Effects of cyanobacteria blooms on fish essential fatty acid levels in freshwater ecosystems

E.L. Nathan¹, K. Bryan², T. Gearhart², K. Ritchie², J.D. Stockwell², and J. Kraft²

¹Skidmore College, Saratoga Springs, NY; en527@rcn.com
²The University of Vermont, Burlington, VT

Hypothesis: Yellow perch essential fatty acid levels decline in the presence of cyanobacteria blooms.

Background
- Cyanobacteria annually form blooms that outcompete other algal species in lakes.
- Cyanobacteria may be considered “junk food” because they are low in essential fatty acids, including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).
- Because energy moves up the food web from primary producers to zooplankton to fish (Figure 1), we predicted that yellow perch (Perca flavescens) livers would have relatively low EPA+DHA levels during cyanobacteria blooms.

Methods
- Yellow perch collected from Missisquoi Bay (eutrophic) and Shelburne Pond (hyper-eutrophic) (Figure 2)
- Lipids were extracted from livers (N = 55) and then converted to fatty acid methyl esters
- Fatty acid profile was analyzed using gas chromatography-mass spectrometry

Results

Results Tables 1 and 2 Two-way ANOVA results for EPA and DHA as percent total fatty acids (1) and mg per gram of liver (2).

<table>
<thead>
<tr>
<th>% Total Fatty Acids</th>
<th>EPA (P-value)</th>
<th>DHA (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>0.0009*</td>
<td>0.0025*</td>
</tr>
<tr>
<td>Location</td>
<td>&lt;0.0001*</td>
<td>NS</td>
</tr>
<tr>
<td>Time X Location</td>
<td>0.0003*</td>
<td>0.0014*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mg / g Liver</th>
<th>EPA (P-value)</th>
<th>DHA (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>0.0094*</td>
<td>0.0011*</td>
</tr>
<tr>
<td>Location</td>
<td>0.0074*</td>
<td>NS</td>
</tr>
<tr>
<td>Time X Location</td>
<td>0.0098*</td>
<td>NS</td>
</tr>
</tbody>
</table>

Conclusions
- Algal blooms have varying effects on fish essential fatty acid levels.

- % Total fatty acids (Figure 3)
  - Eutrophic site: EPA and DHA did not change
  - Hyper-eutrophic site: EPA and DHA increased over time

- mg/g liver (Figure 4)
  - Eutrophic site: EPA and DHA increased during the bloom
  - Hyper-eutrophic site: EPA increased over time; DHA increased during the bloom and then decreased post-bloom, but did not decrease to pre-bloom levels

Acknowledgements: N. Hill and A. Noor assisted with laboratory procedures. Support for this project was provided by the National Science Foundation (Award DBI-1358838).