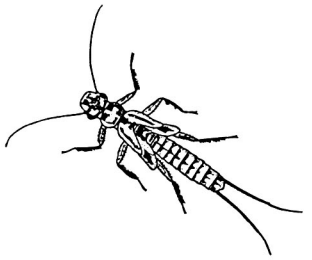
Environmental Indicator Profile Sheet



Indicator Profile No. 13

Macro-Invertebrate Assemblage

Category: **Biological**

Tools Used to Measure Indicator:

- Hilsenhoff Biotic Index
- Rapid. Bioassess. (RBP)
- EPT Index
- Invertebrate Community Index (ICI)

Description:

Benthic macro-invertebrates are used to evaluate the aquatic health of waterbodies. Several metrics (e.g. taxa richness, ratio of scrapers to filterers, ratio of sensitive to tolerant species, abundance, etc.) are used to assess the relative health of a given system. Aquatic systems are usually compared to a reference condition which is defined as the natural or "least impacted" habitat of a particular region. The maximum expectations for macro-invertebrate community structure and function are determined by monitoring the set of streams selected to establish reference conditions.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to depict the existence and severity of degradation.
- Can be used to help screen possible sources and causes of degradation.
- Can be used to help assess the performance of watershed restoration measures (particularly in-stream habitat restoration projects).
- Can be used to help evaluate the performance of stormwater BMPs (both structural and non-structural)
- Provides short term responses to changes in aquatic systems and therefore is a valuable tool to measure short term impacts (such as effects from construction projects).

Advantages of Method:

- Macro-invertebrates have limited mobility, and therefore are good assessors of site specific impacts (mobility, however, may be affected by storm flows and drift).
- Aquatic insects have relatively short lifespans and respond quickly to stress. Therefore, they provide good short term monitoring results.
- Macro-invertebrates are relatively easy to identify, sampling is reasonably easy and does not effect the resident biota. It is relatively easy to identify degraded systems through casual observations.
- Macro-invertebrates are usually abundant in most small streams where few fish are present.
- Citizen volunteers can quickly learn insects to family level, more comprehensive training is required for other metrics.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	◖
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	●
* Industrial Sites	◖
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	●
* Accuracy	●
* Low cost	●
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3C

Disadvantages of Method:

- Some regional modifications of metrics are required to ensure that data is representative of ecoregion.
- Seasonal changes in species composition and populations requires strict adherence to consistent sampling frequency.
- Data collected after major flow events is likely not to be representative of normal conditions due to habitat disruptions.
- The relative health of a selected reference condition can skew the results of the system being evaluated.
- Species identification may be time consuming and complex.
- Sensitive macro-invertebrate species seem to decline significantly at relatively low watershed imperviousness ($\leq$ 15%) and therefore are less effective as predictive tools for more densely urbanized areas.
- Paired sampling sites must have comparable habitat to produce valid results. Macro-invertebrate prevalence may be as much a function of habitat type as quality.

Case Study: Jones, R.C.; Clark, C.C. 1987
Impact of Watershed Urbanization on Stream Insect Communities
Water Resources Bulletin, American Water Resources Association, Vol 23, No. 6

The effects of urbanization on aquatic insects were analyzed for 22 sites in five watersheds in northern Virginia. The amount of urbanization was measured in terms of human population. Population densities ranged from near 0 in one watershed to nearly 20 individuals per hectare at one sampling site. Sampling sites were located so as to only collect data for non point source discharges. Three samples were obtained for each stream reach, each for a separate riffle. Organisms were collected using a modified circular Hess sampler. During sample collection other physio-chemical parameters were also measured: temperature, dissolved oxygen, conductivity, pH, alkalinity and hardness, and canopy coverage. Organisms were identified to genus using the method of Merrit and Cummins (1984).

Results of the study showed that abundance of Diptera was strongly correlated with increasing urbanization. The relative abundance of other groups was negatively correlated with urbanization. Trichoptera and Ephemeroptera as a percent of total organisms, each decreased with increasing urbanization. Coleoptera, Megaloptera, Plecoptera and Odonata were found almost exclusively at low to moderately urbanized stations. The 22 sites were placed into two groups; 9 sites were in watersheds that had population densities less than 10 per hectare and 13 sites were in watersheds with human populations greater than 10 per hectare. The less urbanized watersheds had significantly less Diptera and significantly more Ephemeroptera, Coleoptera, Megaloptera, Plecoptera and Odonata. The total number of insects was not significantly affected by urbanization. Trichoptera was the only group which did not vary significantly with increasing urbanization. Genus richness and diversity was also significantly higher in the less urbanized group. The result of the study indicates that the relative urbanization has a significant effect on aquatic insect community.

Method References:

- Hilsenhoff Biotic Index: Hilsenhoff, W.L. 1982. Using a Biotic Index to Evaluate Water Quality in Streams., In: *Technical Bulletin No. 132.* Department of Natural Resources, Madison, Wisconsin.

- Hilsenhoff Improved Biotic Index: Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution., *Great Lakes Entomology.* 20:31-39

- Rapid Bioassessment Protocols (RBP): Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes., 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers Benthic Macroinvertebrates and Fish.* Report No. EPA/440/4-89/001. U.S. EPA, Office of Water

- Invertebrate Community Index (ICI): Ohio Environmental Protection Agency, 1987. *Users Manual for Biological Field Assessment of Ohio Surface Waters. Vol. II of Biological Criteria for the Protection of Aquatic Life.* Div. Water Quality Monitor. and Assess. Surface Water Section, Columbus, OH0