Calculating and Interpreting the Genus-Level B-IBI

(adapted from http://www.cbr.washington.edu/salmonweb/)

A B-IBI is created by first identifying and counting benthic macroinvertebrates found from a stream sampling event. Various metrics are then tabulated using these raw data. After the metrics are calculated, they are each converted to a score of 1, 3, or 5 in order to facilitate comparisons between areas both over time and space (i.e., between sampling site, watersheds, or regions). A value of "5" is assigned for the range of expected results (i.e., for each metric) in an UNDISTURBED SITE. A value of "3" is designated for results expected from a SOMEWHAT DEGRADED SITE, and a value of "1" is assigned for values expected in SEVERELY DEGRADED SITES.

The individual metric scores are added together for a Total B-IBI score.

B-IBIs can be created for different ecoregions, stream sizes, microhabitats (e.g., riffles vs. pools), seasons, or levels of taxonomic classification to which the specimens are identified. The B-IBI that Streamkeepers of Clallam County uses is the 10-metric genus-level B-IBI for the Puget Sound Lowlands, developed by Dr. James Karr and students at the University of Washington in the 1990s (see references below). In this B-IBI, 10 metrics are calculated with a score of 1, 3, or 5, so a total score can range from 10 (i.e., 10 X 1) to 50 (i.e., 10 X 5). The total B-IBI score can then be assessed using a qualitative coding system (see “grading” table near the end of this document).

Taxonomic Levels of Identification for the Genus-Level B-IBI

Taxon (plural “taxa”) means a single taxonomic group such as family, genus, or species. For the purposes of ecological assessment, benthic macroinvertebrates do not necessarily need to be identified “all the way” to species. In fact, the B-IBI for the Puget Sound Lowlands has been calibrated at three different levels of taxonomic precision: species-level, genus-level, and family-level. Streamkeepers of Clallam County uses the genus-level index.

It’s not quite that simple, though. For **genus-level scoring**, most taxa are identified to genus, but there are some exceptions that were established by the developers of the index in the course of its calibration. Here is the complete taxonomic identification protocol that we use for the genus-level B-IBI:

- Hydras and relatives, flat and segmented worms: to class (e.g., hydrozoa, turbellaria, hirudinoidea, oligochaeta)
- Roundworms: to phylum (e.g., nematoda)
- Molluscs: to family
- Arthropods:
    - Non-insects:
        - Acarina, amphipoda, isopoda: to order*
        - Cladocera, ostracoda, copepoda: to subclass*
        - (*Streamkeepers recognizes that nomenclature and hierarchy calls may differ between taxonomists in the above cases, but we request ID as specified above.)
        - Decapoda: to genus (as possible, depending on life stage and gender)
    - Insects: to genus, except:
        - Capniidae, Chironomidae, Dolichopodidae to family
        - Leuctridae: to family, except Despaxia, Megaleuctra, Moselia as possible
        - Dytiscidae: to Hydroporinae subfamily as possible
        - Sciomyzidae: to genus as possible (see key in Merritt & Cummins 4th ed.)
- Early instar larvae, pupae, incomplete organisms: ID to the lowest taxon possible (or the levels specified above, whichever comes first), if that taxon can be positively distinguished from other taxa found in that replicate.

Metric Descriptions

The following ten metrics are calculated from the sample's taxonomic identification:

Total Taxa Richness

The total number of unique taxa is identified in each replicate. The numbers from the three replicates are then averaged for this metric.

Ephemeroptera Taxa Richness

The total number of unique mayfly (Ephemeroptera) taxa is identified in each replicate. The numbers from the three replicates are then averaged for this metric.

Plecoptera Taxa Richness

The total number of unique stonefly (Plecoptera) taxa is identified in each replicate. The numbers from the three replicates are then averaged for this metric.

Trichoptera Taxa Richness

The total number of unique caddisfly (Tricoptera) taxa is identified in each replicate. The numbers from the three replicates are then averaged for this metric.

Number of Long-Lived Taxa

The cumulative number of *unique long-lived taxa identified across all three replicates*.

Number of Intolerant Taxa

The cumulative number of unique *intolerant taxa identified across all three replicates*.

Percent Tolerant Individuals

The total number of tolerant individuals counted in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100*. The percentages from the three replicates are then averaged for this metric.

Number of Clinger Taxa

The total number of unique clinger taxa is identified in each replicate. The numbers from the three replicates are then averaged for this metric.

Percent Predator Individuals

The total number of predator individuals counted in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100*. The percentages from the three replicates are then averaged for this metric.

Percent Dominance

The sum of individuals in the three (3) most abundant taxa in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100*. The percentages from the three replicates are then averaged for this metric.

Percent Dominance Example

Step 1 **Calculate taxa totals**	**Step 2** **Sum 3 Most numerous Taxa**	**Step 3** **Calculate Percentage**
Taxon 1 = 10 organisms Taxon 2 = 8 organisms Taxon 3 = 3 organisms	Pick Top 3: Taxa 1 = 10 Taxa 2 = 8	(# organisms in 3 dominant taxa / Total # individuals) X 100

Taxon 4 = 1 organism	Taxa 3 = 3	(21 / 22) X 100
Total = 22 organisms	Total = 21 organisms	Percent Dominance = 95%

10-Metric Genus-Level Scoring Criteria

Square braces indicate the value next to the brace is included in the range; rounded parentheses indicate the value is *not* included. When scoring, use the raw decimal number, not rounded, so that 14.3 would count as > 14.

	Scoring Criteria:	**1**	**3**	**5**
Metrics: **Taxa richness and composition**				
	Total number of taxa	[0, 14)	[14, 28]	> 28
	Number of Ephemeroptera (mayfly) taxa	[0, 3.5)	[3.5, 7]	> 7
	Number of Plecoptera (stonefly) taxa	[0, 2.7)	[2.7, 5.3]	> 5.3
	Number of Trichoptera (caddisfly) taxa	[0, 2.7)	[2.7, 5.3]	> 5.3
	Number of long-lived taxa	[0, 4)	[4, 8]	> 8
Tolerance				
	Number of intolerant taxa	[0, 2)	[2, 4]	> 4
	% of individuals in tolerant taxa	> 44	[44, 27]	< 27
Feeding ecology				
	% of predator individuals	[0, 4.5)	[4.5, 9]	> 9
	Number of clinger taxa	[0, 8)	[8, 16]	> 16
Population attributes				
	% dominance (top 3 taxa)	≥ 75	(75, 55]	< 55

10 Metric Genus Level B-IBI Worksheet

METRICS (averaged)	**Rep 1**	**Rep 2**	**Rep 3**	**Replicate Average**	**Metric IBI Score** (1, 3, or 5)
Total number of taxa					
Number of Ephemeroptera (mayfly) taxa					
Number of Plecoptera (stonefly) taxa					
Number of Tricoptera (caddisfly) taxa					
% of individuals in tolerant taxa					
Number of clinger taxa					
% of predator individuals					

% dominance (3 taxa)					
METRICS (cumulative)	**Rep 1**	**Rep 2**	**Rep 3**	**Cumulative Unique**	**Metric IBI Score** (1, 3, or 5)
Number of long-lived taxa					
Number of intolerant taxa					
Total B-IBI Score (Add Metric B-IBI scores for Total B-IBI score):					

For the percentage metrics, remember to multiply the final computation by 100 for each replicate, e.g., % predator individuals = (total number predator individuals / total number individuals) X 100.

Interpreting your IBI Score

Once you've calculated the Puget Sound B-IBI, you have a number between 10 and 50. What does that number mean?

The B-IBI is a measure of a stream's biological condition (i.e., health). Each of the individual metrics reflect the condition of important biological components. These components provide insight and clues about the types of degradation responsible for changes within the biological community of benthic macroinvertebrates.

A value close to 50 indicates that the stream's biology is equivalent to what would be found in a "natural" stream of that area. A value close to 10 indicates a poor biotic condition within the stream. Most scores will fall somewhere in between these two extremes. Listed below are thresholds for B-IBI scores and their qualitative interpretation, developed in consultation with the developers of the B-IBI.

"Grading" System For B-IBI For Puget Sound Lowlands:

Score	Grade	Definition
50-46	Healthy	Ecologically intact, supporting the most sensitive life-forms.
44-36	Compromised	Showing signs of ecological degradation. Impacts expected to one or more salmon life-stages.
34-28	Impaired	Healthy ecosystem functions demonstrably impaired. Cannot support self-sustaining salmon populations.
26-18	Highly impaired	Highly adverse to salmon and various other life-forms.
16-10	Critically impaired	Unable to support a large proportion of once-native life-forms.

It is important to not only look at the final B-IBI score, but to look at the individual metric scores for clues to the types of impacts affecting the final score. For example: Did you have a high percentage of pollution-tolerant taxa? Were long-lived taxa present? Were sediment-tolerant taxa present? The individual metrics, the original data set, and your notes on the land uses surrounding the site will help you understand the processes occurring within and around your sampling site.

Indices of Biological Integrity do more than generate a final score - they provide the opportunity to investigate the types of influences acting upon a watershed. However, keep in mind that human disturbances act upon stream systems in complex ways, and thus, the resulting IBI scores should be interpreted as a whole (Rossano 1996). For example, a sampling site may possess high diversity (i.e., total taxa richness) and thus indicate a high biological integrity score. However, if the species contributing to a high diversity are pollution-tolerant species, the overall biological integrity of the system may be poor. Knowing the stream ecology of the different taxa associated with streams in your region will aid in the interpretation of your data and the resulting IBI.

References

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