



## Biological Indicators of Watershed Health

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### Biological Response Signatures

#### For More Information:

Biological indicators are both accurate and sensitive measures of the health of waterways and they can also be used to diagnose sources and causes of pollution. Definite patterns exist in the responses of biological communities to stress (pollution), and finding these patterns can show what types of pollution are present, and sometimes the source of those problems. When the response patterns of the various metrics and components of IBIs (Indices of Biotic Integrity) are identified, these unique combinations of biological community characteristics that aid in distinguishing one impact type over another are referred to as "Biological Response Signatures."

[Ohio Case Studies](#)

#### Metrics

When conducting biological assessments, measurements are taken in the field or lab. Metrics (or biological attributes) for each assemblage sample (e.g., benthic invertebrates, fish, periphyton, macrophytes) are calculated from these measurements. The following table presents an example of representative metrics for each type of assemblage.

| Biological Assemblage             | Metric  | Response to Stress                   |
|-----------------------------------|---|--------------------------------------|
| <b>Benthic Macroinvertebrates</b> | No. of taxa                                     | Reduced                              |
|                                   | ETO taxa (ephemeroptera, trichoptera, odonates) | Reduced under enrichment, DO, stress |
|                                   | % intolerant species                            | Reduced                              |
|                                   | % suspension feeders                            | Reduced                              |
| <b>Fish</b>                       | No. of taxa                                     | Reduced                              |
|                                   | % piscivores                                    | Reduced                              |
|                                   | No. of intolerant species                       | Reduced                              |
| <b>Macrophytes</b>                | No. of sunfish species                          | Reduced                              |
|                                   | No. of taxa                                     | Low                                  |
|                                   | % dominant species (by weight)                  | High                                 |
|                                   | No. of exotic species                           | High                                 |
| <b>Periphyton</b>                 | Species richness                                | Not Determined                       |
|                                   | Pollution Tolerance Index for Diatoms           | Not Determined                       |
|                                   | Achnanthes minutissima                          | Not Determined                       |
|                                   | Shannon Diversity (for diatoms)                 | Not Determined                       |

Each metric is then assigned a score which is related to its deviation from the reference (or expected) site values. In more complicated studies, multimetric indices can be calculated, which is the sum of all the metric scores within each biological assemblage. [<more on metrics>](#)

#### **For more information on biological response signatures:**

Please see the discussions on the diagnostic value of biological

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indicators in EPA's [Stressor Identification Evaluation Manual](#) and Ohio EPA's discussion on [Biological Response Signatures](#) (pdf file) and the Area of Degradation Value.

Reader to view some of the files on this page. See [EPA's PDF page](#) to learn more.

***To learn more about metrics please visit the following sites:***

- The Rapid Bioassessment Protocols For Use in Streams and Rivers: Periphyton, Benthic, Macroinvertebrates, and Fish Protocols Chapter has a nice section on [Metrics](#)
- [The Lake and Reservoir Bioassessment and Biocriteria Technical Guidance Document](#)