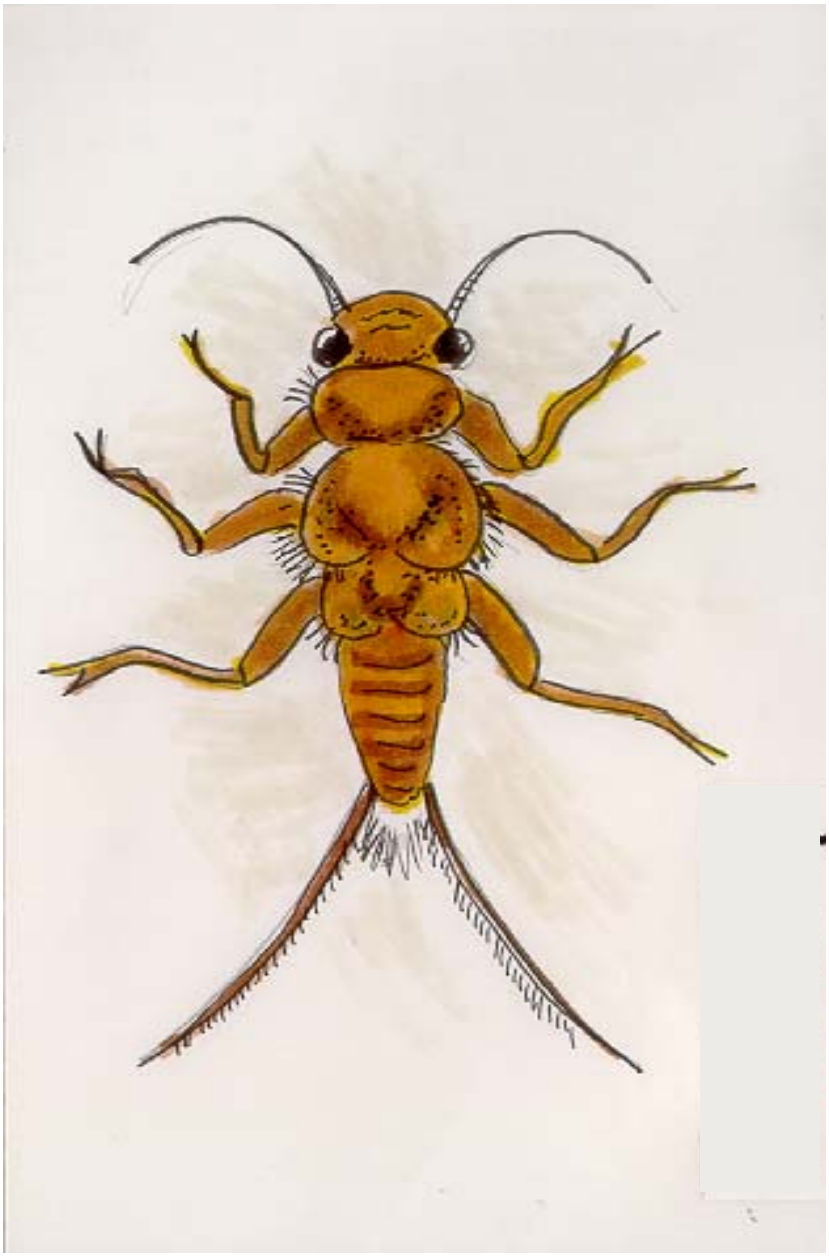
Making the Most of Your Monitoring Using Macroinvertebrates!



Macroinvertebrates and Stream Quality

Adapted from Hoosier Riverwatch, the Isaak Walton League Save our Streams Program, and Kentucky Watershed Watch

The water quality of the streams of the Ohio River Valley can be assessed with some accuracy using macroinvertebrates as indicators. Macroinvertebrates are those animals that lack a backbone (invertebrate), and are large enough to be seen with the naked eye. Macroinvertebrates found in the streams of the Ohio River Valley include mussels, snails, worms and numerous insects. Macroinvertebrates live in the sand and mud, and on rocks, logs, sticks and vegetation in water bodies. The flow of water provides a steady stream of organic material on which the organisms can feed. The numerous rocks, submerged logs and plants provide nooks and crannies for the organisms to hide in and plenty of surface area for attachment. There are thousands of different macroinvertebrate species in the Ohio River Valley, each with its own unique requirements for survival. Many organisms require high levels of oxygen and cannot tolerate substantial amounts of toxic substances. Those few organisms that can withstand very low oxygen levels or high toxicity are known as pollution-tolerant species.

Macroinvertebrates are suitable for assessing water quality for many reasons:

-Macroinvertebrates are relatively immobile. They cannot escape from changes in water quality. When pollution has an impact on a water resource, macroinvertebrate populations are adversely affected and require considerable time to recover. It is thus possible to assess the overall health of a water resource by determining the number and variety of organisms present. In general, the greater the diversity of organisms the better the water quality.

-Macroinvertebrates are easy to sample. They are abundant and can be easily collected.

-Macroinvertebrates are a critical part of the aquatic food web. They form a vital link in the food chain connecting aquatic plants, algae, and leaf litter to the fish species of streams. The stability and diversity of the aquatic food web is reflected by macroinvertebrate health.

Life cycle

Most of the benthic macroinvertebrates you will encounter are aquatic insects. Aquatic insects have complex life cycles and live in the water only during certain stages of development . Aquatic insects may go through one or two kinds of development or metamorphosis. Aquatic insects that go through complete metamorphosis undergo four stages of development: egg, larva, pupa and adult. They lay their eggs in water. The eggs then hatch into larvae that feed and grow in water. These larval insects do not resemble the adult insects; many appear wormlike. The fully-grown larvae develop into pupae and then into adults. The fully formed adults of some species emerge from the water and live in the habitat surrounding the stream. Others continue to live in the stream as adults. Aquatic insects that go through incomplete metamorphosis undergo only three stages of development: eggs, nymphs and adults. The eggs hatch into nymphs (also called larvae). Nymphs feed and grow in the water while they develop adult structures and organs.

Feeding habits

The feeding habits of macroinvertebrates show how the stability of one taxa can be dependent upon the welfare of another:

Shredders - such as many stoneflies, feed on detritus (mostly larger dead plant materials such as fallen leaves), by shredding it into smaller particles during the feeding process.

Collectors - such as most caddisflies and blackflies, feed on shredded detritus by filtering it from the water and gathering it from the stream bed.

Grazers - such as snails and beetles, roam about the stream bed scraping algae and other organisms from stone and plant surfaces.

Predators - represented by damselflies, dragonfly larvae, and hellgrammites, attack other living organisms and engulf their prey whole or in parts.

Because of this interdependence, the greater the diversity of organisms, the better the water quality. Each taxonomic grouping is also species-specific in its tolerance to low oxygen levels and toxic substances. Being rather restricted to their specific habitats, these organisms cannot escape changes in water quality. If a mild-to-severe pollution problem impacts the stream, a considerable period of time may be required for the macroinvertebrates to fully recover former community structure.

Macroinvertebrate Sampling Methods

Hester-Dendy Sampling Method

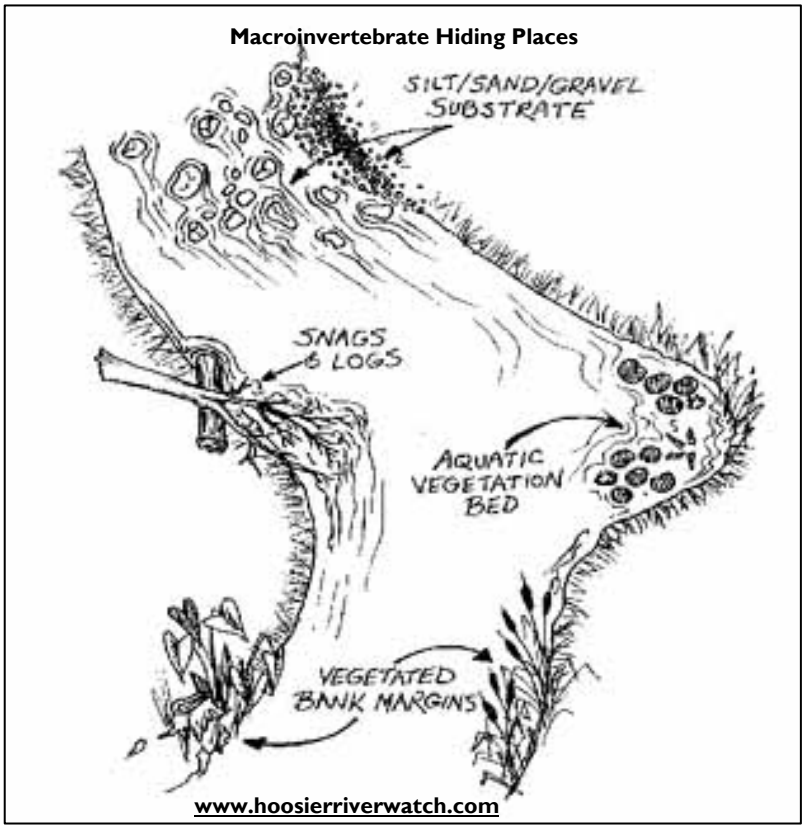
1. Submerge the Hester-Dendy Sampler by attaching it to a rock or cement block with "zip ties". Make careful notes about the sampler location. Measure out to the location from a permanent structure such as a tree or dock.
2. After 4-6 weeks, retrieve the sampler.
3. Carefully extract the debris and organisms from between the plates. Make sure that this occurs over a tub to collect loose objects.
4. Separate the macroinvertebrates from the other debris.
   Arrange the organisms on a white plate or ice cube tray according to groups of the same kind. Identify each kind according to Appendix B and keep a tally on the data sheet. Empty the plate, returning the organisms to the stream.

Leaf Bag Sampling Method

1. Fill the leaf bag with decomposing leaves.
2. Submerge the leaf bag with rocks or by tying it to the bank.
3. After six weeks, retrieve the leaf bag.
4. Carefully extract the debris and organisms from the bag. Make sure that this occurs over a tub to collect loose objects.
5. Separate the macroinvertebrates from the other debris.
6. Arrange the organisms on the plate according to groups of the same kind. Identify each kind according to Appendix B and keep a tally on the data sheet. Empty the plate, returning the organisms to the stream.

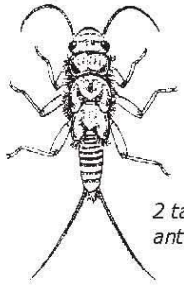
D-Net Sampling Method

1. Choose a "riffle" portion of the stream with shallow, faster-moving water and a stream bed of one-quarter inch gravel or sand to ten-inch cobbles.
2. Select an area and avoid disturbing the area upstream.
3. Have one person hold the net perpendicular to the flow.
4. Another person should stand beside the sampling area and remove stones and other objects, holding below the water as the organisms from the rocks go into the net.
5. When objects have been brushed into the net, kick the sampling area vigorously from the upstream edge toward the net. Also, jab the net into the bottom of the stream to loosen other organisms.
6. Dump the collected materials into a shallow white container. Place any macroinvertebrates into another container with clear water for easier identification.
7. Arrange the organisms into a tray (ice cube trays work well) according to groups of the same kind. Identify each kind with available identification charts and dichotomous keys and keep a tally on the data sheet. Empty the plate, returning the organisms to the stream.



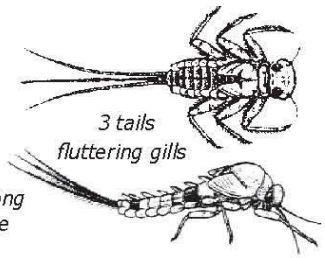
Macroinvertebrate Identification Key

GROUP 1 – Very Intolerant of Pollution



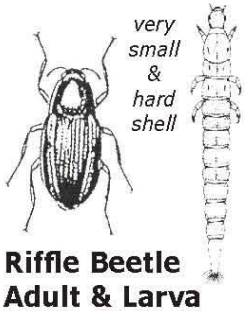
2 tails long antennae

Stonefly Nymph



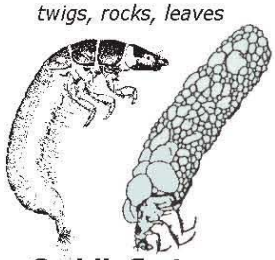
3 tails
fluttering gills

Mayfly Nymph



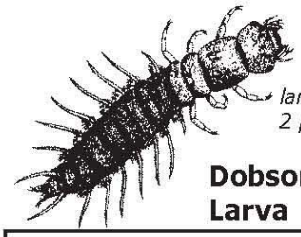
very small & hard shell

Riffle Beetle Adult & Larva



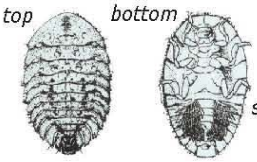
makes a case from twigs, rocks, leaves

Caddisfly Larva



large head & 2 pinchers

Dobsonfly Larva



top bottom

looks like a suction cup

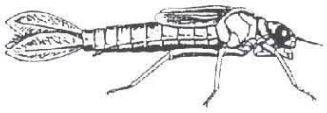
Water Penny Larva

Right-Handed Snail

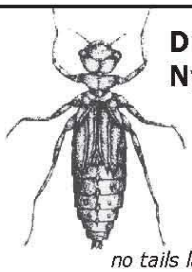
must be alive to count

GROUP 2 – Moderately Intolerant of Pollution

3 paddle-like (feathery) tails

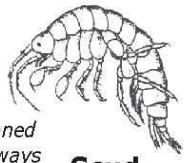


Damselfly Nymph



Dragonfly Nymph

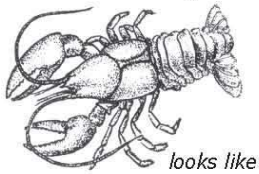
no tails large eyes



flattened side-ways & swims on side

Scud

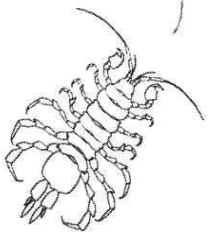
Crayfish

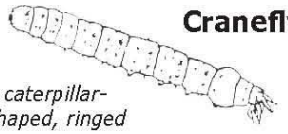


looks like a mini-lobster

Sowbug

flattened top to bottom (looks like a pill bug)





Cranefly

caterpillar-shaped, ringed

Clam/Mussel

must be alive to count

GROUP 3 – Fairly Tolerant of Pollution

Midge Larva

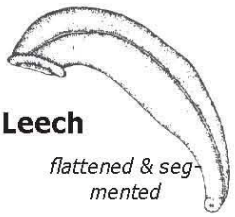
small, but visible head
intense wiggler

Planaria

2 eye spots & very small

one end is swollen

Black Fly Larva

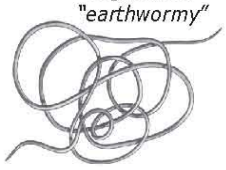


Leech

flattened & segmented

GROUP 4 – Very Tolerant of Pollution

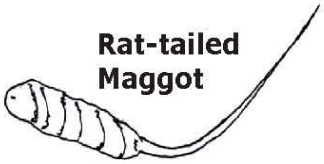
segmented "earthwormy"



Aquatic Worms

must be alive to count

Left-Handed Snail



Rat-tailed Maggot

bright red

Blood Midge Larva

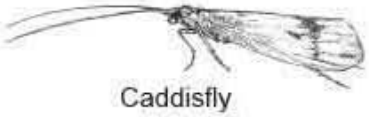
Macroinvertebrate Adults Key

GROUP 1 – Young are Very Intolerant of Pollution

Stonefly Adult

Mayfly Adult

Riffle Beetle Adult



Caddisfly Adult

Dobsonfly Adult

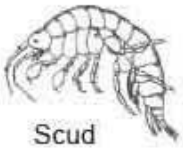
Water Penny Adult

Right-Handed Snail

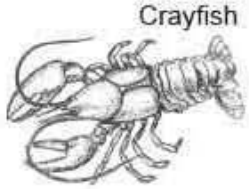
GROUP 2 – Young are Moderately Intolerant of Pollution

Damselfly Adult

Dragonfly Adult



Scud



Crayfish

Sowbug

Cranefly Adult

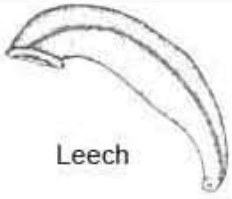
Clam/Mussel

GROUP 3 – Young are Fairly Tolerant of Pollution

Midge Adult

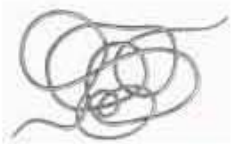
Planaria

Black Fly Adult



Leech

GROUP 4 – Young are Very Tolerant of Pollution



Aquatic Worms

Left-Handed Snail

Hoverfly
(Rat-tailed maggot adult)

Blood Midge Adult

Hoosier Riverwatch

Biological Monitoring Data Sheet

Date ____/____/____ Volunteer ID _____ Site ID _____

Stream Name _____ Latitude _____ Longitude _____

Time ____:____ AM / PM Time Sampling _____ hrs Air Temp _____ C

Current Weather: ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (steady) ☐ Storm (heavy)

Worst Weather (past 48 hours): ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (steady) ☐ Storm (heavy)

Check Methods Used: ☐ Kick Seine Net (3 times) ☐ Dip Net (20 jabs or scoops

Check Habitats Sampled: ☐ Undercut Banks ☐ Riffles ☐ Leaf Packs ☐ Snags/Vegetation ☐ Sediment

Pollution Tolerance Index (PTI)

Record the taxa (group) represented in your sampling by either entering the number of organisms you counted or by a

Group 1 - Intolerant

- ☐ Stonefly Nymph 
- ☐ Mayfly Nymph 
- ☐ Caddis Fly Larva 
- ☐ Riffle Beetle 
- ☐ Dobsonfly Larva 
- ☐ Right-Handed Snail 
- ☐ Water Penny 
- ☐ **# of TAXA**
- ☐ Weighting Factor (x4)

Group 2 - Moderately Intolerant

- ☐ Damselfly Nymph 
- ☐ Dragonfly Nymph 
- ☐ Scud 
- ☐ Sowbug 
- ☐ Crane Fly Larva 
- ☐ Clam/Mussels 
- ☐ Crayfish 
- ☐ # of TAXA
- ☐ Weighting Factor (x3)

Group 3 - Fairly Intolerant

- ☐ Leech 
- ☐ Midge Larva 
- ☐ Planaria/Flatworm 
- ☐ Black Fly Larvae 
- ☐ # of TAXA
- ☐ Weighting Factor (x2)

Group 4 - Very Intolerant

- ☐ Aquatic Worms 
- ☐ Blood Midge Larva (red) 
- ☐ Rat-tailed Maggot
- ☐ Left - Handed or Pouch Snail 
- ☐ # of TAXA
- ☐ Weighting Factor (x1)

Pollution Tolerance Index Rating

(Add the final index values for each group)

PTI Ratings	
Excellent	23 or More
Good	17 - 22
Fair	11 - 16
Bad	10 or Less

Please check other Biological Indicators you observed:

☐ Native Mussels ☐ Zebra Mussels ☐ Rusty Crayfish ☐ Aquatic Plants _____%Algae Cover _____Diversity Index

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