Cyanobacteria Monitoring at Connecticut State-Owned Swimming Areas

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Introduction: Cyanobacteria

Cyanobacteria are naturally occurring microscopic organisms that exist in surface water bodies. Higher nutrient concentrations and warming water temperatures have caused cyanobacteria blooms to occur at an increasing number of locations. Because cyanobacteria have the potential to produce toxins that can be harmful to humans and pets, "blooms" have recently become a greater public health concern.

Sample Location	Reason For Sample
Lake Waramaug	Cyanobacteria Bloom Historically Reported
Gardner Lake	
Kettletown (Lake Zoar)	
Lower Bolton Lake	
Mount Tom Pond	
Squantz Pond	
Pattaconk Reservoir	Reference Site

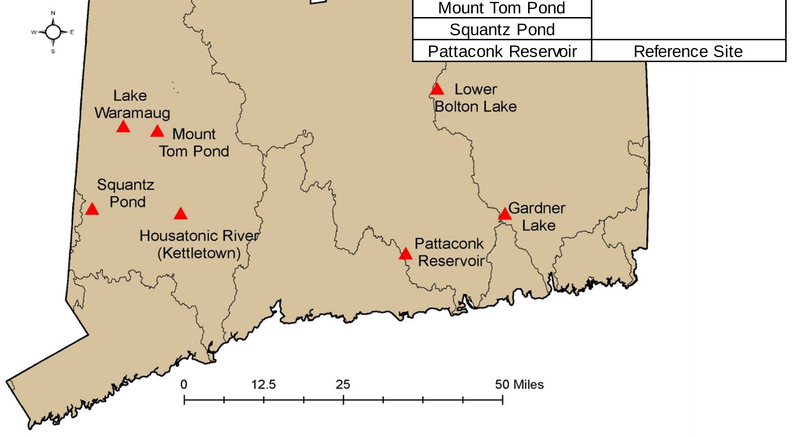

Figure 1. Connecticut cyanobacteria sampling locations.

CT DEEP Monitoring Program

During the summer of 2012, the local community and news media raised concern over a cyanobacteria bloom in Lower Bolton Lake. The following summer, the Connecticut Department of Public Health (DPH) and CT DEEP established the *Guidance to Local Health Departments For Blue–Green Algae Blooms in Recreational Freshwaters, July 2013*. Following the guidance of other states in the region, this document suggests the need for visual assessment, cell count values, and toxin concentration values for the most informed response to a bloom. The toxin threshold suggested by this document is **15 µg/L** for total microcystin.

Up until 2013, CT DEEP had no formal cyanobacteria monitoring program for recreational waters of CT. That summer, CT DEEP partnered with the Center for Environmental Science and Engineering (CESE) at the University of Connecticut to conduct a three year survey of cyanobacteria toxin concentrations of microcystin and anatoxin-a. For the survey, staff from CT DEEP collected weekly water samples that were frozen and brought to CESE for testing of toxin analysis. Cell counts were completed in the DEEP lab.

EPA Draft Recreational Ambient Water Quality Criteria

In December of 2016, EPA released the draft *Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin.* The recommended ambient water quality criteria for **total microcystins** and **cylindrospermopsin** are **4 µg/L** and **8 µg/L**, respectively, and are not to be exceeded on any given day. These values are meant to be protective against child exposure during recreation and are therefore protective against adult exposure.

Methods

Water samples were collected from six state-owned swimming areas and one state-owned boat launch [Figure 1] on a weekly basis from mid-June to early September in 2013, 2014, and 2015. Composite samples were taken in each swimming area at just over one meter in depth using an integrated water sampling tube [Figure 2].

Frozen samples sent to CESE were tested for total microcystin using the Beacon Analytical Systems, Inc. ELISA plate kit (#20-0068). The ultra-high performance liquid chromatography tandem mass spectroscopy (UPLC/MS/MS) method was used to test for microcystin analogs and anatoxin-a. Microcystin analogs that were tested for were microcystin-LA, LR, RR, and YR.

Methods continued…

During 2014 and 2015, CT DEEP staff tested thawed samples in the DEEP laboratory for total microcystins using the Beacon Analytical Systems, Inc. ELISA tube kits (# 20-0098) as recommended by CESE.

Results: 2013 – 2015 Total Microcystin

59 frozen samples were tested for total microcystin by CESE between 2013 and 2015. The highest value of **0.81 µg/L** was from Gardner Lake, taken on 8/5/2014. Only Gardner Lake, Kettletown, and Lower Bolton Lake had detectable levels of total mycocystin. 48 of the 59 samples were less than the method detection level of 0.1 µg/L [Figure 3].

The highest microcystin analog values were from microcystin-LR at 0.44 and 0.32 µg/L, sampled from Gardner Lake in August 2014.

Figure 2. Sampling Mount Tom Pond State Park with integrated water sampling tube.

CT DEEP tested 95 samples using ELISA tube kits during 2014 and 2015. The sample from Gardner Lake [Figure 4], taken on 8/11/2015, had a value of **1.2 µg/L** and was the only sample found to be over 1 µg/L. 80 of the 95 samples were less than the method detection level of 0.3 µg/L [Figure 3].

Censored Box Plots

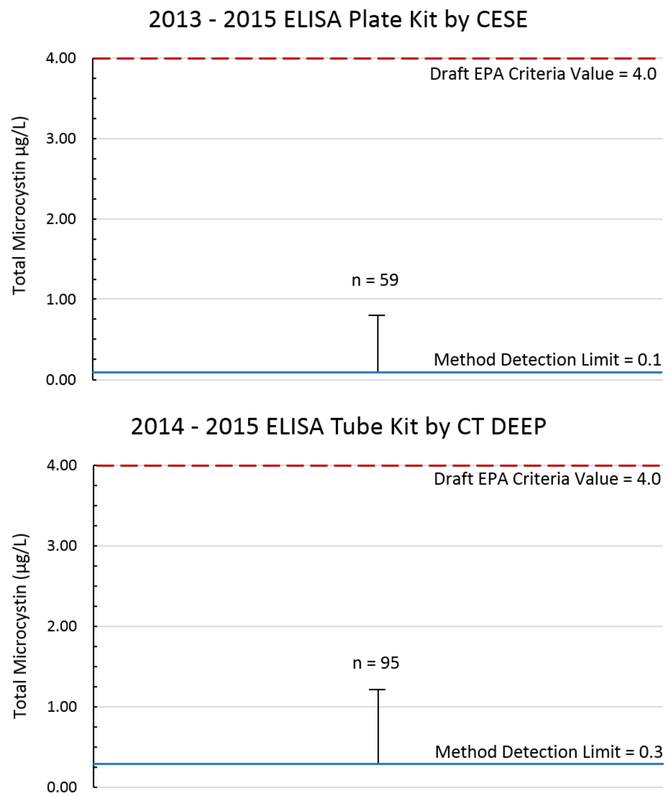

Figure 3. Censored box plots of total microcystin data from CESE and CT DEEP

Figure 4. Sampling Gardner Lake State Park on August 11, 2015.

Results: 2016 Cylindrospermopsin

In 2016, 12 samples were submitted to CESE to get an initial idea of cylindrospermopsin concentrations. These twelve samples were selected based on the quantity of identified cyanobacteria species known to produce the toxin, cylindrospermopsin. Using the UPLC method with a method detection limit of 0.5 µg/L, all twelve samples came back as non-detect for cylindrospermopsin.

Conclusion

Since CT DEEP began the summer cyanobacteria monitoring program in 2013, there have not been any total microcystin results that have exceeded either the CT guidance or the draft EPA recreational criteria limits. In 2015, CT DEEP temporarily closed three state-owned swimming areas due to the presence of cyanobacteria blooms. In each of the three cases, the beaches were originally closed due to visual assessment and stayed closed due to cell count values above the 100,000 per mL limit.

After being closed for 8 days in early June, the swimming area at Squantz Pond was re-opened due to visual clarity, low cell counts, and toxin values below the detection limit. In August, both Kettletown and Indian Wells swimming areas were closed for 2-3 weeks [Figure 5] until the swimming season ended on September 6th at which time monitoring was discontinued for the year. Although Indian Wells is not regularly monitored for cyanobacteria, CT DEEP staff were notified of an observed bloom in the stated-owned swimming area.

In the future, CT DEEP plans to continue monitoring the seven state-owned sample locations.

Figure 5. Sampling Kettletown State Park on August 24, 2015.

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