ADEQ Macroinvertebrate Indexes of Biological Integrity: Calculation Procedures

General instructions for calculating the Indexes of Biological Integrity

1. Calculate macroinvertebrate metric values for a sample

2. Identify the appropriate reference community using the site elevation (warm water community <5000'; cold water community >5000')

3. Calculate the metric percent of reference score (using either the warm or cold water reference metric threshold values associated with the appropriate community type)

4. Average the percent of reference scores for all metrics in the warm or cold water index to calculate the IBI score

5. Determine assessment category for IBI score

Descriptions for the warm water and cold water metrics used in Arizona's IBIs.

Category	Metric	Definition	Expected Response to increasing disturbance
Richness measures	Total number of taxa	Number of different macroinvertebrate taxa	Decrease
	# Ephemeroptera taxa	Number of mayfly taxa	Decrease
	# Trichoptera taxa	Number of caddisfly taxa	Decrease
	# Diptera taxa	Number of true fly larvae.	Decrease
	# Intolerant taxa	Number of taxa having a tolerance value ≤3	Decrease
Composition measures	% Dominant taxon	Percent abundance of the single most abundant taxon.	Increase
	% Ephemeroptera	Percent abundance of mayflies, compared to total abundance of the sample	Decrease
	% Plecoptera	Percent abundance of stoneflies, compared to total abundance of the sample	Decrease
Tolerance measure	Hilsenhoff Biotic Index	Abundance-weighted average tolerance of assemblage	Increase
Trophic measures	% Scrapers	Percent abundance of the scraper functional feeding group, compared to total abundance of the sample	Decrease
	# Scraper taxa	Number of taxa in the scraper functional feeding group	Decrease

Index Scoring System

Use the follow formula to calculate the metric score (percentage of reference) for sensitive metrics whose values decrease with disturbance. Apply this formula to the following metrics:

1. Total taxa richness
2. Number of ephemeroptera taxa
3. Number of trichoptera taxa
4. Number of diptera taxa
5. Number of intolerant taxa
6. Percent ephemeroptera
7. Percent plecoptera
8. Percent scrapers
9. Number of scraper taxa

$$\text{Metric Score} = \left(\frac{\text{Sample value}}{\text{Metric threshold value}} \right) \times 100$$

Apply the following formulas to calculate the metric score (percentage of reference) for tolerant metrics whose values increase with disturbance.

1. Hilsenhoff Biotic Index

$$\text{Metric score} = \left(\frac{10 - \text{Sample value}}{10 - \text{Metric threshold value}} \right) \times 100$$

2. Percent dominant taxon

$$\text{Metric score} = \left(\frac{100 - \text{Sample value}}{100 - \text{Metric threshold value}} \right) \times 100$$

Reference scoring thresholds for warm water metrics

Metric	Taxonomy ID Level	Metric threshold value
Total taxa	Split-Level ID	34
Trichoptera taxa	Split-Level ID	8.0
Ephemeroptera taxa	Split-Level ID	7.0
Diptera taxa	Split-Level ID	9.0
Scraper taxa	Split-Level ID	7.0
Percent scraper	Split-Level ID	25.1
Percent Ephemeroptera	Split-Level ID	70.8
Percent Dominant Taxon	Split-Level ID	20.9
Hilsenhoff Biotic Index	Split-Level ID	4.9

Reference scoring thresholds for cold water metrics

Metric	Taxonomy ID Level	Scoring threshold
Total taxa	Split-Level ID	23
Diptera taxa	Split-Level ID	5.0
Intolerant taxa	Split-Level ID	4.0
Scraper taxa	Split-Level ID	5.0
Percent scraper	Split-Level ID	8.8
Percent Plecoptera	Split-Level ID	1.3
Hilsenhoff Biotic Index	Split-Level ID	5.5

ADEQ Warmwater IBI scoring example; Sycamore Creek near Round Valley bridge (Hwy 87), spring 1995

Metric	Metric Value	Reference Scoring Threshold	Metric Score
Total taxa	24	34	71
Trichoptera taxa	6	8	75
Ephemeroptera taxa	5	7	71
Diptera taxa	7	9	78
Scraper taxa	3	7	43
Percent scraper	20.3	25.1	81
Percent Ephemeroptera	26	70.8	37
Percent Dominant Taxon	41	20.9	75
Hilsenhoff Biotic Index	5.73	4.9	84
WW IBI Score Assessment category			68 Good

Index of Biological Integrity (IBI) assessment categories and ranges of values for each waterbody type.

Waterbody type	Exceptional	Good	Fair/Impaired	Poor/Very Impaired
Warm water	73 - 100	53 - 72	27 - 52	0 - 26
Cold water	97 - 100	88 - 96	44 - 87	0 - 43

* Exceptional and good are attaining A&W use.
* Fair and Poor are not attaining A&W use.

Interpretive descriptions of the assessment categories.

Assessment Category	Description	Attainment Status
Exceptional	Exceptionally high species richness, sensitive species abundant, community tolerance low	Attains A&W use
Good	High species richness, sensitive species present, community tolerance moderate	Attains A&W use
Fair/Impaired	Declining species richness, sensitive species absent or in low abundance, community tolerance high	Does not attain A&W use
Poor/Very impaired	Very low species richness, only most tolerant species present, community tolerance very high and community organization lacking	Does not attain A&W use