Hierarchical Stability within a Large River Fish Community in Response to Multiple Ecological Perturbations: Linking Community Theory to Management Application

Brent A. Murry*
John M. Farrell
SUNY-ESF
% Change in CPUE From Pre- to Post-Invasion

![Graph showing % Change in CPUE from Pre- to Post-Invasion](image-url)
Hypothesis of Hierarchical Community Stability

- Size-Structure
  - High Stability
- Species Composition
  - Unstable

Stronger Species Stability Within Size Classes
Ecological Basis for Size-Stability

- **Eltonian Pyramid**
  - Distribution of Biomass and Production

- **Scaling Relationships**
  - Metabolism & Production $\propto$ Body Mass$^{3/4}$
  - Trophic Transfer Efficiency

- **Size-structured Feeding Relationships**
Annual Fish Community Biomass Spectrum 1977-2001

P/B ratios

\[ B = Nw \]
\[ P = B_{t2} - B_{t1} \]
\[ P/B = \frac{(B_{t2} - B_{t1})}{B_{t1}} \]
### Stability in Species Abundance

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><img src="image1.png" alt="Fish 1977" /></td>
<td><img src="image2.png" alt="Fish 1978" /></td>
<td><img src="image3.png" alt="Fish 1979" /></td>
<td><img src="image4.png" alt="Fish 1980" /></td>
</tr>
<tr>
<td>2</td>
<td><img src="image5.png" alt="Fish 1977" /></td>
<td><img src="image6.png" alt="Fish 1978" /></td>
<td><img src="image7.png" alt="Fish 1979" /></td>
<td><img src="image8.png" alt="Fish 1980" /></td>
</tr>
<tr>
<td>3</td>
<td><img src="image9.png" alt="Fish 1977" /></td>
<td><img src="image10.png" alt="Fish 1978" /></td>
<td><img src="image11.png" alt="Fish 1979" /></td>
<td><img src="image12.png" alt="Fish 1980" /></td>
</tr>
<tr>
<td>4</td>
<td><img src="image13.png" alt="Fish 1977" /></td>
<td><img src="image14.png" alt="Fish 1978" /></td>
<td><img src="image15.png" alt="Fish 1979" /></td>
<td><img src="image16.png" alt="Fish 1980" /></td>
</tr>
<tr>
<td>5</td>
<td><img src="image17.png" alt="Fish 1977" /></td>
<td><img src="image18.png" alt="Fish 1978" /></td>
<td><img src="image19.png" alt="Fish 1979" /></td>
<td><img src="image20.png" alt="Fish 1980" /></td>
</tr>
</tbody>
</table>
Overall Species Composition: Stability in Rank Abundance

Kendall’s W = 0.012

Scale 0 – 1

0 = total instability
1 = complete stability
Number of Species per Size Class

SPECIES RICHNESS

SC1: 14
SC2: 16
SC3: 18
SC4: 12
SC5: 8
SC6: 6
SC7: 4
Stability of Species Composition Within Size Classes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Y</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>N*</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>N</td>
<td>Y*</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

• Community stability appears nested in structure
  – Species composition occurs within a hierarchical framework of size-structure

• Perturbations differentially influenced stability among size classes

• Species management needs to occur in a community / ecosystem context
Acknowledgements

• Rodger Klindt, NYSDEC

• Funding: Sportfish Restoration Act

• Finger Lakes Institute
Species Composition in Each Size Class