Lakes on Long Island: Environmental problems and Solutions
Matthew Harke, Timothy Davis, Ryan Wallace, Lucas Merlo, Jennifer Goleski, Florian Koch, Christopher Gobler

Introduction
- Blooms of cyanobacteria are associated with eutrophic and poorly flushed waters and can produce toxins that threaten the health of animals and humans.
- Blooms increase the turbidity of aquatic ecosystems, smothering aquatic plants and thereby suppressing important invertebrate and fish habitats.
- When these blooms die and decompose, they can reduce the levels of dissolved oxygen in the water to very low concentrations which can cause fish to suffocate.
- Managers of affected water bodies have considered a number of remediation techniques to reduce and control the occurrence of blooms.
- During the past decade, Lake Agawam (Southampton) and Mill Pond (Water Mill) have experienced annual, dense cyanobacteria blooms and occasional fish kills.

Nutrients
- Since nutrient loading is the root cause for many of problems in Mill Pond including cyanobacteria blooms, low oxygen levels and fish kills nutrient budgets were constructed for nitrogen and phosphorus loads into Mill Pond.
- Groundwater is the largest source of nitrogen entering the system (68%) while sediments are the largest source of phosphorus (59%).
- A successful management plan to improve water quality in this lake and other lakes must target the largest nutrient source(s) in the system.

Remediation Options Under Consideration for Mill Pond

<table>
<thead>
<tr>
<th>Treatment, goal</th>
<th>Description</th>
<th>Cavet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alum or Phoslock Treatment: prevent blue green algal blooms by “capping” the phosphorus in the sediment.</td>
<td>A method to bind phosphorus in precipitate which sinks to the bottom of the pond. This will reduce phosphorus available to phytoplankton and may prevent the occurrence of algal blooms.</td>
<td>Nearly half of the phosphorus entering Mill Pond comes from external sources; may promote the overgrowth of bottom plants such as water lilies or mililts; will require up to three, $50,000 applications annually.</td>
</tr>
<tr>
<td>Bottom Situated Air Diffusers: prevent fish kills and thermal stratification.</td>
<td>Artificial circulation to prevent low oxygen events during algal die-offs. Also will eliminate thermal stratification.</td>
<td>Will not reduce nutrients or effect algal blooms.</td>
</tr>
<tr>
<td>Improvement of septic systems: Reduce the flow of nutrients from household waste to the pond.</td>
<td>Upgraded septic systems can significantly reduce the contribution of both nitrogen and phosphorus to Mill Pond</td>
<td>The current composition of the fish community is unknown; Will not significantly reduce nutrients or effect algal blooms.</td>
</tr>
<tr>
<td>Application of “Lake Clear”: Reduces the amount of “muck” at the bottom of a lake that can fuel algal blooms.</td>
<td>Addition of bacteria and enzymes to eat away the bottom layer of organic rich mud in a lake thereby reducing the amount of nutrients available for suspension.</td>
<td>The precise microbes and chemicals to be introduced are proprietary and unknown and thus their effects are difficult to evaluate.</td>
</tr>
</tbody>
</table>

Chlorophyll, & Dissolved Oxygen
- Chlorophyll in Mill Pond and Dissolved Oxygen in Mill Pond

Conclusions
- The total contribution of nutrients from home septic systems and agriculture to groundwater entering Mill Pond needs to be determined.
- Management plans will need consider downstream effects of remediation treatments applied to lakes as many of our lakes and streams flow into estuaries. (e.g. Mill Pond discharges in Mecox Bay, the most productive oyster population in NYS).
- As each lake is ecologically different, remediation techniques will vary between lakes and may require a combination of multiple techniques.

Acknowledgements
We would like to sincerely thank the Tamarind Foundation for the funding to conduct this research. We would further like to thank the Southampton Town Trustees for support and the Southampton Town Marine Unit for their assistance collecting data after the fish kill event.