Habitat Suitability Criteria for Fishes of the South Fork of the Shenandoah River

Valley Regional Water Resources Policy Committee Meeting

R. Clay Ramey
Instream Flow Study:

Goal is to link discharge to fish habitat:

Discharge = volume of water (ft$^3$/s, m$^3$/s)

- How does habitat availability change in response to discharge?

- What discharge is required to support species A? The community?

- What might be the response of species A to discharge $Q$? The community?
Habitat Suitability Criteria

Physical habitat parameters: depth, velocity, substrate, cover

Based on observations of fish habitat use
  – Undisturbed fish
  – All mesohabitat types
  – As many species and life stages as feasible
Habitat Suitability Criteria, cont.

(Engbretson Underwater Photo. 2009)
Data Collection Sites

Randomly selected transects from USGS sites:
Kaufman’s Mill, Thunderbird Farms, Lynnwood, River Bend Pool, Compton, Rte. 661
~ from Grottoes to Front Royal

(Map from Krstolic 2009)
Methods

Snorkeling:

Roving Observer:
Snorkeling, cont.

Stationary Observer:

- Transect
- Direction of Current
  - 1 m
  - 2 m
Methods, cont.

Electroshocking component
- shocked cells with pre-positioned electroshocking devise
- limited boat shocking
Field Summary

- 31 days in the field
- 495 point measurements of habitat (fish locations + available habitat measurements)
- ~4,455 rocks measured (495*9)
- 909 sampling events
- ~1,629 individual fish
- Representing 46 species and life stages (~28 species)
Habitat Suitability Criteria

Use criteria
-based on the distributions of observations
Habitat Suitability Criteria, cont.

Preference criteria
- accounts for available habitat
- pref. = \% use/\% avail.

Depth Preference for Cyprinella spp.

![Graph showing depth preference for Cyprinella spp.](image)
Criteria from chi-square tables

A tool to make inferences about the quality of a specific habitat

Multivariate

Optimal vs. useable,

Suitable vs. unsuitable

(www.fishbase.org)
Chi-square Tables, cont.

80% = Suitable

50% = Optimal

15% = Useable

15% = Useable

10% x 2 = Unsuitable
Habitat Classification, cont.

- Optimal + Useable

  Suitable VS. Unsuitable
Chi-square table for *Cyprinella* spp.

<table>
<thead>
<tr>
<th></th>
<th>SUITABLE</th>
<th>UNSUITABLE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCCUPIED</td>
<td>40</td>
<td>21</td>
<td>61</td>
</tr>
<tr>
<td>UNOCCUPIED</td>
<td>88</td>
<td>116</td>
<td>204</td>
</tr>
<tr>
<td>TOTAL</td>
<td>128</td>
<td>137</td>
<td>265</td>
</tr>
</tbody>
</table>

\[ T = 3.0768 \]

Duplicated from Ken Bovee, USGS (2009)
Criteria for the South Fork

smallmouth bass (sub-adult and adult)

(Engbretson Underwater Photo. 2009)
Criteria:

Redbreast sunfish (3 lifestages)

(www.fishbase.org)
Criteria:

Margined madtom
(www.fishbase.org)
Criteria:

River chub  
(www.fishbase.org)
## Criteria for USGS

<table>
<thead>
<tr>
<th>Taxa/Life Stage</th>
<th>n (event)</th>
<th>Useable</th>
<th>Optimal</th>
<th>Useable</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA MDO</td>
<td>61</td>
<td>1.3</td>
<td>1.7</td>
<td>2.9</td>
<td>5.5</td>
</tr>
<tr>
<td>MDO</td>
<td>19</td>
<td>2.1</td>
<td>2.8</td>
<td>5.5</td>
<td>6.2</td>
</tr>
<tr>
<td>J LAU</td>
<td>31</td>
<td>0.8</td>
<td>1.1</td>
<td>1.9</td>
<td>2.4</td>
</tr>
<tr>
<td>SA LAU</td>
<td>31</td>
<td>1.3</td>
<td>1.8</td>
<td>3.6</td>
<td>4.4</td>
</tr>
<tr>
<td>LAU</td>
<td>30</td>
<td>0.9</td>
<td>1.6</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Cyp. spp.</td>
<td>61</td>
<td>0.9</td>
<td>1.1</td>
<td>1.8</td>
<td>2.4</td>
</tr>
<tr>
<td>NIN</td>
<td>30</td>
<td>0.7</td>
<td>0.9</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td>NMI</td>
<td>54</td>
<td>0.1</td>
<td>1.1</td>
<td>2.1</td>
<td>2.9</td>
</tr>
<tr>
<td>YOY**</td>
<td>37</td>
<td>0.9</td>
<td>1.1</td>
<td>2.0</td>
<td>3.7</td>
</tr>
</tbody>
</table>
Findings:

We know that shallow/fast habitats are most affected by low flow:

madtoms, chubs, minnows, arguably sub-adult smallmouth

Deep/slow habitats are more resistant:

smallmouth, sunfish, catfish
Now what?

USGS will be able to estimate the area of the river that is suitable for each species

- water allocation decision making tool

- provides biologically based rationale for those decisions
Other implications:

Methodological test: roving vs. stationary observers

Using data gathered in the South Fork to explore transferability

- Persinger’s *Cyprinella* spp. criteria from the North Fork (2003) transferred, and

- Groshens and Orth (1994) SA MDO, North Anna

- 11 other tests, all failed to transfer, more dubious evidence

- Fish kill
In closing . . .

Thank you

Northern Shenandoah Valley Regional Commission

Central Shenandoah Planning District Commission