North Point Park Summer Monitoring 2017-2018 Executive Summary

Max Rome, PhD Candidate
Ed Beighley PhD, Advisor
Northeastern University
College of Engineering
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Purpose

Bacterial water quality in the Charles River Lower Basin is highly variable throughout the year and between locations. In 2016, the Charles River Conservancy (CRC) contracted with Northeastern University to conduct a program of high frequency summer monitoring of cyanobacteria and E. coli at North Point Park. The purpose of this study was to evaluate the potential swim-ability of a site being considered for a seasonal swimming facility. This executive summary is intended to highlight the key findings from the study. Results are presented in the context of existing regulatory limits and advisories for E. coli, an indicator of fecal contamination, and cyanobacteria which are known to produce toxins.

Methods

Daily surface water grab samples were taken from a dock at North Point Park during June, July and August of 2017 and 2018 following the Environmental Protection Agency (EPA) guidelines for sample collection and storage.

E. coli concentration was determined using the IDEXX Colilert system. Colilert is a statistical assay that provides a most probable number (MPN) of cells per 100 ml with an undiluted quantification range of up to 2419 MPN / 100 ml. The Colilert system was chosen to match the Massachusetts Water Resource Authority (MWRA) lab that performs bacterial water quality testing for the lower basin. Quality assurance and quality control was conducted on a minimum of every 10th sample using a combination of split samples, duplicates, inter-lab comparison, and positive bacterial control.

Cyanobacteria were quantified following a standard operating procedure from the *Handbook of Cyanobacterial Monitoring and Cyanotoxin Analysis*. Counts were performed on live samples using a gridded Sedgewick-Rafter counting chamber. During the bloom period a minimum of 40 filaments were counted and cell density (cells per ml) was calculated based on average number of cells per filament and the number of counted grid squares.

Results

During the study period, water at North Point Park met E. coli based bathing standards 92% of the time[1]. Of over 170 days of sampling, only 5 days exceeded the single day threshold. These violations all occurred on wet weather sampling dates[2]. Three of the five violations occurred on dates with 72 hour cumulative rainfall totals greater than 1.5 inches. The median cell count over the two year period was 14 MPN/100 ml.

Table 1: Summary of E. coli Results

	Dry Weather		Wet Weather[2]		Sampling
Year	Violations	Passing	Violations	Passing	Days
2017	0	100%	0	100%	77
2018	0	100%	5	91%	94

E. coli concentrations were lowest in 2017, which had zero single-day violations compared to five in 2018. These results are consistent with sampling conducted elsewhere in the Charles River[3].

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[1] At bathing beaches the Massachusetts Department of Public Health requires that no single day sample exceed 235 colonies forming units (CFU) per 100 ml, and that the average of the 5 most recent samples not exceed 126 CFU per 100 ml. (105 CMR 445.010)

[2] Defined as days in which >0.1 inches of rain was measured for the preceding 72 hours at the Logan Airport NOAA rain gauge.

[3] The EPA issues a letter grade for the Charles River based on E. coli violations of recreational thresholds. In 2017, the Charles River received an A-; in 2018 it received a B.

Cyanobacteria blooms were observed during both summers. These blooms were dominated by the species Aphanizomenon which forms colonies of rafted single cell-wide filaments. Cell counts performed in 2017 failed to adequately disaggregate colonies and as a result indicate bloom duration but provide an underestimate of cell density. During the summer of 2018, the Aphanizomenon bloom reached a peak density of over 250,000 cells per ml and exceeded the DPH advisory level of 70,000 cells per ml for 6 days.

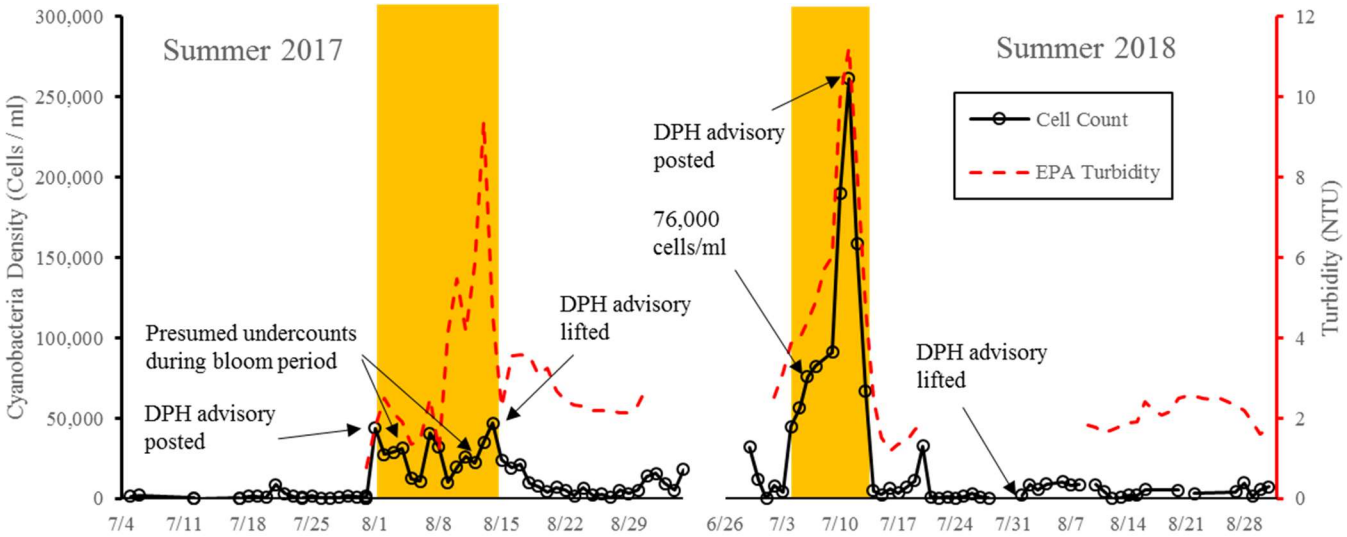


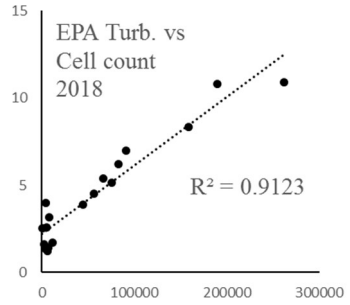
Figure 1: Cyanobacteria density is shown alongside EPA daily median turbidity. Observed bloom duration based on cell counts and turbidity is highlighted in yellow. DPH advisory period is indicated.

During the bloom period a strong correlation between turbidity and cell count was observed ($R^2 > 0.9$). This relationship was used to interpret in-vivo measurements captured by the EPA's Charles River Buoy. A comparison of bloom duration from laboratory cell counts, EPA bouy, and DPH posted advisory is shown in table 2. Conservative thresholds are used to estimate bloom duration.

Table 2: Comparison of estimated bloom duration (left).
A strong linear relationship is seen between turbidity and cell count (right)

	Bloom Duration (days)		
Year	DPH Advisory	EPA Buoy*	Cell Counts**
2017	14	9	14
2018	19	10	9

* Turbidity >= 3.5 NTU
**Duration of cell counts > 40,000



Conclusion

During the months of June, July, and August, with respect to cyanobacterial cell counts and E. coli, the waters near North Point Park met bathing standards greater than 80% of the time. During the study period cyanobacteria blooms appear to pose a greater obstacle to swimming then elevated E. coli concentrations. EPA buoy and DPH posted advisories from 2015 and 2016 suggest that the study period may have had comparatively short bloom periods. While cell counts are time consuming and difficult to conduct, calibrated turbidity measurements might be used to automate the advisory process, provide near real-time bloom alerts.

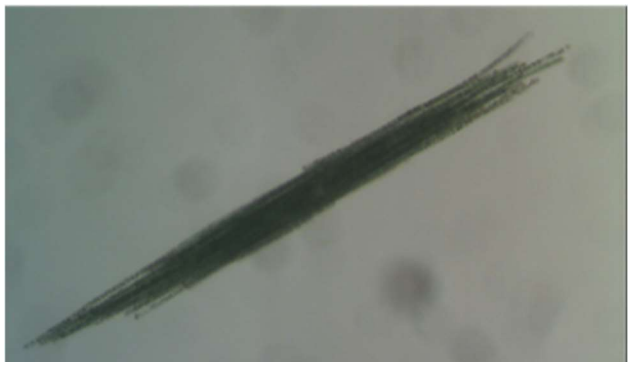


Figure 2: Filaments of Aphanizomenon raft together to form large units visible to the naked eye. (100X magnification)

Contact: *rome.m@husky.neu.edu*