The Lakeshore Guardian, 2010 October
Thumb Habitats
Aquatic Macroinvertebrates As Water Quality Indicators
by Bill Collins

September's article was an introduction to aquatic macroinvertebrates, water creatures visible without a microscope and lacking internal skeletons: aquatic insects, worms, leeches, crustaceans (crayfish, shrimp, scuds, sowbugs), snails, and mussels. These are "benthic" or bottom dwellers, and also near the bottom of the aquatic food chain, the primary food of many fish, amphibians and some waterfowl. Their abundance determines, in large part, the wildlife that thrives in our waters, from wetlands, ponds, ditches, creeks, streams, rivers, inland lakes, to the Great Lakes.

Aquatic macroinvertebrates, being the primary food of larger stream fish, are critical to maintaining the overall fish community. Like fish, aquatic macroinvertebrates are sensitive to water quality conditions. Good water quality means a healthy macroinvertebrate community, which means a healthy fish community. Trout are very sensitive, requiring clean, cold water and an abundant variety of macroinvertebrate food. Poor water quality takes a double toll on fish by creating intolerable conditions and by eliminating their food.

In turn, fish support the macroinvertebrate community. A surprising example is how mussel larvae, called glochidia, hitch rides on fish. Looking like a microscopic fanged PacMan, they usually attach to a gill or fin for days or weeks, feeding on the fish's fluids, then drop off to the stream bed as juvenile mussels. In this way, fish are hosts to particular mussel species, transporting the relatively immobile creatures to favorable habitat throughout the stream and maintaining good clam beds.

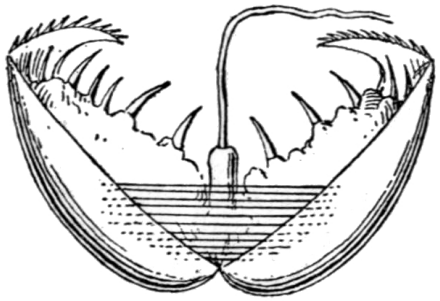

Diagram of a glochidium: A pacman with an attitude. You may never think of humble bottom-dwelling filter-feeding mussels the same. Source: Wikimedia Commons: Step, Edward, Shell life: An Introduction to the British Mollusca. - London, New York: F. Warne & Co. (1901).

Good fish and macroinvertebrate communities depend on good habitat: coarse stream beds of sand, gravel and cobble; natural morphology with lots of riffles, pools, meanders; stable base flows; and moderate flooding. Water quality factors include temperature, dissolved oxygen, turbidity (suspended particles), and toxins such as excess nutrients, pesticides, herbicides, and pollution. Streams are warmer that lack a forest canopy, are fed by surface water more than groundwater, or receive storm sewer and industrial drainage. Warmer water has less dissolved oxygen. Fish and aquatic macroinvertebrates breathe oxygen from the water with gills or modified lungs and suffocate when oxygen is too low. Bacterial decomposition of rotting algae and aquatic weeds also lowers oxygen. High turbidity clogs fish gills and filter feeders like mussels. Silt deposits in the gaps between gravel and fills pools, eliminating spaces for egg deposition and calmer waters where macroinvertebrates are sheltered. Toxins are obviously not good in anyone's water.

Aquatic macroinvertebrates are generally divided into those “tolerant” of degraded water quality versus those that are “sensitive,” requiring good water quality and good stream habitat. Tolerant organisms include leaches, worms, pouch snails, and midge flies. Sensitive organisms include stoneflies, mayflies, caddisflies, stoneflies, dobsonflies, riffle beetles, water penny beetles, and gilled snails, and are susceptible to conditions that cause “fish kills,” most often by sudden oxygen depletion. Some organisms range between tolerant and sensitive, including mussels, crayfish, scuds, alderflies, craneflies, damselflies, and dragonflies.

Inventories of aquatic macroinvertebrates are used as indicators of water quality. Surveys are usually conducted in spring and fall when their numbers tend to be higher, and sometimes in winter for stoneflies. Sampling is done by dip netting throughout a stretch of stream. Captured organisms are placed in a bucket, taken to shore and placed in pans to make it easier to pick them out from leaves and other debris. Smaller creatures are selected with droppers or tweezers and placed in partitioned containers like egg cartons or ice cube trays, or in jars. Like organisms are placed with like so that a total of each type can be tallied. There can be many species of each organism, but samplers usually need only discern general types. Some are easy, like crayfish, snails and mussels. Sorting mayflies from damselflies, or alderflies from stoneflies takes more knowledge, but with a little help, everyone catches on pretty quick. Sitting around a picnic table sorting water creatures can make for an enjoyable afternoon, with lots of time for shooting the breeze, jokes, and stories. Sometimes it is necessary to keep samples in a jar of alcohol for later verification, but if not, my wife and I always make a point of returning the water babies to their stream.

Sorting aquatic macroinvertebrates beside Mill Creek, May 29, 2010. Left to right, back: Terry Gill, Fred Fuller and Will Fuller. Front facing away: Bobbi Filanda. Photograph by Kay Cumbow.

Mill Creek location of macroinvertebrate monitoring shown in previous photograph, May 29, 2010. Photograph by Bill Collins.

The goal of collecting and sorting is to count the number of individual organisms in each macroinvertebrate group, up to a point, usually about a dozen, and then to mathematically produce a quality score that allows comparison with other stream sections. Some study goals may require counting hundreds of individuals and different scoring methods. Final scores can be left as numbers, but in most cases, the numbers are expressed as ranges of “excellent,” “good,” “fair”, or “poor.”

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	Group 2 - Moderately Intolerant	Group 3 - Fairly Tolerant	Group 4 - Very Tolerant
☐ Stonefly Nymph	☐ Damselfly Nymph	☐ Leech	☐ Aquatic Worms
☐ Mayfly Nymph	☐ Dragonfly Nymph	☐ Midge Larva	☐ Blood Midge Larva (red)
☐ Caddis Fly Larva	☐ Scud	☐ Planaria/Flatworm	☐ Rat-tailed Maggot
☐ Riffle Beetle	☐ Sowbug	☐ Black Fly Larvae	☐ Left - Handed or Pouch Snail
☐ Dobsonfly Larva	☐ Crane Fly Larva		
☐ Right-Handed Snail	☐ Clam/Mussels		
☐ Water Penny	☐ Crayfish		
☐ # of TAXA	☐ # of TAXA	☐ # of TAXA	☐ # of TAXA
☐ Weighting Factor (x4)	☐ Weighting Factor (x3)	☐ Weighting Factor (x2)	☐ 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

I am aware of a few ongoing macroinvertebrate monitoring projects in the Thumb. Perhaps the longest running has been on the Mill Creek, a major tributary of the Black River. Started in 1999 by Terry Gill, now the Greenwood Township Supervisor, she has led the project for 11 years. The Saint Clair County Health Department has conducted monitoring on the Black, Pine and Belle Rivers in recent years. Aquatic macroinvertebrate surveys are excellent projects for schools and other youth groups. Stream monitoring leaders are always looking for help. Contact the Thumb Land Conservancy if you are interested in the fall surveys coming up soon.

2026 Update: Parts of Mill Creek were eventually dredged according to a compromise agreement. There has been additional dredging since with more planned. However, the macroinvertebrate sampling of the early 2000s and extensive reporting helped to oppose and limit larger-scale dredging.

Macroinvertebrate sampling continues throughout the Thumb region, conducted by the Michigan Department of Natural Resources and various groups concerned with water quality.

Regarding the Thumb Land Conservancy Dead End Woods Sanctuary mentioned in the September article, caddisflies have not been observed in the wetlands and vernal pools on that site for many years and aquatic macroinvertebrates seem to be lacking in general, along with frogs and salamanders.