

Statewide Benthic Macroinvertebrate IBI Metrics and Calculations

Lauren Pulliam

**TCEQ Water Quality Planning Division
Surface Water Quality Monitoring Team**

Statewide Benthic Macroinvertebrate IBI

Developed in 1996 by Bill Harrison. See *'Metric Set for Use in Setting Aquatic Life Use Designations Using Benthic Macroinvertebrate Samples Collected from Texas Streams Following Rapid Bioassessment Protocols'*

- Used to evaluate benthic macroinvertebrate RBP kicknet and snag samples collected in wadeable streams and rivers
- Includes 12 metrics that integrate structural and functional attributes of macroinvertebrate assemblages to assess biotic integrity
- Metrics help establish the appropriate ALU for unclassified water bodies and help to evaluate the appropriateness or attainment of the existing ALU for classified water bodies

Metric 1: Taxa richness

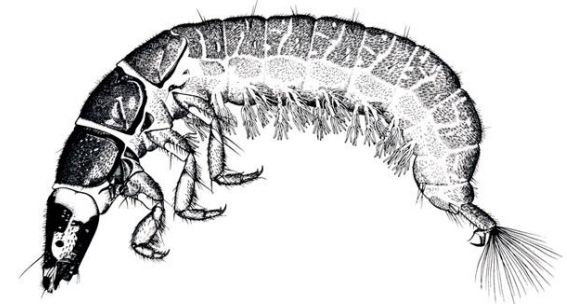
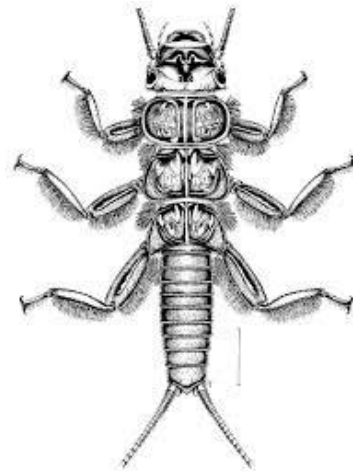
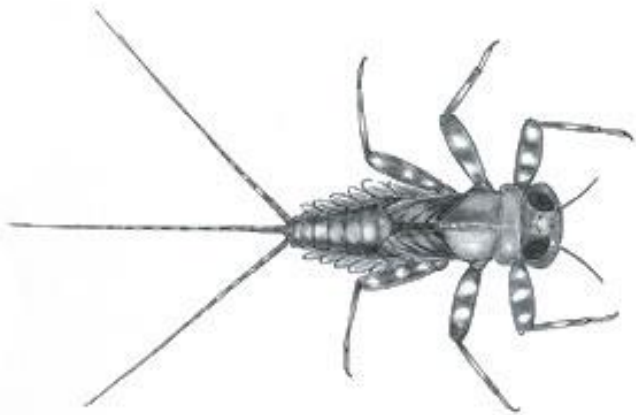
- Total number of taxa in a sample
- Separate all macroinvertebrates into appropriate taxonomic categories and count the number of categories present
- In general, lower taxa richness values reflect lower biotic integrity

Table 5.1. Taxonomic levels for identification of organisms.

Taxon	Identify to this level
Insecta	genus, except leave Chironomidae at family
Oligochaeta	leave at Oligochaeta
Hirudinea	leave at Hirudinea
Hydracarina	leave at Hydracarina
Isopoda	genus
Amphipoda	genus
Nematoda	leave at Nematoda
Ostracoda	leave at Ostracoda
Palaemonidae	genus
Cambaridae	leave at Cambaridae
Gastropoda	genus
Turbellaria	family
Pelecypoda	genus

Metric 2: EPT taxa abundance

- Total number of distinct taxa (genera) within the orders of Ephemeroptera (mayflies), Plecoptera (stone flies), and Trichoptera (caddis flies)
- This metric tends to decrease with increasing physicochemical disturbance because the majority of taxa in these orders are considered pollution sensitive



Metric 3: Hilsenhoff Biotic Index (HBI)

- Calculated as $\sum n_i t_i / N$
 - n_i is the number of individuals of a particular taxa (for example, genus or family)
 - t_i is the tolerance value of that taxon → see table B.13 in Procedures Manual Vol. 2
 - N is the total number of organisms in a sample
- Tolerance values are assigned on a scale of 0 to 10, with increasing values reflecting increasing tolerance to physicochemical degradation
- N must include counts of organisms only from those taxa that have tolerance values
- The index weights the relative abundance of each taxon in terms of its pollution tolerance in determining a community score
- In general, the index increases as the relative abundance of tolerant taxa increases

Metric 4: Percent Chironomidae

- Ratio of the number of individuals in the family Chironomidae to the total number of individuals in the sample multiplied by 100
- Chironomidae are relatively ubiquitous in aquatic habitats. Although the Chironomidae are often considered pollution tolerant, the variability in tolerance at the species level is apparently quite large



Metric 5: Percent dominant taxon

- Ratio of the number of individuals in the numerically dominant taxon to the total number of individuals in the sample multiplied by 100
- In general, a community dominated by relatively few taxa may indicate environmental stress, and a high percentage of one or two taxa represents an imbalance in community structure

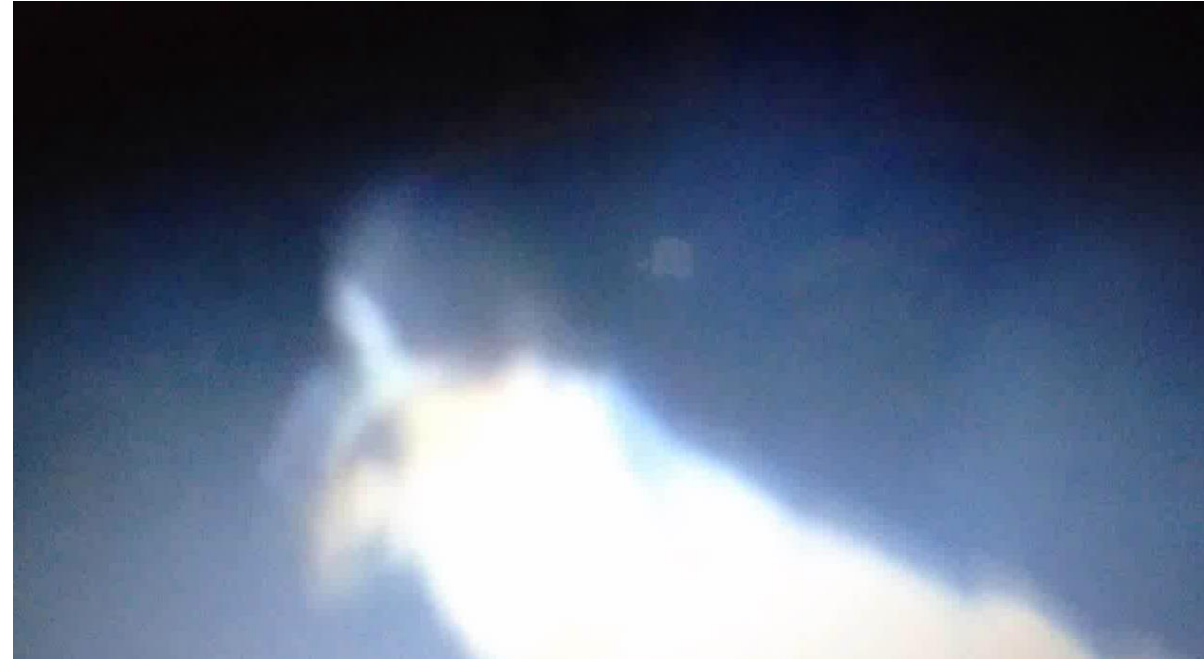


Metric 6: Percent dominant functional feeding group (FFG)

- Ratio of the number of individuals in the numerically dominant functional group to the total number of individuals in the sample multiplied by 100
- Sort aquatic macroinvertebrates into functional feeding groups (FFGs) according to Merritt, Cummins and Berg (2008). The FFG classification places taxa in categories based on morphological/behavioral mechanisms used to obtain food (Merritt, Cummins and Berg 2008).
- Based on the premise that physicochemical disturbance can result in modification of the food resources available to consumers in aquatic systems which can lead to an imbalanced trophic structure

Functional Feeding Groups

- **Scrapers (grazers).** Benthic macroinvertebrates adapted to consume periphyton (complex of algae, fungi, bacteria) attached to the substrate
- **Collector-gatherers (deposit feeders).** Benthic macroinvertebrates adapted to use fine particulate organic matter (FPOM) deposited either interstitially or on the surface of the substrate
- **Filtering collectors (suspension feeders).** Benthic macroinvertebrates adapted to use particulate organic matter (POM) suspended in the water column



Functional Feeding Groups



- **Predators (engulfers and piercers).** Benthic macroinvertebrates adapted to use other living organisms (prey)
- **Shredders (living or dead plant material).** Benthic macroinvertebrates adapted to use coarse particulate organic matter (CPOM)—especially leaf litter and the associated algal, bacterial, and fungal complex
- **Note:** The groups are not mutually exclusive—that is, one taxon may be considered both a scraper and collector-gatherer. In this situation, place half of the organisms from that taxon in the scraper category and half in the collector-gatherer category
- Scoring for the metric is based on the premise that relatively low to moderate percentages for all functional groups reflect a balanced trophic structure, whereas extremely high or low percentages reflect an imbalance, possibly due to physicochemical degradation

Metric 7: Percent predators



- Ratio of the number of individuals in the predator functional group to the total number of individuals in the sample multiplied by 100
- Most predators have relatively long aquatic life stages, usually greater than six months, which reflects the integration of physicochemical conditions over longer periods of time
- Scoring for the metric is based on the premise that relatively low to moderate percentages of predators reflect a balanced trophic structure, while extremely high or low percentages reflect an imbalance, possibly due to physicochemical degradation

Metric 8: Ratio of intolerant to tolerant taxa

- Ratio of the number of individuals in taxa with tolerance values < 6 to the number of individuals in taxa with tolerance values ≥ 6
- It measures the relative contribution of tolerant and intolerant taxa to the benthic assemblage
- The metric increases as the relative number of intolerant individuals increases; thus, higher values must reflect favorable physicochemical conditions



Metric 9: Percent of total Trichoptera as Hydropsychidae

- Ratio of the number of individuals in the family Hydropsychidae to the total number of individuals in the sample in the order Trichoptera multiplied by 100
- Trichoptera are ubiquitous in Texas streams and the family Hydropsychidae tends to be among the most tolerant of Trichoptera
- This metric is based on the observation that reference streams in Texas typically contain representatives of Hydropsychidae as well as representatives from other families in the order Trichoptera
- A high relative percentage of total Trichoptera from family Hydropsychidae, or a complete lack of Trichoptera, likely reflects physicochemical degradation



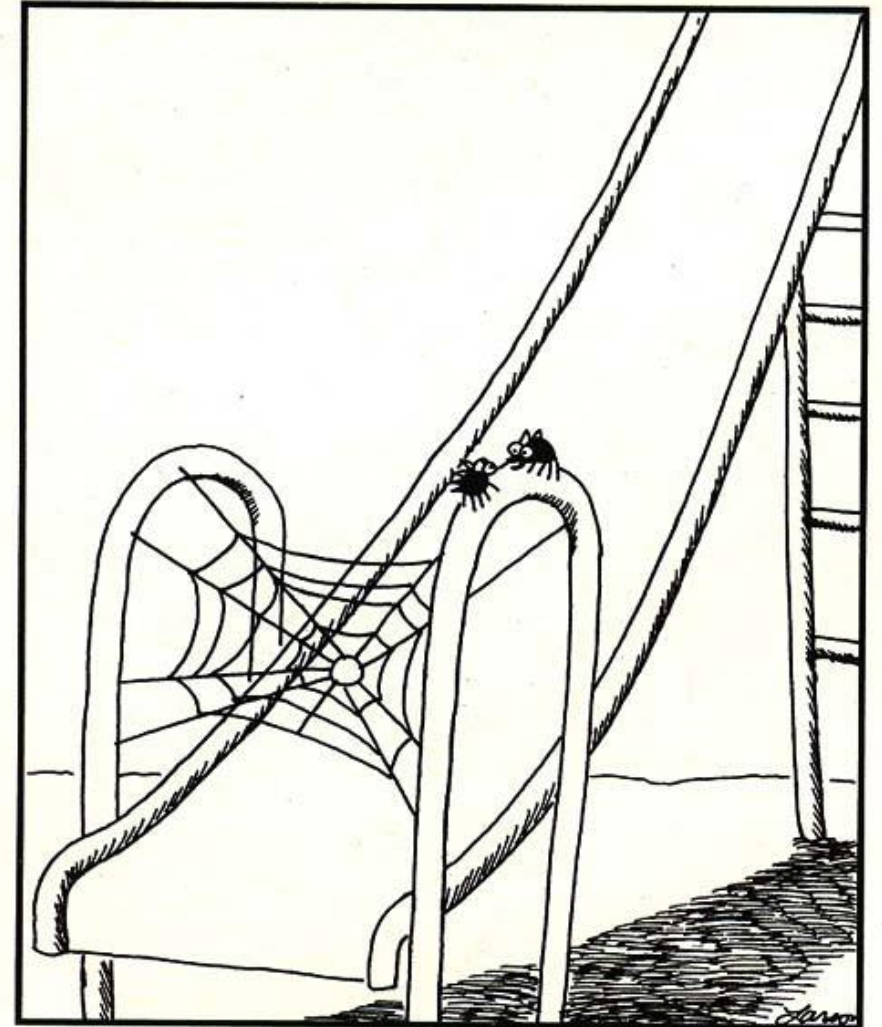
Metric 10: Number of non-insect taxa

- This metric is based on the finding that kicknet samples from reference streams in Texas typically include representatives from several non-insect taxa
- The number of non-insect taxa typically is lower in impaired streams



Metric 11: Percent collector-gatherers

- Ratio of the number of individuals in the collector-gatherer functional group to the total number of individuals in the sample multiplied by 100
- Collector-gatherers use fine particulate organic matter (FPOM) as the primary food source
- Physicochemical disturbance, especially organic enrichment, can cause an increase in the availability of FPOM
- A high percentage of collector-gatherers may indicate degradation



“If we pull this off, we’ll eat like kings.”

Metric 12: Percent of total as Elmidae

- Ratio of the number of the individuals from the family Elmidae to the total number of individuals in the sample multiplied by 100
- Riffle beetles are typically found in reference stream samples in Texas
- Species of *Stenelmis* are relatively tolerant of pollution and thus apparently may become dominant in situations where a moderate tolerance to organic enrichment offers an advantage
- Low scores for this metric are associated with either an extremely high percentage of, or a complete absence of, Elmidae



Metric Scoring Criteria

Table B.11. Benthic Index of Biotic Integrity metrics and scoring criteria for kick samples, rapid bioassessment protocol—benthic macroinvertebrates (Harrison 1996).

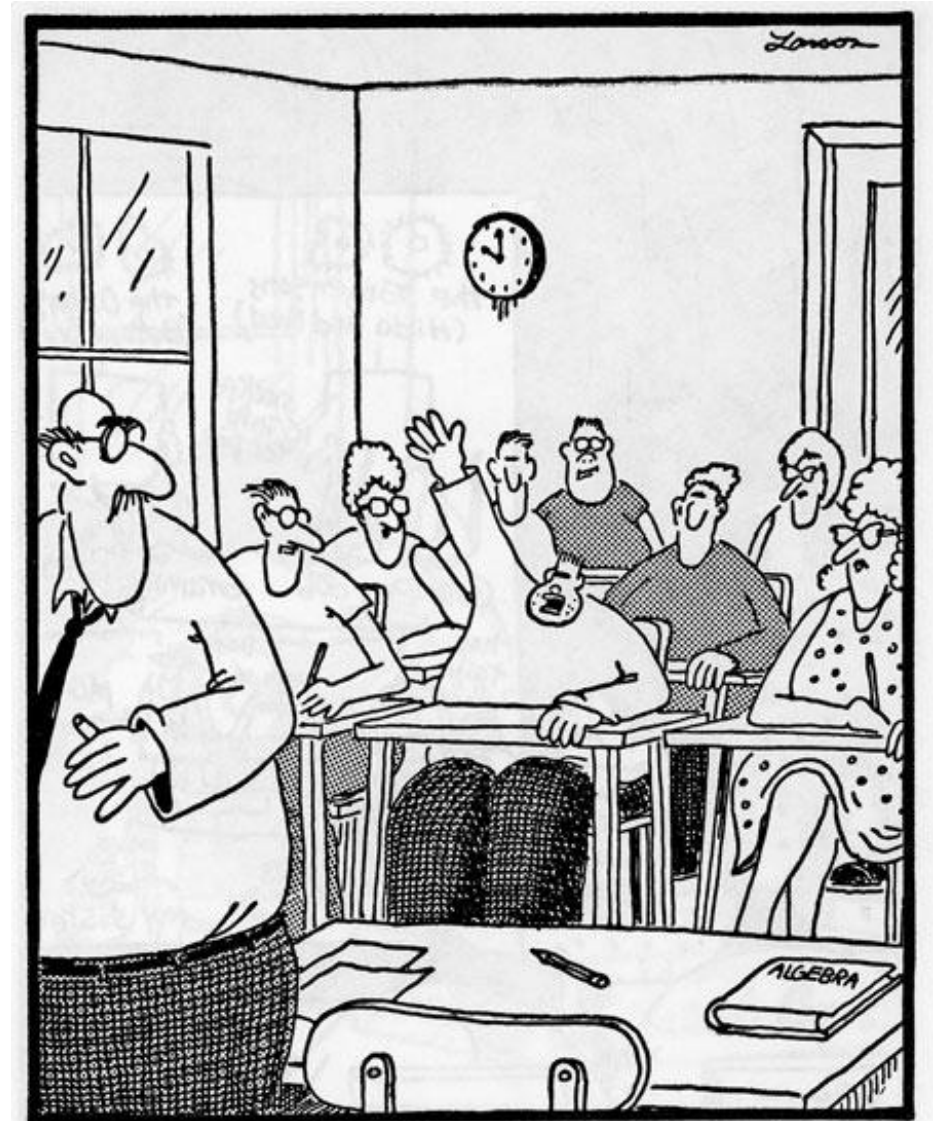
METRIC	SCORING CRITERIA			
	4	3	2	1
Taxa richness	> 21	15–21	8–14	< 8
EPT taxa abundance	> 9	7–9	4–6	< 4
Biotic index (HBI)	< 3.77	3.77–4.52	4.53–5.27	> 5.27
% Chironomidae	0.79–4.10	4.11–9.48	9.49–16.19	< 0.79 or > 16.19
% Dominant taxon	< 22.15	22.15–31.01	31.02–39.88	> 39.88
% Dominant FFG	< 36.50	36.50–45.30	45.31–54.12	> 54.12
% Predators	4.73–15.20	15.21–25.67	25.68–36.14	< 4.73 or > 36.14
Ratio of intolerant : tolerant taxa	> 4.79	3.21–4.79	1.63–3.20	< 1.63
% of total Trichoptera as Hydropsychidae	< 25.50	25.51–50.50	50.51–75.50	> 75.50 or no Trichoptera
# of non-insect taxa	> 5	4–5	2–3	< 2
% Collector-gatherers	8.00–19.23	19.24–30.46	30.47–41.68	< 8.00 or > 41.68
% of total number as Elmidae	0.88–10.04	10.05–20.08	20.09–30.12	< 0.88 or > 30.12
Aquatic-life-use point-score ranges:	Exceptional: > 36 High: 29–36 Intermediate: 22–28 Limited: < 22			

- Draft Regionalized Metrics for benthic macroinvertebrates are in testing phase and can be provided to anyone with interest to use as supplemental data for ALM

Questions?



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"Mr. Osborne, may I be excused? My brain is full."