Interactions between the spiny waterflea (*Bythotrephes longimanus*) and pumpkinseed sunfish (*Lepomis gibbosus*)
Overview

- Specific Research Objectives
- Background
  - Spiny waterflea
    - Impacts/adaptations
  - Pumpkinseed
    - Specialized feeding habits-breakthrough
- Specific Research Questions
- Methods/Results
- Discussion/Questions/Feedback
Specific Research Objectives

- Establish whether or not the feeding behavior of pumpkinseeds is population specific

- Quantify how frequently pumpkinseeds exhibit the spine removal behavior

- Determine if they are more efficient at ingesting *Bython* than other fishes
Predatory cladoceran that competes directly with juvenile fish
Drastically affects native zooplankton communities
  • Abundance and species richness reduced
  • Alterations in zooplankton body sizes and structures

The Spiny Waterflea

Photo by Foad Yousef

http://www.evolution.unibas.ch
YOY fishes have difficulty ingesting
- Reject and recapture
- Whole-body convulsions
- Learned aversion
- Small fish avoid eating the spiny waterflea
- Large fish switch to feeding on larger prey
Pumpkinseed (*Lepomis gibbosus*)

- Eat snails as adults
- Specialized jaw with neuromuscular motor pattern
- Analogous to manipulating, separating, and ejecting the spine from the spiny waterflea?
Research Question 1

- Is the feeding behavior displayed by local pumpkinseed fed *Bythotrephes* population specific?
  - i.e. compare pumpkinseed over geographic regions
Seined fish from Minnesota and Michigan
Spine removal success: proportion of instances spine was removed by individual fish
Research Question 2

- How frequently do pumpkinseed exhibit the spine removal behavior compared to other species?
<table>
<thead>
<tr>
<th>Species</th>
<th># of Fish</th>
<th>Location</th>
<th>Sizes (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkinseed</td>
<td>8</td>
<td>UP MI</td>
<td>45-70</td>
</tr>
<tr>
<td>Pumpkinseed</td>
<td>9</td>
<td>Northern MN</td>
<td>48-65</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>7</td>
<td>Northern MN</td>
<td>49-57</td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>7</td>
<td>UP, MI</td>
<td>50-57</td>
</tr>
</tbody>
</table>
Spine Removal Success

Fish Species
Pumpkinseed Yellow Perch Small Mouth Bass

N=7
M=0.00, SD=0.00

N=17
M=0.87, SD=0.12

N=7
M=0.01, SD=0.02

Kruskal-Wallis Rank Sum Test: p-value=1.16e-05
Research Question 3

- Are pumpkinseed more efficient at ingesting *Bythotrephes* than other fishes?
One-way ANOVA $P=1.212 \times 10^{-15}$

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Handling Time (s)</th>
<th>$N$</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkinseed</td>
<td>10 15 20 25</td>
<td>17</td>
<td>9.00</td>
<td>1.83</td>
</tr>
<tr>
<td>Bluegill</td>
<td></td>
<td>7</td>
<td>11.29</td>
<td>1.52</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td></td>
<td>7</td>
<td>19.07</td>
<td>2.59</td>
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<tr>
<td>Small Mouth Bass</td>
<td></td>
<td>7</td>
<td>21.04</td>
<td>3.01</td>
</tr>
</tbody>
</table>
Summary

- The pumpkinseeds from multiple geographic regions were more successful at removing *Bythotrephes*’ spine, and more efficient at ingesting *Bythotrephes* than the yellow perch and smallmouth bass used in the study.

Do pumpkinseeds have the ability to influence the distribution of *Bythotrephes*? Could they be used as a control agent?
References


Maki, R., Lafraancois, M.B., Elias, J., Kitson, T.M., Branstrator, D. Zooplankton assemblages at Voyaguers National Park: Establishing a pre-Bythotrephes baseline. Proceedings from 7th annual Western Great Lakes Research Conference 2009 April 1-2; Ashland, WI.


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Questions/Comments
Native pumpkinseed distribution

Bythotrephes distribution

Figure by Dr. Casey Huckins and Kerfoot et al. 2011
Phenotypic Polymorphism

- In lakes where pumpkinseed and bluegill coexist, pumpkinseed remain in littoral zone.
- In lakes where bluegill are historically absent there are two forms of pumpkinseed
  - Littoral - feeds mainly on snails
  - Limnetic - planktivorous