Effects of Diet Differentiation on the Fatty Acid Content of White Perch

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Introduction

- One of the major impacts of climate change on Lake Champlain is the increase in harmful algal blooms.
- Favorable conditions for cyanobacteria blooms include warmer temperatures, shallower water, less mixing of waters, and greater nutrient availability [1].
  - -Climate change promotes these conditions both directly and indirectly.
- These blooms can have a variety of negative impacts on lake ecosystems and also pose human health risks [1,2,3].
- Essential fatty acids (EFA) can serve as trophic tracers and health indicators in ecosystems [4,5,6,7].
  - -Cyanobacteria are poor producers of EFA compared to other types of phytoplankton [3].
- This research examines the effects of cyanobacteria blooms on energy flow through the food web of Missisquoi Bay, Lake Champlain, investigating whether a lower quality food base will negatively affect ecosystem health.

Hypotheses

- A food web based on cyanobacteria will likely support a lower level of fitness than a similar food web based on other algae species.
- Expected relationships between cyanobacteria blooms, EFA transfer and fish health are described in Figure 1.
- Fish raised on a diet based on nutritional yeast (as an alternative low quality food source in place of cyanobacteria) will have lower fatty acid (FA) concentrations and exhibit less growth than those raised on a phytoplankton-based diet due to yeast's lower nutritional quality.

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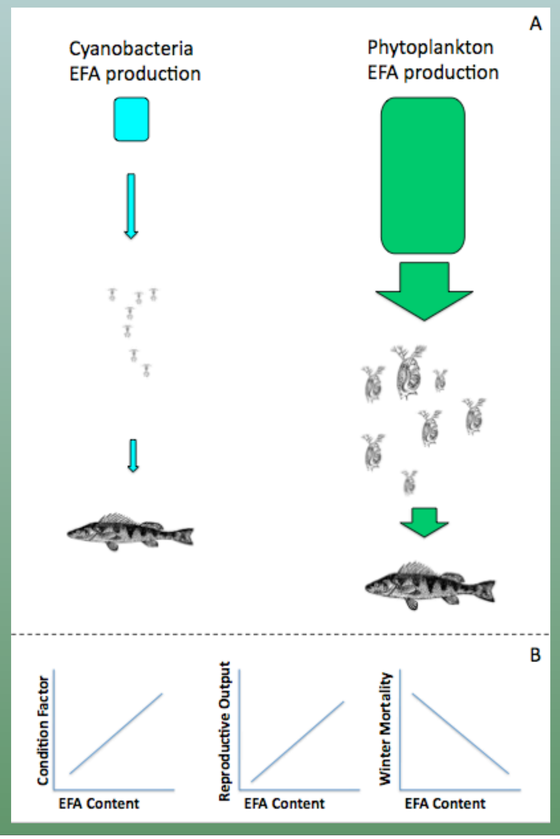

Figure 1. (A) Hypothesized effects of cyanobacteria blooms on EFA transfer and availability. (B) Hypothesized relationships between EFA and fish health and population demographics.

Figure 2. Beginnings of the *Selenastrum* culturing system.

Methods

- We set up two experimental food chains, each with three trophic levels and a different source of FA.
  - -Nutritional yeast served as a low nutrition diet in place of cyanobacteria.
- The overall design is described in Figure 3.
- *Selenastrum* and yeast cultures were maintained in the lab and fed to two separate populations of *Daphnia*.
- White perch were caught via seining at the Rock River boat launch.
- Fish were fed *Mysis* ad libitum for three months prior to the start of the experiment, then were switched to a diet of either *Selenastrum*-fed or yeast-fed *Daphnia*.
- One fish was sampled from each tank at Weeks 0, 1, 2 and 4.

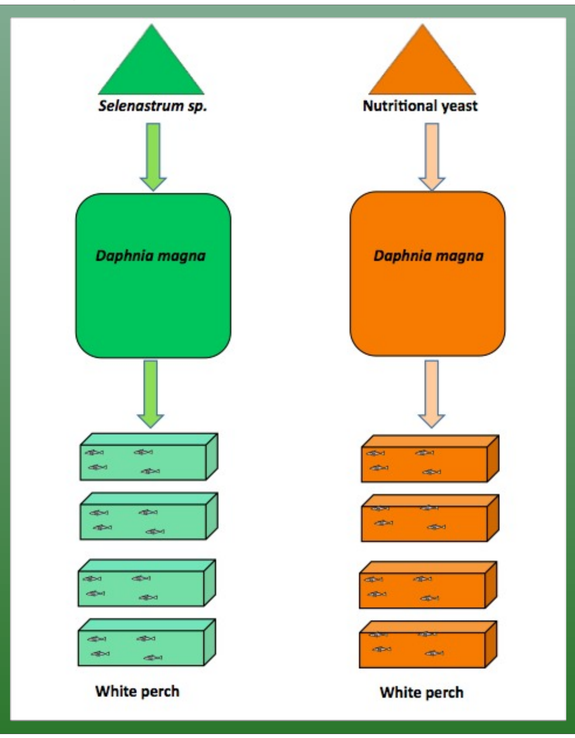

Figure 3. *Daphnia magna* were fed either *Selenastrum* or nutritional yeast to establish contrasting FA profiles. White perch were placed in eight 40 L tanks, with four tanks per treatment and four fish per tank. Fish were fed *Selenastrum*-fed or yeast-fed *Daphnia* for the duration of the experiment.

Results to Date

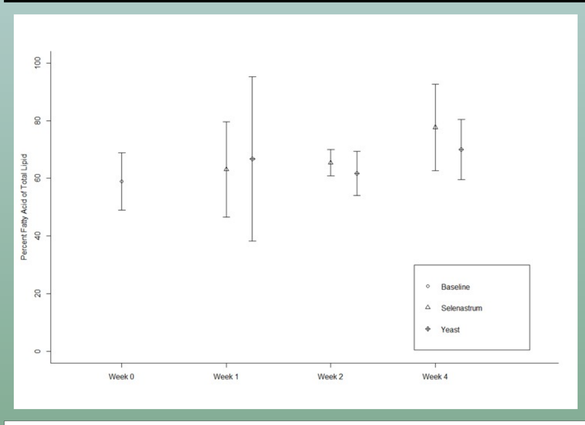

Figure 4. Percent FA of total lipids over time (mean ± 1SD).

- All samples have been analyzed for total lipid content, total FA content, and percent FA of total lipids.
- Testing for variance in each of these between food types and over the course of the four weeks revealed no significant differences (using Student's t-test and one-way ANOVA or Wilcoxon and Kruskal-Wallace tests depending on normality of the data).
  - -ANOVA for %FA over time:
    - Yeast-fed: $F_{(2,9)} = 0.27$, $p = 0.769$
    - *Selenastrum*-fed: $F_{(2,9)} = 1.39$, $p = 0.298$
- These results are as expected because we are expecting changes in the accumulation of specific FA rather than changes in total lipid or FA content.

Next Steps

- Samples are currently being analyzed to determine their profiles of specific FA concentrations.
- In the future we plan to couple our FA research with physical, biological and geochemical data from Missisquoi Bay to study trophic interactions in the context of a changing environment.

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