UI Extension Forestry Information Series II

Water Quality No. 8

Don't Let Water Quality Bug You Out

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Using insects to monitor water quality may sound like something from a *Far Side* cartoon, but in reality, bugs are a "quick and dirty" method of assessing water quality. The traditional water quality monitoring approach has been to collect stream water samples and have them analyzed for physical and chemical contaminants. Since water sampling and analysis is expensive, insect monitoring is a more economical and quicker method of determining water quality. In the U.S., much as canaries are used in mineshafts, the use of stream organisms as biological indicators of water quality has become widespread over the past few decades.

Biological monitoring is used to assess a water body's environmental conditions. One type of biological monitoring is a biological survey or biosurvey (also called stream insect survey if only monitoring aquatic insects). This involves collecting and analyzing aquatic organisms (fish, bugs, and algae) to determine the health of an aquatic biological community.

Aquatic insects are termed benthic macroinvertebrates (BMI's). Benthic means bottom dwellers, and macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). BMI's inhabit all types of running waters, from fast-flowing mountain streams to slow-moving muddy rivers. Examples of aquatic macroinvertebrates include insects (in their larval or nymph form), crayfish, clams, snails, and worms. Most live partly or nearly all of their life cycle attached to submerged rocks, logs, and vegetation.

There are three groups (taxa) of BMI's:

- Group one BMI's are pollution sensitive and found in good quality water. This group includes stonefly larvae, caddisfly larvae, water pennies, riffle beetles, mayfly larvae, gilled snails, and dobsonfly larvae.
- Group Two BMI's are somewhat pollution tolerant organisms that can be found in good or fair quality water. This group includes crayfish, sowbugs, scuds, alderfly larvae, fishfly larvae, damselfly larvae, watersnipe fly larvae, crane flies, beetle larvae, dragon fly larvae, and clams.
- Group Three BMI's are pollution tolerant organisms that can be found in any quality water (from good to poor). This group includes aquatic worms, midge fly larvae, black fly

larvae, leeches, pouch snails, pond snails, and other snails.

Aquatic BMI's are good indicators of stream water quality because:

- They are affected by the physical, chemical, and biological conditions of the stream.
- They cannot escape pollution and show the effects of short-and long-term pollution events.
- They may show the cumulative impacts of pollution.
- They may show the impacts from habitat loss not detected by traditional water quality assessments.
- They are a critical part of the stream's food web.
- Some are very intolerant of pollution.
- They are relatively easy to sample and identify.

The basic principle behind surveying BMI's is that some are more sensitive to pollution than others. If a stream site is inhabited by organisms that can tolerate pollution (those from Group Three) - and the more pollution-sensitive organisms are missing (those from Group One) - a pollution problem is likely.

For example, stonefly nymphs (see Figure 1) are very sensitive to most pollutants and cannot survive if a stream's dissolved oxygen falls below a certain level. If a biosurvey finds no stoneflies present in a stream that used to support them, a conclusion might be that dissolved oxygen has fallen below the point that keeps stoneflies from reproducing - or has killed them outright.

In this example, the absence of stoneflies might indeed be due to low dissolved oxygen. But is the stream under-oxygenated because it flows too slowly or because pollutants in the stream are damaging water quality by using up the oxygen? The absence of stoneflies might also be caused by pollutants discharged by factories or running off the watershed, high water temperatures, habitat degradation such as excess sand or silt on the stream bottom that has ruined stonefly sheltering areas, or other conditions. When changes are noticed a biosurvey is best accompanied by an assessment of habitat and water quality conditions (such as a stream reach inventory) in order to help explain biosurvey results.

Because BMI's are stationary and sensitive to different degrees of pollution, changes in their abundance and variety illustrate pollution impact on the stream. Loss of BMI's in a stream, or better yet, loss of trees along a stream bank, are environmental impacts that society can relate to. Similarly, when a pollution control activity takes place - say, a fence is built to keep livestock out of the stream - a biosurvey may show that the sensitive BMI's have returned and a habitat assessment might find that the formerly eroded stream banks have recovered and trees now shade the stream.

BMI's are quantified by species richness (number of unique types of invertebrates found in a sample), abundance (total number of invertebrates in a sample), relative abundance (number of invertebrates in a sample from one species relative to another), and species diversity (distribution of total individuals across species in the sample). Once counted, the invertebrates

Figure 1. Stonefly nymph. Note the two tails.

Figure 2. Note the three tails.

Figure 3. Caddisfly (aka periwinkles).

can be compared to samples taken in the same stream at earlier times, such as before and after a suspected pollutant has entered the stream. One popular index for monitoring species richness is the "EPT index". This measures the total number of species within the three most pollution sensitive aquatic insect orders: **E**phemeroptera (mayflies, Figure 2), **P**lecoptera (stoneflies, Figure 1), and **T**richoptera (caddisflies, Figure 3). This index assumes that streams showing high EPT richness/numbers are less likely to be polluted than streams showing relatively low EPT richness in the same region. If a stream has few EPT's (compared to other streams in the region), water quality has likely been impacted. This will warrant further investigation however, to discern the reasons for the lack of EPT's.

In summary, BMI's are a useful indicator of water quality in northwest streams. Most all of Idaho's streams have good water quality conditions and support healthy populations of BMI's and EPT's. Next time you're along or in a stream, pick up a rock off the bottom and see what's crawling on it. You might be surprised to find several of these beneficial, indicator species.

Proper protocol exists for sampling aquatic BMI's in Idaho, and can be found at http://www.deq.idaho.gov/water/data_reports/surface_water/monitoring/burp_field_manual_2007_entire.pdf

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