Stream Bioassessment in Washington: where Science and Policy Intersect

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Freshwater systems under threat

Vörösmarty et al. (2010) *Nature*
Supporting the mandates of the Clean Water Act

• Historically better at monitoring chemical and physical integrity

• Assessing biological communities has lagged behind despite being a more comprehensive measure of stream health

• Monitoring the biological communities of streams supports one of the mandates of the CWA to restore and maintain the chemical, physical and biological integrity of the Nation’s waters

• Establishing reference or ‘least impacted’ conditions are vital for assessing status and trends
Beginning in 2008, Water Quality Assessment in WA adopted a new policy for listing stream reaches on the state’s 303(d) list using biological criteria:

• **Category 5** ("poor" and "very poor") when B-IBI score is less than 28 or RIVPACs score of ≤0.73.

• **Category 2** ("waters of concern") when B-IBI score is between 28 and 37 or RIVPACs score of 0.74-0.86.

• **Category 1** (no biological impairment) when B-IBI score is 38 or higher or RIVPACs score of >0.86.

Starting 2013, WDOE started requiring that data used for listing stream reaches should be analyzed at a fine taxonomic resolution (i.e. genus/species) for all groups.
Benthic Index of Biotic Integrity (B-IBI)

10 Component Metrics:

1) Total taxa richness
2) Ephemeroptera (Mayfly) taxa richness
3) Plecoptera (Stonefly) taxa richness
4) Trichoptera (Caddisfly) taxa richness
5) Intolerant taxa richness
6) Clinger taxa richness
7) Long-lived taxa richness
8) Percent tolerant
9) Percent Predator
10) Percent Dominance

Each metric receives a score of 1, 3, or 5 and the scores for all metrics are summed to produce a component score ranging from 10-50.
Attempts to start thinking regionally and standardize methodology for data collection

Puget Sound Stream Benthos

King County refined scoring of the B-IBI; now available on a scale of 10-50 and 0-100
Three primary biomonitoring programs at Ecology:

1) Ambient Biological – reference sites from eight of Washington’s Level III ecoregions (8-10 sites in each ecoregion)

2) Sentinel – reference sites sampled annually from 16 sites statewide

3) Watershed Health and Salmon Recovery – randomly selected sites sampled throughout seven Status and Trends Monitoring Regions (50 sites per region, with 25 new random sites & 25 revisits on repeat cycle)
Ambient Biological
Sentinel
Watershed Health Monitoring

2009-2015
Ambient Biological – 76 sites
Sentinel – 16 sites
WHM – 474 sites
Table 1 Results from individual t-tests for reference versus random sites for Western Washington MMI metrics. Results based on 1000 bootstrap replications.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Mean (random)</th>
<th>Mean (reference)</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine sediment biotic index</td>
<td>50.587</td>
<td>162.358</td>
<td>10.198</td>
<td>0.00000000000000006</td>
</tr>
<tr>
<td>Cold stenotherm richness</td>
<td>11.57</td>
<td>19.389</td>
<td>7.602</td>
<td>0.0000000000283145</td>
</tr>
<tr>
<td>CTQa</td>
<td>56.459</td>
<td>40.072</td>
<td>-6.462</td>
<td>0.000000035613524</td>
</tr>
<tr>
<td>Predator richness</td>
<td>9.089</td>
<td>14.019</td>
<td>6.402</td>
<td>0.000000056942509</td>
</tr>
<tr>
<td>Percent clingers</td>
<td>0.323</td>
<td>0.593</td>
<td>6.162</td>
<td>0.00000184392463</td>
</tr>
<tr>
<td>Long-lived taxa richness</td>
<td>5.785</td>
<td>9.199</td>
<td>5.191</td>
<td>0.000005285704274</td>
</tr>
<tr>
<td># of different Orders</td>
<td>10.656</td>
<td>8.442</td>
<td>-5.08</td>
<td>0.000008251023046</td>
</tr>
<tr>
<td>Percent non-insect taxa</td>
<td>0.269</td>
<td>0.085</td>
<td>-4.797</td>
<td>0.00002621632451</td>
</tr>
<tr>
<td>Percent EPT taxa</td>
<td>0.308</td>
<td>0.549</td>
<td>4.587</td>
<td>0.00037116696689</td>
</tr>
<tr>
<td>Percent scrapers</td>
<td>0.139</td>
<td>0.226</td>
<td>2.938</td>
<td>0.006354149297873</td>
</tr>
</tbody>
</table>
#### Table 2 Biological response metrics for macroinvertebrate communities used in the two bioassessment models evaluated.

<table>
<thead>
<tr>
<th>B-IBI (0-100)</th>
<th>Western WA MMI (0-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Total taxa richness</td>
<td># different Orders</td>
</tr>
<tr>
<td>2: Ephemeroptera richness</td>
<td>Long-lived taxa richness</td>
</tr>
<tr>
<td>3: Plecoptera richness</td>
<td>Predator richness</td>
</tr>
<tr>
<td>4: Trichoptera richness</td>
<td>Percent Clingers</td>
</tr>
<tr>
<td>5: Intolerant richness</td>
<td>Percent EPT taxa</td>
</tr>
<tr>
<td>6: Clinger richness</td>
<td>Percent non-insect taxa</td>
</tr>
<tr>
<td>7: Long-lived taxa richness</td>
<td>Fine sediment biotic index</td>
</tr>
<tr>
<td>8: Percent tolerant</td>
<td>CTQa</td>
</tr>
<tr>
<td>9: Percent predators</td>
<td>Percent scrapers</td>
</tr>
<tr>
<td>10: Percent dominance (top 3)</td>
<td>Cold stenotherm richness</td>
</tr>
</tbody>
</table>
B-IBI Scores western WA

Reference Sites
5th percentile = 57.550
25th percentile = 72.675
WW-MMI Scores

Reference Sites
5th percentile = 42.808
25th percentile = 55.355
Puget Sound Watershed Health

- **BIBI_100**
  - Good: 34.23 km
  - Fair: 18.03 km
  - Poor: 47.75 km

- **WEST_MMI**
  - Good: 17.5 km
  - Fair: 29.62 km
  - Poor: 52.88 km

Stream length assessed (km)
Coastal Region Watershed Health

Stream length assessed (km)

- **BIBI_100**
  - Good: 36.54 km
  - Fair: 23.2 km
  - Poor: 40.25 km

- **WEST_MMI**
  - Good: 24.97 km
  - Fair: 25.52 km
  - Poor: 49.51 km
Lower Columbia Region Watershed Health

Stream length assessed (km)

- BIBI_100
  - Good: 59.62 km
  - Fair: 22.96 km
  - Poor: 17.42 km

- WEST_MMI
  - Good: 41.18 km
  - Fair: 28.03 km
  - Poor: 30.79 km
Western WA
Summary:

- Developing regional multimetric indices for WA (Western WA, Eastern WA, Columbia Plateau)
- Development/refinement of RIVPACs O/E models
- Need to develop models for periphyton communities
- Further evaluation of the links between the response of biological communities to environmental variables/stressors