Freshwater Bioassessment Tools for the Puget Sound Basin: Enhancing a Science-Based Performance Measure of Stream Condition

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Funded by a US EPA Scientific Studies and Technical Investigation Assistance Program Grant
Puget Lowland Benthic Index of Biotic Integrity (B-IBI)

- Multi-metric index measures stream health
- Developed in late 90’s
- 10 individual metrics
- Individual B-IBI metrics scored on scale of 1-3-5; B-IBI score 10-50
- Widely used by PS agencies/tribes
  - Track status/trends, focus restoration, effectiveness monitoring tool, PSP Action Agenda, Vital Sign FW Indicator, etc.
- Today’s session presentations highlight B-IBI uses

**Puget Lowland B-IBI Metrics**

<table>
<thead>
<tr>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Taxa</td>
</tr>
<tr>
<td>Mayfly Taxa</td>
</tr>
<tr>
<td>Stonefly Taxa</td>
</tr>
<tr>
<td>Caddisfly Taxa</td>
</tr>
<tr>
<td>Long-lived Taxa</td>
</tr>
<tr>
<td>Intolerant Taxa</td>
</tr>
<tr>
<td>% Tolerant individuals</td>
</tr>
<tr>
<td>% Predator individuals</td>
</tr>
<tr>
<td>Clinger Taxa</td>
</tr>
<tr>
<td>% Dominance</td>
</tr>
</tbody>
</table>
## Regional Benthic Monitoring Issues

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Desired Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differing collection methods</td>
<td>Standardization</td>
</tr>
<tr>
<td>Decentralized data mgmt</td>
<td>Centralized data mgmt</td>
</tr>
<tr>
<td>Outdated taxa attributes</td>
<td>Peer-reviewed or Empirically derived attributes</td>
</tr>
<tr>
<td>Insufficient B-IBI sensitivity</td>
<td>Re-calibrated scoring 0-100</td>
</tr>
<tr>
<td>&gt;20 cities, counties, tribes monitoring independently</td>
<td>Collaboration and communication</td>
</tr>
</tbody>
</table>

2011-14 EPA Grant with goal to address limitations and meet desired outcomes
Analyzing Stream Health

This site analyzes benthic macro-invertebrate community structure to determine the ecological health of Puget Sound Stream Benthos. The B-IBI Scoring System is used to score the health of different streams.

The B-IBI Scoring System

We use the Benthic Index of Biotic Integrity (B-IBI) scoring system to determine stream health. Since the B-IBI is a standardized scoring system, it can be used to compare and rank the health of different streams.

B-IBI has several variants, and we will support many of them over time. Currently, we are using Puget Sound Lowlands B-IBI. This site allows you to filter the scores by a variety of parameters and then:

- Plot the scores on maps
- Show the scores in tables

B-IBI Recalibration

We are currently working to enhance benthic macroinvertebrate monitoring tools for the Puget Sound region. For more information and to view documents and other products please go to the B-IBI Recalibration page.

www.pugetsoundstreambenthos.org
Standardize Collection Methods: Side by Side Sampling

- 3 vs. 8 ft² sample area
- 55 sampling sites
- 9 regional partners

3ft² and 8ft² Data Are Comparable
Strengthen Sensitivity of Taxa Attributes

Puget Lowland B-IBI Metrics with Attributes

- Long-lived Taxa*
- Clinger Taxa*
- % Predator Individuals*
- Intolerant Taxa**
- % Tolerant individuals**

* Peer-Reviewed Literature
** Empirically with Existing Data  n = 784

Biggest change for tolerant/intolerant taxa

Taxa attribute update requires B-IBI recalibration
### B-IBI Recalibration: Taxa Resolution

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Fine (Ecology)</th>
<th>Medium</th>
<th>Coarse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligochaetes</td>
<td>Subfamily/Genus</td>
<td>Family</td>
<td>Subclass</td>
</tr>
<tr>
<td>Acari</td>
<td>Genus</td>
<td>Subclass</td>
<td>Subclass</td>
</tr>
<tr>
<td>Gastropods</td>
<td>Genus</td>
<td>Genus</td>
<td>Family</td>
</tr>
<tr>
<td>Dytiscids</td>
<td>Genus</td>
<td>Genus (adults)</td>
<td>Family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family (larvae)</td>
<td></td>
</tr>
<tr>
<td>Simulids</td>
<td>Genus</td>
<td>Genus (larvae)</td>
<td>Family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family (pupae)</td>
<td></td>
</tr>
<tr>
<td>Chironomids</td>
<td>Genus/Sp/Sp grp</td>
<td>Subfamily/tribe</td>
<td>Family</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichoptera (Pupae only)</td>
<td>Genus/Sp/Sp grp</td>
<td>Family</td>
<td>Order</td>
</tr>
</tbody>
</table>
Goal - better precision, sensitivity and reduced variance

New metric scoring – convert to 0 -10 scale

Calculated 10th and 90th %iles for individual metrics using existing data >850 sites

Incorporate new taxa attributes

Initial testing resulted in need to apply taxa resolution adjustments

\[
10 \times (\text{Observed Metric Value} - 10\text{th %ile of metric}) \\
\frac{90\text{th %ile metric} - 10\text{th %ile metric}}{90\text{th %ile metric} - 10\text{th %ile metric}}
\]

Metrics that increase with disturbance

= 10 - (same equation presented above)

Metrics that decrease with disturbance
B-\text{IBI}_{0-100}: \text{No Taxa Resolution Adjustment}

Average B-\text{IBI} score difference $\sim 7.5$

$N = 186$
Taxa Effort: 3 Metrics Influenced
**B-IBI_{0-100}: Adjusted for Taxa Resolution**

![Graph showing the relationship between B-IBI values and coarse resolution. The graph includes points for medium and fine resolution, with a total of 186 data points.](#)
B-IBI Recalibration: Old \(_{10-50}\) vs. New \(_{0-100}\)

- **R² = 0.9285**

0-100 scale in line with National indices

Increased precision
Acknowledgements

- Gretchen Hayslip - US EPA Region 10
- Peter Leinenbach - US EPA Region 10
- Wease Bollman - Rhithron Associates, Inc.
- Sean Sullivan - Rhithron Associates, Inc.
- Karen Adams - formerly of WA Dept. of Ecology
- James Develle - King County
- Doug Henderson - King County
- Staff from numerous Puget Sound Basin agencies/tribes

All Grant Materials Can be Found at: www.pugetsoundstreambenthos.org
Standardize Collection Methods

% Urban Area (Watershed)

$B-IBI$

- 0
- 20
- 40
- 60
- 80
- 100

3 ft$^2$

8 ft$^2$