Changes in Benthic Macroinvertebrate Community Structure Following Stream Restoration

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Restoration Theory

**Field of Dreams Hypothesis**: If you build it they will come
- Underlying tenet of most projects
- Requires rigorous biomonitoring surveys to detect changes in population/community composition

**Intermediate Disturbance Theory**: Moderate levels of disturbance will support higher species diversity
- Disturbance regime: frequency, magnitude, severity
- Low or high levels of disturbance decrease species diversity and abundance
What types of disturbance occur in a stream corridor?

- storm flow
- predation
- riparian loss
- invasive spp
- sedimentation
- water quality

Fig. 3.2 -- Chain of events due to disturbance. Disturbance to a stream corridor system typically results in a causal chain of alterations to stream corridor structure and functions.
**Hypothesis**: Restoration of fish habitat will impact community structure of benthic macroinvertebrates over time.
Cold Brook
Hammondsport, NY

Keuka Lake

Bath, NY
Goals of Stream Restoration

- To improve spawning and rearing habitat for Rainbow Trout *Oncorhynchus mykiss*

- To improve longitudinal connectivity between the lake and upper stream reaches to encourage spawning migration
A control reach and restoration reach were sampled at each site 1 & 3 years post-restoration. Control was always upstream of restored.
Benthic Macroinvertebrate Community Response

**Family Richness: Railroad site**

<table>
<thead>
<tr>
<th>Year</th>
<th>Control</th>
<th>Restored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter 2008</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Spring 2008</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Winter 2010</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Spring 2010</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

**Family Richness: Winery Site**

<table>
<thead>
<tr>
<th>Year</th>
<th>Control</th>
<th>Restored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter 2008</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Spring 2008</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Winter 2010</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Spring 2010</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>
PMA: Measure of Stream Health

PMA Composition: 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 20% Chironomidae, 10% Coleoptera, 5% Oligochaeta, 10% Other; Novak and Bode. 1992. Percent model affinity, a new measure of macroinvertebrate community composition. JNABS 11(1):80-85.
Response: Differences between Sites

- *Oligochaeta* (tubificid worms) were high at Winery Restored in 2008 – otherwise negligible at other sites
- *Physidae* (snails) & *Sphaeridae* (fingernail clams) were only found at control sites
- *Simuliidae* (black flies) were much more abundant at Railroad than Winery
- *Tipulidae* (crane flies) were only present in 2010, but only in restored sites
- Abundance of *Ephemerellidae* (mayflies) was higher at restored sites than control
Response: Changes over Time

- **Plecoptera** (stoneflies) were completely absent at Railroad Restored in 2008.
- **Perlodidae** stoneflies were not found in CB until 2010.
- **Chloroperlidae** stoneflies were only found in 2008.
- Abundance of **Baetidae** (mayflies) was higher in 2008 than in 2010 at Railroad Restored.
Conclusions

• Habitat restoration in streams do act as a disturbance to macroinvertebrate communities

• Generally, family richness was higher at Winery:
  – Size/discharge of stream
  – Extent of upstream restoration activity
  – Differences in physical habitat/substrate
  – Increased predation
Conclusions cont’d

Railroad:
• Community at restored & control sites were similar in 2008
• Greater response at restored site over time – shift in community based on richness and PMA
  – Presence of stoneflies?

Winery:
• Community at restored & control sites were similar in 2008, but restored site health dropped in 2010
  – PMA: Drop in Tricoptera *Hydropsychidae* (caddisflies)
Restoration Theory Revisited

• Disturbance from stream restoration is a concern in the short term for macroinvertebrates

• Shifts in community composition may relate differences in sediment tolerances, water quality preferences, or biological interactions

• Dynamics of macroinvertebrate community may contribute to the success of juvenile rainbow trout population restoration
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