Using Real-Time Monitoring and Phycocyanin Probes to Track Cyanobacteria Blooms

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Measuring Cyanobacteria

- EPA buoy monitoring program
- Cyanobacteria cell counts differences
- Using probes for measuring phycocyanin
- Probes and calibrating options
Background

- Monitoring locations were selected for
  - High recreational use
  - Historic algal blooms
- Coincide with other monitoring
- Data available real-time to project partners through a password protected website
- Monitoring began in 2010
Environmental Protection Agency (EPA) has established monitoring buoys in the Charles and Mystic Watersheds. These buoys collect and transmit water quality data that is available to the public. EPA has established these buoys to help with the tracking of cyanobacteria blooms and water quality conditions.

Note: All water quality measurements are collected 1 meter below the water's surface.

Last Sonde verification: Charles 9/12/12 Mystic 9/12/12

Project Partners:

Disclaimer:
The data presented on this website is considered preliminary data and may be subject to future revision or qualifiers. The data from this site is transmitted directly from the instrument with no or little review. Inaccuracies may be presented because instrument malfunction or physical changes at buoy location.
Buoy measures water quality conditions and helps to track cyanobacteria blooms.
Sonde Measurements

- Recorded every 15 minutes
- Measurements collected at 1 meter depth
- Probes checked and recalibrated ~ every 2 weeks
- Parameters
  - Temperature
  - Conductivity
  - pH
  - Dissolved Oxygen
  - Turbidity
  - Chlorophyll
  - Phycocyanin
Field samples collected and processed for Chlorophyll a and Phycocyanin to correct and evaluate data.
Note: Two high points truncated
Mystic Cyanobacteria cell counts - 2012
(GW Lab)
Mystic Blue Green Algae – Phycocyanin 2012
(Estimated - Corrected)

Note: two Points truncated
Charles Phycocyanin 2012
(Truncated)
### Charles River Cyanobacteria Advisories from DPH - 2012

<table>
<thead>
<tr>
<th>Water Body</th>
<th>City/Town</th>
<th>Advisory recommended</th>
<th>Advisory rescinded</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles River</td>
<td>Boston</td>
<td>6/20/2012</td>
<td>7/20/2012</td>
<td>MIT Boathouse to New Dam, reduced to Swim Dock on 7/13/12</td>
</tr>
<tr>
<td>Charles River</td>
<td>Newton</td>
<td>8/9/2012</td>
<td>8/29/2012</td>
<td>Sampled at Charles River Canoe and Kayak, ended everywhere but Lasell Boathouse 8/22</td>
</tr>
<tr>
<td>Charles River</td>
<td>Boston</td>
<td>8/22/2012</td>
<td>10/19/2012</td>
<td>Lower Basin</td>
</tr>
<tr>
<td>Charles River</td>
<td>Waltham</td>
<td>8/24/2012</td>
<td>9/6/2012</td>
<td>Moody St. Dam</td>
</tr>
</tbody>
</table>

Data courtesy of Vanessa Curran (DPH)
Split samples collected at Community Boating

9/12/12

10/10/12
Corrected Phycocyanin - 2012
(Estimated and Truncated)

DPH advisory 6/20-7/20

DPH advisory 8/22-10/19
Calibration options for Phycocyanin Probe

- Factory default and zero calibration standard
- Phycocyanin standard
- Culture – Microcystis aeruginosa
- Rhodamine dye solution
# Calibration options for Phycocyanin Probes

<table>
<thead>
<tr>
<th>Calibration option</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero calibration standard (DI water)</td>
<td>Easy</td>
<td>Hard to compare with other meters</td>
</tr>
<tr>
<td>Phycocyanin standard</td>
<td>Relates directly to phycocyanin</td>
<td>Short shelf life, not easy to use</td>
</tr>
<tr>
<td>Culture</td>
<td>Relates to cell counts</td>
<td>Time consuming, need equipment</td>
</tr>
<tr>
<td>Rhodamine dye</td>
<td>Easy to use, store, and repeat</td>
<td>Secondary standard</td>
</tr>
</tbody>
</table>
## Meter Day at Mass DEP on 5/31/12

Is there a way to relate different meters?

<table>
<thead>
<tr>
<th>Organization</th>
<th>Instrument</th>
<th>Excitation nM</th>
<th>Emission nM</th>
</tr>
</thead>
<tbody>
<tr>
<td>MassDEP</td>
<td>Turner Designs Databank Datalogger with Cyclops 7 probe (phycocyanin sensor)</td>
<td>590</td>
<td>650</td>
</tr>
<tr>
<td>US EPA</td>
<td>YSI multi-sensor probe/sondes</td>
<td>565-605&lt;sup&gt;1&lt;/sup&gt;</td>
<td>620-700&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>NE University</td>
<td>YSI multi-sensor probe/sondes</td>
<td>565-605&lt;sup&gt;1&lt;/sup&gt;</td>
<td>620-700&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>MWRA</td>
<td>Turner Designs AquaFluor (cuvette, no probe)</td>
<td>590</td>
<td>670-680</td>
</tr>
<tr>
<td>MyRWA</td>
<td>Turner Designs AquaFluor (cuvette, no probe)</td>
<td>590&lt;sup&gt;2&lt;/sup&gt;</td>
<td>670-680&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>CRWA</td>
<td>Hydrolab (Hach) (uses Turner Designs sensor)</td>
<td>590&lt;sup&gt;2&lt;/sup&gt;</td>
<td>650&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> Email from David Fraley, YSI Tech Support, 6/13/12  
<sup>2</sup> From product literature, assuming Phycocyanin sensor

Data courtesy of John Fitzgerald-Mass DEP
# Meter Day at Mass DEP on 5/31/12

Is there a way to relate different meters?

Data Obtained from Measurements of 3 Samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>MassDEP (Turner Cyclops 7)</th>
<th>CRWA (Hydrolab)</th>
<th>US EPA (YSI)</th>
<th>NE Univ (YSI)</th>
<th>MWRA (Turner Aquaflor)</th>
<th>MyRWA (Turner Aquaflor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles River (clean)</td>
<td>2 µg/L PC (70 mV)</td>
<td>6.1 mV</td>
<td>Not measured</td>
<td>0.3 RFUs 700 cells</td>
<td>0.283 units</td>
<td>-0.023 units</td>
</tr>
<tr>
<td>90 µg/L Phycocyanin</td>
<td>90 µg/L PC (1700 mV)</td>
<td>53.8 mV</td>
<td>30.1 RFUs 49,600 cells</td>
<td>18.4 RFUs 39,000 cells</td>
<td>9.863 units</td>
<td>11.21 units</td>
</tr>
<tr>
<td>Lake Quannapowitt</td>
<td>150 µg/L PC (2800 mV)</td>
<td>100 mV</td>
<td>17.4 RFUs 30,000 cells</td>
<td>10.5 RFUs 23,000 cells</td>
<td>22.07 units</td>
<td>23.52 units</td>
</tr>
</tbody>
</table>

PC = Phycocyanin  
mV = millivolts  
RFU = Relative Fluorescence Units

Data courtesy of John Fitzgerald-Mass DEP
Can meters and probes be standardized?

- How do you deal with different units?
- Should probes only be used for screening?
- Is it possible to standardize meters at the beginning of the year and establish a conversion.
- Are there other standard indicators that are just as good?
IDEAS, COMMENTS or QUESTIONS?