Aquatic Insects as Indicators of Water Quality

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Aquatic insects, also called benthic macroinvertebrates, are ideal bioindicators of water quality. What the heck is a benthic macroinvertebrate? Benthic means “bottom of a body of water” and macroinvertebrate means you can see the insect with your eye and insect has no backbone. Benthic macroinvertebrates are used as bioindicators of water quality because they are sensitive to environmental changes and its presence or lack thereof determines clean water or polluted water.

How can an aquatic insect like a dragonfly, which lives in the air, help us determine the quality of the water? Aquatic insect adults lay their eggs in the water. The eggs hatch and the immature form lives in the water, sometimes for years, before transforming into winged adults. The composition of the aquatic insects population (aka bioindicators) is used to ascertain water quality and reveal pollution impact. Much like plants are assigned conservation numbers, aquatic insects have a numeric designation, too. This designation is called a Tolerance score and ranges from 0-10 with zero being the least tolerant to pollution.

Peltodytes edentulus: Haliplidae (crawling water beetle) would have a tolerance score of 7

Cybister fimbriolatus: Dytiscidae (predaceous diving beetle) would have a tolerance score of 5

Aquatic insects are a great starting point to get a sense of the water quality. To assess a body of water using water sampling would require repeated testing visits to the site.

Aquatic insects are not highly mobile and reside in the body of water for long periods of time. This means monitoring and testing the water isn’t needed as often.

This Hydropsychidae (common net spinning caddisfly) nymph would have a tolerance score of 4

For example, you are monitoring the water quality of Stream A. You sample the water for aquatic insects in June 2015, June 2016 and June 2017 and find diverse insect populations – stoneflies, caddisflies, beetles, dragonflies – and then you sample again in June 2018 and only find beetles and dragonflies. Generally, stoneflies and caddisflies are less tolerant to pollution when compared to beetles and dragonflies, so you deduce that somehow the water was polluted over the past year and wiped out those populations. You determine, based on talking to people along the stream, that the paper mill accidentally polluted the water in November 2017.

Now, let's imagine you are sampling Stream A using water samples and laboratory tests. You sample in January, March, June and September of 2015-2018. Based on the tests, you determine the water is clean. Because you didn't sample in November or December of 2017, there were no indicators showing the stream was polluted.

Now that you know WHY aquatic insects are great indicators of water quality, you may be wondering what they look like and how you can identify them. Purdue Extension publishes a Bioindicators of Water Quality Guide that provides detailed instructions for using bioindicators to determine the water quality. Using this excellent guide, the insects and their conservation values (known as a Tolerance Value) can be identified and calculated to estimate the water quality. Remember, there are other factors that impact the ability of aquatic insects to live in water, such as temperature, sediment, etc. Generally, where possible, it's always best to collect other water data such as pH, temperature, and dissolved oxygen.

Additionally, the University of Wisconsin Extension offers citizen science training for monitoring water quality using benthic macroinvertebrates. For more information on that, check out the Water Action Volunteers (WAV) site. These classes will teach you how to sample bodies of water using a combination of tests, including aquatic insects.

For more information, check out these additional resources:

Entomology Today has an article about insects and mites and what they tell us about water quality