Missouri Streams Fact Sheet

BIOLOGICAL MONITORING

Written by Danny Brown & Jim Czarnezki

Edited by Sarah Wolken

The physical and chemical aspects of water are frequently looked at to assess the health of a stream or to determine the degree that a stream is polluted. These physical and chemical measurements tell us what is in the water at the point in time the sample is collected. However, one drawback of physical and chemical aspects of water is that they can not tell us what condition the stream was in yesterday or last week. The creatures that live in a stream, however, are an indication of how healthy the stream is and how healthy it has been for some time. Invertebrates like stoneflies, for example, are indicators of healthy water (Figure 1).

Figure 1

Bioassessments and *biomonitoring* are based on two main principles: different organisms have varying tolerances to degraded environments and degraded environments usually support fewer types of organisms. Biomonitoring implies comparing samples over time to look for changes, whereas bioassessments involve similar methods of sampling, but are usually a one-time effort that compares one location of good quality to a location in question. Biomonitoring involves sampling the stream for fish, aquatic macroinvertebrates and/or algae. These organisms are then identified and counted, the results are scored and the stream is given a quality rating. Macroinvertebrates are used for biomonitoring more frequently than the other animals, because they are relatively easy to collect and identify, have a one to three year life cycle and are continuous indicators of environmental quality.

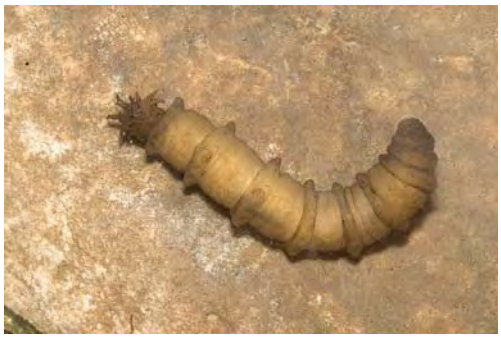

Figure 2

Benthic macroinvertebrates are animals that lack a backbone, live on the stream bottom and can be seen without magnification. Unlike fish, macroinvertebrates, like cranefly larva (Figure 2), are not mobile enough to move in and out of an area if pollution is a problem. Macroinvertebrate communities contain many species, each with its own preferred environmental conditions and life histories. The *benthic* macroinvertebrate community, or those organisms living on the stream bottom, can yield a great deal of insight into the environmental conditions present in a stream.

Macroinvertebrates can be divided into three groups, depending upon their tolerance to pollutants. Group 1 is pollution intolerant and their presence or dominance in a sample indicates good water quality. Group 2 invertebrates can survive in streams with moderate impairment. Invertebrates in Group 3 are very tolerant and are the only organisms you will find in streams with severe impairment. Be aware that tolerant organisms can be present in all streams, including those with excellent water quality. Once the sample has been collected, the invertebrates must be picked from the net or sampler, identified and counted (Figure 3). A water quality rating can be assigned to the sample based on the number of organisms in each group by completing a macroinvertebrate count sheet.

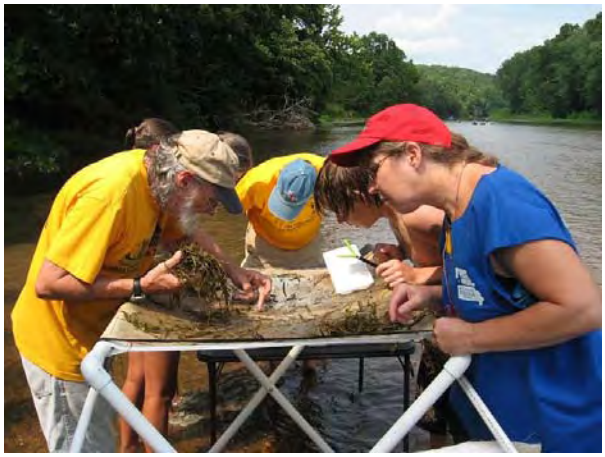

Figure 3

The advantage of biological sampling versus chemical testing is that it looks at indicators of conditions which are present in the stream over a period of time rather than checking conditions just at the moment a water sample is collected.

Sampling a subject as dynamic and varied as a river or stream in a truly quantitative manner is difficult. Matching the physical characteristics of the sites and expending the same amount of effort in sampling at each site are both important. This is done in an effort to control all variables between sites (except water quality) so that differences between sites may be attributed to water quality.

There are a variety of methods for sampling benthic macroinvertebrates. The method used depends on the nature of the stream and site to be sampled. Normally, organisms are collected from the stream bottom in a riffle, which is a shallow area with a steady flowing current and a rock and gravel substrate. Artificial substrate samplers can be used when it is not possible to sample the stream bottom. The artificial substrate sampler provides a site for organisms to colonize. This sampler must be placed in the stream for 4 to 6 weeks to allow for colonization.

Figure 4

Some sampling devices are considered qualitative samplers because the bottom area sampled is not precisely measured. *Kick nets* work well in sampling riffle areas and permit a larger area to be sampled. The kick net consists of two poles that anchor a 3x3 net (Figure 4). Sampling is done by placing the two poles into the substrate so the

bottom of the net is on the stream bottom. Organisms are dislodged by disturbing the substrate on the upstream side of the net. The current then carries them into the screen. Kick nets can be easily constructed by stapling window screen onto two wooden poles.

D-frame nets are a basic tool for collecting benthic macroinvertebrates. They work well because the flat area can rest on the bottom preventing loss of organisms underneath the net. They can also be used for sampling along banks and in vegetation. D-frame nets are used mainly in the prairie streams of north and west Missouri and in the channelized ditches of the Missouri bootheel.

Artificial substrates, like rock baskets (Figure 5), can be useful in situations where it is not possible to sample the natural substrate, such as in large rivers, channelized areas, or in deep water. They can also provide standardized samples as long as setting and retrieving procedures are the same for each site. Artificial substrates may be difficult to retrieve without disturbing organisms and causing them to release and drift. The monitor should keep in mind that the artificial substrate may select for certain types of organisms and such a sample will not fully represent the diversity of a site. Cinder blocks can be placed in streams or rivers to check for zebra mussel colonization (Figure 6).

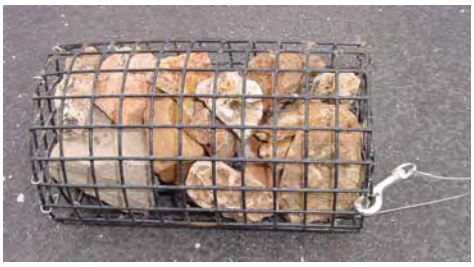

Figure 5

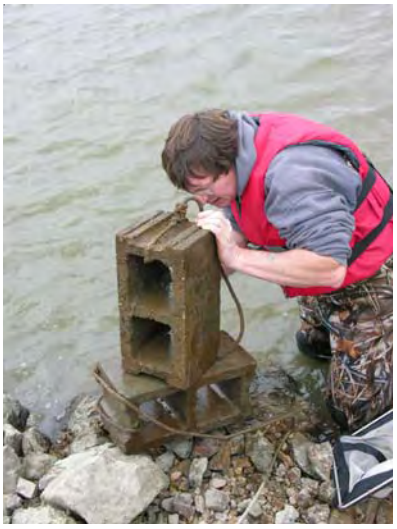

Figure 6

There are some drawbacks to biomonitoring. Without a background in stream ecology, it may be difficult to sample a stream and determine if it is healthy, moderately impacted or seriously polluted. The cause of a low water quality rating based on biomonitoring may not be easy to determine. Causes could be due to a number of influences: sewage treatment plant wastes, poor land-use practices, streambank erosion, confined animal feeding operations or the stream may simply be a coldwater spring branch that naturally has a limited biological community. A low rating could also be due to degraded physical habitat. Other factors to consider are the time of year and recent streamflow conditions. Many benthic macroinvertebrates are insect larva and emerge at varying times of the year. If you monitor when they are in the adult or egg stage, your rating will be lowered. If recent rains have resulted in elevated stream flows, these animals could be scoured and washed downstream. Sampling will take practice and probably some assistance by a biologist for the volunteer monitor to effectively use biological sampling methods to determine water quality conditions.

Saving representatives of each type of invertebrate you collect is a great idea. Place them in vials or small baby food jars and preserve them with a 30% solution of rubbing alcohol and water. These specimens can be used to help you verify the identification of the invertebrates with an expert or to identify invertebrates in the future. The reference collection can also be used to verify the presence or absence of invertebrates at a site over time.

Putting Your Data to Use

After you have conducted a watershed inventory, compiled a library of information about your stream and its watershed, collected samples and have thorough data and information about the quality of your stream, *what are you going to do with all this great information*?

By itself, raw data can be informative, and as the collector, you can be proud of your accomplishment. However, most of your audiences will need your data presented in a form they can understand. Raw data should be converted to tables, charts and graphs that have an impact on your audience. A good first step for presenting data is to construct a table summarizing the results obtained over a period of time. Once you summarize your data in a table, the next step is to make it even more meaningful by presenting that data in graphical form. Some basic types of graphs are pie charts, line graphs and bar graphs.

Your data can be used to improve the conditions in your stream or protect it from a proposed development of land use change. Before you can become an effective advocate, you first must know stream protection and land-use laws and regulations, as well as the rule makers, who are your elected and appointed officials.

You are responsible for learning the rules, meeting the rulers, knowing the process and the best place in the process to advocate for your stream.

Interested in receiving training to monitor a stream? Contact these groups:

Stream Unit

Missouri Department of Conservation

PO Box 180

Jefferson City, MO 65102-0180

573-522-4115 ext 3167

Stream Team Voicemail: (800) 781-1989

www.mostreamteam.org

Volunteer Water Quality Monitoring Program

Water Pollution Control Program

Missouri Department of Natural Resources

PO Box 176

Jefferson City, MO 65102-0176

573-526-3406

Water Quality Volunteer