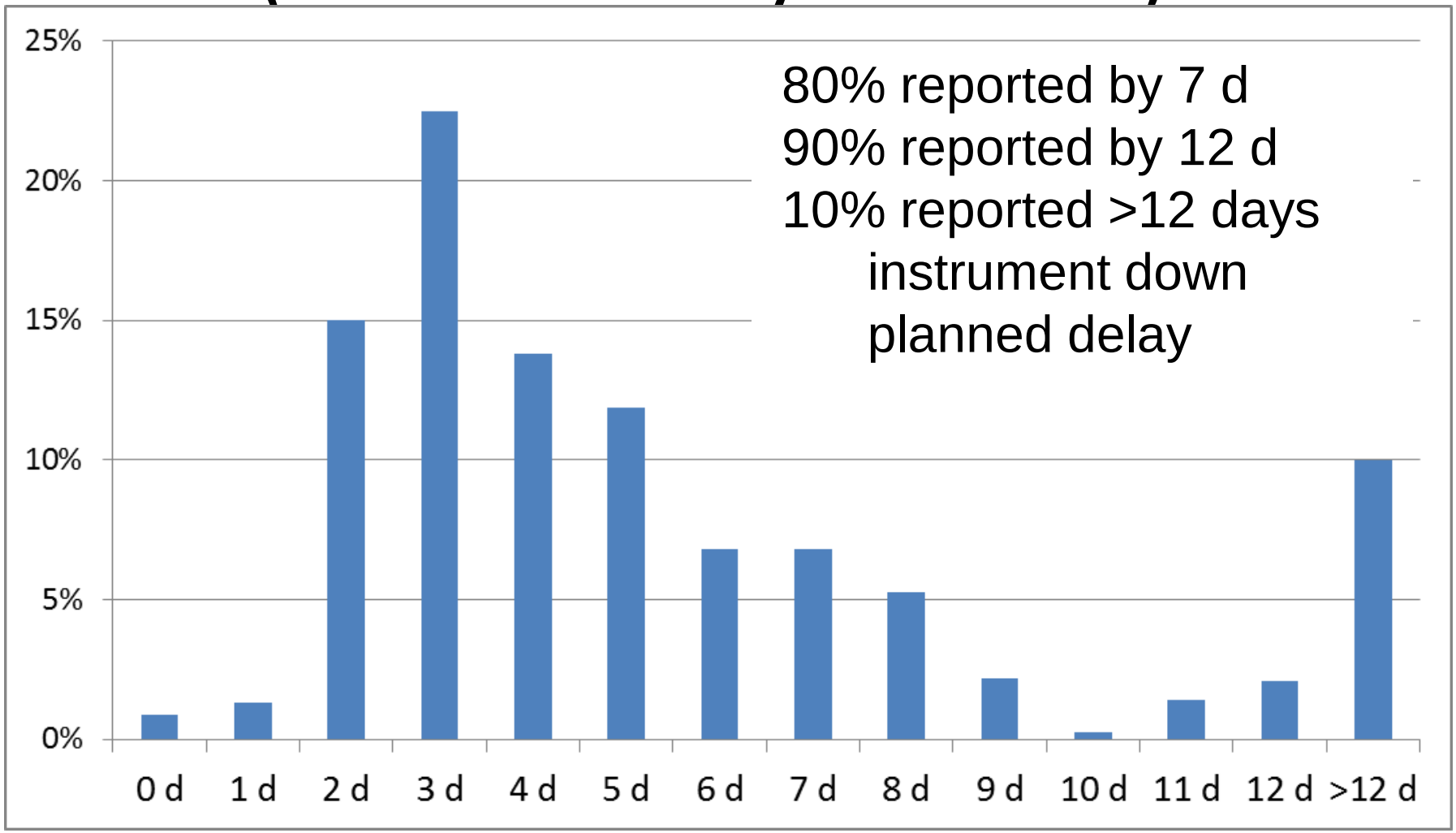
Most volunteers collect samples on a weekend (Saturday),

Sample shipped on Monday arrive Thursday

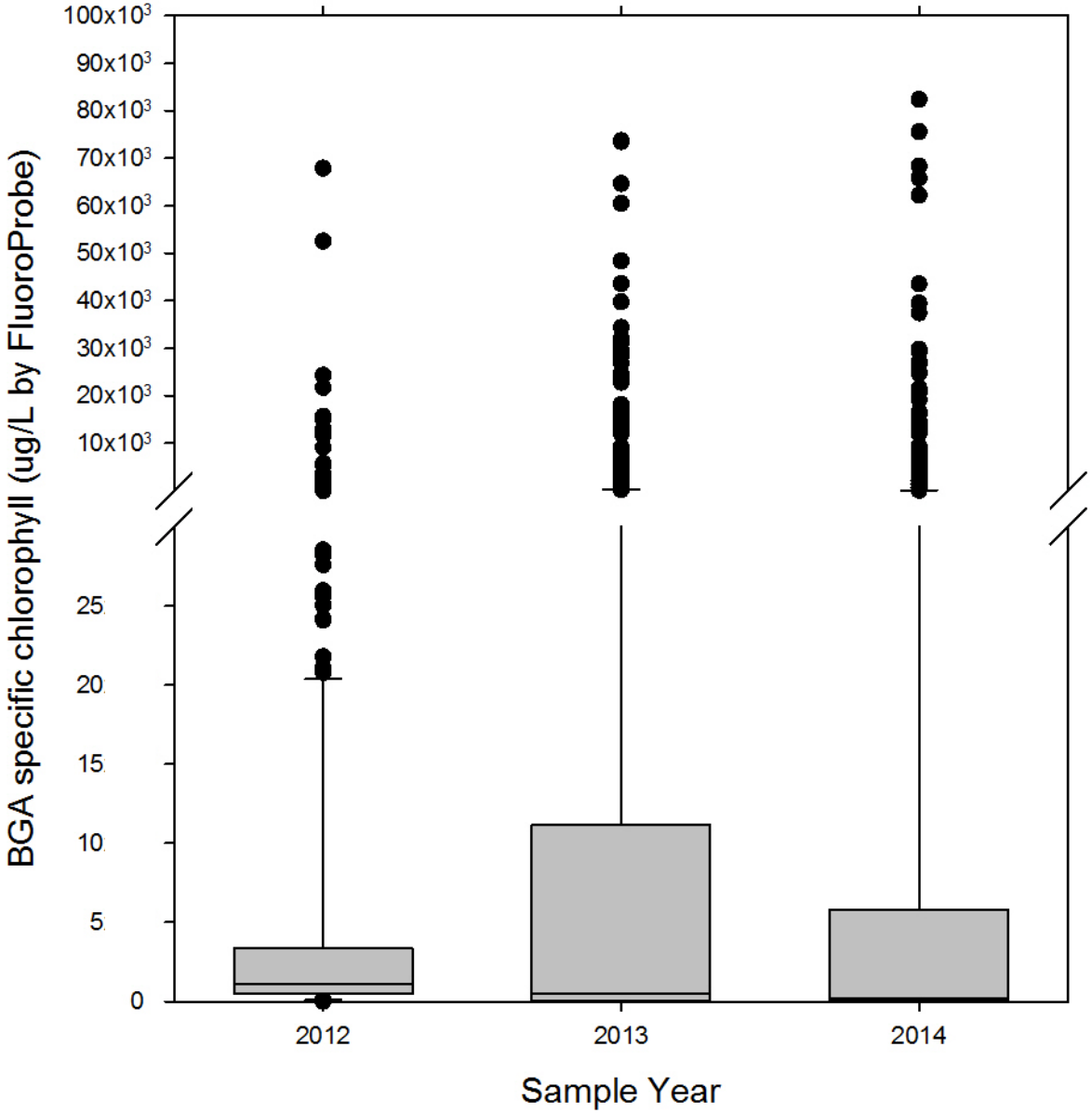
Several options

- Courier (Blooms)
- Drop off Locations
- Hand delivery

What is the analysis time?
(2014 microcystin data)



Cyanobacteria (FluoroProbe)



Most samples have low levels of BGA:

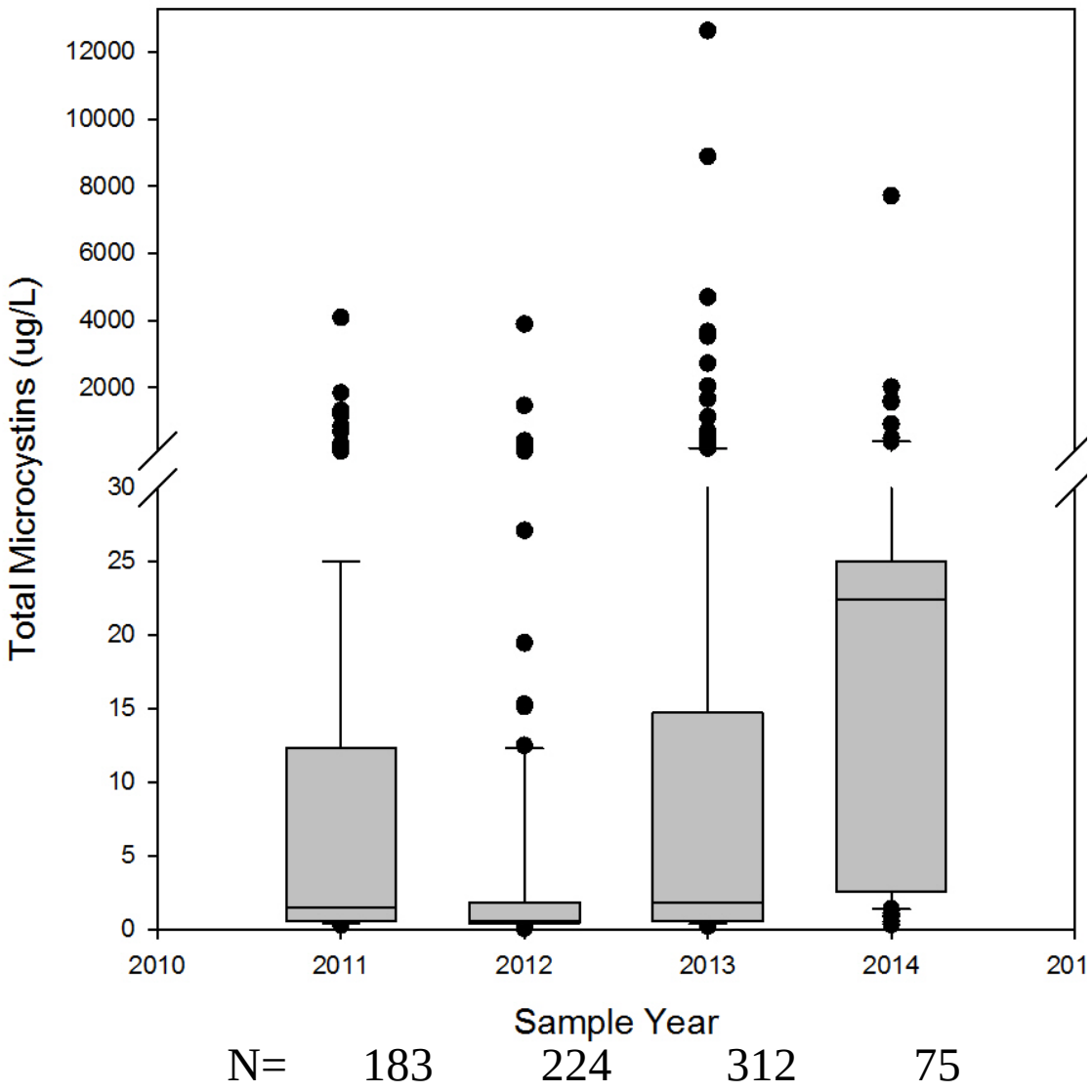
BGA specific Chl-a ranges from 0-100% of total Chl-a.

Scum levels can be very high:

- 600,000 ug/L chl-a

Visual exams show: *Microcystis, Anabaena, Aphanizomenon*, diatoms fish, duckweed, etc.

Microcystin abundance in NY



Most samples are non-toxic:

- 65-75% 2011-2013
- 90% in 2014

Toxin levels range:
0.3 ug/L (detection limit)
12,300 ug/L (scum)

WHO Recreational levels of <20 ug/L would catch 75% of the samples

Other toxins:
Anatoxin-a (yes)
CYL, BMAA (no)

How do my numbers compare with others? ……

Top five microcystin lakes

1. Mohegan Lake (7712)
2. Lime lake (1600)
3. Mohegan Lake (1555)
4. Mohegan Lake (898)
5. Lawson Lake (490)
6. Mohegan Lake
7. Mohegan Lake, etc.

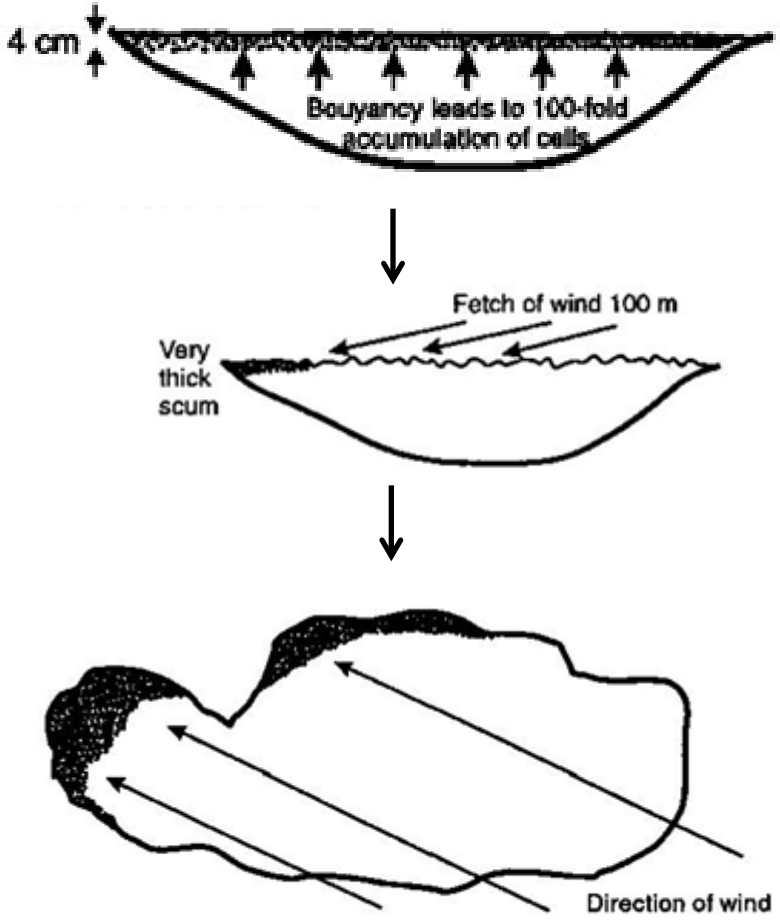
Top five cyanobacteria lakes

(100% BGA >20,000+)

- Beaver dam Lake
- Deans Pond
- Java Lake
- Cossayuna Lake
- Lake Mohegan

Three of the top cyanobacteria blooms had little toxicity (<10 ug/L)

Careful of wind concentrated scums.



2014 CSLAP results

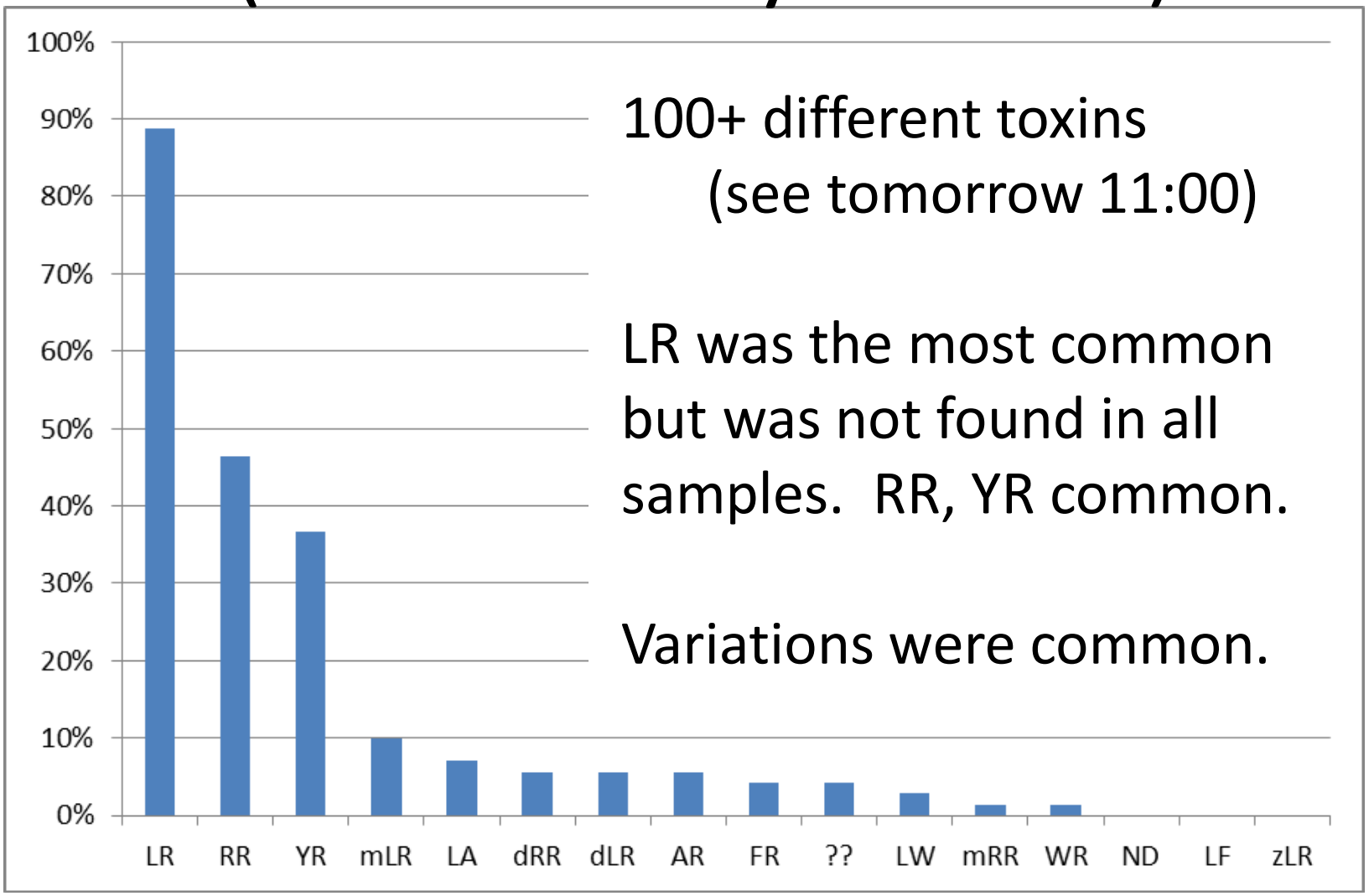
Open water samples

- 865 samples
- 2 positive (0.23%)
- Range (1.1 – 1.4)

"Bloom" Samples

- 290 samples
- 70 positives (24%)
- Range (0.3 – 7,710)

CSLAP Toxin Composition
(2014 microcystin data)



100+ different toxins
(see tomorrow 11:00)

LR was the most common but was not found in all samples. RR, YR common.

Variations were common.

Are there other toxins I should worry about?

Some Anabaena sp. make anatoxin-a

Remember Anni?

- Anatoxin –a
  - Potent Neurotoxin.
  - Less toxic but quicker.
  - Very rare.
  - Toxin is not very stable
- Responsible for a number of animal fatalities
- Often shows up early in the season

New toxins are appearing constantly on the internet…..

BMAA
(beta methyl amino alanine)

Potent neurotoxin in Guam associated with ALS-Parkinsonism dementia.

<u>May</u> be produced by blue-green algae -

Not found in New York but we continue to test for it

Take-home messages:

- 2014 was a moderate year for blue-green algae and microcystin toxins
  - Most lakes were better than in past years
  - Some exceptions
- In contrast, 2014 was a much higher year for the neurotoxin anatoxin-a
  - More occurrences (21 vs 10)
  - Higher levels (1-108 ug/L vs 0.2-18 ug/L)$_{n=10}$
  - Rarely the same lakes as for microcystins
- Other toxins remain absent

Questions?

If not now – then free to ask them later in the comfort of your home.

Glboyer@esf.edu

And thanks to all those who have donated pictures!