Large River Semi-wadeable MMI

Dustin Shull

2017
Large Rivers

- > 1000 mi²
- Typically non-wadeable
- Lacking description in literature
- Requires more resources to conduct surveys
Introduction: Complex Systems

Susquehanna River at Rockville, PA

Specific Conductance

Monitoring Location

Tributaries

Juniata

West Branch

Mainstem

125.00
150.00
175.00
200.00
225.00
250.00
275.00
300.00
325.00

4/2/2013
4/24/2013
5/7/2013
6/4/2013
6/26/2013
7/17/2013
8/7/2013
Introduction: Complex Systems
Introduction: Semi-wadeable

– Semi-wadeable Large Rivers

• Definition:
  – Water influence differences are maintained downstream of major tributary confluences
  – Free flowing river systems
  – Difficult to wade
  – Difficult to boat

• Importance:
  – More than 50% of PA rivers are semi-wadeable
  – Non-mixing waters across the width of a river can cause biological community differences
  – Wadeable biological methods can be utilized with modification (= saving resources)
  – National methods may be mischaracterizing these rivers (shoreline biological collections)
Introduction: Complex Systems

Large Rivers

Semi-wadeable Rivers
Susquehanna River at Sunbury, PA
Major influences do not mix for 65 miles

Non-wadeable Rivers
Ohio River at Pittsburg, PA
Major influences mix in about 1 mile
Macroinvertebrate Method

- **Two approaches**
  - **Wadeable method**
    - Standard method for PADEP/WQN
    - Problematic in large rivers
  - **Transect Method**
    - Multiple samples taken based on water quality
    - Addresses major water influence differences
Macroinvertebrate Method

- Revisit sample data (both methods)

Drainage area (square miles) vs. CV for Wadeable Method Samples.
Method: Test

Needed to test why wadeable methods have more variability.
Method: Test

Sunbury, PA

Rockville, PA

Marietta, PA

(a)  

(b)  

(c)
Introduction: Complex Systems

Rockville, PA

Marietta, PA
Assessing the expansion of wadeable benthic macroinvertebrate collection methods in large semi-wadeable rivers

Shull and Lookenbill 2017, Freshwater Science
What is “Reference” for a Large River?

- Traditionally refers to natural or undisturbed
  - Does not exist for large rivers

- Moving forward with “least disturbed” (LD)
  - Inherently accepts that ambient conditions are no longer natural, but not degraded enough to lose an acceptable level of range within the stressor gradient.

(Stoddard et al., 2006)
MMI: Metric Evaluation

[Map showing major rivers including Allegheny River, Susquehanna River, Delaware River, and Potomac River with markers indicating calibration and validation points.]

- Calibration
- Validation
- Large River Flowlines
- States
- Counties

[Legend for map symbols and scales indicating 0, 30, 60 miles.]
# MMI: Stressor Gradient

- Based on abiotic factors (traditional method)
  - Numbers/thresholds from literature and reports
  - First true incorporation of laboratory chemical data for PA

<table>
<thead>
<tr>
<th>Stressor</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Developed land use in the watershed</td>
<td>&lt; 5</td>
<td>5 to 10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>% Agriculture land use in the watershed</td>
<td>&lt; 10</td>
<td>10 to 30</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>&lt; 0.1</td>
<td>0.1 to 0.2</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>&lt; 1.0</td>
<td>1.0 to 2.0</td>
<td>&gt; 2.0</td>
</tr>
<tr>
<td>Specific Conductance (µS/cm)</td>
<td>&lt; 300</td>
<td>300 to 600</td>
<td>&gt; 600</td>
</tr>
<tr>
<td>Total Chloride (mg/L)</td>
<td>&lt; 15</td>
<td>15 to 200</td>
<td>&gt; 200</td>
</tr>
<tr>
<td>Total Sulfate (mg/L)</td>
<td>&lt; 20</td>
<td>20 to 200</td>
<td>&gt; 200</td>
</tr>
<tr>
<td>Total Ammonia (mg/L)</td>
<td>&lt; 0.03</td>
<td>0.03 to 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Instream Habitat (Total of instream cover, epifaunal substrate, and embeddedness)</td>
<td>&gt; 45</td>
<td>45 to 30</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>Within 10 miles of a major impoundment</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 1 mile of a minor impoundment</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
178 sites evaluated

- LD: 48 sites
- I: 77 sites
- S: 53 sites
- How many classifications do we have?
- What kind of classification should there be based on natural variability?
  - Ecoregion
  - Season
  - Drainage
  - etc....
– How many classifications?
  * Definitely 2 naturally unique macroinvertebrate communities.

– What are they?
– Clearly season is the strongest driver of the two classifications
– Moving forward with:
  • 2 classifications based on seasonality
  • 2 semi-wadeable MMIs, one for summer, one for fall? Metrics will determine.
– Calibration Dataset
  • 275 samples from 126 sites
    – Summer 155 samples from 114 sites
    – Fall 120 samples from 93 sites

– Validation Dataset
  • 106 samples from 42 sites
    – Summer 63 samples from 42 sites
    – Fall 43 samples from 32 sites

– 167 total metrics analyzed
  • Each metric needed to pass 8 different tests to be included
  • 6 metrics for each index were selected
MMI: 2 SWMMIs

Summer SWMMI
Impairment Threshold: 49

Fall SWMMI
Impairment Threshold: 57
Implementation: Zonation
Implementation: Zonation
Independent Applicability
Questions?

Dustin Shull
dushull@pa.gov